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Comparative Effects of Inquiry and Self-Regulated Learning Instructional Strategies on Secondary School Students' Retention in Physics in Lagos State

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Abstract

Successful learners are independent, planning, monitoring, and evaluating their learning. This study examined the comparative effects of Inquiry and Self-regulated Learning Instructional Strategies (IIS and SLIS) on Physics retention among secondary school students in Lagos State's Education District II. Guided by two research questions and two hypotheses at a 0.05 significance level, the study was based on social constructivism, social-cognitive, and information-processing theories. Using a quasi-experimental post-test and retention test design, 137 students from four schools were selected. Data were collected using the Physics Achievement Test and Retention Test, adapted from WASSCE past questions. The retention test was administered seven weeks post-treatment. Analysis involved descriptive (mean, standard deviation) and inferential statistics (t-test, ANOVA, ANCOVA, and Scheffe's test). Results showed both strategies improved retention. SLIS is more effective, especially for high achievers. No significant gender difference was found. It is recommended that Physics teachers adopt and receive training in SLIS.

Keywords: *Inquiry, Physics, Retention, and Self-regulated Learning*

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Background to the Study

Physics as a school subject is essential for studying Science, Technology, Engineering, and Mathematics (STEM) courses in Nigerian tertiary institutions, with a good credit pass in the West African Senior School Certificate Examination (WASSCE) or National Examination Council (NECO). Various teaching methods have been explored in studies aimed at improving students' academic performance in the subject; for instance, team teaching was recommended by Achor, Imoko, & Jimin (2012), field trips by Amosa, Ogunlade, & Atobatele (2015), peer tutoring by Offordile et al. (2021), among others. Despite this submission, the performance of the students has not been excellent. This may be due to numerous factors. For example, Sanyang-Gibba quoted the WASSCE chief examiners' report of 2023, which stated that most Physics students find it difficult to do arithmetic operations. Also, a clear analysis of the trend of the West African Examination Council (WAEC) results in Physics from 2008 to 2020 showed a fluctuation in students' performance in Physics. This fluctuation was attributed to poor methods of instruction (Adeyemo, 2010; Offordile et al., 2021) and examination malpractice (Achor & Gbadamosi, 2020). Table 1 illustrates the performance of students in Physics in the WASSCE from 2008 to 2020, reflecting this inconsistency.

Table 1: Students' Performance in May/June SSCE (WAEC) Physics 2008– 2020

PHYSICS				CHEMISTRY			BIOLOGY		
YEAR	TOTAL SAT	CREDITS PASS	%	TOTAL SAT	CREDIT PASS	%	TOTAL SAT	CREDIT PASS	%
2008	415,113	200,345	48.26	418,423	185,949	44.47	1,259,964	427,644	33.94
2009	465,636	222,722	47.83	422,091	194,035	45.97	1,903,552	644,733	33.87
2010	463,755	237,756	51.27	465,643	236,059	50.70	1,300,418	427,644	33.90
2011	563,161	360,096	63.94	565,692	280,250	49.54	1,505,199	579,443	38.50
2012	624,658	429,415	68.74	627,302	270,570	43.13	1,646,150	587,044	35.66
2013	636,857	296,910	46.62	539,296	143,218	72.34	1,648,363	854,743	51.73
2014	635,739	386,270	60.75	636,268	397,649	62.49	1,365,384	766,971	56.17
2015	657,266	390,446	59.40	680,357	412,323	60.60	1,390,234	798,246	57.42
2016	666,855	508,523	76.25	667,156	546,910	81.97	1,087,698	802,539	73.78
2017	70,813	373,647	53.08	703834	590,629	83.91	1,093,597	719,585	65.79
2018	727733	570,606	78.40	727954	423451	58.17	1,086,081	677,229	62.35
2019	742,394	571,276	76.95	742678	572,044	77.02	1,058,149	784,757	74.16
2020	749,780	634,400	84.61	750182	674361	89.89	1,039,766	874,237	84.08

Source: The West African Examinations Council (WAEC) Head Quarters, Yaba, Lagos. 2021.

Furthermore, an unstructured interview conducted by the researcher with some Physics lecturers at the Federal College of Education, Technical Akoka, explored the relationship between students' performance in WASSCE Physics and their performance in Physics in the College of Education. The results revealed that many students who scored 'A' or 'B' in WASSCE struggled to solve basic Physics problems in the college. Also, a similar interview

with some University of Lagos lecturers forms the department of science education reinforced this observation. These findings align with the NECO Chief Examiners' report, indicating significant examination malpractice and suggesting that many students who pass the SSCE may not be independent learners. This raises the concern that while many WASSCE or NECO candidates meet the entry requirements for tertiary institutions, they may struggle to retain much of the secondary school curriculum. This highlights the need to cultivate independent learners who take ownership of their learning and become lifelong learners.

Research increasingly suggests that educational models designed to address the needs of the industrial age are insufficient for the complex challenges facing 21st-century learners (Sharon & David, 2013). These challenges include technology integration, information overload, critical thinking, problem-solving, lifelong learning, environmental awareness, and sustainability. Such challenges emphasize the importance of adopting innovative and holistic educational approaches that equip learners to thrive in a dynamic, interconnected world. New educational environments demand fresh ways of planning learning outcomes and employing methodologies for teaching and assessment. The push for reform from passive, transmission-based learning toward more dynamic and comprehensive approaches is not recent. Educational institutions worldwide are rethinking their foundational beliefs about learning and the purpose of education (Sharon & David, 2013). This shift is evident in Alberta, where the Ministry of Education's "Inspiring Education" framework (2010) aims to prepare students for the changing economic, technological, and socio-political realities of the 21st century. The vision calls for fostering intellectual engagement, entrepreneurial thinking, and ethical citizenship, with students developing competencies through inquiry and discovery. The goal is for learners to work collaboratively to create new knowledge, engage in critical and creative thinking, and embrace processes of inquiry, reflection, exploration, and experimentation (Sharon & David, 2013).

Inquiry-based learning is a key strategy within the constructivist learning approach. It creates a learning environment where learners are empowered to formulate and explore effective and testable questions; develop hypotheses and consider alternatives; collect data; and apply, assess, analyse, and interpret scientific methods and techniques (Kartal, 2014; in Kaçar, Terzi, Arıkan, & Kırıkçı, 2021). The inquiring approach is more focused on using learning content as a means to develop information processing and problem–solving skills. It is a more student-centered approach than traditional methods. There is great emphasis on "how one comes to know" and less on "what one knows". Llewellyn (2002) in Makale, Başvuru, Yayına, and Yurdagül (2018) stated that the inquiry-based learning strategy makes learners gain the needed expertise and skills to become free persons and lifelong learners.

Li, Ye, Tang, Zhou, and Hu (2018) defined self-regulated learning as the process of monitoring and controlling individual cognitive achievement before, during, and after the learning process. Self-regulated learning has been commended as the main skill needed to start and sustain lifelong learning (Hoyle & Dent, 2018). Researchers have shown that self-regulated learning effectively promotes academic achievement (Sadati & Simin, 2015).

Zimmerman first used self-regulated learning as an instructional strategy in the United States in the 1980s. Zimmerman, a prominent educational psychologist, is widely recognized for his work on self-regulation in learning, particularly about how students can actively control their learning processes through goal setting, self-monitoring, and self-reflection.

Gender and ability level were the moderator variables in this study. They were chosen as moderator variables due to mixed findings from previous researchers and their significant influence in conventional classes. Gender, as a psychological construct describes maleness and femaleness, reflects the behaviours and attitudes expected of individuals based on their biological sex (Yunusa, 2019). Slavin (1990) in Abubakari (2020) defined ability grouping as the practice of organizing students into groups based on their academic achievement. Retention was dependent variable. Achor and Gbadamosi (2020) defined retention as the transfer of knowledge from short-term to long-term memory. Retaining knowledge is crucial for learners to apply ideas from lessons effectively in their assignments Therefore, this study determined Comparative Effects of Inquiry and Self-Regulated Learning Instructional Strategies on Secondary School Students' Retention in Physics in Lagos State.

Statement of the Problem

Students who write examinations are expected to pass and maintain excellent grades. However, as noted in the study's background, this is not the situation in most Nigerian secondary schools. Although several teaching strategies have been employed over the years, students' performance has not been consistently excellent, highlighting the need for innovative approaches to enhance achievement and retention. The WASSCE chief examiners' report of 2023 noted that most Physics students find it challenging to do arithmetic operations. Also, a precise scrutiny of the trend of the WAEC results in Physics for 10 years showed instability in students' performance in Physics. This variation was attributed to poor methods of instruction (Adeyemo, 2010; Offordile et al., 2021) and examination malpractice (Achor & Gbadamosi, 2020). Therefore, there is a need for innovative and student-centred strategies such as Inquiry and Self-regulated Learning Instructional Strategies, which have proved successful in enhancing students' achievement in science in the Western world. These strategies empower students to develop high-level thinking skills and positive attitudes toward learning. These approaches also encourage active engagement, critical thinking, and problem-solving, which are essential for understanding complex scientific principles. The researcher believes that implementing these strategies will enhance students' creative thinking and performance in WASSCE and beyond, which is the focus of this study.

Theoretical Framework

Three theories underpinned this study. They are Social Constructivism, Social-cognitive, and Information-processing theories.

Social Constructivism Theory (Vygotsky 1978)

This theory, advocated by Vygotsky 1978 emphasizes that learning is a collaborative process that occurs through social interaction and group engagement, where learners actively construct knowledge. This emphasizes the social aspect of concept formation, suggesting that

knowledge is constructed through social interactions, making it a shared experience rather than an individual one.

Relevance of Vygotsky's theory of Social Constructivism to the study

Vygotsky's theory of Social Constructivism emphasizes the Zone of Proximal Development (ZPD), the gap between what a learner can do alone and with support. It underscores the value of social interaction and collaboration in cognitive development. In the context of SLIS and IIS, students work in groups, allowing peer support within their ZPD. Physics classrooms applying this theory foster collaborative, context-rich learning with teachers acting as guides. Scaffolding, self-regulation, and reflection are key components of this approach.

Social-Cognitive Theory (Bandura, 1953)

Social-cognitive theory, founded by Albert Bandura in 1953, emphasizes observational learning, modelling, and self-efficacy. It asserts that people learn by observing others and the outcomes of their behaviours.

Relevance of the Social-Cognitive theory of Bandura to the study

This theory is highly relevant to inquiry and self-regulated learning strategies in teaching Physics due to its focus on observation, modelling, and self-efficacy. Self-regulated learning encourages students to learn by observing teachers and peers' model problem-solving and critical thinking. Inquiry-based instruction allows teachers to demonstrate experiments and concepts, aiding students in developing their investigative skills. Self-efficacy—students' belief in their ability to succeed—can be strengthened through these strategies, boosting confidence and persistence in learning Physics.

Information Processing Theory (Miller, 1956)

Miller was the proponent of Information Processing Theory. He and other psychologists used computer processing as a method to explain how the human mind locates, receives, processes, stores, and responds to stimuli. His information processing theory offers insights into how learners perceive and handle information, leading to key principles for teaching Physics with self-regulated learning (SRL) and IIS, such as chunking, encoding, storage, retrieval, and selective attention, among others.

Relevance of Miller's Information Processing Theory to the Study

Miller's Information Processing Theory is highly relevant to teaching Physics through inquiry-based learning and self-regulated learning. By understanding how students process, store, and retrieve information, educators can design instruction that minimizes cognitive load, encourages active engagement, and fosters metacognitive skills. Inquiry-based learning promotes deep, active engagement with content, while self-regulated learning allows students to manage their cognitive resources effectively. Both strategies align with Miller's theory by emphasizing the importance of how information is processed and retained, leading to more effective learning experiences in Physics.

Purpose of the Study

The main purpose of this study was to determine the effects of inquiry (IIS) and self-regulated learning instructional strategies (SLIS) on students' retention in Physics among Secondary School Students II in Education District II, Lagos State.

Specifically, this study sought to:

1. Examine the mean difference of the students who were exposed to the inquiry instructional strategy (IIS) and students exposed to the self-regulated learning instructional strategy (SLIS) on students' retention of Physics; and
2. Determine the interaction effect of IIS, SLIS, gender, and ability level on students' retention of Physics.

Research Questions

The following research questions guided this study:

1. What is the mean difference between students who were exposed to SLIS and those exposed to IIS on students' retention in Physics?
2. What is the interaction effect of experimental treatments (self-regulated learning and inquiry instructional strategies), gender, and ability level on students' retention in Physics?

Hypotheses

The following hypotheses were tested at $\alpha = 0.05$ significance level in the study:

H_{01}: There is no significant mean difference between students who were exposed to self-regulated learning and those exposed to inquiry instructional strategies on students' retention in Physics.

H_{02}: There is no significant interaction effect between experimental treatment (IIS and SLIS), gender, and ability level on students' retention of Physics.

Research Methodology

Design of the study

The design for this study was a post-test, retention test quasi-experimental research design.

Sampling Procedure

A multi-stage sampling procedure was used. First, Education District 2 was chosen out of six districts in Lagos state using a simple random sampling procedure. Then, a purposive sampling procedure was used to select schools and teachers from the district based on criteria such as being government-owned, co-educational, and have qualified Physics teachers.

Instruments for Data Collection

The research instruments used for data collection were the Physics Achievement Test (PAT), and the Physics Retention Test (PRT) adapted from the WASSCE objective past questions.

Validity of the Instruments

The PAT and PRT were validated by two experts from the Physics Education in the Department of Science Education, University of Lagos, and two from the test development

department from the University of Education, Lagos State. Based on their observations and comments, some items in PAT and PRT were modified and some were removed before the final drafts were printed. The instruments were made up of 20 items. Bloom's taxonomy of education was used for the table of specification.

Reliability of the Instrument

To ensure the internal consistency of PAT and PRT, they were pilot-tested to obtain their reliability coefficient. The reliability of PAT and PRT was calculated using Kuder Richardson (KR-20) statistics, which gave a value of 0.74 and 0.71. All the items had an item difficulty index of 0.4 – 0.8. The discrimination index was 0.8.

Procedure for Data Collection

An introductory letter was obtained from the Department of Science Education at the University of Lagos to request permission from the Permanent Secretary, Public Service Office, to use senior secondary school II students for data collection in Education District II, Lagos State. The instruments were administered for six weeks, with an additional retention test given in the 16th week.

Procedure for the administration of the Instrument

Week 1: A training programme for research assistants.
Week 2: Pre-test administration in all the sampled schools.
Week 3 – 9: These weeks were used to administer the treatment to groups using the instructional procedural steps for each simultaneously.
Week 10: This week was characterised by administering the post-test to the groups.
Week 16: After 7 weeks, the groups were tested to check their level of retention of the concepts taught 7 weeks earlier. The groups were taught Physics using inquiry or self-regulated learning strategies. Both groups were taught by research assistants trained for one week, and lessons were conducted during students' prep time to avoid disrupting the school timetable.

Method of Data Analysis

Data were analysed using quantitative methods. Mean and standard deviation were used to analyse descriptive data. Analysis of variance (ANCOVA) was used to test the hypotheses and the Scheffe Post-hoc test was used as the inferential statistics.

Research Question one: What is the mean difference between students who were exposed to SLIS and those exposed to IIS on students' retention in Physics?

Table 2: Descriptive statistics of students' post-test and retention test in the treatment groups

		Self-Regulated	Inquiry	Between-group mean difference
Post-test	N	50.00	87	
	Mean	60.00	43.39	16.61
	Std. dev	15.91	14.54	
Retention	N	50.00	87.00	
	Mean	64.80	47.30	17.50
	Std.dev	15.62	15.85	
	Within group retention-post-test mean difference	4.80	3.91	

Table 2 shows that students in the (SLIS) group had a post-test mean score of 60.00 and a retention mean score of 64.80, with a mean improvement of 4.80, indicating effective retention. In contrast, the (IIS) group had a post-test mean score of 43.39 and a retention mean score of 47.30, with a smaller improvement of 3.91. The between-group mean difference was 16.61 for the post-test and 17.50 for the retention test, both favouring the SLIS group, suggesting SLIS was more effective for the long-term retention of Physics concepts.

Research Question Two: What is the interaction effect of treatments (SLIS and IIS), gender, and ability level on students' retention of Physics?

Table 3: Descriptive statistics of students' retention scores based on treatment, gender, and ability level interaction

Treatment	Gender	Ability Level	N	Mean	Std. Deviation
SLIS	Female	Low	8	53.75	15.295
		Moderate	13	64.62	12.494
		High	2	80.00	.000
	Male	Low	13	61.54	19.936
		Moderate	12	70.83	10.408
		High	2	80.00	.000
IIS	Female	Low	3	55.00	18.028
		Moderate	29	43.28	12.195
		High	4	42.50	11.902
	Male	Low	6	38.33	13.292
		Moderate	35	49.00	16.925
		High	10	58.00	19.032

Table 3 shows that in the (SLIS), high-ability students of both genders achieved perfect retention scores, with moderate- and low-ability males outperforming their female counterparts. In contrast, the (IIS) group had lower retention scores across all ability levels, with male high-ability students achieving the highest retention scores. Overall, SLIS was more effective than IIS in promoting retention, particularly for high-ability students. The interaction effect further revealed that SLIS outperformed IIS across both gender and ability groups.

Hypotheses Testing

Hypothesis one (H_{01}): There is no significant mean difference between students who were exposed to self-regulated learning instructional strategy and those exposed to inquiry instructional strategies on students' retention in Physics.

Table 4: Independent Samples t-test of the significance of the effect of experimental treatment (SLIS) and (IIS) on students' retention of Physics concepts

	Levene's test for equality of variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig	t	df	Sig. (2-tailed)	Mean diff	Std. Error diff	Lower	Upper
Retention	0.00	0.985	6.257	135	0.000	17.501	2.797	11.969	23.033

Table 4 shows a significant difference between the effects of (SLIS) and (IIS) on students' retention of Physics ($t(135) = 6.257, p = 0.000$). Since $p < 0.05$, the null hypothesis is rejected. This indicates that SLIS is more effective than IIS in enhancing students' retention of Physics concepts. Therefore, the SLIS had a significantly greater impact on retention compared to the IIS.

Hypothesis two (H_{02}): There are no Significant Interactions Effects of between Treatment, Gender, and Ability Level on Students' Retention of Physics

Table 5: Testing of the significance of the effect of factors on students' retention of Physics concepts.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14669.903[a]	11	1333.628	5.830	0.000
Intercept	213426.373	1	213426.373	933.016	0.000
TREATMENT	6826.611	1	6826.611	29.843	0.000
GENDER	151.465	1	151.465	0.662	0.417
ABILITY LEVEL	1314.307	2	657.154	2.873	0.060
TREATMENT * GENDER	39.241	1	39.241	0.172	0.679
TREATMENT * ABILITY LEVEL	789.335	2	394.668	1.725	0.182
GENDER * ABILITY LEVEL	516.998	2	258.499	1.130	0.326
TREATMENT * GENDER * ABILITY LEVEL	932.660	2	466.330	2.039	0.135
Error	28593.601	125	228.749		
Total	438125.000	137			
Corrected Total	43263.504	136			

Table 5 shows that the type of experimental treatment significantly impacted students' retention of Physics concepts ($F(1,125) = 29.843$, $p = 0.000$). Gender does not significantly influence retention ($F(1,125) = 0.662$, $p = 0.417$). The effect of ability level on retention was marginally significant ($F(2,125) = 2.873$, $p = 0.060$), suggesting a potential influence but not at the conventional $p < 0.05$ level.

The interaction between treatment and gender is not significant ($F(1,125) = 0.172$, $p = 0.679$), meaning their combination does not affect students' retention of Physics. Similarly, the interactions between treatment and ability level ($F(2,125) = 1.725$, $p = 0.182$), and gender and ability level ($F(2,125) = 1.130$, $p = 0.326$), are not significant. The three-way interaction between treatment, gender, and ability level is also not significant ($F(2,125) = 2.039$, $p = 0.135$). Therefore, while treatment significantly affects retention, gender, ability level, and their interactions with treatment do not, leading to the conclusion that the null hypothesis is not rejected.

Discussion of the Findings

The study revealed a statistically significant difference favouring SLIS over IIS in students' retention of Physics concepts, indicating that SLIS is an effective active learning strategy. This is in line with (Panadero, 2017; Schunk and Zimmerman, 2011) finding that self-regulated learning enhances knowledge retention. Also, the study indicated that the interaction effects between treatment, gender, and ability level on students' retention in physics, only treatment was significant. This finding is at variance with the finding of Tournki (2003) in Dada, (2021), who found no interaction effect between treatment and learners' attributes on latency.

Conclusion

The study examined the strategies that promote learners' success and independence through IIS and SLIS, empowering them to take ownership of their learning journey. The study established that SLIS is more effective than IIS in enhancing students' retention in Physics. Additionally, the study found that IIS is more effective in improving the retention of low-ability learners. Furthermore, there was no significant gender difference in learners' retention in Physics.

References

Abdi, A. (2014). The effect of inquiry-based learning method on students' academic achievement in science course, *Universal Journal of Educational Research*, *2*(1), 37–41. https://doi.org/10.13189/ujer.2014.020104

Abubakari, A. (2020). Effects of ability grouping on the performance of basic school pupils in Ghana. In *the International Journal of Humanities & Social Studies* 8. https://doi.org/10.24940/theijhss/2020/v8/i1/HS2001-001

Achor, E. E., & Gbadamosi, O. (2020). Raising the achievement and retention levels of secondary school students in physics through brain-based learning strategy in Taraba State, Nigeria, *BSU Journal of Science, Mathematics and Computer Education*, *1*(2), 87–97.

Achor, E. E., Imoko, B. I., & Jimin, N. (2012). Improving some Nigerian secondary students' achievements in Geometry: A field report on team teaching approach, *New York Science Journal*, *5*(1), 37–43.

Amosa, A. A., Ogunlade, O., & Atobatele, A. S. (2015). Effect of field trip on students' academic performance in basic technology in Ilorin Metropolis, Nigeria, *Malaysian Online Journal of Educational Technology*, Retrieved from https://www.semanticscholar.org/paper/Effect-of-Field-Trip-on-Students%27-Academic-in-Basic-Amosa-Ogunlade/1a035de31b1bf72052b619b260100c27db964f3b

Aykan, A., & Dursun, F. (2022). The effect of active learning techniques on academic performance and learning retention in science lesson: An experimental study, *Journal of STEM Teacher Institutes*, *2*(1), 42–48.

Babajide, V. F. T., & Togbe, G. T. (2016). Effect of PowerPoint presentation strategy on secondary school students' achievement and interest in physics, *Journal of Studies in Education*, *16*(1), 355–386.

Bot, T. D., & Davou, T. (2016). Effects of back–to–back instructional strategy on junior secondary School Students' Motivation and Achievement in Algebra in Jos, Plateau State, Nigeria. *Journal of Mathematics Association of Nigeria*, *41*(1), 114–125.

Chijiuka, I., & Ugwu, I. (2019). Self-regulated Learning as correlates of academic achievement of Students of Economics in Secondary Schools in Imo State, *South-Eastern Journal of Research and Sustainable Development*, *2*(2).

Dada, F. H. (2021). *Effectiveness of 4-Stage Proficiency approach on the mathematical proficiency of Public Senior Secondary School Students in Lagos State. (Unpublished PhD Thesis.* University of Lagos.

Eastwood, J., Kleinberg, K., & Rodenbaugh, D. (2020). Collaborative testing in medical education: student perceptions and long-term knowledge retention, *Medical Science Educator*, 30. https://doi.org/10.1007/s40670-020-00944-x

Ejubovic, A., & Puska, A. (2019). Impact of self-regulated learning on academic performance and satisfaction of students in the online environment, *Knowledge Management & E-Learning: An International Journal*, *11*, 345–363. https://doi.org/10.34105/j.kmel.2019.11.018

Eladl, A., & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, Learning motivation and mathematics achievement, *Cypriot Journal of Educational Sciences*, *15*, 104–111. https://doi.org/10.18844/cjes.v15i1.4461

ElAdl, A. M., & Ismail, M. E.-S. A. (2021). The effect of self-regulated learning strategies on developing working memory and achievement goal orientation among high school students, *Egyptian Journal of Psychological Studies*. https://doi.org/10.21608/ejcj.2021.206030

Everaert, P., Opdecam, E., & Maussen, S. (2017). The relationship between motivation, learning approaches, academic performance and time spent. *Accounting Education*, *26*, 78–107. https://doi.org/10.1080/09639284.2016.1274911

Gafoor, K., & Kurukkan, A. (2016). Self-regulated learning: a motivational approach for learning mathematics. *International Journal of Education and Psychological Research (IJEPR)*, *5* (3), 65-79.

Hoyle, R. H., & Dent, A. L. (2018). Developmental trajectories of skills and abilities relevant for self-regulation of learning and performance. In *Educational Psychology Handbook Series. Handbook of self-regulation of learning and performance, 2nd ed* (pp. 49–63). New York, NY, US: Routledge/Taylor & Francis Group. https://doi.org/10.4324/9781315697048-4

Jirgba, C., & Bur, J. (2019). Effect of self-regulated learning strategy on students' achievement in basic science in Makurdi Local Government, Benue State, Nigeria. *African of Teacher Education*, *8*, 361–379.

Kaçar, T., Terzi, R., Arıkan, İ., & Kırıkçı, A. C. (2021). The effect of inquiry-based learning on academic success: A meta-analysis study, *International Journal of Education and Literacy Studies*, *9*(2), 15–23. https://doi.org/10.7575/aiac.ijels.v.9n.2p.15

Li, J., Ye, H., Tang, Y., Zhou, Z., & Hu, X. (2018). What Are the effects of self-regulation phases and strategies for Chinese students? A meta-analysis of two decades research of the association between self-regulation and academic performance. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.02434

Maxwell, D. O., Lambeth, D. T., & Cox, J. T. (2015). Effects of using inquiry-based learning on science achievement for fifth-grade students. *Asia-Pacific Forum on Science Learning and Teaching.*, *16*, 1–31.

Mohammed, A. A. (2018). Effects of constructivist and inquiry teaching strategies on senior secondary school's students' academic achievement in ecology in Adamawa State, Nigeria, *Journal of Educational Research*, *4*(1), 186–197.

Moore, P. J. (2019). Academic achievement, *Educational Psychology*, 39(8), 981–983. https://doi.org/10.1080/01443410.2019.1643971

Nota, L., Soresi, S., & Zimmerman, B. J. (2004). Self-Regulation and academic achievement and resilience: A longitudinal study, *International Journal of Educational Research*, *41*(3), 198–215. https://doi.org/10.1016/j.ijer.2005.07.001

Offordile, E. E., Umeano, E. C., Adene, F. M., Obi, M. C., Ugwuanyi, C. S., Okeke, C. I., & Adimora, D. E. (2021). improving the academic achievement of low achieving secondary school students in physics using peer tutoring learning strategy: implications for engineering career, *International Journal of Mechanical and Production Engineering Research and Development*, *11*(3), 201–212.

Onyenma, C., & Olele. (2020). Effect of blended learning on students' retention of physics in federal Colleges of Education in South East, Nigeria. *International Journal of Education, Learning and Development*, *8*(1), 66–76. https://doi.org/10.37745/ijeld/vol8.no1p.66-76

Panadero, E. (2017). *A review of self-regulated learning: Six models and four directions for research Frontiers in Psychology*, 8 https://doi.org/10.3389/fpsyg.2017.00422

Sadati, S., & Simin, S. (2015). The relationship between metacognitive and self-regulated learning strategies with Learners' L2 learning achievement, *International Journal of Research Studies in Language Learning*, 4(5). https://doi.org/10.5861/ijrsll.2015.1267

Sanyang-Gibba, F. (2023). *Chief examiner's report*. 126–130.

Schunk, D. H., & Greene, J. A. (Eds.). (2017). *Handbook of self-regulation of learning and Performance (2nd ed.)*, New York: Routledge. https://doi.org/10.4324/9781315697048

Schunk, D. H., & Zimmerman, B. (Eds.). (2011). *Handbook of self-regulation of learning and performance*, New York: Routledge. https://doi.org/10.4324/9780203839010

Sharon, F., & David, S. (2013*). Inquiry-based learning: A review of the research literature*, Retrieved October 24, 2024, from Galileo Educational Network website: https://galileo.org/publication/inquiry-based-learning-a-review-of-the-research-literature/

Sunday, N. F., Nyakno, F. J., & Assan, E. F. (2023). Influence of think pair share instructional Strategy on senior secondary school students' academic performance and retention in science subject in Akwa Ibom North East Senatorial District, Nigeria, *Science and Technology*, *6*(2).

Yunusa, U. (2019). Effect of metacognitive strategy on mathematics learned helplessness among undergraduate students of Ahmadu Bello University Zaria, Nigeria, *Internal Journal of Studies in Education*, *16*(1), 286–298.