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IMPACT OF PROCESS ORIENTED COOPERATIVE-INQUIRY LEARNING STRATEGIC INSTRUCTION METHOD (POCILSIM) ON STUDENTS' LEARNING STRATEGIES USE AND ACADEMIC ACHIEVEMENT IN CHEMISTRY

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Abstract
This study investigated the relationship between learning strategies and the academic achievement of chemistry students. Three research questions guided the study. A correlation survey research design was used. Four hundred and twenty-one (421) Senior Secondary (II) chemistry students in twelve (12) intact chemistry classes from nine public schools in Lagos State, Nigeria participated in the study. Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method (POCILSIM) was used as the learning strategy intervention. Learning Strategies Scale (LSS), and Chemistry Achievement Test (CAT) were used for data collection. Mean, Standard deviation, and t-test were used to analyze the data collected. AMOS 26 was employed to calculate the path coefficient and goodness of fit statistics. Findings showed that the learning strategies used by the students improved after they were exposed to learning strategies intervention; high achievers students use more of the higher-order learning strategies such as metacognitive self-regulation skills than the average and the low achievers; learning strategies have a significant positive relationship with academic achievement, it, therefore, contributed significantly to improve achievement in chemistry, however, the strength of the relationship is low. Also, the metacognitive self-regulation skill strategy has the highest correlation with chemistry students' achievement while the effort regulation strategy has the least. In addition, learning strategies have equal variances between male and female students. Based on the findings, it is recommended that the policymakers should approve the inclusion and teaching of learning strategies using POCILSIM in the national curriculum at all levels.

Introduction

Academic achievement tells the extent to which a student has achieved his educational goal. There are many factors that can influence students' academic achievement in chemistry such as the cognitive, affective, and psychosocial states. The explanation of academic achievement and the examination of the factors relating to academic achievement are of greatest importance at different educational levels. Nasir (2010) posited that tests and examinations at all stages of education, are considered an important and powerful tool for inference and making decisions in our competitive society, with people across ages being evaluated with respect to their achievement. They observed that the lives of many students are determined by their test performance. Academic achievement prepares students for future careers,

and competitive fields, and provides opportunities for their future occupations. Thus, examination scores can predict the future success of individuals as measured by education, occupation, and income (Jonsdottir, 2012; Amalu, 2017). The statistics of students' performance in chemistry during the West African Senior School Certificate Examinations (WASSCE) in Nigeria from 2010 to 2019 are displayed in Table 1.

Table 1: Instability in the achievement of secondary school chemistry students in WAEC, 2010 to 2019

Year	No of candidates who sat for the examination	No of candidates who passed at credit level	% of candidates who passed at credit level.
2010	465,643	236,059	50.70
2011	565,692	280,250	49.54
2012	627,307	270,570	43.14
2013	639,131	531,745	72.4
2014	644, 913	399,072	61.88
2015	665,527	463,140	69.59
2016	672,637	546,910	81.97
2017	709,404	590,629	83.91
2018	732,508	423,451	58.17
2019	747, 075	572.044	77.02

Source: The West African Examination Council (WAEC), National Office (2020), Ikeja, Lagos. Nigeria.

The instability in students' performance revealed an achievement gap. The WAEC Chief Examiner's report on the students' poor performance in chemistry includes candidates' weakness in some aspects of chemistry, lack of understanding of the demands of the questions; poor knowledge of laboratory apparatus; lack of adequate knowledge of some concepts; inability to relate learned concepts and principles in chemistry to their everyday life and poor study habits (WAEC, 2018). Studies carried out on factors contributing to low achievement in chemistry include lack of qualified chemistry teachers; insufficient number of chemistry teachers, lack of instructional materials; over-loaded chemistry syllabus; abstractness and difficult nature of many chemistry concepts; poor teaching methods employed by most chemistry teachers; and lack of interest among chemistry students (Ezeano, 2013; Jegede; 2010). Most teachers used the lecture method in chemistry instruction, which encourage rote learning of facts and concepts. It makes the subject uninteresting and difficult, resulting in poor students' academic achievement (Njoku and Ezinwa, 2014). Problem–solving, critical thinking, creative thinking, communication, collaboration with others, adaptive, and entrepreneurship skills are skills that students need to work in the 21st Century (Malik, 2018). To meet this challenge, schools must be transformed to enable students to acquire creative thinking, flexible problem solving, collaboration, and innovative skills referred to as the 21st-century learning skills required to be successful at work and in life. Thus, the 21st Century learning skills emphasize the importance of learning strategies (critical thinking, social skills, time management, self-regulation, and executive functioning) in the education program which prepare the students for lifelong learning.

Learning strategy according to Schumacher, and Deshler (2006) is an individual's approach to a task which includes how a person thinks and acts when planning, executing, and evaluating performance on a task and its outcomes. According to the Center for Research University of Kansas article (2009), a learning strategy is a person's approach to learning and using information. Students use learning strategies to help them understand information and solve problems. There may be many strategies as the number of students because each student selects and employs different strategies 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. Learning strategies instruction is supposed to be a part of the school curriculum so that students can acquire these as prerequisites to regulate their own learning, but this has not been the practice in Nigeria.

Nine learning strategies considered in this study are rehearsal, elaboration, organization, critical thinking, metacognition self-regulation skill, time and study environment management, effort regulation, help-seeking, and peer learning. Some students failed to utilize the learning strategies which are effective and get used to becoming passive learners at a young age, as most of the activities in the classroom do not provide opportunities for students to direct their own learning (Catnahalan, 2006). Studies carried out on learning strategies showed that self-regulated learning is important, as failure to self-regulate can lead to students' poor achievement (Schloemer and Brenan, 2006). Pintrich (2000) explains self-regulated learning as an active and constructive process whereby students set goals for their

learning and then try to monitor, regulate, and control their cognition, motivation, and behavior guided and constrained by their goals and the contextual features in the environment. This definition parallels Zimmerman's (2000) definition of self-regulated learning that puts emphasis on the interaction of three major elements: (a) personal regulation strategies which refer to goal setting, planning, transferring information, keeping records, controlling emotion, etc., (b) behavioral self-regulation strategies that mainly takes into account the process of self-observation, self-evaluation, task analysis, questioning, self-feedback and modifying performance and (c) environmental self-regulation strategies that mainly involve analyzing learning context, asking others for help, seeking information from different sources, and making adaptations in a way that optimizes performance. Most students lack self-regulation, and this lack of self-regulation has a great impact on how well students perform in school and later in life.

The gender of students has been the subject of controversy in the domain of educational research. Some findings report that males do better in competitive learning while females do better in cooperative learning settings. This has led to single-sex schooling advocacies due to perceived male domination and potential harassment, which confirms gender difference effects on students' achievement in science (Ogunkola and Garner-O'Neale, 2013). A statistically significant effect of gender on chemistry achievement was reported in WASSCE with male students' domination (Ezeudu & Obi, 2013). A statistically non-significant effect of gender on science achievement in different studies was reported by Abubakar and Oguguo, 2011; Ejimaji and Emekeme, 2011; Ogunkola and Olatoye, 2010. This study, therefore, investigated the effects of gender on students' learning strategies used and their achievement in chemistry. Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method (POCILSIM), which is the method engaged in this study, is the integration of Cooperative and inquiry learning with the nine learning strategies. To use POCILSIM, the class is divided into small groups of 6-7 students who learn about a joint topic. The joint topic is divided into 6-7 sub-units of similar size and responsibility and each of these is assigned to one of the students in the group. The subunits are independent of each other so that each of the group members can learn about it individually using rehearsal, elaboration, time and study management, effort regulation, and help-seeking strategies (Individual engagement). After becoming familiar with the piece of information the students from all groups with responsibility for the same sub-unit are grouped together (expert round). These expert groups continue working on their topic as a group with the aim of developing an explanation of the topic that can be shared with others using organization, time and study management, critical thinking, and peer learning strategies (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 (teaching round) using elaboration, organization, time and study management, critical thinking, and peer learning strategies (Interactive engagement). The groups appoint among them a leader, a recorder, a reporter, a timekeeper, and a questioner. After the group discussion, the reporter from each group is called out one by one to present their report to the whole class. The questioner from the group asks the reporter questions which the reporter responds to. The group is then given 5 minutes to self-critique their work highlighting areas they feel they have performed well and where they performed poorly using metacognition self-regulation skills and critical thinking skills (individual monitoring and evaluation). Next, the other groups are allowed to critique the reporter. After all the groups have presented, the teacher gives a summary of the topic, then the students write down all the important points on the board in their notes.

Statement of the Problem

Despite the importance and the position, chemistry occupies as a pivot on which other sciences hinge for industrial and national development, WAEC results and WAEC chief examiner's reports have shown that it has been plagued with students' low achievement and little improvement over the years. Studies had been carried out on how to improve students' achievement in chemistry, but gaps still exist as shown in Table 1. The literature review has shown that there were many studies on students' cognition, but less attention has been given to the learning strategy used by the students and its effects on students' achievement at the secondary school level. Even the few studies that investigated the effects of learning strategies on students' achievement in chemistry were done outside Nigeria. It is on this premise that the study investigated the impact of the learning strategies on the academic achievement of secondary school chemistry students in Nigeria.

Objectives of the study

1. Identify the difference in learning strategies used by high, average, and low achiever chemistry students.
2. Examine the correlation between learning strategies used by the students and their achievement in chemistry.
3. determine the difference in learning strategies used towards chemistry achievement of secondary school students by gender.

Research Questions

1. What is the difference in learning strategies used by high, average, and low achiever chemistry students?
2. What is the correlation between learning strategies used by students and their academic achievement in chemistry?
3. What is the difference in learning strategies used towards chemistry achievement of secondary school students by gender?

Research Methodology

A correlation survey research design was used without manipulating the sample subject but sought to establish what relationship exists between students' learning strategies and student achievement in chemistry. A pre, post, and delayed post single case experimental design was used to give intervention to students on learning strategies using the Process-Oriented Cooperative-Inquiry Learning Strategic Instruction Method. The population of the study consists of all Senior Secondary School (II) Chemistry students from three Education Districts in Lagos State, Nigeria. A Simple random technique was used to select three Education districts and a purposeful sampling technique was used to select three schools from each district based on these criteria: (1) Chemistry teachers with master's degree certificate in Education Chemistry. (2) Adequate consumables and non-consumables for chemistry practical. (3) Readiness of school management and the Chemistry teachers to support the research. The sample is made up of four hundred and twenty-one (421) Senior Secondary (II) chemistry students in twelve (12) intact chemistry classes between the age range of 14 and 18 years from nine public schools in Lagos State, Nigeria participated in the study. Learning Strategy Scale (LSS), a-50 item self-reporting questionnaire, and Chemistry Achievement Test (CAT); a-40 item objective questions selected from past WAEC examination questions relevant to SS (II) chemistry scheme of work for standardization were used to collect data. Face, content, and construct validation were employed to determine the validity of the items, and the appropriateness and relevance of the instruments to the research study by two senior secondary school chemistry teachers. Reliability of the CAT was done by test-retest and Pearson Moment Correlation Coefficient, which gave the value of 0.89 and this is considered good enough for the instrument.

The learning strategies Scale (LSS) was administered 3 times while the Chemistry Achievement Test (CAT) was administered 2 times during the study which lasted for twelve (12) weeks. During these twelve weeks, the instruments were administered, then, the nine strategies were explained to the students, and they were given the opportunity to use them. The students were later taught the contents in the scheme of work using POCILSIM. The chemistry teachers from the nine selected schools were used as research assistants to collect the data for the study. The statistical tools used for the analyses of data collected were: Mean, Standard deviation, ANOVA, and t-test. SPSS and AMOS 26 software program was employed to calculate the path coefficient and goodness of fit statistics automatically. Chi-square statistics was used to test the significance and goodness of fit.

Results

Research Questions 1

What is the difference in learning strategies used by high, average, and low achiever chemistry students?

The mean scores of the data from the Learning Strategy Scale of high, average, and low achiever chemistry students are computed and shown in Table 2

Table 2:
Mean Learning Strategy Scores by Students' Performance Levels

.		T1			T2			T3		
ACADEMIC PERFORMANCE	LEARNING STRATEGIES	N	M	SD	N	M	SD	N	M	SD
AVERAGE	RE	176	2.06	0.808	96	2.09	0.809	34	2.03	0.717
ACHIEVERS	EL		2.18	0.642		2.25	0.711		2.41	0.609
	ORG		2.04	0.831		2.21	0.82		2.32	0.727
	CT		2.2	0.626		2.33	0.61		2.5	0.663
	METS		2	0		2	0		2	0
	TSM		2.28	0.5		2.46	0.597		2.53	0.615
	ER		2.19	0.766		2.36	0.783		2.26	0.71
	PL		2.23	0.805		2.4	0.9		2.44	0.746
	HS		2.31	0.7		2.34	0.662		2.47	0.563
HIGH	RE	218	3.2	0.851	314	3.34	0.775	386	3.56	0.682
ACHIEVERS	EL		3.18	0.798		3.42	0.711		3.56	0.618
	ORG		3.11	0.784		3.32	0.764		3.43	0.747
	CT		3.09	0.76		3.33	0.74		3.53	0.649
	METS		3.19	0.392		3.36	0.48		3.51	0.501
	TSM		3.05	0.605		3.3	0.654		3.49	0.595
	ER		2.83	0.801		3.08	0.732		3.27	0.698
	PL		3.09	0.843		3.24	0.864		3.46	0.742
	HS		3.2	0.764		3.33	0.691		3.52	0.645
LOW	RE	27	1.41	0.636	11	1.82	1.079	1	2	.
ACHIEVERS	EL		1.26	0.526		1.73	1.009		2	.
	ORG		1.15	0.362		2	1		2	.
	CT		1.52	0.753		2	1		2	.
	METS		1	0		1	0		1	.
	TSM		1.67	0.784		1.73	0.647		2	.
	ER		1.59	0.888		2.27	1.104		2	.
	PL		1.44	0.751		2	0.894		1	.
	HS		1.63	0.792		1.82	0.751		2	.

Note. RE = Rehearsal; EL = Elaboration; ORG = Organization; CT = Critical Thinking; METS = Metacognitive Self-Regulation Skills; TSE = Time and Study Environment Management; ER = Effort Regulation; PL = Peer Learning; HS = Help-seeking. T1 = Time 1; T2 = Time 2; T3 = Time 3; N = Number of variables; M = Mean; SD = Standard deviation.

From Table 1, it can be observed that all the students at the levels of performance have increasing mean scores from T1 to T3.

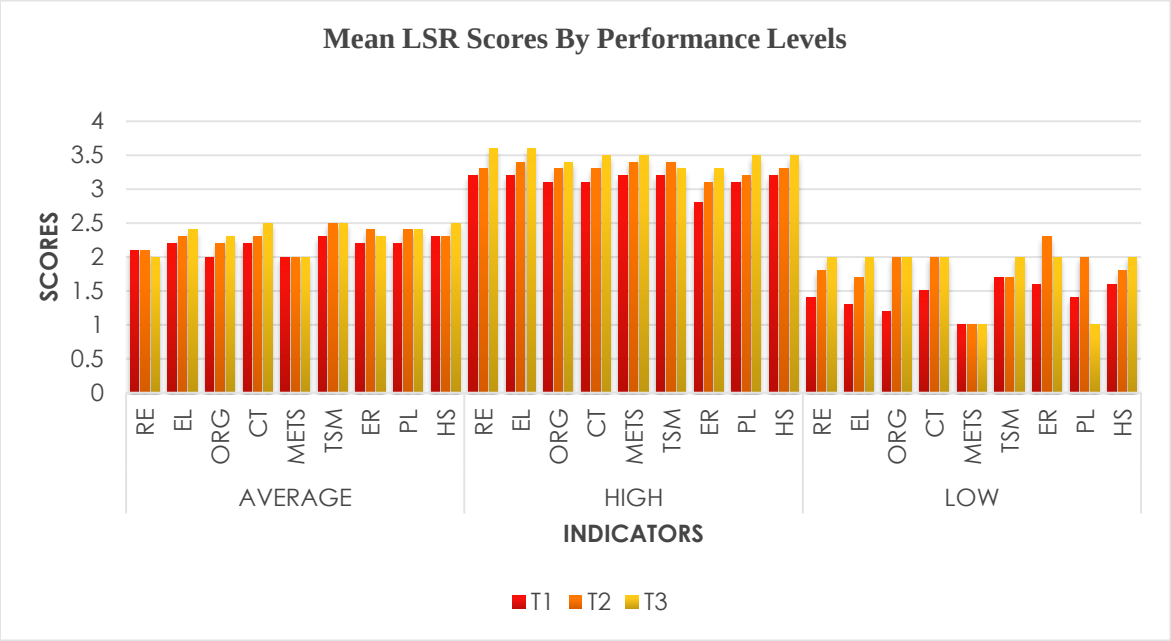

Figure 1 Mean Learning Strategy Scores by chemistry Performance Level.

From Table 2 and Figure 1, it can be observed that the learning strategies mean scores increase considerably across the three-time intervals (Time 1, Time 2 and Time 3) of pretest, post-test and delayed post-test.

For the high achievers, the learning strategies mean score is high at the three-time intervals (T1, T2, and T3). For the average performance level students (average achievers), the learning strategies mean score is moderate and for low-performance level students (low achievers), the learning strategies mean score at T1, T2, and T3 are very low.

The pre-test shows that students made use of the help-seeking learning strategy the most (M=2.73) and the effort regulation strategy the least (M=2.28). The post-test shows that the students made use of the elaboration strategy the most (M = 3.11), followed by the critical thinking strategy (M=3.07) and use effort regulation strategy the least (M=2.90). The delayed post-test shows that the students made use of elaboration strategy the most (M=3.47), followed by critical thinking strategy (M=3.44) and use of effort regulation strategy, the least (M=3.18), The result also showed that both average and low achievers have their mean scores to be the same at the three time-intervals for METS.

To test if there is any significant difference between the learning strategies used and achievement in chemistry, the ANOVA was carried out and presented in Table 3.

Table 3:

ANOVA result of Mean scores of LSR by Performance levels.

SV	SS	df	MS	F	P-value	F-crit
LSR	36.6967	2	18.3484	347.995	0.0000	3.12391
INTERVALS	1.37677	2	0.68839	13.0559	0.0000	3.12391
LSR*INTERVALS	0.30849	4	0.07712	1.46272	0.2225	2.49892
Error	3.79627	72	0.05273			
Total	42.1783	80				

Note: LSR=Learning Strategies, SV = Sample variable, SS = Sum of square, df = degree of freedom, MS= Mean square, F-crit = F critical. Intervals = (Tim1, Time 2, Time 3).

Table 3 shows the significance of the test (p-value < 0.001). Hence, learning strategies contributed significantly to improving performance in chemistry.

Research Question 2

What is the correlation between learning strategies used by students and their academic achievement in chemistry?

The correlations were found at the three time-intervals.

Table 4:

Sample Pearson Correlations by AMOS 26 (Time 1 Achievement in chemistry)

	RE1	EL1	ORG1	CT1	METS1	TSM1	ER1	PL1	HS1	ACA
RE1	1.000									
EL1	.699	1.000								
ORG1	.717	.705	1.000							
CT1	.724	.717	.671	1.000						
METS1	.731	.749	.739	.713	1.000					
TSM1	.630	.649	.642	.642	.727	1.000				
ER1	.467	.386	.428	.446	.552	.527	1.000			
PL1	.549	.563	.644	.536	.611	.573	.401	1.000		
HS1	.684	.679	.619	.664	.700	.653	.481	.525	1.000	
ACA	.122	.150	.134	.088	.124	.094	.064	.121	.149	1.000

Note: RE1= Rehearsal, EL1 = Elaboration, ORG1 = Organization, CT1 = Critical Thinking, METS1 = Metacognitive self-regulation skill, TSM1 = Time and Study management, ER1 = Effort Regulation, PL1 = Peer Learning, HS1 = Help Seeking, ACA = Academic Achievement.

Table 4 presents the correlation of the learning strategies (RE1, EL1, ORG1, CT1, METS1, TSM1, ER1, PL1, and HS1) for Time 1 with students' academic achievement in chemistry. The table shows that all the strategies have weak correlation with academic achievement in chemistry.

Table 5:

Sample Pearson Correlations by AMOS 26 (Time 2 Achievement in chemistry)

	RE2	EL2	ORG2	CT2	METS2	TSM2	ER2	PL2	HS2	ACA
RE2	1.000									
EL2	.655	1.000								
ORG2	.635	.731	1.000							
CT2	.676	.728	.705	1.000						
METS2	.703	.745	.720	.729	1.000					
TSM2	.607	.640	.613	.648	.713	1.000				
ER2	.480	.392	.411	.438	.549	.498	1.000			
PL2	.594	.607	.644	.628	.620	.576	.459	1.000		
HS2	.680	.666	.623	.655	.704	.623	.474	.602	1.000	
ACA	.133	.164	.105	.150	.113	.094	.008	.122	.163	1.000

Note: RE2 = Rehearsal, EL2 = Elaboration, ORG2 = Organization, CT2 = Critical Thinking, METS2 = Metacognitive self-regulation skill, TSM2 = Time and Study management, ER2 = Effort Regulation, PL2 = Peer Learning, HS2 = Help Seeking, ACA = Academic Achievement

Table 5 presents the correlation of the learning strategies with academic achievement in chemistry at Time 2. A similar weak correlation can be observed between learning strategies with academic achievement as described in Table 4. The visualized heatmap shows the weak correlation of the learning strategies to be less than 0.2 or 20%.

Table 6:

Sample Pearson Correlations by AMOS 26 (Time 3 Achievement in chemistry)

	RE3	EL3	ORG3	CT3	METS3	TSM3	ER3	PL3	HS3	ACA
RE3	1.000									
EL3	.716	1.000								
ORG3	.677	.693	1.000							
CT3	.707	.746	.661	1.000						
METS3	.754	.749	.720	.746	1.000					
TSM3	.632	.644	.590	.673	.749	1.000				
ER3	.539	.485	.482	.530	.655	.597	1.000			
PL3	.608	.593	.640	.642	.653	.537	.499	1.000		
HS3	.727	.625	.612	.637	.703	.639	.519	.558	1.000	
ACA	.149	.116	.094	.080	.137	.122	-.012	.040	.120	1.000

Note: RE3 = Rehearsal, EL3 = Elaboration, ORG3 = Organization, CT3 = Critical Thinking, METS3 = Metacognitive self-regulation skill, TSM3 = Time and Study management, ER3 = Effort Regulation, PL3 = Peer Learning, HS3 = Help Seeking, ACA = Academic Achievement.

Table 6 presents the correlation of the learning strategies (RE3, EL3, ORG3, CT3, METS3, TSM3, ER3, PL3, and HS3) based on Time 3 with academic achievement in chemistry. It can be observed that there is a weak correlation between the learning strategies used by the students and their academic achievement in chemistry.
The result of standardized regression weights shows that the factor loading for learning strategies and achievement for Time 1, Time 2, and Time 3 is less than 0.2. This means that though learning strategies contributed significantly to improving students' performance the relationship between learning strategies and students' performance is weak.

Research Question 3
What is the significant difference in learning strategies used toward chemistry achievement of secondary school students by gender?

The research question was answered by raising a hypothesis.

Ho: There is no significant difference in learning strategies towards chemistry achievement of secondary school students by gender.

The t-test analysis of students' academic achievement and the learning strategies used was carried out and the results are shown in Table 7

Table 7:

t-test results for gender against each of the variables

		T	df	Tail	p-val	CI95%	cohen-d	BF10	Power
ACA	T-test	1.315454	419	two-sided	0.189077	[-0.61, 3.06]	0.128266	0.249	0.259180
LSR	T-test	0.480855	419	two-sided	0.630871	[-6.18, 10.18]	0.046887	0.121	0.076758

ACA=Academic achievement, LSR = Learning strategy used
The t-test was run using the t-test function of Pingouin library for the test of significant differences between genders. The result of the student's t-test is presented in Table 7. The result shows that the p-values are greater than .05,

meaning, there is no significant difference between the *mean* of both females and males. Since the p-value is not enough to draw a conclusion on the difference in *means*, Cohen's d effect size was used to determine if the significant difference is large enough or not. The cohen-d values for the variables is less than 0.2 which means there is a 'small' effect size between female and male. It was concluded that the significant difference between the two groups is less than 0.2 standard deviation, and the significant difference is negligible. Moreover, the BF10 (Bayes Factor is in favor of H_1 over H_0) are all between 0 and 1. The BF interpretation is given in Table 7. For instance, the BF10 = 0.249 for achievement means, that the data is 0.2 as likely to have occurred under the H1 (significant difference) than the H0 (no significant difference).

Table 8:
t-test results for gender against the learning strategies.

		T	df	Tail	p-val	CI95%	cohen-d	BF10	Power
RE	T-test	-0.813040	419	two-sided	0.416657	[-1.23, 0.51]	0.079277	0.149	0.128115
EL	T-test	1.536247	419	two-sided	0.125233	[-0.26, 2.1]	0.149795	0.338	0.334842
ORG	T-test	1.006114	419	two-sided	0.314941	[-0.42, 1.29]	0.098104	0.176	0.171017
CT	T-test	0.912647	419	two-sided	0.361953	[-0.51, 1.4]	0.088990	0.162	0.149044
METS	T-test	0.419274	419	two-sided	0.675230	[-1.54, 2.37]	0.040882	0.118	0.070276
TSM	T-test	0.682241	419	two-sided	0.495463	[-0.81, 1.67]	0.066524	0.135	0.104536
ER	T-test	-1.448630	419	two-sided	0.148189	[-1.21, 0.18]	0.141252	0.298	0.303728
PL	T-test	1.076407	419	two-sided	0.282365	[-0.27, 0.98]	0.104958	0.189	0.189010
HS	T-test	-0.801780	419	two-sided	0.423138	[-1.03, 0.43]	0.078179	0.147	0.125910

The student's t-test was carried out on the learning strategies (RE, EL, ORG, CT, METS, TSM, ER, PL, and HS). The result of the student's t-test is presented in Table 8 which shows that all the p-values are greater than .05 meaning there is no statistical significance difference. The p-value may not be enough to draw a conclusion if the significant difference is large enough or not. The cohen-d values for the variables are less than 0.2 which means there is a 'small' effect size between females and males. We then conclude that the significant difference between the two groups is less than 0.2 standard deviation, and the significant difference is negligible. Moreover, the BF10 for the learning strategies is less than 0.4, the likelihood that the data occurred under the H_1 (significant difference) than the H_0 (no significant difference).

Discussion

The findings of this study show that the learning strategies mean scores increase considerably across pretest, post-test, and delayed post-test. In Pre-test, the students made use of help seeking learning strategy the most and effort regulation strategy the least. In Post-test, the students made use of elaboration strategy the most and used effort regulation strategy the least (M=2.90). In Delayed Post-test, the students made use of elaboration strategy the most and used effort regulation strategy the least (M=3.18). This is in conformity with previous study of Sungur and Yerdelen (2011) which revealed that high school students seem to utilize effort regulation strategy the less.

Also, the findings on students' performance showed that with learning strategy treatment given to the students during this study, the students were able to use more advanced learning strategies like elaboration strategy and critical thinking strategy and show that high achiever students use more advanced learning strategies such as elaboration, metacognition self-regulation skill and critical thinking strategies than the average and the low achievers hence, learning strategies contributed significantly to improve performance in chemistry. This result is supported by the previous study of Simsek & Balaban, (2010) that found that high-achieving students used more advanced strategies than low achieving students.

The t-test shows that learning strategies have equal variances between males and females. The result of the student's t-test shows that there is no significant difference between the mean of both females and males. The Cohen's d effect size was used to determine if the significant difference is large enough or not. The cohen-d values show there is a

'small' effect size between females and males. It was concluded that the significant difference between the two groups is less than 0.2 standard deviation, and the significant difference is negligible. This is supported by the previous study by Hong et al., (2009) that investigated the differences in students' motivational and self-regulated strategies in doing homework in relation to grade, gender, and achievement level in China. According to the study, students' use of strategies had a decreased as they progress through the educational system but there was no significant difference between male and female students' learning strategies use.

Conclusions

There is a positive correlation between the learning strategies used by students and their achievement in chemistry, however, the relationship is weak. Also, learning strategies contribute positively to improving students' academic achievement in chemistry. Metacognitive self-regulation skills have a higher predictive power on students' achievement in chemistry while effort regulation has the least. Gender did not show a statistically significant difference in students' learning strategies and chemistry achievement.

Recommendations

1. Teachers should teach the students how to self-regulate and integrate the various learning strategies into their teaching strategies. Teachers should also use instructional strategies that is student – center
2. Curriculum developers should design materials on shaping instructional delivery and designing support programs to foster students' success, increase retention and Instill learning strategies culture in the students.
3. Policymakers should approve the inclusion and teaching of learning strategies in the National curriculum at all levels.

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