



Effect of Personalized Learning Strategy on Academic Performance and Motivation in Chemistry among Public Senior Secondary School Students in Kaduna State, Nigeria

¹Moses Solomon, ²Binta Ado Ali, ³Adamu Alhaji Bagudu

¹Department of Educational Psychology, Federal University of Education, Zaria,

^{2&3}Department of Educational Psychology and Counseling, Federal University, Dutsin-Ma, Katsina State

ABSTRACT

This study examined the effect of Personalized Learning Strategy on motivation and academic performance in Chemistry among public senior secondary school students in Kaduna State, Nigeria. Grounded in Constructivist Learning Theory and Self-Determination Theory, the study aimed to assess how personalized instruction influences student outcomes. Using a quasi-experimental pre-test, post-test control group design, 82 SS II Chemistry students from two randomly selected public schools participated. The experimental group (n=44) received personalized learning, while the control group (n=38) was taught with conventional methods. Data were collected through a validated 50-item Chemistry Performance Test (CPT) and an Academic Motivation Questionnaire (AMQ) with a reliability index of 0.805. Descriptive statistics (mean and standard deviation) were used for research questions, while Analysis of Covariance (ANCOVA) tested the hypotheses at the 0.05 significance level. Results showed significant improvements in the experimental group for both academic performance ($F(1,79) = 160.543, p < 0.001, \eta^2 = 0.670$) and motivation ($F(1,79) = 65.967, p < 0.001, \eta^2 = 0.455$), indicating large effect sizes. The findings confirm that Personalized Learning Strategy enhances students' motivation and performance in Chemistry. It is recommended that educators adopt this approach, supported by educational psychologists and counselors to meet students' cognitive, emotional, and motivational needs.

ARTICLE INFO

Article History

Received: December, 2024

Received in revised form: January, 2025

Accepted: April, 2025

Published online: June, 2025

KEYWORDS

Personalized Learning Strategy, Academic Motivation, Academic Performance

INTRODUCTION

Traditional lecture-based instruction dominates chemistry classrooms, often resulting in passive learning and reduced student motivation. Studies indicate that this teacher-centered approach fails to address individual learning differences and does not actively engage students in the learning process (Samba & Eriba, 2012). Research suggests that personalized learning strategies can enhance students' understanding and performance in chemistry by catering to individual learning needs and interests (Eriba & Anchor, 2018).

Personalized learning tailors education to individual student needs, interests, and

strengths. Unlike traditional teaching, which follows a one-size-fits-all approach, personalized learning allows students to learn at their own pace and in ways that suit their abilities (O'Rourke, 2022). Main (2022) describes personalized learning as an educational model that provides customized learning experiences, enabling students to develop a deeper understanding of concepts. Nahas (2022) notes that personalized learning ensures students maximize their potential by catering to their unique learning styles. Studies have shown that personalized learning leads to improved content mastery and cognitive engagement (Abedi et al., 2021). Dockterman (2024) argues that personalized learning fosters

Corresponding author: Moses Solomon

✉ smoses@fcezaria.edu.ng

Department of Educational Psychology, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved



intrinsic motivation, allowing students to explore topics of interest and receive targeted support, which enhances academic performance.

Motivation plays a vital role in academic performance, influencing students' engagement and persistence in learning (Kendra, 2023). It can be intrinsic (driven by personal satisfaction) or extrinsic (driven by external rewards). Effective teaching strategies that foster autonomy, competence, and social interaction enhance motivation (Lundahl, 2022). Personalized learning enhances motivation by allowing students to take ownership of their learning process, improving engagement (Valamis, 2023).

Academic performance in chemistry is influenced by teaching strategies and motivation. Poor performance in chemistry can hinder students' progress in science-related careers (Freeman, 2014). Studies indicate that ineffective teaching methods, lack of instructional resources, and inadequate teacher training contribute to low achievement in chemistry (Ajayi, 2017b). A shift to innovative, student-centered approaches, such as personalized learning, can enhance understanding and motivation, leading to improved academic outcomes.

Several studies have investigated the impact of personalized learning strategies on academic performance and motivation across different educational settings. For example, Abedi et al. (2021) conducted an experimental study with undergraduate students, finding that personalized learning significantly improved content mastery, engagement, and self-regulated learning. Ogwari et al. (2020) also examined the effect of personalized learning on mathematics performance in Kenyan secondary schools, reporting a higher post-test performance in the experimental group, though not statistically significant. Similarly, Jirapipat (2019) studied the role of digital media preferences in personalized learning, demonstrating that customized digital content enhanced students' motivation and performance. Furthermore, Makhambetova et al. (2021) examined personalized strategies in Russian and Kazakhstani universities, emphasizing the need for institutional adaptation to effectively implement such approaches.

This study is anchored in Constructivist Learning Theory and Self-Determination Theory (SDT) to explain the impact of personalized learning strategy on students' motivation and academic performance in Chemistry. Constructivism, as proposed by Piaget, Vygotsky, and Bruner, emphasizes that learners actively construct knowledge by integrating new information with prior experiences. It highlights active engagement, individual differences, social interaction, and scaffolding, all of which align with personalized learning by allowing students to learn at their own pace, based on their unique needs and interests.

Self-Determination Theory (SDT) by Ryan and Deci further supports personalized learning by focusing on three psychological needs: autonomy, competence, and relatedness. Personalized learning strategies foster autonomy by enabling students to set their own goals, enhance competence through adaptive instruction, and promote relatedness by incorporating collaborative tools and teacher guidance.

The West African Examination Council (WAEC) reports from 2020 to 2024 indicate both progress and setbacks in Nigeria's education sector. In 2020, Kaduna State recorded a 46% pass rate in chemistry, followed by an improvement to 51% in 2021, but a decline in subsequent years, with an average of 44% in 2024. Fluctuating academic performance in science subjects can significantly affect students' overall academic progression and development. Freeman (2014) revealed that poor performance in chemistry can hinder comprehension of other science subjects, leading to academic difficulties. Factors such as overcrowded classrooms, inadequate resources, and reliance on traditional teaching methods contribute to poor chemistry performance in the region (Federal Ministry of Education, 2020).

Kaduna State, a key educational hub in Northern Nigeria, faces challenges such as limited teaching resources, large class sizes, and ineffective teaching strategies. Given the significance of chemistry in national development, exploring innovative teaching methods is crucial.

Corresponding author: Moses Solomon

✉ smoses@fcezaria.edu.ng

Department of Educational Psychology, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

International studies suggest that personalized learning strategies enhance student engagement and motivation (Roschelle et al., 2010; Slavin, 2014). Implementing these strategies in Kaduna's secondary schools could help bridge the performance gap and contribute to educational advancement in Nigeria. Despite the recognized benefits of personalized learning, research gaps remain. Most studies on this strategy are conducted in Western contexts, with limited research in African settings, particularly in Nigeria (Okoye et al., 2020). Additionally, few studies examine the effect of personalized learning on academic motivation and performance in chemistry. This study aims to fill these gaps by investigating the effect of personalized learning strategies on motivation and academic performance in chemistry among public senior secondary school students in Kaduna State.

Objective of the study

1. To determine the effect of Personalized Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state.
2. To investigate the effect of Personalized Learning strategy on Motivation among senior secondary school students in Kaduna state.

Research Questions

The following research questions guided the study:

1. What is the effect of Personalized Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state?
2. What is the effect of Personalized Learning strategy on Motivation among senior secondary school students in Kaduna state?

Hypotheses

The following hypotheses were tested at 0.05 level of significance

H₀₁: There is no significant effect of Personalized Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state.

H₀₂: There is no significant effect of Personalized Learning strategy on Motivation among senior secondary school students in Kaduna state.

METHODOLOGY

This quasi-experimental study employed a pre-test, post-test, and control group design using intact classes. The population consisted of 62,072 SS II Chemistry students in Kaduna State, with two randomly selected schools: Government Secondary School Aminu (experimental, 44 students) and Government Senior Secondary School Tudun Wada (control, 38 students).

Data collection involved a 50-item Chemistry Performance Test (CAT) adapted from WAEC past questions (2021–2023) and an Academic Motivation Questionnaire based on Personalized Learning Strategy (AMQ). Both instruments were validated by experts, and the AMQ achieved a reliability index of 0.805

Following approval from the Kaduna State Ministry of Education, a six-week intervention was conducted. A pre-test established baseline scores, after which the experimental group received personalized learning instruction while the control group continued with conventional teaching. A post-test and motivation questionnaire assessed the intervention's impact. Descriptive statistics (Mean & Standard Deviation) answered research questions, while ANCOVA tested hypotheses at a 0.05 significance level, adjusting for pre-test differences to ensure accurate evaluation.

RESULTS

Research Question One

What is the effect of Personalized Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state?

Table 1: Mean and Standard Deviation of Experimental and Control Group on the effect of Personalized Learning Strategy on Academic Performance in Chemistry

Group	Pretest			Posttest		Mean Gain
	N	M	SD	M	SD	
Experimental Group	44	50.05	8.96	71.14	10.53	21.09
Control Group	38	46.08	10.43	50.03	11.30	3.95

Table 1 shows that the Experimental Group (PLS) had a pre-test score of 50.05 (SD = 8.96), while the Control Group had 46.08 (SD = 10.43), indicating comparable baseline performance. After the intervention, the Experimental Group's post-test score increased to 71.14, while the Control Group's rose slightly to 50.03. The Experimental Group achieved a mean gain of 21.09, suggesting that the Personalized

Learning Strategy significantly improved academic performance.

Research Question Two

What is the effect of Personalized Learning strategy on Motivation among senior secondary school students in Kaduna state?

Table 2: Mean and Standard Deviation of Experimental and Control Group on the effect of Personalized Learning Strategy on Motivation in Chemistry

Group	Pretest			Posttest		Mean Gain
	N	M	SD	M	SD	
Experimental Group	44	50.00	11.39	66.71	10.33	16.71
Control Group	38	47.00	10.66	52.03	11.47	5.03

Table 2 shows that the Experimental Group (PLS) had a pre-test score of 50.00 (SD = 8.96), while the Control Group had 47.00 (SD = 10.66), indicating similar initial motivation levels. After the intervention, the Experimental Group's post-test score increased to 66.71, while the Control Group's rose slightly to 52.03. The Experimental Group achieved a mean gain of 16.71, suggesting that the Personalized Learning Strategy significantly enhanced students' motivation.

Testing of Hypotheses

The hypotheses were tested using Analysis of Covariate (ANCOVA) at 0.05 alpha level of significance.

H₀₁: There is no significant effect of Personalized Learning Strategy (PLS) on Academic Performance in Chemistry among senior secondary school students in Kaduna state.

Table 3: Results of ANCOVA Analysis on effect of Personalized Learning Strategy (PLS) on Academic Performance in Chemistry

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	14120.393 ^a	2	7060.196	250.208	.000	.864	
Intercept	241.786	1	241.786	8.569	.004	.098	
Treatment	4530.100	1	4530.100	160.543	.000	.670	
Pretest	6067.382	1	6067.382	215.023	.000	.731	
Error	2229.168	79	28.217				
Total	330814.000	82					
Corrected Total	16349.561	81					

Corresponding author: Moses Solomon

smoses@fcezaria.edu.ng

Department of Educational Psychology, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

a. R Squared = .864 (Adjusted R Squared = .860)

Table 3 showed that effect of Treatment (Personalized Learning Strategy) on Academic Performance. The result revealed that the effect of treatment (PCLS) on academic performance is statistically significant $F(1,79) = 160.543$, $p = .000$, Partial Eta Squared (η^2) = .670. Since the p-value (.000) is significant we reject the null hypothesis (H04). This means that PLS has a significant effect on students' academic performance in Chemistry. The Partial Eta Squared (0.670) suggests that 67.0% of the variance in posttest

scores is due to the PLS treatment, which indicates a very strong effect. The corresponding research question 1 indicated that the experimental group had mean gain of 21.09 in favor of PLS.

H02: There is no significant effect of Personalized Learning strategy (PLS) on Motivation among senior secondary school students in Kaduna state.

Table 4: Results of ANCOVA Analysis on effect of Personalized Learning strategy (PLS) on Motivation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9565.714 ^a	2	4782.857	172.624	.000	.814
Intercept	278.446	1	278.446	10.050	.002	.113
Treatment	1827.741	1	1827.741	65.967	.000	.455
Pretest	7162.994	1	7162.994	258.529	.000	.766
Error	2188.835	79	27.707			
Total	294489.000	82				
Corrected Total	11754.549	81				

Table 4 showed the result of effect of Treatment (PLS) on Motivation. The result revealed that the effect of treatment (Personalized Learning Strategy) on students' motivation is statistically significant $F(1,79) = 65.967$, $p = .000$, Partial Eta Squared (η^2) = .455. Since $p < 0.05$, we reject the hypothesis (H05) and conclude that Personalized Learning Strategy significantly increases students' motivation in Chemistry. The Partial Eta Squared (0.455) suggests that 45.5% of the variance in posttest motivation scores is because of the PLS treatment, indicating a large effect. The corresponding research question 2 also indicated that the experimental group had mean gain of 16.71 in favor of PLS.

DISCUSSION OF FINDINGS

This study investigated the Effect of Personalized Learning Strategy on Motivation and Academic Performance in Chemistry among Public Senior Secondary School Students in Kaduna State, Nigeria. The findings of this study reveal that the Personalized Learning Strategy

(PLS) had a statistically significant and positive effect on both academic performance and motivation in Chemistry among public senior secondary school students in Kaduna State. Both descriptive and inferential statistical analyses, particularly the ANCOVA results, support this conclusion.

Students who were exposed to PLS demonstrated a remarkable improvement in their academic performance, with a mean gain of 21.09, in contrast to the control group, which had a mean gain of only 3.95. The ANCOVA confirmed that this difference was statistically significant, with $F(1,79) = 160.543$, $p < 0.05$, and a Partial Eta Squared of 0.670, indicating that 67.0% of the variance in academic performance was attributable to the personalized learning intervention. These findings align with previous research by Abedi et al. (2021), who found that personalized learning significantly improved students' content mastery and academic outcomes. Similarly, Jirapipat (2019) emphasized the positive impact of digital and individualized

Corresponding author: Moses Solomon

smoses@fcezaria.edu.ng

Department of Educational Psychology, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved



content delivery on student engagement and performance. The evidence from this study reinforces the idea that tailoring instruction to students' individual needs, learning pace, and preferences results in deeper understanding and improved academic success, especially in complex subjects like Chemistry.

In terms of motivation, the students in the experimental group also demonstrated substantial improvement, with a mean gain of 16.71, compared to 5.03 in the control group. ANCOVA results further confirmed the statistical significance of this effect, with $F(1,79) = 65.967$, $p < 0.05$, and a Partial Eta Squared of 0.455, suggesting that 45.5% of the variance in students' motivation was due to the personalized learning treatment. This outcome is consistent with Self-Determination Theory (SDT) proposed by Ryan and Deci, which holds that fostering autonomy, competence, and relatedness enhances intrinsic motivation. The motivational impact observed in this study also echoes the findings of Jirapipat (2019) and Makhambetova et al. (2021), both of whom reported that personalization in teaching strategies leads to increased student engagement and motivation across different learning environments.

Although Ogwari et al. (2020) did not find statistically significant results in their study conducted in Kenya, their findings still indicated improved post-test performance for students exposed to PLS. This suggests that factors such as regional context, implementation fidelity, and sample size may influence the effectiveness of personalized learning strategies in different educational settings.

The positive outcomes of this study are theoretically grounded in Constructivist Learning Theory, which emphasizes the importance of active student engagement and the relevance of prior knowledge in constructing new understanding. PLS aligns with this theory by providing learning experiences that are meaningful and tailored to the learner's background and needs. Additionally, Self-Determination Theory provides a strong psychological framework for interpreting the increase in motivation, as the strategy satisfies

learners' basic psychological needs for autonomy and competence. Together, these theoretical underpinnings explain why personalized learning was effective in enhancing both the academic and motivational outcomes of students in this study.

CONCLUSION

Overall, the findings strongly support the effectiveness of Personalized Learning Strategy in enhancing both academic performance and motivation in Chemistry among senior secondary school students in Kaduna State. The high effect sizes observed in this study underscore the potential of PLS as a transformative pedagogical tool in chemistry.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

1. Teachers and Schools should adopt peer collaborative and personalized learning strategies to enhance student engagement, academic performance, and retention, especially in science subjects like Chemistry.
2. Educational Psychologists and Counsellors should support the implementation of these strategies by addressing students' cognitive, emotional, and motivational needs, while guiding teachers on best practices.

REFERENCES

- Abedi, R., Nili, A., Taghiyareh, F., Aliabadi, K., & Pourroustaei, A. S. (2021). The effects of personalized learning on achieving meaningful learning outcomes. *Interdisciplinary Journal of Virtual Learning in Medical Sciences*, 12(3), 177–187.
<https://doi.org/10.30476/ijvllms.2021.89371.1072>
- Ajayi, V. O. (2017). Effect of hands-on activities on senior secondary chemistry students' achievement and retention in stoichiometry in Zone C of Benue



- State. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.2992803>
- Bingham, A. (2018). A look at personalized learning: Lessons learned. *Kappa Delta Pi Record*, 55(3), 116–121.
<https://doi.org/10.1080/00228958.2019.1622383>
- Carnevale, A. P., Smith, N., & Melton, M. (2011). *STEM: Science, technology, engineering, mathematics*. Georgetown University Center on Education and the Workforce.
- Dockterman, J. (2024). What the history of personalized learning teaches us about it today. Retrieved from
<https://www.learning.com/>
- Duckett, P. (2012). Personalized learning and vocational education and training. In *International Encyclopedia of Education* (pp. 457–462).
<https://doi.org/10.1016/B978-0-08-044894-7.00789-2>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415.
<https://doi.org/10.1073/pnas.1319030111>
- Jirapipat, T., & Thanya, P. (2019). Investigated effect of personalized learning with preferred digital media types on learning motivation. *Social Sciences Issue*.
<https://www.scopus.com/inward/record.uri?partnerID=HzOxMe3b&scp=85077507990&origin=inward>
- Jones, A., & Brown, K. (2020). Longitudinal effects of personalized learning paths in online high school programs. *Educational Psychology Review*, 32(4), 589–605.
<https://doi.org/10.1007/s10648-020-09533-6>
- Keile, P. (2023). *The effects of personalized learning on student achievement* [Master's thesis, Western Kentucky University]. TopSCHOLAR®.
<https://digitalcommons.wku.edu/theses/225>
- Kendra, C. (2023). Motivation: The driving force behind our actions. *Verywell Mind*.
<https://www.verywellmind.com/what-is-motivation-2795378>
- Khan, M. (2024). Impact of personalized learning paths on student motivation and achievement in online high school programs in Pakistan. *International Journal of Online and Distance Learning*, 5(2), 52–61.
<https://doi.org/10.47604/ijodl.2748>
- Lundahl, B. (2022). *Texts, topics, and tasks - Teaching English in years 4–6* (2nd ed.). Studentlitteratur.
- Makhambetova, A., Zhivenbayeva, N., & Ergeshev, A. E. (2021). Personalized learning strategies as a tool to improve academic performance and motivation of students. *International Journal of Web-Based Learning and Teaching Technologies*, 16(4), 1–15.
<https://doi.org/10.4018/IJWLTT.286743>
- Nahas, E. (2022). Impact of personalized learning. *eLearning Industry*.
<https://elearningindustry.com/impact-of-personalized-learning>
- NAU Journal of Technology & Vocational Education. (2018). *NAU Journal of Technology & Vocational Education*, 3(1).
- Ogwari, P., Mendoza-Role, E., & Amimo, C. (2020). Effect of personalized learning on mathematics performance among secondary schools in Awendo Sub-County, Kenya. *East African Journal of Education and Social Sciences*, 1(2), 98–108.
<https://doi.org/10.46606/eajess2020v01i02.0025>
- O'Rourke, S. (2022). Top 9 strategies to support personalized learning. *RingCentral Blog*.



- <https://www.ringcentral.com/us/en/blog/top-9-strategies-to-support-personalized-learning/>
- Pemberton, A., & Moallem, M. (2013). The impact of personalized learning on motivation in online learning. In R. McBride & M. Searson (Eds.), *Proceedings of SITE 2013--Society for Information Technology & Teacher Education International Conference* (pp. 907–914). Association for the Advancement of Computing in Education (AACE).
<https://www.learntechlib.org/primary/pl/48228/>
- Phillips, K. (2023). *The effects of personalized learning on student achievement* [Doctoral dissertation, Western Kentucky University].
<https://digitalcommons.wku.edu/diss/225>
- Raman, A. H. (2024). Analysis of the impact of personalized learning paths in mobile learning platforms on the development of self-directed learning strategies among Brazilian college students. *Research and Advances in Education*, 3(3), 9–14.
<https://www.paradigmpress.org/rae/article/view/1043>
- Rashidat, A. A., Adelana, O. P., Okubanjo, G. A., & Ayanwale, K. (2022). Personalized learning and achievement in basic science: An experimental report. *EDUCATUM Journal of Science, Mathematics and Technology*, 9(1), 38–47.
- <https://doi.org/10.37134/ejsmt.vol9.1.4.2022>
- Samba, R. M. O., & Eriba, J. O. (2012). *Innovative approaches in teaching different science concepts*. Makurdi: Destiny Ventures.
- Smith, A. (2019). Effectiveness of personalized learning paths in online high school settings. *Educational Technology Research & Development*, 67(1), 45–62. <https://doi.org/10.1007/s11423-018-9622-8>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Yang, C. C., & Ogata, H. (2023). Personalized learning analytics intervention approach for enhancing student learning achievement and behavioral engagement in blended learning. *Education and Information Technologies*, 28(3), 2509–2528.
<https://doi.org/10.1007/s10639-023-11543-3>
- Zhou, Y., Ye, X., & Liu, Y. (2022). The influence of personalized learning intervention system on student learning: A study of junior middle school. *Interactive Technology and Smart Education*, 19(4), 441–459.
<https://doi.org/10.1108/ITSE-02-2022-0022>
- Reichardt, C. S. (2019). *Quasi-experimentation: A guide to design and analysis*. Guilford Press.