EXAMINING TEACHER DEMAND-SUPPLY TRENDS AND STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN SOUTHWEST NIGERIA: EVIDENCE FOR QUALITY ASSURANCE REFORM

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Abstract

The study examined chemistry teacher demand-supply trends alongside students' academic achievement in chemistry in West African Senior School Certificate Examination (WASSCE) from 2017-2023 in public secondary schools in Southwest, Nigeria with a view to providing evidence-based directions for sustainable quality assurance reform. The research design adopted was retrospective-trend survey. The population comprised 6 directors of Administration and Supplies of State Ministries of Education and 2,140 principals of Senior Secondary Schools in Southwest Nigeria. Multi-stage sampling procedure involving the use of simple random sampling, total enumeration, and convenience sampling techniques were used to select 30 respondents which comprised 3 directors and 27 principals from 27 schools in Ekiti, Ogun and Oyo States. Three validated research instruments were used for data collection. Descriptive statistics and trendline charts were used to analyse the research questions while the null hypotheses tested for lag effects between two time-series datasets using Cross Correlation Function. Findings revealed that chemistry achievement trends showed a general decline from 2017 to 2023 (55.4% to 45.2%). The trend of demand for chemistry teachers showed consistent increase from 3.93 to 4.60 with an annual average of 4.05, whereas supply trend showed a general decline from 1.81 to 1.19. There was a significant time-based relationship between supply of chemistry teachers from 2017-2023 and academic achievement of students in Chemistry (Lag 0: $r = .889$, $p < .05$). The study concluded that declining supply of Chemistry teachers over the years was matched by a corresponding drop in students' academic achievement rates. Teacher supply and workforce planning emerges as a critical area requiring quality assurance reform, thus government should prioritise proactive teacher recruitment, improved deployment mechanisms, and retention strategies.

Keywords: Demand-supply trend, chemistry teacher, academic achievement, quality assurance reform
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Introduction

Chemistry is one of the pure science subjects that is crucial for national development by driving industrialization, ensuring food security through fertilizers and pesticides, advancing healthcare with pharmaceuticals and diagnostics, creating new materials for infrastructure/energy, and transforming natural resources into economic growth across industrial sectors. In other words, chemistry is fundamental to all science disciplines ranging from medical, pharmaceutical, pure and applied sciences, biological sciences to science education. At the senior secondary school certificate examination level, a student interested in any of the disciplines mentioned must have at least five credits in Mathematics and English Language, Chemistry and any other science subjects, that is, Physics, Biology, Geography, Further Mathematics and so on (Ojelade & Aregbesola, 2018). As stipulated in the National Policy on Education, the teaching of chemistry at the senior secondary school level is expected to develop essential scientific skills in the learners so as to prepare them for technological development as well as stimulate and enhance their creativity (Federal Republic of Nigeria, 2013). Consequently, chemistry is regarded a compulsory science subject for all science students.

Over the years, there have not been remarkable improvements in students' academic achievement in the subject in internal and external examinations (Umanah & Sunday, 2025). Poor academic achievements in chemistry has been linked to several factors which include high teacher-student ratio shortage of good teaching staff, inadequate learning teaching and facilities, poorly equipped laboratory and poor knowledge of subject matter among others (Chikendu, 2022; Ezeala, 2022; Kalu, 2024). Academic achievement in chemistry refers to a student's academic success at school as measured in terms of grades in internal and external examinations. The importance of teachers in the academic achievement of students in chemistry is paramount. To occupy a central position to transform complex chemical concepts into understandable, real-world knowledge, thereby fostering their critical thinking and problem-solving skills. Also, they engage learners to build essential reasoning skills by linking theory to practical laboratory work. Ojelade and Aregbesola (2018) posited that experienced and skill chemistry teachers are needed in schools for effective chemistry learning. This is because the pass or failure rates depends on the availability of qualified, competent and dedicated teachers. However, the availability of science teachers in most public senior secondary schools has not been steady over the years due to demand and supply forces (Durojaiye, 2025).

According to Durojaiye (2025), teacher demand represents the expected number of secondary school teachers required to teach a particular subject in school. This is usually assessed based on the teacher-students ratio of 1:40 standard set in the National Policy on Education (NPE) which is expressed in schools as staff quota. On the other hand, teacher supply represents the total number of teachers engaged and deployed by state governments on full or temporary basis to teach a particular subject in public secondary schools. This is often expressed in terms of staff in post. According to Ige cited in Awofala and Lawani (2020), teachers' demand bears little relationship with the economic indices of demand for goods and services. The major determinant of the demand for qualified teachers in public schools has always been linked to students' enrolment. Hence, it could be deduced that an increase in chemistry students' enrolment would naturally cause a rise in the demand for

additional chemistry teachers. Awofala and Lawani (2020) also stated that the demand for teachers is an age-long issue, usually determined by the number of students available. Apart from students' enrolment, stakeholders are looking at other factors such as student-teacher ratio policy, enrolment dynamics, teacher demand/supply flow, teacher demand/supply gap and teacher recruitment/retention practices.

As students' enrolment continues to rise and more schools are being established by government, teachers demand will continue to attract the attention of education stakeholders. The concept of teacher supply is used to refer to the composition of the actual teaching force and teacher supply shortages. Teachers' supply is the size of the teaching force, determined by the demand forces. The student-teacher ratio policy in Nigeria of 40:1 as contained in the 2013 revised NPE document also plays major role in defining teacher demand and supply. Edwards et al. (2023) defined teacher supply as the number of individuals completing approved programmes of teacher education and the number of active certificates for individuals who are not currently working in education. Also, Olojo et al. (2022) noted that teachers' supply may vary in terms of consideration due to geographical location, time and system of education in place. Whatever the case may be, the issue of teacher demand and supply has continued to attract the attention of education stakeholders from time immemorial.

Recently, Yusuf (2023) in their investigation of the factors responsible for science teacher shortage including chemistry in public secondary schools in Oyo State, found out that the available science teachers were 225 while the number of expected science teachers that would meet up with the students-teacher ratio of 35:1 was 349 (a shortage of 123 science teachers). The study attributed this shortfall to factors such as transfer of science teachers without replacement, and increase in science student enrolment. Kayode (2011) examined the demand, supply and utilisation of secondary school teachers in Kabba. The result of their study showed inadequate basic science teachers in both rural and urban schools with 81 per cent qualified teachers. In their work on the influence of teacher demand and supply on students' academic performance at upper basic schools in North-West Nigeria, Adedeji et al. (2022) revealed a positive significant inter-relationship among teacher demand, supply and students' academic performance.

The theoretical framework explaining the relationship between the two variables of this study (teacher demand-supply trend and academic achievement of students in Chemistry) is human capital theory propounded by Schultz (1961) and advanced by Becker (1964). Human capital theory posits that investment in education and skilled manpower enhances productivity and performance outcomes. In the case of teacher demand-supply trends, the theory explains how adequate supply, proper training, and effective deployment of qualified chemistry teachers constitute critical human capital investments that directly influence students' academic achievement rates. A shortage or uneven distribution of qualified chemistry teachers reduces instructional quality, thereby undermining learning outcomes. This theory provides a strong framework for examining how teacher availability and quality function as inputs that affect students' achievement and justify quality assurance reforms aimed at strengthening teacher recruitment, training and retention for public secondary schools in Nigeria. The need for policy reform was emphasised on yearly recruitment of teachers most especially in science subjects in order to improve students' academic performance rates.

Problem Statement

The persistent concern over students' poor academic achievement in Chemistry at the senior secondary school level in Nigeria has continued to attract the attention of educators, policymakers, and quality assurance agencies. Chemistry remains a core science subject critical to national development, technological advancement, and students' progression into science-based careers. Despite sustained investments in curriculum reforms and school approval exercises, the researchers observed that academic achievement outcome in Chemistry in many public secondary schools in Southwest Nigeria remain inconsistent and, in some cases, declining. A major dimension of this problem is the apparent imbalance between the demand for and supply of qualified Chemistry teachers. Rapid growth in student enrolment, uneven teacher deployment, retirements, and limited recruitment have widened this observed gap in some states in Southwest Nigeria. Consequently, many schools rely on inexperienced, out-of-field, or overstretched teachers to handle chemistry classes which potentially disrupt instructional quality, curriculum coverage, and students' learning abilities. However, the existing quality assurance practices by government's supervisory and regulatory bodies tend to focus more on periodic inspections and infrastructural compliance than on longitudinal analysis of human resource adequacy and its potential implications. This therefore presents education policy interventions with risk of being reactive rather than being preventive measures.

Objectives of the Study

The broad objective of this study was to examined chemistry teacher demand-supply trends alongside students' academic achievement in chemistry in West African Senior School Certificate Examination (WASSCE) from 2017-2023 in public secondary schools in Southwest, Nigeria with a view to providing evidence-based directions for sustainable quality assurance reform. The specific objectives were to:

i. find out the trend of academic achievement of students in chemistry in Senior Secondary Schools in Southwest states from 2017-2023;
ii. investigate the trend of demand for chemistry teachers in public secondary schools from 2017 to 2023 in Southwest states;
iii. examine the trend of supply of chemistry teachers in public secondary schools from 2017 to 2023 in Southwest states;
iv. find out the trend in academic achievement rates of students in chemistry based on supply of chemistry teachers to public secondary schools in Southwest, Nigeria from 2017-2023;
v. find out if there is a significant time-based relationship between school demand for chemistry education teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria; and
vi. investigate whether there is a significant time-based relationship between supply of chemistry education teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria.

Research Questions

The following research questions were answered in this study:

i. What is the trend of students' academic achievement in chemistry in public schools from 2017-2023 in Southwest Nigeria?
ii. What is the trend of demand for chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria?
iii. What is the trend of supply of chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria?
iv. What is the trend in academic achievement of students in chemistry based on supply of chemistry teachers to public secondary schools in Southwest, Nigeria from 2017-2023?

Hypotheses

The following null hypotheses were tested in this study:
H_{01}. There is no significant time-based relationship between school demand for chemistry teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria.
H_{02}. There is no significant time-based relationship between supply of chemistry teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria.

Methodology

This study adopted descriptive research design of retrospective-trend survey. This was done by examining past records of chemistry teachers' demand and supply to identify patterns in students' academic achievement in WASSCE. Also, the study involved the selection of appreciable number of schools out of the large population of schools in Southwest Nigeria to examine changes or development in students' academic achievement at different points in time from 2017 to 2023. This study gathered and described existing data obtained from the officials of State Ministries of Education and Principals of senior secondary schools on the demand and supply of chemistry education teachers and students' academic achievement in chemistry in Southwest, Nigeria without manipulation. The population of this study comprised all Directors of Administration and Supplies of State Ministries of Education and Principals of Public Senior Secondary Schools (SSS) in Southwest, Nigeria.

Southwest Nigeria constitutes a critical geopolitical zone in Nigeria for examining teacher demand-supply trends and students' academic achievement in chemistry due to its strategic educational, economic, and demographic significance within the country. The region comprises six states (Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti), and is widely recognised for its relatively high concentration of public secondary schools, tertiary institutions, and industrial activities that may influence science education demand. There were six (6) Directors of Administration and Supplies in State Ministries of Education and 2,140 Public Senior Secondary School Principals in Southwest, Nigeria (Federal Ministry of Education, 2025).

The sample size for this study was 30 respondents which comprised three (3) Directors of Administration and Supplies and 27 Senior Secondary School Principals in Southwest, Nigeria. Multistage sampling procedure was used to select the sample size. At stage one, simple random sampling technique of ballot type was adopted to select three states (Ekiti, Ogun and Oyo) out of the six states in Southwest, Nigeria (Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti). This was done to give each state equal chance of being selected. Still at stage one, total enumeration was used to select all the three (3) Directors of Administration and Supplies of the Ministries of Education in charge of recruitment, induction, and confirmation of service of teaching personnel in Ekiti, Ogun and Oyo States, since there was one Director of Administration and Supplies in each of the State Ministries of Education. At stage two which is at the local government level, simple random sampling technique was used to select 27 out of the 137 local government areas in Ekiti, Ogun and Oyo states. This represented 37% of the entire local government areas in the three states. At stage three which is at the school level, purposive sampling technique was employed to select 27 senior secondary schools (one in each of the 27 selected local government areas in Ekiti, Oyo and Ogun states, based on the oldest Senior Secondary Schools by year of establishment that met the criteria set for this study (availability of data on trends of teacher demand and supply as well as students' academic performance from 2017 to 2023). Still at stage three, total enumeration was used to select 27 senior secondary school principals (one in each of the 27 selected local government areas of Ekiti, Oyo and Ogun states, since one senior secondary school is administered by one principal.

Three research instruments were developed by the researchers for this study. These include Trend of Chemistry Teachers' Demand Checklist (TCTDC), Trend of Chemistry Teachers' Supply Checklist (TCTSC), and Trend of Chemistry Students' Academic Achievement Proforma (TCAAP). Trend of Chemistry Teachers' Demand Checklist (TCTDC) is a researcher-structured instrument comprising items completed by the Director of Administration and Supplies of the Ministries of Education and school Principals, basically to indicate the trend of chemistry teachers demand at state and school levels respectively from 2017-2023 based on science student-teacher ratio and yearly science students school enrolment. Trend of Chemistry Teachers' Supply Checklist (TCTSC) is a researcher-designed instrument comprising items completed by the Director of Administration and Supplies of the Ministries of Education and school Principals, basically to indicate the trend of chemistry teachers' supply at state and school levels respectively from 2017-2023. Trend of Chemistry Students' Academic Achievement Proforma (TCAAP) is a researcher-designed instrument which comprises the state, name of school, school location and local government area. This was used by the researchers to source for information from school Principals on the performance grades of exam candidates who sat for chemistry in WASSCE conducted by WAEC from 2017-2023.

The content validity of the instruments was established through expert validation by Professors of Measurement and Evaluation, and Educational Management. The experts scrutinised and edited the items in each instrument to ensure that they are in line with the purpose of the study. After which the items were re-framed as suggested to ensure the validity of the instruments. Letter was written to the officials of the State Ministries of Education (SMoE) for permission to access the sampled Senior Secondary Schools to administer the instruments. Thereafter, six (6) research assistants were trained and employed in the administration of these research

instruments. The approval letter from the SMoE and the letter of introduction from the Department of Educational Management, TASFUED, were presented to the Principals of the selected schools accordingly. Informed consent were collected and incorporated into the instruments. Respondents were assured of high level of confidentiality and anonymity of all information supplied and the data collected by the instruments were used strictly for academic purpose only. Hence the completion of the checklists was voluntary.

Descriptive statistics (counts and percentages) and trendline charts were used to answer research questions. Hypotheses 1 and 2 were analysed using inferential statistics. To test the null hypotheses for relationships, a lagged-variable was created for time series data of the independent variables. Cross Correlation Function (CCF) was used to assess lagged effects or correlations between two data series. Lagged correlation was used to determine the relationship between the observations of two time series, X_t and Y_t, separated by k time units (the correlation between Y_{t+k} and X_t) (Puetz & Borchardt, 2015). A correlation is significant when the absolute value of r is greater than $2/\sqrt{n - |k|}$, or when p-value < .05.

Results

Research Question One: What is the trend of students' academic achievement in chemistry in public schools from 2017-2023 in Southwest Nigeria?

Table 1: Summary of the Selected Public Senior Secondary Schools' Annual Academic Achievement Rates in Chemistry of Candidates in WASSCE from 2017-2023

Science subject		2017	2018	2019	2020	2021	2022	2023	Annual Average (%)
Chemistry	A	1186	1345	1154	1123	1463	1054	1590	
	B	657	708	579	547	666	515	718	
	C	55.4	52.6	50.2	48.7	45.5	48.9	45.2	49.50

Source: Computed by the Researchers from each school West African Senior School Certificate Examination Result. *Note*. n (Number of schools surveyed) = 27; i (the number of academic years considered) = 7; A = Total Number of Registered Candidates (in WASSCE) excluding absentees; B = Number of candidates with a credit pass (C6) and above; C = Percentage of candidates with a credit pass (C6) and above.

The results presented in Table 1 showed that the number of candidates varied slightly, with 1,186 in 2017 and a high of 1,590 in 2023. However, the achievement trend showed a steady drop. The number of candidates with credit passes fluctuated, but the percentage steadily decreased from 55.4% in 2017 to 45.2% in 2023. The annual average percentage of credit passes was 49.50%, suggesting a gradual decline in students' success rates in Chemistry across the years. The trendline is illustrated in Figure 1.

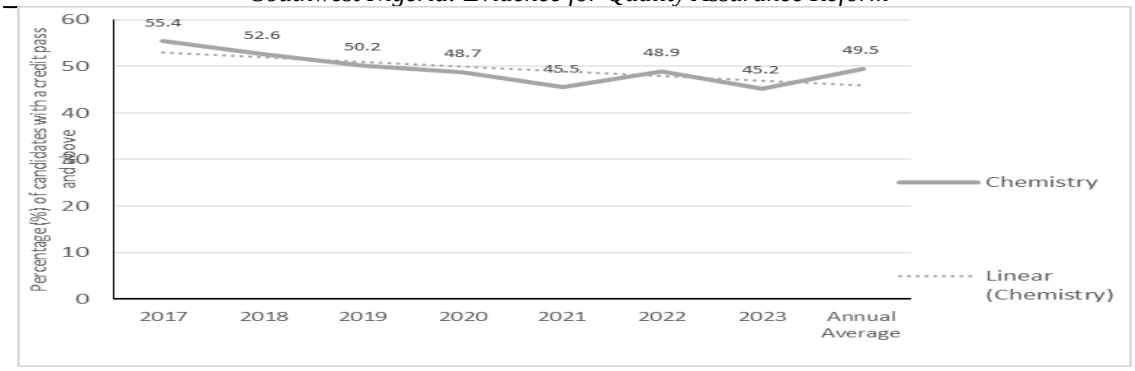

Figure 1: Line graph visualizing the trendline of students' academic achievement rates in chemistry (2017-2023)

Research Question Two: What is the trend of demand for chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria?

Table 2: Average Number of Students that Offered Chemistry, Average Number of Teachers Deployed to Teach Chemistry, and Average Number of Chemistry Teachers Demanded by Public Secondary Schools from 2017-2023

	2017	2018	2019	2020	2021	2022	2023	Average (per school per year
A	4242	4482	4265	3865	4719	4045	4972	162
B	49	50	36	32	30	32	32	1.38
C	3.93	4.15	3.95	3.58	4.37	3.75	4.60	4.05

Source: Computed by the Researchers from individual school data using the required baseline standard of teacher-to-student ratio of 1:40. Note. n (Number of schools surveyed) = 27; *i* (the number of academic years considered) = 7. A = Total number of students that offered the subject; B = Total number of chemistry teachers deployed to schools; C = Chemistry teachers demanded by public secondary schools.

The data in Table 2 showed that demand for Chemistry teachers followed a pattern, starting at an average of 3.93 in 2017 and slightly increasing to 4.15 in 2018. A gradual dip occurred through 2020, hitting a low of 3.58. However, demand recovered from 2021 onward, ending at 4.60 in 2023. The trend implied a steady rise in demand, especially in the last three years of the period. The annual average of 4.05 chemistry teachers were demanded across schools in Southwest Nigeria. Overall, the trends revealed a growing and consistent demand for chemistry teachers.

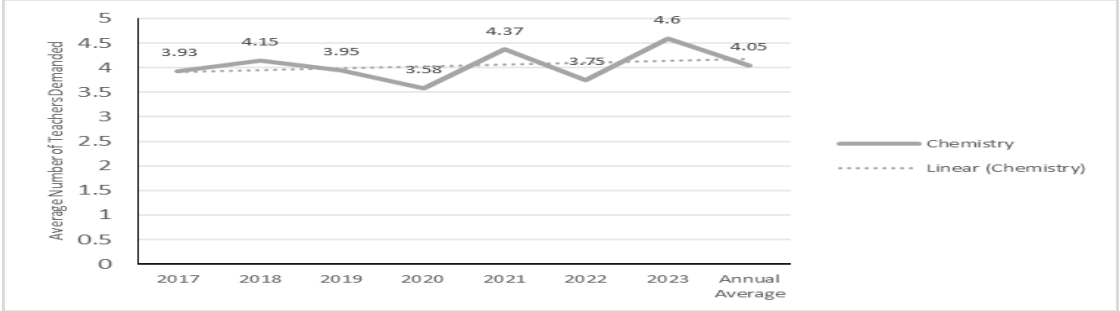

Figure 2: Line graph visualizing the linear trends of demand for chemistry teachers in public secondary schools in Southwest Nigeria from 2017 to 2023

Research Question Three: What is the trend of supply of chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria?

Table 3: Average Number of Chemistry Teachers Supplied to Public Secondary Schools from 2017 to 2023

	Year (*i* = 7)							Annual average
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	
B	49	50	36	32	30	32	32	1.38
C	1.81	1.85	1.33	1.19	1.11	1.19	1.19	1.38

Source: Computed by the Researchers from individual school data on number of teachers employed to teach the subject using the Trend of Chemistry Teachers' Supply Checklist (TCTSC) instrument. Note. B = Total number of teachers deployed to schools; C = Chemistry Teachers Demanded by Public Secondary Schools.

The results presented in Table 3 showed that the annual average number of chemistry teachers supplied to public secondary schools from 2017 to 2023 in Southwest, Nigeria was 1.38. The data revealed that chemistry teacher numbers showed a decreasing trend, starting at 1.81 in 2017 and falling to 1.19 by 2020, remaining at that level through 2023, with an annual average of 1.38 teachers. Figure 3 illustrated a general decline in the supply of chemistry teachers over the period of 2017 to 2023.

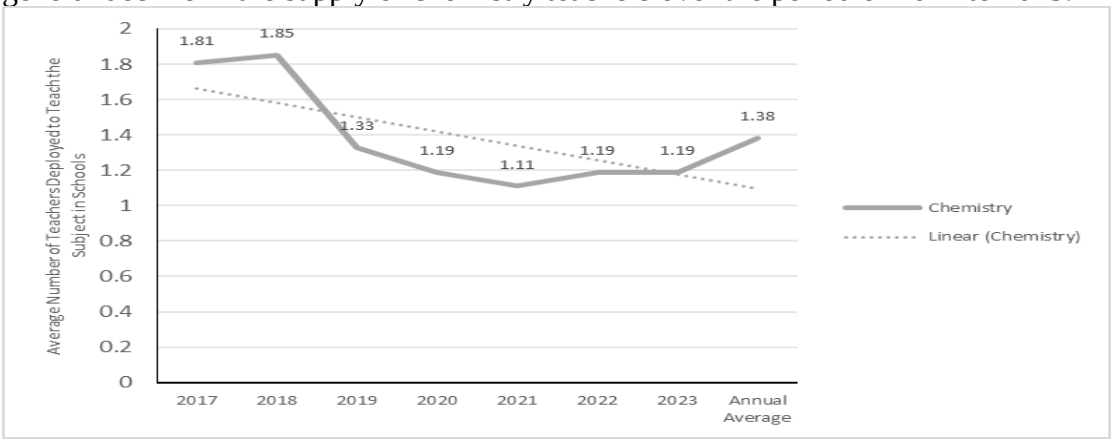

Figure 3: Line graph visualizing the linear trend of supply of chemistry teachers to public secondary schools in Southwest Nigeria from 2017 to 2023

Research Question Four: What is the trend in academic achievement of students in chemistry based on supply of chemistry teachers to public secondary schools in Southwest, Nigeria from 2017-2023?

Table 4: Trend in Academic Achievement of Students in Chemistry According to the Average Number of Chemistry Teachers Supplied to Schools (2017-2023)

	Year (*i* = 7)							Annual
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
Academic performance rates in chemistry (%)	55.4	52.6	50.2	48.7	45.5	48.9	45.2	49.50
Supply of chemistry teachers (Average)	1.81	1.85	1.33	1.19	1.11	1.19	1.19	1.38

The data in Table 4 showed clear downward trend in both teacher supply and students' academic achievement, suggesting a possible correlation between these two variables. In 2017, the academic achievement rate in Chemistry was relatively high at 55.4%, with an average of 1.81 Chemistry teachers per school. However, as the number of teachers began to decline, student achievement also followed a downward trajectory. By 2018, teacher supply slightly increased to 1.85, yet the performance dropped to 52.6%, indicating that other factors might have started influencing academic achievement rates. A more noticeable decline occurred in 2019, when teacher supply reduced significantly to 1.33 and achievement dipped further to 50.2%. This declining trend continued through 2020 and 2021, with teacher supply falling to 1.19 and 1.11 respectively, and student academic achievement rates correspondingly dropping to 48.7% and 45.5%. Although the average number of teachers remained constant at 1.19 from 2021 through 2023, student academic achievement rates remained inconsistent, rising slightly to 48.9% in 2022 before falling again to 45.2% in 2023. The annual average teacher supply over the seven year periods was 1.38, while the average academic achievement rate was 49.5%. These figures indicate that a lower number of Chemistry teachers is associated with lower academic performance rate. The parallel downward trends (Figure 4) suggested that inadequate teacher supply may be a significant factor contributing to the decline in students' academic achievement in Chemistry.

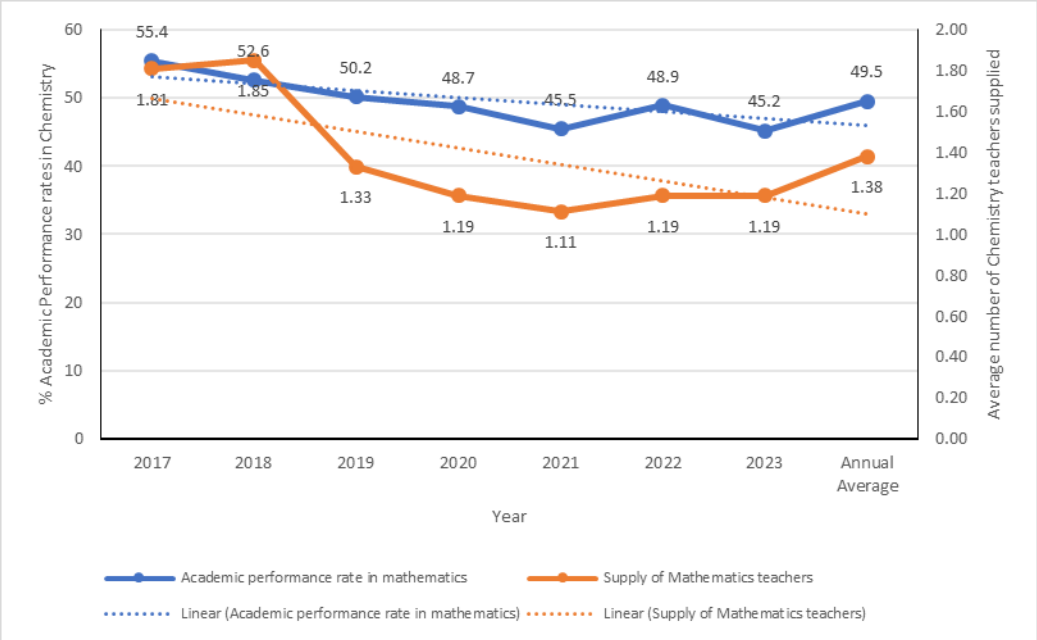

Figure 4: Academic achievement rate of students versus supply of Chemistry teachers (2017-2023)

Hypothesis One: There is no significant time-based relationship between school demand for chemistry teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria.

Table 5: Time-Lagged Correlation Results for the Relationship between School Demand for Teachers (2017-2023) and Academic Achievement in Chemistry

Lags ($Y_{t\pm k}$)	r	r^2	Sig.
Lag -1 (Previous year's school demand)	.555	.308	.253
Lag 0 (No time lag)	-.458	.210	.301
Lag +1 (Next year's school demand)	.075	.006	.888

Note. *Correlation is significant at .05 level, **Correlation is significant at .01 level, r^2 is the coefficient of determination.

Table 5 presented the lagged correlation results analysing the relationship between the demand for Chemistry teachers and students' academic achievement in Chemistry from 2017 to 2023. The table included three lag periods: Lag -1 (previous year's demand), Lag 0 (current year's demand), and Lag +1 (next year's demand). At Lag -1, the correlation coefficient, r was 0.555, with a coefficient of determination (r^2) of 0.308 and a significance level of 0.253. This indicated a moderate positive relationship between the demand for Chemistry teachers in the previous year and students' academic achievement in the current year. Although the relationship was not statistically significant, it suggested that schools that had higher demand for Chemistry teachers in the preceding year may have experienced better academic outcomes the following year, potentially due to improved staffing. At Lag 0, the correlation becomes negative (r = -0.458) with r^2 = 0.210 and a p-value of 0.301. This moderate negative correlation implied that in years when the demand for Chemistry teachers was high, academic achievement in Chemistry was relatively low. This may reflect situations where a shortage of qualified Chemistry teachers coincided with or contributed to poor student outcomes. However, this relationship is also statistically insignificant. At Lag +1, the correlation dropped further to a very weak positive value (r = 0.075), with a negligible r^2 of 0.006 and a high p-value of 0.888, indicating no meaningful or statistically significant relationship between current academic achievement and future teacher demand. Overall, the most substantial correlation appeared at Lag -1, suggesting that previous demand for Chemistry teachers may influence academic outcomes in the following year, albeit not significant result. The lack of statistical significance across all lags implied that while patterns exist, they are not strong or consistent enough to draw firm conclusions. Nonetheless, the data hinted that proactive staffing in Chemistry may have a delayed positive effect on students' academic achievement in Chemistry. Thus, the null hypothesis one was not rejected.

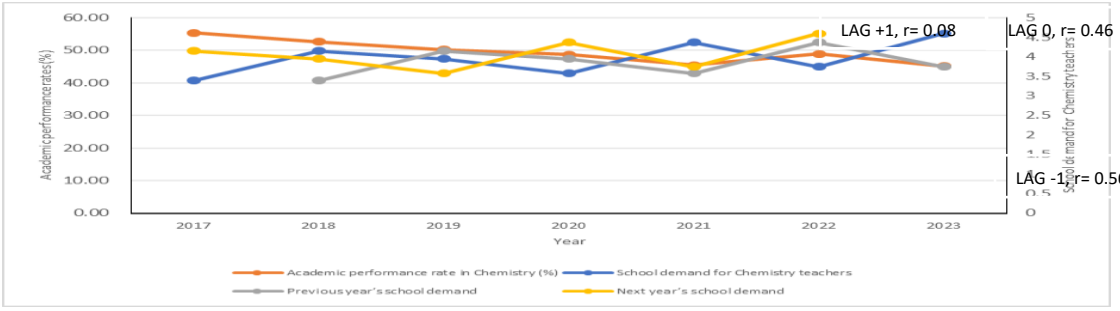

Figure 5: Time series graph of lagged correlation between school demand for Chemistry teachers and academic achievement of students in Chemistry from 2017 to 2023

Hypothesis Two: There is no significant time-based relationship between supply of chemistry teachers from 2017-2023 and academic achievement of students in chemistry in public secondary schools in Southwest, Nigeria.

Table 6: Time-Lagged Correlation Results for the Relationship between Supply of Teachers from 2017-2023 and Academic Achievement in Chemistry

Lags ($Y_{t\pm k}$)	**r**	**r^2**	**Sig.**
Lag -1 (Previous year's teacher supply)	.780	.608	.067
Lag 0 (No time lag)	.889**	.790	.007
Lag +1 (Next year's teacher supply)	.825*	.681	.043

Note. *Correlation is significant at .05 level, **Correlation is significant at .01 level, r^2 is the coefficient of determination.

The lagged correlation results presented in Table 6 showed the relationship between the supply of Chemistry teachers and the academic achievement of students in Chemistry in public secondary schools in Southwest, Nigeria from 2017 to 2023. At lag -1 (the previous year's teacher supply), the correlation coefficient, r was 0.78, indicating a strong positive relationship between the supply of Chemistry teachers in the previous year and the students' academic achievement in the current year. Although the relationship is strong, the result is not statistically significant at the 0.05 level (p=0.067), suggesting that while the supply of Chemistry teachers from the previous year influences students' achievement positively, the evidence is not strong enough to generalise this finding. At lag 0 (the same year's teacher supply), the correlation coefficient increased to 0.89, showing a very strong positive relationship between the supply of Chemistry teachers and students' academic achievement within the same year. This correlation was statistically significant at the 0.05 level (p=0.007), indicating that the availability of Chemistry teachers in a particular year has a significant and immediate positive relationship with students' academic achievement in Chemistry.

At lag +1 (the following year's teacher supply), the correlation coefficient was 0.83, which still represented a very strong positive relationship. This result was statistically significant at the 0.05 level (p=0.043), suggesting that the supply of Chemistry teachers in the current year has a substantial positive effect on students' achievement in the subsequent year. Overall, the results from Table 6 revealed that the supply of Chemistry teachers was strongly related to students' academic achievement in both the current and subsequent years. The strongest and most statistically significant relationship occurred when the supply of teachers and students' achievement are measured within the same year (lag 0). These findings pointed to the critical role of timely and adequate teacher supply in improving students' academic achievement in Chemistry. Therefore, the null hypothesis two was rejected.

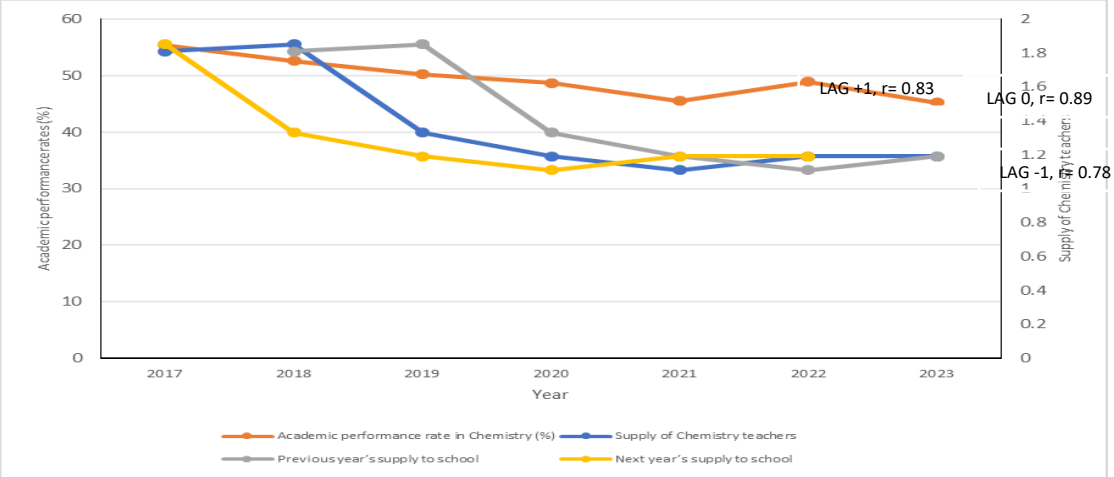

Figure 6: Time series graph of lagged correlation between supply of Chemistry teachers and academic achievement of students in Chemistry from 2017 to 2023

Discussion

Research question one was on the trend of students' academic achievement in chemistry in public schools from 2017-2023 in Southwest Nigeria. Findings revealed that students' academic achievement from 2017 to 2023 showed a general decline in Chemistry. This reflects the conclusions of Oloruntegbe and Omoifo (2010), who noted that Chemistry is conceptually difficult and requires practical engagement that is often missing in many public schools. Faleye and Afolabi (2017) identified inadequate laboratory facilities and poorly trained teachers as significant impediments to effective Chemistry instruction. Although enrolment in Chemistry remained fairly stable, the downward trend in credit passes could be linked to limited student exposure to hands-on experiments, which are crucial for mastering chemical concepts. This trend suggests a need for curriculum review and investment in chemistry laboratory infrastructure.

Research question two was on the trend of demand for chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria. The results showed a consistent gradual increase in the demand for chemistry teachers in public senior secondary schools in Southwest Nigeria from 2017 to 2023. The trends observed in the demand for teachers reflect broader national challenges within the Nigerian education system. The increasing demand for Chemistry teachers aligns with documented shortages of qualified educators across the country. According to the Universal Basic Education Commission (UBEC), Nigeria experienced a 29% reduction in teachers during the COVID-19 pandemic, exacerbating existing deficits (UBEC, 2023). This decline has intensified the need for science teachers, particularly in specialised subjects. The shortage of qualified science teachers has significant implications for educational quality. This supported Ogunmade's (2013) findings that factors such as insufficient teaching resources, inadequate teacher training, and poor working conditions hinder effective science instruction. These challenges contributed to diminished student performance and interest in science subjects, further emphasizing the necessity for competent educators in these disciplines. Efforts to address these shortages have been inconsistent across Nigerian states. For instance, in

2023, only 12 out of 36 states recruited new teachers, with a total of 23,092 hires (National Union of Teachers, 2024). However, this number falls short of the estimated 300,000 additional teachers needed to tackle the out-of-school children crisis and improve educational outcomes (Teachers Registration Council of Nigeria, 2023). The uneven recruitment efforts highlighted the necessity for a coordinated national strategy to address teacher shortages.

Research question three captured the trend of supply of chemistry teachers in public secondary schools from 2017 to 2023 in Southwest Nigeria. Findings revealed that the overall trends indicate a general decrease in the supply of Chemistry teachers. This finding aligned with broader concerns about teacher shortages and attrition in science education observed by Darling-Hammond (2003) and Ingersoll (2001). The decline observed in the supply of Chemistry teachers reflected a challenge in attracting and retaining qualified educators in critical science subjects. This trend is consistent with the studies of findings of Darling-Hammond (2003) and Ingersoll (2001) that showed the difficulties in recruiting and retaining science teachers, often due to factors such as demanding workloads, inadequate compensation, and limited opportunities for professional development. The overall trend of decline across other science disciplines raises concerns about the potential impact on the quality of science education. Teacher shortages in science subjects can lead to overburdened educators, larger class sizes, and the assignment of teachers to subjects outside their area of expertise, all of which can negatively affect students' learning outcomes (Rice, 2003). The implications of these findings for Southwest, Nigeria are significant. A shortage of qualified science teachers can hinder the development of a scientifically literate population, which is crucial for economic growth and technological advancement. Addressing this challenge requires improvement of teacher preparation programmes, offering competitive salaries and benefits, and creating supportive working environments that foster teacher retention and professional growth (National Commission on Teaching and America's Future, 1996).

Research question four was on the trend in academic achievement of students in chemistry based on supply of chemistry teachers to public secondary schools in Southwest, Nigeria from 2017-2023. Findings revealed a consistent decline in the supply of Chemistry teachers from 2017 to 2023 is matched by a corresponding drop in students' academic achievement in the subject. The observed decline in Chemistry achievement alongside reduced teacher supply from 2017 to 2023 is in line with the findings of Hazzan (2024) on the critical role of teacher availability in student achievement. Hazzan (2024) found out that teacher availability, including punctuality and promptness, significantly influences student academic performance in public secondary schools in Southwestern Nigeria. Similarly, a study in Ogbia Local Government Area, Bayelsa State, revealed that teachers' qualifications and years of experience significantly impact students' academic achievement in Chemistry (Cleopas & Onwuchekwa, 2024). Also, Ikpe (2024) noted that the lack of qualified Chemistry teachers contributed to poor student performance in the subject. Additionally, Nwafor (2024) highlighted that inexperienced teachers often struggle to convey complex Chemistry concepts effectively, leading to lower student performance. These findings supported the necessity of employing well-trained and experienced teachers to enhance student outcomes in Chemistry.

Hypothesis one tested the time-based relationship between school demand for teachers from 2017-2023 and academic achievement of students in Chemistry in public secondary schools in Southwest, Nigeria. Findings revealed a moderate but statistically insignificant positive relationship between the previous year's school demand for Chemistry teachers and current academic achievement in Chemistry. However, a moderate negative correlation at Lag 0 and a negligible relationship at Lag +1 indicate inconsistency in the direction and strength of associations. This mixed trend found both agreement and contradiction in the literature. Some studies supported the idea that demand in the previous year may positively affect future academic performance, reflecting time lags in the benefits of teacher recruitment and integration into the school system. Osei (2006) found out that improvements in science teaching often materialize after a lag due to the time needed for newly recruited teachers to adjust and for teaching strategies to impact students. Similarly, Mulkeen (2010) argued that teacher deployment and demand metrics might only show measurable academic benefits over time, especially in subjects like Chemistry that require laboratory resources and teacher expertise. On the contradictory, Akinsolu (2010) found out a significant positive relationship between the immediate availability of subject teachers, including Chemistry, and student performance in Nigerian secondary schools. This contradicts the negative correlation seen at Lag 0 in the result. Darling-Hammond (2000) also found out that timely and consistent availability of qualified teachers is essential for academic achievement, suggesting that delays in meeting teacher demand may hinder academic performance. Moreover, Okebukola (2002) pointed out that fluctuations in teacher demand without adequate consideration for quality and specialisation, especially in science subjects, may lead to inconsistent student outcomes, which aligns with the varying correlations observed in the time-lag results.

Hypothesis two tested the time-based relationship between supply of teachers from 2017-2023 and academic achievement of students in Chemistry in public secondary schools in Southwest, Nigeria. Findings revealed that the supply of Chemistry teachers was significantly related to students' academic achievement in both the current and subsequent years. The strongest and most statistically significant relationship occurred when the supply of teachers and achievement were measured within the same year (lag 0). Thus, the null hypothesis two was rejected. This finding substantiated the findings of Cleopas and Onwuchekwa (2024) who examined the impact of Chemistry teachers' qualifications and years of experience on students' academic performance in Bayelsa State. Their study revealed that teachers' qualifications and experience significantly influence students' academic achievement, pointing to the importance of supply of qualified and experienced teachers in enhancing student outcomes.

Conclusion

The findings of this study provided an evidence that the supply of Chemistry teachers over the years was matched by a corresponding drop in students' academic achievement rates in Chemistry. The trend in academic achievement of students in Chemistry based on supply of teachers to public secondary schools in Southwest, Nigeria from 2017-2023 showed a consistent decline. The study revealed a significant time-based relationship between supply of teachers and academic achievement of Chemistry students. The most substantial and significant correlation appeared at Lag 0

and Lag +1 which showed a strong positive relationship between the supply of Chemistry teachers and students' academic achievement within the same year, and a strong positive relationship between the supply of Chemistry teachers in the current year and students' academic performance in the subsequent year. However, there was no evidence of significant time-based relationship between school demand for teachers and chemistry academic achievement in public secondary schools in Southwest, Nigeria.

Recommendations for Quality Assurance Reform

Based on the findings, teacher supply and workforce planning emerged as a critical area requiring quality assurance reform. The persistent increase in demand for chemistry teachers alongside a declining supply between 2017 and 2023 revealed an imbalance in staffing public secondary schools. This gap has direct instructional consequences, as evidenced by the significant positive relationship between teacher supply and students' academic achievement in Chemistry within the same year and the subsequent year. Quality assurance reforms should therefore prioritise proactive teacher recruitment, improved deployment mechanisms, and retention strategies, such as incentives, continuous professional support, and better working conditions, to ensure adequate availability of qualified chemistry teachers in public schools. This would directly enhance instructional quality and learning outcomes. Another major reform area relates to monitoring and evaluation of students' academic achievement standards. The sustained decline in Chemistry achievement in WASSCE from 2017 to 2023 indicates weaknesses in instructional effectiveness and outcome-based accountability. Quality assurance frameworks need to move beyond routine inspection to data-driven monitoring that tracks subject-specific performance trends over time. Regular analysis of examination outcomes, classroom assessment practices, and alignment between curriculum objectives and instructional delivery would help education authorities identify early warning signs of learning deficits. Embedding achievement benchmarks and feedback mechanisms within quality assurance processes would support timely interventions aimed at reversing declining performance trends. The third area of reform concerns evidence-based policy alignment between teacher demand, supply, and instructional outcomes. The finding that teacher demand did not significantly relate to academic achievement, while teacher supply did, suggests that planning focused solely on enrolment growth or staffing requests is insufficient. Quality assurance reform must emphasise the effectiveness and actual availability of teachers rather than nominal demand figures. This calls for a quality planning practice that synchronise teacher education output, subject specialisation, school-level needs, and student performance data. Such alignment would ensure that policy decisions are grounded in empirical evidence, thereby strengthening the capacity of quality assurance mechanisms to support sustainable improvements in teaching quality and student achievement in public secondary schools.

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