



21st Century Learning Skills Level And Secondary School Students' Academic Achievement In Chemistry In Ukanafun Local Government Area Of Akwa Ibom State, Nigeria

Abstract

This study investigated 21st century learning skills level and secondary school students' academic achievement in chemistry in Ukanafun Local Government Area of Akwa Ibom State, Nigeria. To achieve the purpose of the study, 2 research questions guided the study and corresponding 2 null hypotheses were formulated and tested in the study. Literature was reviewed based on the variables of the study. A survey research design was adopted for the study. The sample used for the study consisted of 500 students selected from the population of 958 SSII chemistry students using simple random sampling technique. Two instruments were used for data collection which included the Students' 21st century learning skills level Variables Questionnaire (S21STCLSLVQ) and the Chemistry Achievement Test (CAT). The two instruments were validated by expert in the Department of Science Education, Akwa Ibom State University, and a test expert in the same University. Kuder Richardson Formular-20 (KR₂₀) was used to measure the reliability of CAT and the index was 0.89. Cronbach Alpha was used to measure S21ST CLSLVQ and the index ranged from 0.73 to 0.79. The data obtained from the administration of these instruments were analyzed using means, standard deviation, independent t-test and Analysis of Variance (ANOVA). All the hypotheses were tested at a .05, level of significance. The result of the findings showed that the influence of critical thinking skill level and technology literacy skill level were found to be significant on chemistry students' academic achievement. The researcher recommended among others that teachers, parents and school administrators should encourage students to actively engage with 21st century learning skills alongside traditional academic knowledge.

Keywords: Chemistry, Secondary School Students, Academic Achievement, and 21ST Century Learning Skills Level.

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Introduction

Development of any nation is largely determined by its level of advancement and innovation in technology, physics, biology and chemistry. Chemistry is one of the core

science subjects taught and learned in Nigeria public senior secondary schools (Ababio 2016) and is concerned with the compositions and structure of matter. The theoretical and practical aspects make

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chemistry prominent in the global technology-driven society.

Chemistry is very important to humanity and for the development of the nation. Knowledge gained in chemistry exposes students to scientific concepts, principles, and laboratory skills that are essentials for pursuing higher education, develop students' analytical skills, critical thinking abilities, and problem-solving techniques that are applicable in various real-world situations (National Center for Science Education, NCSE 2020). The study of chemistry offers opportunities in developing and understanding of scientific concepts, methods and processes. It fosters creativity and innovative in secondary school students which has significant impact on students' academic achievements (National science foundation NCF, 2020 & World Health Organizations WHO, 2019). Secondary School Students refers to the senior secondary two (SSII) students who offered chemistry among public secondary schools in Ukanafun Local Government Area of Akwa Ibom State, Nigeria.

Academic achievement is the extent to which the student reaches their academic goals. It means students' level of attainment at senior school certificate examinations (SSCE) against higher set grades that range from F9 and A1 conducted by West African Examinations Councils (WAEC) in Nigeria. (Joshua, 2023) reported that for the past five years ago, the level of poor academic achievement of secondary school

chemistry students in senior school certificate examinations is continually increasing. According to Chief examiners' report on West African Senior School Certificate Examinations (WASSCE) from 2020 to 2024, the percentage of students' poor achievement in chemistry are : (30.0% in 2020, 31.7% in 2021, 41.8% in 2022, 57.5% in 2023 & 72.1% in 2024). This indicates low level of students' achievement in chemistry and also shown poor state of chemistry education at secondary school level. Some factors like students lack of interest, poor study habits, teachers' incompetence and 21st century learning skills level has been reported to account for students' poor performance.

This research study is concerned with investigating the influence of 21st century learning skills level on secondary school chemistry students' academic achievement in Ukanafun Local Government Area, Akwa Ibom State, Nigeria. According to National science foundation (2017), 21st century learning skills refer to the specific abilities and competencies that students possess and utilizing in learning. This includes skills such as critical thinking, creative thinking, technology literacy, communication, and collaboration, while 21st century learning skills level depicts the overall proficiency and understanding that students have in relation to learning. And can encompass a broader range of knowledge and capabilities, such as understanding the impact of learning skills on learning and academic performance, being able to

critically evaluate digital information, and possessing the ability to adapt to new and emerging technologies (National science foundation, 2017).

The present study is solely concerned with 2 of these 21st century learning skills; which are critical thinking skills and technology literacy skills. This is because it is relevance at the secondary school level. More so, this study used 21st century learning skills level because it focuses on a more comprehensive understanding and proficiency in relation to learning and achievement as a whole.

Critical thinking skill level is one of the variables of interest in this study. It refers to the students' ability level in analyzing, synthesizing, and evaluating information. These abilities may have influence on academic success of secondary school students. Facione, (2015) and Lawson (2020) conceptualized critical thinking as involving several components: interpretation, analysis, inference, explanation, evaluation, and self-regulation that enables learners to understand complex information, question assumptions, and solve problems logically. The author highlighting those two categories of students can be observed: Those with strong critical thinking skills, who question information, make connections between concepts, and apply knowledge to new situations.

Those with poor critical thinking skills, who may struggle to understand abstract concepts, rely on rote memorization, and have difficulty

applying learned material. According to NEA (2013); Olatoye and Aderogba (2023), Nigerian secondary school students with high critical thinking skills tend to score higher in chemistry exams compared to those with low critical thinking ability. In a related assertion by Nwafor & Obi (2024) Poor critical thinking do not limits students' ability to engage with scientific methods, which is central to learning of chemistry effectively (Nwafor& Obi, 2024) and consequently does not resulting in academic underachievement.

Technology literacy level depicts the overall proficiency and understanding that students have in relation to technology. It can encompass a broader range of knowledge and capabilities, such as understanding the impact of technology on society, being able to critically evaluate digital information, and possessing the ability to adapt to new and emerging technologies (National science foundation, 2017). However, the present study used technology literacy level because it focuses on a more comprehensive understanding and proficiency in relation to technology as a whole. Technology literacy level refers to the degree of attainment in the use of technology (Baboo 2013; NEA, 2013) and the author asserted that the extent of attainment in the use of mobile phone, computer, word processing, and internet facilities by the students can impact academic achievement. Technology literacy refers to the skills acquired by students using Android smart phones and computers.

Yuli & Achmad (2017) submitted that it is important for students to acquire the basic level of technology literacy in this 21st century, as technology becomes more widespread in workplaces. The authors added that today's workplace is rich in technology ranging from Android smart phones, computers, internet facilities, and online calendars to accounting software, to project management tools. Yuli & Achmad (2017) argued that possessing basic level of digital literacy might make it easier for students to grasp a new type of technology for personal use, and with basic level of technology literacy, students can organize videos call, exchange ideas with peers, and communicate effectively.

In the opinion of Prasad *et al*, (2016) and Partnership for 21st century learning skills, technology literacy level has a significant influence on academic performance of secondary school students. Livingstone (2013) posited that students' performance in science subject in school is affected their technology literacy level. Smith (2015) defines technology literacy as a meaningful use of technology to achieve learning goals and submitted that students' technology literacy level has no significant relationship with their academic success. Ferrari (2013); Kral & Renganathan, (2018) reported that technology literacy level of students does not influence their academic achievement in school. In this study, the technology literacy level of students refers to the degree of attainment in the use of computer, internet facilities, and word

processing by the chemistry students for learning.

Review of Theoretical Studies

This study is anchored on two theoretical perspectives. First, Brunner's constructivist learning theory which posits that students learn meaningfully by constructing new knowledge from past experience, and through active engagement in the learning process. 21st century learning skills aligns with constructivism by offering experiential and active learning environment that respond to individual student needs. Studies using 21st century learning skills, such as critical thinking skills demonstrate how it can promote learning and achievement in chemistry, support problem-solving, and deepen conceptual understanding (Adeyemi & Olufunke, 2023).

Second, Vygotsky's social learning theory argues that people learn more effectively from engagement and interaction with classmates, teachers, significant objects like toys, books, and technology tools than from engagement alone. 21st century learning skills also aligns with Vygotsky's theory by employing dual channels- critical thinking skill and technology literacy skills that foster meaningful learning processing, thereby enhancing comprehension and achievement. Evidence from Nigerian contexts support this theory, with technology literacy skill and critical thinking ability consistently enhancing chemistry achievement (NSF,

2017; Olatoye & Aderogba, 2023). Relating the two theories to this study, learning and academic achievement is influenced by 21st century learning skills which involve critical, creativity and technology literacy skills.

Review of Empirical Studies

Several studies in Nigeria and Abroad have shown that level of critical thinking skill either enhances or hinder students' achievement in chemistry. For instance, in Lagos State, Adeyemi & Olufunke (2023), found that Students with high critical thinking ability achieve more than students with low critical thinking ability. The gap in this literature is that the study was carried out in Lagos State and not in Ukanafun Local Government Area of Akwa Ibom State; the study used 300 students and not 500 students; and Z-test statistical analysis and not a t-test and ANOVA statistical analysis. Similarly, in Owerri education zone of Imo State, Gottfried *et al*, (2021), found that critical thinking ability has a significant influence on students' academic achievement. The study was conducted in Owerri education zone of Imo State while the present study is conducted in Ukanafun Local Government Area of Akwa Ibom State. in Enugu State, Yusuf & Aramide (2023) found that critical thinking ability did not have a significant relationship with the student's academic achievement.

Beyond critical thinking skills, technology literacy skills level has been reported to influence students' academic

achievement in chemistry. Daxuaua (2022) in Shaan, China, found that there was significant relationship between levels of technology literacy and students' academic achievement. In the same vein, Bogelund, *et al*, (2019) found that technology literacy skill has a significant effect on students' academic achievement, but students with higher technology literacy tend to have better achievement. In Chinese and American adolescent, Guo and Reimers (2014), found that students with low technology literacy skills tend to have low levels of academic achievement. In Kogi State of Nigeria, Ovansa, (2017), found that there was no significant effect of the levels of technology literacy on academic achievement means score of students. The gap here is that the study was carried out in Adavi education zone of Kogi State while this study was carried out in Ukanafun education zone of Akwa Ibom State. And the study was done using a given sample size of 300 students not 500 students.

Statement of the Problem

Chemistry plays a vital role in the development of almost all the sectors of the Nations' economy such as health, agriculture, industry and education. Following the relevance of chemistry in the nation's economic development, chemistry education should be held high in the public senior secondary schools.

Unfortunately, in Ukanafun Local Government Area of Akwa Ibom State, Students' academic achievement in chemistry has consistently been reported

to be poor, especially, in the West African senior school certificate examination. This research therefore, sought to investigate if the students' poor academic achievement in chemistry is influenced by the 21st century learning skills level such as: critical thinking skill level and technology literacy skill level of chemistry students among secondary schools in Ukanafun Local Government Area of Akwa Ibom State, Nigeria.

Objectives of the Study

Specifically, the study sought to investigate:

1. The difference in the academic achievement of secondary school chemistry students whose level of critical thinking skill is high and low.
2. The influence of high, average, and low levels of technology literacy skills on students' academic achievement in chemistry

Research Questions 1

1. What is the difference in the academic achievement of secondary school chemistry students with high level of critical thinking skill and those with low level of critical thinking skill?
2. What is the influence of high, average, and low levels of technology literacy skills on secondary school students' academic achievement in chemistry?

Research Hypotheses

1. There is no significant difference in academic achievement of secondary school chemistry students whose level of critical thinking skill is high and those whose level of critical thinking skill is low.
2. There is no influence of high, average, and low level of technology literacy skill on secondary school students' academic achievement in chemistry.

Methodology

The study adopted a survey design and the population of the study consisted of all 958 SSII chemistry students from 7 public senior secondary schools in Ukanafun. The sample of the study was made of 500 SSII students selected from the population using a simple random sampling technique. From the study sample, the numbers of chemistry students that assessed themselves as having high and low level of critical thinking skill were 370 and 130 respectively, while those that have high, average and low technology literacy skills were 87, 293 and 120 respectively.

The data used for the study were collected using balloting method during the third term of the 2024/2025 school academic year. The researcher visited the principal of the sampled schools and secured permission to use SSII chemistry students for the study. The students were selected using the balloting method and

addressed on how to respond appropriately to the study instrument.

The two study instruments: S21stCLSLVQ and CAT were stapled together and administered to the students in the class. Thereafter, all the study instruments were retrieved on the spot. Hence, 100 percent retrieval of the study instrument was achieved. The approach was repeated in other schools selected for the study until 500 SSII chemistry students needed for the study were sampled.

The research instruments were the students' 21st century learning skill status variables questionnaire (S21stCLSLVQ) used to gather data on students' 21st century learning skills status and the chemistry achievement test (CAT) for gathering of data on students' academic achievement in chemistry. The reliability of the instruments was ensuring by subjecting them to testing. The students' 21st century learning skills status variables questionnaire (S21stCLSLVQ) was tested for reliability using Cronbach's Alpha Analysis and the co-efficient of the reliability was 0.79. The chemistry achievement test (CAT) was tested using the Kuder Richardson formula-20 which yielded a reliability coefficient of 0.89.

The independent t-test and analysis of variance (ANOVA), statistics were employed for the statistical analysis of data generated using the SPSS version 20 computer program. All hypotheses were tested at a 0.05, level of significance.

Results

Research question 1: What is the difference in the academic achievement of secondary school chemistry students with high level of critical thinking skill and those with low level of critical thinking skill? The research question was answered with the mean and standard deviation of the academic achievement scores of the students in the two students' critical thinking skill groups (high and low). The results are shown in Table 1.

As shown in Table 1, there is a difference in the mean scores of students in the two students' critical thinking skill groups. The mean scores are different as observed and hence the influence of high students' critical thinking skill is higher (39.88) than that of low students' critical thinking skill (35.42). This implies that high students' critical thinking skill had a better influence on chemistry students' academic achievement.

Table1: Mean and standard deviation of the mean score of the academic achievement of secondary school chemistry students based on students' critical thinking skill group

Dependent variable	Students' critical thinking skill group	N	Mean	Std. Deviation
Achievement test	HIGH	370	39.88	9.352
	LOW	130	35.42	8.512
	Total	500	37.69	8.932

Table2: Mean and standard deviation of the mean score of the academic achievement of secondary school chemistry students based on technology literacy skill group
55-75=High, 35-54=Average 15-34=Low

Technology literacy skill group	N	Mean	Std. Deviation
HIGH	87	41.13	7.881
AVERAGE	293	37.10	9.321
LOW	120	40.93	9.604
Total	500	38.72	9.341

Research question 2: What is the influence of high, average and low levels of technology literacy skills on secondary school students' academic achievement in chemistry? The research question was answered with the mean and standard deviation of the mean score of the academic achievement of the students in the three students' technology literacy skill groups (high, average, and low).

The results are shown in Table 2. As shown in Table 2, there is a difference in the mean scores of students in the three technology literacy skill groups (high, average, and low).

The mean scores are different as observed and hence the influence of high technology literacy skill is highest (41.13) followed by a low technology literacy skill 40.93 and an average technology literacy skill of 37.10. This implies that high-technology literacy skill had the best influence on biology students' academic achievement.

Hypothesis 1: There is no significant difference in the academic achievement of secondary school chemistry students whose critical thinking skill is high and low. The hypothesis was tested with independent t-test statistics. Levene's test of equality of error variances indicates a non-significant F value (.396, $p = .529$), which means that equal variance is assumed for the two groups. So the first line of the t-test is used. The results are shown in Table 3. The results in Table 3 indicate that the t-calculated value was 4.794 and a p-value of 0.001 at 0.05 level of significance with 498 degrees of freedom. Since the p-value was less than 0.05 significance level, the null hypothesis was rejected. That means there is a significant difference in the mean academic achievement of students whose critical thinking skill is high and low.

Table3: Independent t-test analysis of the influence of high and low students' critical thinking skill level on academic achievement of chemistry students: 21-40=High, 10-20=Low using (SPSS, version 20)

		Levene's Test for Equality of Variances	T-test for Equality of Means			
Dependent Variable		F	Sig.	t	Df	Sig. (2-tailed)
Biology achievement test	Equal variances assumed	.396	.529	4.794	498	0.001
	Equal variances not assumed			5.015	246.140	0.001

Hypothesis 2: There is no significant influence of high, average and low level of technology literacy skill on secondary school students' academic achievement in chemistry. The hypothesis was tested using one-way analysis of variance (ANOVA) statistics. The results of the data analyses are shown in Table 4. As shown in Table 4, the calculated F value is 11.079 with a p-value of 0.001 ($p < .05$) which is statistically significant at a .05 significance level and (2, 497) degrees of freedom. Since the p-value is .001 ($p < .05$), the null hypothesis was rejected. This means that there was a significance difference in the academic achievement means scores level of chemistry students whose technology literacy skill is low, average and high.

Table4: One-way analysis of variance of the difference technology literacy skill level and chemistry students' academic achievement: 55-75= High, 35-54=Average, 15-34=Low using (SPSS 20)

Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1858.354	2	929.177	11.079	0.001
Within Groups	41684.004	497	83.871		
Total	43542.358	499			

Summary of findings

The following major findings were obtained in this study:

- There is a significant difference in the academic achievement mean score of chemistry students whose students' critical thinking skill is high and those whose critical thinking skill is low.
- There was a significance difference in the academic achievement mean score level of chemistry students whose technology literacy skill is low, average and high.

Discussion of findings:

The result of hypothesis one indicated that there was a significant difference between the mean academic achievement scores of students from high and low students' critical thinking skill status. This may be because critical thinking skill enhances students' engagement in chemistry concepts which promote academic achievement of students in secondary school.

This study agrees with an earlier study by, Adeyemi and Olufunke (2023), who examined the influence of critical thinking skill on academic achievement of secondary school students in Lagos state and found that, there was a significant difference in the mean achievement score of students with high and low critical thinking skills. Students with high critical thinking ability achieve more than students with low critical thinking ability. The study also support the study of Gottfried *et al*, (2021) who assessed the impact of critical thinking instruction on secondary school students' academic achievement in mathematics in Owerri education zone of Imo State, and found that critical thinking ability has a significant influence on students' academic achievement. The present study is not in agreement with the findings of Yusuf and Aramide (2023) who examine the influence of critical thinking skills on the academic achievement of students in selected schools in Enugu state and that critical thinking ability of students has no significant relationship with the student's academic achievement. Findings of this study is in support of the assertion of Facione, (2015), Olatoye and Aderogba(2023) who asserted that Nigeria secondary school students with high critical thinking abilities achieve higher in chemistry examinations compared to those with low critical thinking.

Hypothesis two was tested with one-way analysis of variance (ANOVA) statistic. The result from the findings

showed that there was a highest mean score in favour of students with high technology literacy skill and hence the influence of high technology literacy skill on students' academic achievement is highest followed by low technology literacy skill and average technology literacy skill respectively. The reason for this result might be that students with high have gain access to learning materials such as textbooks and quiet study space in their homes. For students with low technology literacy skill to acquire high academic achievement means score than students with average technology literacy skill, it could be that their students had actively engaged in teamwork with their peers and do their assignment at home.

The result of this finding is in agreement with the findings of Daxuaa (2022) who examined the relationship between technology literacy skill and students' academic achievement in Shaan, China and reported that there was significant relationship between levels of technology literacy skill and students' academic achievement. This study agrees with the study of Bogelund, et al (2019) and Guo & Reimers (2014) who found a significant impact of technology literacy skill on students' achievement. The findings of the present study is contrary to the finding of Ovansa, (2017) who examined the effect of the levels of technology literacy skill on academic performance of senior secondary school

students in the Adavi education zone of Kogi State, Nigeria.

Conclusion

Based on the findings of the study, the researcher concluded that students' 21st century learning skills have influence on chemistry students' academic achievement.

Recommendations

Keeping in view the findings of this research, the researcher recommended as follows:

- i. Administrators should encourage students to actively engage with 21st century learning skills alongside traditional academic knowledge.
- ii. Students should study and be engaged with 21st century learning skills such as critical thinking and technology literacy skills, which enhances meaningful learning and academic achievement.
- iii. Teachers should design instructional strategies that stimulate students' critical thinking skill and technology literacy skill which equip students for real-world opportunities.
- iv. Parents should provide a serene home environment, love, care, and financial support for their children's education as well as be supportive in their studies to motivate learning and enhance academic achievement.

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