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Students Motivation as a Predictor of Chemistry Performance among Secondary School in Sabon Gari Area of Kaduna State

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Abstract

Students' academic performance in Chemistry remains a concern in secondary education, and motivation may influence their learning outcomes. This study examined the predictive effect of students' motivation on academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State, Nigeria. A quantitative cross-sectional correlational design was adopted, involving 205 Senior Secondary School students selected from co-educational public secondary schools. Data were collected using the Chemistry Motivation Questionnaire (CMQ) and the Chemistry Performance Test (CPT), which had reliability coefficients of .81 and .75, respectively. A scatter plot was used to examine the relationship between the variables, while simple linear regression was employed to determine the predictive effect of motivation on academic performance. The findings revealed a weak positive relationship between students' motivation and academic performance in Chemistry. Regression analysis showed that motivation significantly and positively predicted academic performance ($\beta = .227$, $p = .001$). Consequently, the null hypothesis was rejected. The study concludes that students' motivation is a significant predictor of academic performance in Chemistry, although other factors may also contribute to differences in achievement. Based on the findings, it was recommended that Chemistry teachers and other educational stakeholders should provide supportive learning environments that encourage students' motivation, participation and commitment to learning Chemistry.

Keywords: students' motivation, academic performance, chemistry, secondary school students, Sabon Gari

1 Introduction

Chemistry plays an important role in scientific advancement, medicine, agriculture, industrial development, and technological innovation. At the secondary school level, the subject helps students understand matter, chemical reactions, and the scientific principles underlying everyday phenomena. It also provides opportunities for developing critical thinking, problem-solving, and scientific reasoning skills. Despite the importance of Chemistry, many secondary school students experience difficulties in learning the subject. These difficulties include understanding abstract concepts, balancing chemical equations, performing calculations and interpreting chemical symbols. Oladejo et al. (2023) identified calculations, chemical equations and equilibrium among the Chemistry concepts students find difficult. Similarly, the WAEC Chief Examiners' Report (2023) highlighted weaknesses in candidates' ability to apply chemical principles and interpret experimental results. These difficulties may be associated with the nature of Chemistry content and the approaches used in teaching the subject. Students' motivation may also influence how they approach these learning challenges. Motivated students are more likely to participate in classroom activities, make efforts to understand difficult concepts and persist in learning tasks. Previous studies have reported an association between students' motivation and academic performance (Oyekola et al., 2020; Lawal et al., 2024). Furthermore, In Sabon Gari Local Government Area of Kaduna State, the extent to which students experience these difficulties and how their motivation relates to their academic performance in Chemistry have not been sufficiently established. This study therefore investigates the relationship between students' motivation and academic performance in Chemistry in the area.

Motivation is an important aspect of learning because it influences students' willingness to begin a task, maintain their efforts, and continue learning when difficulties arise. In Chemistry, motivated students may show greater interest in practical activities, attempt challenging questions, and seek explanations when they do not understand a concept. Several Nigerian researchers have examined the relationship between motivation and Chemistry achievement. Oyekola et al. (2020) investigated motivation as a predictor of academic achievement among secondary school Chemistry students in Oyo State,

while Lawal et al. (2024) examined the relationship between motivation and Chemistry performance among secondary school students in Katsina State. Research by Offor and Samuel (2022) also considered science-learning motivation and Chemistry achievement among students in Anambra State. However, their findings showed that science-learning motivation was not significantly correlated with Chemistry achievement. This difference suggests that the relationship between motivation and academic performance may not be the same across all student populations and educational settings.

Other Nigerian studies have explored how different aspects of motivation relate to students' achievement in Chemistry. In Lagos State, Okafor and Ogunbodede (2016) examined motivation and reinforcement in relation to female secondary school students' achievement and interest in Chemistry. Samuel and Egolum (2026) investigated intrinsic and extrinsic motivation alongside test anxiety among secondary school students in Anambra State. Their findings indicated that intrinsic motivation positively predicted Chemistry performance, whereas extrinsic motivation did not have a statistically significant predictive relationship with performance. Similarly, Ibrahim et al. (2026) investigated motivation and academic achievement in Chemistry among post-basic school students in Gombe State. Taken together, these studies highlight the importance of examining motivation in Chemistry education while recognising that different dimensions of motivation may relate to academic performance in different ways. Although studies have examined students' motivation and Chemistry achievement in several Nigerian states, the findings may not fully reflect the experiences of students in Sabon Gari Local Government Area of Kaduna State. Students' motivation may be shaped by their classroom experiences, teaching methods, availability of learning materials, and perceptions of Chemistry. These conditions may also influence how students engage with the subject and perform in assessments. Investigating the relationship between motivation and academic performance in Sabon Gari is therefore important for understanding the situation within this particular educational setting.

Against this background, the present study examines the relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State, Nigeria. Specifically, it aims to find out whether students' motivation is related to their academic performance in Chemistry. The study is guided by the following research question:

1. What is the relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State, Nigeria?

The study is based on the null hypothesis that there is no significant relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State. The study also covers secondary school students in selected schools in Sabon Gari Local Government Area, Kaduna State. It focuses on their motivation towards learning Chemistry and their academic performance in the subject.

The findings may help Chemistry teachers and school administrators understand the role students' motivation plays in learning Chemistry. They may also provide useful insights into classroom practices that encourage students to participate actively, put more effort into their studies and develop greater interest in the subject.

2 Theoretical Framework

This study is based on Self-Determination Theory (SDT), developed by Deci and Ryan (1985) and further explained by Ryan and Deci (2000). The theory explains why people engage in particular activities and how their reasons for doing so influence their interest, effort and persistence. It identifies three types of motivation: intrinsic motivation, extrinsic motivation and amotivation. Intrinsic motivation occurs when individuals engage in an activity because they find it interesting or enjoyable. Extrinsic motivation involves taking part in an activity to achieve an external reward or outcome, such as obtaining good grades or preparing for a future career. Amotivation, on the other hand, refers to a lack of willingness or intention to engage in an activity. The theory also identifies three basic psychological needs: autonomy, competence and relatedness. These involve having a sense of choice, feeling capable of achieving a task and having positive relationships with others. According to the theory, satisfying these needs helps to strengthen motivation and encourage continued engagement.

SDT has been applied in studies examining students' motivation and learning in Chemistry. For example, Black and Deci (2000) investigated the relationship between students' motivation, instructors' support and academic performance in an organic Chemistry course. They found that students who had more autonomous reasons for studying Chemistry showed greater interest and perceived competence. The researchers also reported that changes in students' autonomous motivation were related to their performance in the course. This suggests that students' reasons for learning and the support they receive from their teachers can influence their learning experiences and academic outcomes. Similarly, Pratt et al. (2023) examined

students' motivation and learning in foundation-level inorganic Chemistry courses across several institutions in the United States. Their findings showed a positive and significant relationship between intrinsic motivation and academic performance. The study also reported that students' motivation did not change significantly during the courses. In Nigeria, Aliyu et al. (2026) investigated the effects of gamification on students' motivation and academic performance in Electrochemistry in Sokoto Metropolis. Guided by SDT, the researchers found that students taught through gamified instruction recorded higher motivation and academic performance than those taught using the conventional method. These studies show that motivation is an important consideration in understanding students' learning and performance in Chemistry.

The theory is relevant to the present study because students have different reasons for learning Chemistry. Some students may study the subject because they enjoy it, while others may be motivated by good examination results, parental expectations or future career opportunities. These reasons may influence the effort they put into learning and their willingness to continue when they encounter difficulties. Chemistry involves understanding abstract concepts, interpreting chemical symbols, solving equations and applying scientific principles. Students who are interested in the subject and believe they can succeed may be more willing to participate in lessons, complete assignments and practise solving problems. The Chemistry Motivation Questionnaire (CMQ) used in this study covers five dimensions: intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation. These dimensions reflect different aspects of students' reasons and willingness to learn Chemistry. Intrinsic motivation and personal relevance relate to students' interest in learning, while career and grade motivation reflect the value they attach to the subject and the outcomes they hope to achieve. Self-determination and self-efficacy also relate to students' willingness to take responsibility for their learning and their confidence in handling academic tasks. Although these dimensions have connections with some aspects of SDT, the CMQ does not directly measure amotivation or the satisfaction of autonomy, competence and relatedness. Therefore, the theory provides a basis for interpreting students' motivation rather than a complete model being tested in this study. In the present study, SDT helps explain why students' motivation may be related to their academic performance in Chemistry. Students who find the subject interesting, consider it useful for their future and believe they can succeed may be more willing to devote time and effort to learning. This effort may contribute to better academic performance. However, students' achievement may also be influenced by other factors, including prior knowledge, teaching methods, availability of learning resources and study habits. The theory therefore provides a useful foundation for examining the relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State, Nigeria.

3 Materials and Methods

3.1 Research Design

This study adopted a quantitative cross-sectional correlational design to examine the relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State, Nigeria. The design was appropriate because it enabled the researcher to collect numerical data on the study variables at a particular point in time and examine the relationship between them without manipulating the variables (Creswell & Creswell, 2018). Simple linear regression was used to determine the extent to which students' motivation statistically predicts their academic performance. However, this prediction is statistical rather than causal, as the design does not establish a cause-and-effect relationship between the variables.

3.2 Population and Sample

The population of the study comprised 4,615 Senior Secondary School students offering Chemistry in 17 public secondary schools in Sabon Gari Local Government Area, Kaduna State, Nigeria. This consisted of 2,772 male and 1,843 female students, based on the records obtained from the Zonal Education Quality Assurance Office for the 2024/2025 academic session. Out of the 17 schools, nine were co-educational public secondary schools. These nine schools formed the sampling frame from which the participating schools were selected through simple random sampling. The intact Chemistry classes in the selected schools were included in the study, resulting in a sample of 205 students, made up of 96 males and 109 females. Using intact classes allowed the researcher to collect data from students in their regular classroom settings. The 204 students therefore formed the sample for examining the relationship between motivation and academic performance in Chemistry.

3.3 Instrumentation

Two instruments were used for data collection: the Chemistry Motivation Questionnaire (CMQ) and the Chemistry Performance Test (CPT).

3.3.1 Chemistry Motivation Questionnaire (CMQ)

The Chemistry Motivation Questionnaire (CMQ) was adapted from the Science Motivation Questionnaire developed by Glynn and Koballa (2006) and validated by Glynn et al. (2009). The original 30-item questionnaire measures five dimensions of science motivation: intrinsic motivation and personal relevance, self-efficacy and assessment anxiety, self-determination, career motivation, and grade motivation. Items are rated on a five-point Likert scale. The original instrument demonstrated an overall Cronbach's alpha coefficient of .91, while its five-factor structure explained 60.23% of the total variance. The questionnaire was adapted for the present study to assess students' motivation towards learning Chemistry, with modifications made to improve clarity and contextual relevance.

3.3.2 Chemistry Performance Test (CPT)

The CPT was developed by the researcher using multiple-choice questions adapted from West African Examinations Council (WAEC) and National Examinations Council (NECO) past examination papers from 2015 to 2021. Twenty-five items covering the Chemistry content areas relevant to the study were initially selected. Following expert validation, pilot testing, and item analysis, 21 items were retained, while four were excluded based on their suitability and items analysis results. The final CPT comprised 21 multiple-choice questions, each with four options (A-D). Each correct answer attracted one mark, while an incorrect or unanswered item attracted zero marks, giving a maximun obtained raw scores 0-21.

3.4 Validation of the Instruments

The Chemistry Motivation Questionnaire (CMQ) and Chemistry Performance Test (CPT) were subjected to face and content validation by six experts. These comprised two Senior Lecturers in Educational Psychology, two Senior Lecturers in Science Education, one Senior Lecturer in Chemistry at Ahmadu Bello University, Zaria, and one experienced Chemistry teacher with at least a B.Sc. (Ed.) in Chemistry and five years of teaching experience. The Educational Psychology experts reviewed the CMQ, while the Chemistry and Science Education experts assessed the instruments. The validators examined the clarity of items, content appropriateness, alignment with the study objectives, and suitability for the students' level of understanding. Their observations and recommendations were considered in refining the instruments to improve the clarity, relevance and appropriateness of the items before the final administration.

3.5 Reliability of the Instruments

The reliability of the Chemistry Motivation Questionnaire (CMQ) was determined using the split-half method. The questionnaire items were divided into two halves, and the scores obtained from the two halves were correlated to estimate internal consistency. The reliability coefficient obtained was 0.81, indicating satisfactory internal consistency. Similarly, the reliability of the Chemistry Performance Test (CPT) was initially determined using the test–retest method. Pearson's Product–Moment Correlation Coefficient was used to establish the stability of the test scores across the two administrations. The reliability coefficient obtained was 0.75, indicating a satisfactory level of score stability. Taber (2018) emphasised that reliability coefficients, particularly Cronbach's alpha, should be interpreted in relation to the purpose and context of an instrument rather than through rigid cut-off values. Both coefficients were considered adequate for the intended research purposes.

3.6 Procedure for Data Collection and Analysis

Permission was obtained from the relevant school authorities before data collection. The students were informed about the purpose of the study and assured that the information provided would be treated confidentially and used solely for academic purposes. The Chemistry Motivation Questionnaire (CMQ) and Chemistry Performance Test (CPT) were administered to the selected students in their classrooms under the supervision of the researcher. The completed instruments were collected immediately, checked for completeness, coded, and entered into IBM SPSS Statistics Version 20 for analysis. A scatter plot was used to visually examine the relationship between students' motivation and academic performance in Chemistry.

Simple linear regression analysis was employed to determine the extent to which students' motivation predicted their academic performance. The null hypothesis was tested at the 0.05 level of significance.

4 Result

The results were presented in alignment with the research question and hypothesis

4.1 Addressing research question and hypothesis

To address research question Scatter Plot was used to visually the relationship between students' motivation and academic performance in Chemistry. The result is presented in figure 4.1

Figure **4.1**:

Scatter Plot Showing the Relationship Between Students' Motivation and Academic Performance in Chemistry

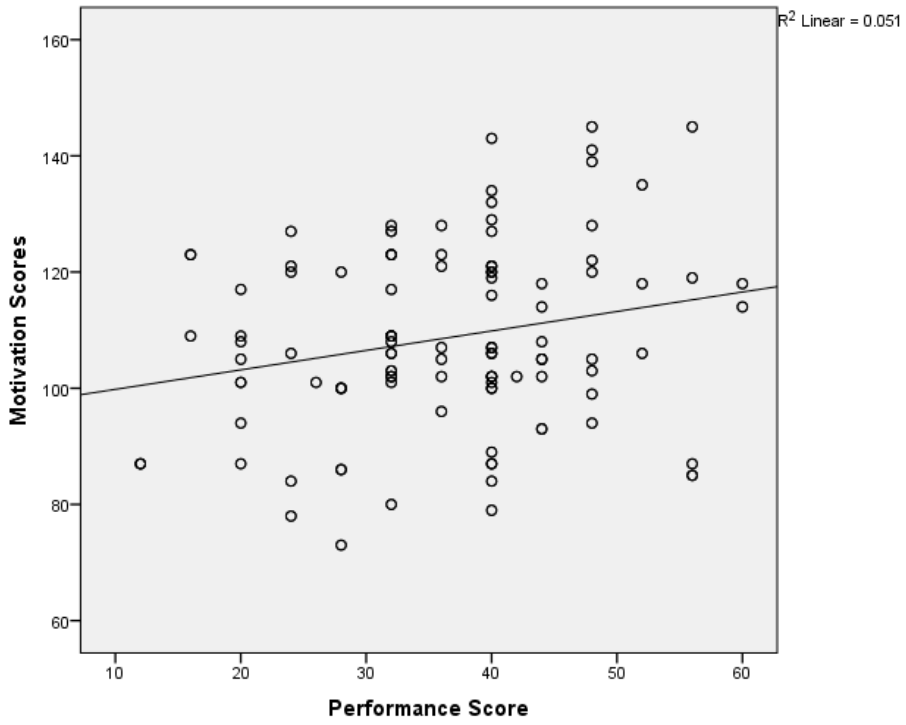


Figure 4.1 shows the scatter plot illustrating the relationship between students' motivation and academic performance in Chemistry. The distribution of the scores generally indicates a positive linear relationship, as shown by the upward-sloping trend line. This suggests that students with higher motivation scores tend to have higher academic performance scores. However, the points are relatively dispersed around the trend line, indicating that the relationship is weak rather than strong. To determine whether students' motivation significantly predicts academic performance in Chemistry, simple linear regression analysis was subsequently conducted. The simple linear regression analysis are presented in table 4.1

Table **4.1**

Simple linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate

1	.227[a]	.051	.047	10.474

a. Predictors: (Constant), Motivation Scores

The Model Summary table revealed an R value of .227, indicating a weak positive relationship between students' motivation and academic performance in Chemistry. The R^2 value of .051 indicated that motivation explained 5.1% of the variation in academic performance. The remaining 94.9% represented variation not explained by the regression model.

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	p-value
1	Regression	1208.009	1	1208.009	11.012	.001[b]
	Residual	22268.986	203	109.699		
	Total	23476.995	205			

a. Dependent Variable: Performance Score

b. Predictors: (Constant), Motivation Scores

The ANOVA results revealed that the regression model was statistically significant, $F(1, 203) = 11.01$, $p = .001$. Since the p value was less than the .05 level of significance, the regression model significantly predicted students' academic performance in Chemistry. Therefore, the null hypothesis was rejected.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	19.905	5.085		3.914	.000	9.878	29.932
	Motivation Scores	.154	.046	.227	3.318	.001	.062	.245

a. Dependent Variable: Performance Score

The coefficients table revealed that students' motivation significantly and positively predicted academic performance in Chemistry, $B = 0.154$, $SE = 0.046$, $\beta = .227$, $t(203) = 3.318$, $p = .001$. The 95% confidence interval ranged from 0.062 to 0.245 and did not include zero. This indicates that a one-point increase in motivation score was associated with an estimated 0.154-point increase in performance score. Therefore, the null hypothesis was rejected.

5 Discussion of Findings

The study investigated the relationship between students' motivation and academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State. The finding revealed that students' motivation significantly and positively predicted their academic performance in Chemistry ($R = .227$, $R^2 = .051$, $F(1, 203) = 11.012$, $p = .001$). This indicates that motivation accounted for 5.1% of the variation in students' academic performance. Although the predictive contribution was relatively small, the result suggests that motivation is a significant factor associated with students' performance in Chemistry. The finding is consistent with Lawal et al. (2024), who studied 315 secondary school Chemistry students in Rimi, Katsina State, and reported a significant positive relationship between motivation and academic performance ($r = .245$, $p < .001$). The relationship reported by Lawal et al. was slightly stronger than that observed in the present study ($R = .227$). The similarity in the direction and statistical significance of the findings may be attributed to the fact that both studies examined motivation in relation to Chemistry performance among secondary school students in Nigeria. It is also consistent with Ibrahim et al. (2026), who studied 370 post-basic school students in Gombe State and found that motivation significantly predicted Chemistry achievement ($R = .565$, $R^2 = .320$, $t(368) = 13.145$, $p < .05$). Their finding showed a stronger predictive relationship, with motivation accounting for 32% of the variation in Chemistry achievement compared with 5.1% in the present study. The difference may be associated with

variations in the motivation instruments, the characteristics of the students, geographical settings and other contextual factors that may influence students' motivation and academic achievement.

However, the finding differs from Offor and Samuel (2022), who investigated science learning motivation and academic achievement among Chemistry students in Anambra State. Their study involved 946 students drawn from 18 public secondary schools, although the motivation correlation table reported 686 cases. They found a very weak positive relationship between science learning motivation and Chemistry achievement ($r = .02$), which was not statistically significant. This contrasts with the significant positive predictive relationship found in the present study. The difference may be related to variations in the instruments used to measure motivation, the dimensions of motivation considered and the characteristics of the students involved. Similarly, Samuel and Egolum (2026), in a study involving 386 Chemistry students in Anambra State, found that intrinsic motivation significantly and positively predicted Chemistry performance ($\beta = .47$, $p < .001$), whereas extrinsic motivation was not a significant predictor ($\beta = .12$, $p = .063$). Although their finding on intrinsic motivation supports the positive contribution of motivation to Chemistry performance, the non-significant result for extrinsic motivation suggests that different dimensions of motivation may not contribute equally to academic achievement. This may partly explain the differences between the present study and previous findings, particularly where studies examined specific types of motivation rather than students' overall motivation. Furthermore, Okafor and Ogunbodede (2016), in a study involving 250 SSII Chemistry students from eight public coeducational secondary schools in Lagos State, reported that motivation and reinforcement significantly influenced students' Chemistry achievement and interest, with motivation having a greater influence than reinforcement. Their finding provides additional support for the importance of motivation in Chemistry learning, although their study examined motivation alongside reinforcement rather than its independent predictive relationship with academic performance.

The positive predictive relationship observed in the present study may be explained by the possibility that motivated students are more willing to participate in classroom activities, complete learning tasks, devote attention to their studies and persist when faced with difficult Chemistry concepts. Such learning behaviours may contribute to improved academic performance. This finding is also consistent with Self-Determination Theory developed by Deci and Ryan (1985) and further discussed by Ryan and Deci (2000). The theory emphasises the importance of motivation in promoting students' engagement, persistence and active participation in learning. It suggests that students who experience motivation are more likely to demonstrate commitment to academic activities and take responsibility for their learning. Therefore, the present finding provides evidence that students' motivation is a significant positive predictor of academic performance in Chemistry, although it does not imply that motivation alone determines students' academic achievement. This study had some limitations that should be considered when interpreting its findings. First, the use of a cross-sectional correlational design limits the interpretation of the findings to statistical relationships and prediction rather than causal effects. Therefore, although students' motivation significantly predicted academic performance in Chemistry, the findings do not establish that increased motivation directly causes improved academic performance.

Second, the study involved students selected from intact classes. Students within the same classes may share similar learning environments, teachers and classroom experiences, which could introduce clustering in the data and potentially affect the independence of observations. The possibility of such classroom-level dependence should therefore be considered when interpreting the regression findings. Third, the regression analysis considered students' motivation as the sole predictor of academic performance. Other potentially relevant factors, such as gender, previous academic achievement, socioeconomic background and learning environment, were not included in the model. Consequently, the model explained only 5.1% of the variation in academic performance, suggesting that other factors may also contribute to differences in students' Chemistry performance. Finally, the study relied on simple linear regression to examine the predictive relationship between motivation and academic performance. Although the regression model was statistically significant, the limited diagnostic evidence available for examining assumptions such as residual normality, homoscedasticity and influential observations should be considered when interpreting the findings. Future studies could address these limitations by using longitudinal designs, accounting for classroom-level clustering, incorporating relevant background variables and conducting comprehensive regression diagnostic tests.

6 Conclusion

Based on the findings, it was concluded that students' motivation was a small but statistically significant positive predictor of their academic performance in Chemistry among secondary school students in Sabon Gari Local Government Area, Kaduna State. Motivation accounted for only 5.1% of the variation in academic performance, suggesting that other factors

may also contribute to students' achievement. Since the study adopted a cross-sectional correlational design, the finding does not establish a cause-and-effect relationship. Based on the findings, Chemistry teachers should create supportive learning environments that encourage students' motivation and participation. School administrators should provide adequate instructional resources and professional development opportunities for Chemistry teachers. Curriculum planners and the Ministry of Education should incorporate motivational considerations into Chemistry teaching guidelines, while parents should provide academic support and encourage positive attitudes towards learning Chemistry.

7 Declaration

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