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DIGITAL LITERACY AS PREDICATOR OF SECONDARY SCHOOL STUDENT'S ACADEMIC ACHIEVEMENT IN CHEMISTRY IN ENUGU STATE

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Abstract
The study investigated digital literacy as predictor of secondary school student's academic achievement in Chemistry in Enugu State. Two research questions and two hypotheses guided the study. The population of study was 4934 SS2 Chemistry students. The sample size of the study consisted of 347 SS2 Chemistry students 186 male and 161 female. The sample was drawn using multistage sampling procedure involving different techniques. Two instruments were used for data collection. They are Chemistry Digital Literacy Inventory (CDLI) and Chemistry Achievement Test (CAT). CDLI contained 26 item questions developed by the researchers while CAT contained 40 objective questions. The two instruments were validated by three experts. The reliability of (CDLI) was 0.77 using Cronbach alpha while the reliability of (CAT) was 0.77 using Kuder-Richardson 20 formula. This indicated that the two instruments were reliable. The research question were answered using r and R^2 while the hypotheses were tested using P- value. The findings revealed that there is moderate predictive power of digital literacy on secondary school student's academic achievement in Chemistry and the prediction was statically significant ($r = 0.793$: $R^2 = 0.629$: Sig. $t = 0.000$). Furthermore, the result revealed a high and moderate positive predictive strength of chemistry digital literacy scores on male and female students' achievement scores in chemistry and the prediction was statically significant (Male: $r = 0.825$: $R^2 = 0.681$: Sig. $t = 0.000$) (Female: $r = 0.753$: $R^2 = 0.567$: Sig. $t = 0.000$). From the findings it was recommended among others that secondary school administrators and guidance and councilors should give priority to chemistry digital literacy of the students in making decisions regarding teaching-learning activities. From the recommendations conclusion were made.
Keywords: Education, Science, Chemistry and Digital literacy

Introduction

Education is more than the accumulation of facts. It is a transformative process that shapes how individuals think, learn, and engage with the world. Through formal schooling, people acquire the knowledge and skills necessary to pursue meaningful work, solve complex problems, and participate responsibly in civic life. Education also nurtures curiosity, creativity, and resilience qualities that empower lifelong learning in a rapidly changing society (Akgül & Güler, 2025). It was averred by Yavuz and Çarkıt (2025) that economically, education expands opportunities, enabling access to better jobs, higher incomes, and greater social mobility. It drives innovation and productivity, which in turn fuel national development. Additionally, educated communities tend

to exhibit stronger social bonds, empathy, and tolerance, contributing to more cohesive and inclusive societies. On an individual level, education fosters self-confidence, critical thinking, and the ability to evaluate information skills essential for navigating the digital age of science (Akgül & Güler, 2025).

Science has penetrated every branch of modern life. It is the noise of machines, cars, mills, and factories that awakens us each morning (Yildirim & Kahraman, 2024). The food we eat, the clothes we wear, the books and papers we read all of these involve the application of science in one way or another. It was in recognition of the importance of science that the Nigerian government has continued to make serious efforts toward providing its citizens with qualitative and quantitative science education programmes. Moreover, given the modernization occurring every day, the world's workforce requires people who have acquired the necessary attitudes and skills of science and technology. For these reasons, educational bodies like Science Technology Engineering and Mathematics (STEM) have been established to help train young learners to grow in science, technology, engineering, and mathematics, fostering a stable and improved technological society (Janštová, et al., 2024). Aboagye et al., (2020) stated that for a technical society, science and technological education are regarded as vehicles for economic and social development. Yavuz and Çarkıt (2025) further maintained that this is only possible depending on the quality of scientists produced through science education. This implies that a nation's advancement in science depends largely on its strong science education programmes.

Science education is the field of study concerned with sharing science content and processes with individuals not traditionally considered part of the scientific community, thereby producing a scientifically literate society. Nwafor et al., (2022) averred that science education is a process of teaching and training, especially in schools, to improve one's knowledge of the environment and skills for systematic inquiry. It is important to note that science education and its application in technology is one of the most powerful instruments enabling all members of society to face the dynamic nature of science in the modern world. Science education has many branches in accordance with the Nigerian secondary school curriculum, including Basic Science, Basic Technology, and Mathematics for junior secondary, and Physics, Biology, Mathematics, and Chemistry for senior secondary (Yildirim & Kahraman, 2024). Since the present study focused on Chemistry, the subject was considered,

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Chemistry is the branch of science that explores the properties, composition, and structure of matter, along with the changes matter undergoes and how those changes affect humanity and society. Its contributions to the world have been immense. Chemistry has deepened our understanding of the human body, the environment, and both the benefits and dangers present in our world. It has increasingly provided solutions across health, agriculture, food, shelter, clothing, and education (Obikezie, 2023). There is hardly any area of daily life untouched by Chemistry. Yet, it is troubling that students' academic achievement in Chemistry at the senior secondary school certificate level remains disappointing. This is confirmed by the West African Examination Council (WAEC) Chief Examiner's report on persistent weaknesses from 2015 to 2024. Furthermore, WAEC results from 2015 to 2025 show that the percentage of students earning passes between C6 and A1 has never reached 70%.

Supporting this, Obikezie et al., (2023) reported that for any nation to advance technologically, student achievement in science subjects like Chemistry in examinations such as WAEC must reach at least 70%. The authors further argued that the continued underdevelopment of many nations in Latin America and Africa, particularly Nigeria, may stem from the below-distinction performance of secondary school Chemistry students in these external exams. This raises an important question: what causes these persistent weaknesses and low achievement among secondary school Chemistry students?

According to the literature, several factors are responsible. Johnston and Wu (2023) identified cognitive load, gaps in prior knowledge, ineffective instructional strategies, and limited hands-on experimentation as key contributors. Hake (2020) added language and communication barriers, socioeconomic constraints, anxiety, low chemistry self-efficacy, inadequate feedback, access disparities, cultural relevance, and digital literacy. For the purpose of this study, digital literacy was considered

Digital literacy consists of information, internet basics, using emails, using computer application, social media, collaboration and communication. According to Solomon and Batista (2023), digital literacy is the integrated ability to critically find, evaluate, create, and communicate information using digital technologies, while understanding online safety, ethical considerations, and the social Implications of digital participation. It encompasses technical skills (navigating devices, using software, and managing data), cognitive skills (evaluating credibility, discerning

bias, and solving problems creative within digital environments), and sociocultural competencies (understanding digital citizenship, privacy, and ethical collaboration). As information ecosystems evolve, digital literacy also requires adaptability to new platforms, regulatory contexts, and evolving norms around data provenance and reproducibility (Solomon & Batista 2023). Enhanced digital literacy enables individuals to access diverse resources, participate in digital communities responsibly, and apply digital tools to learning, work, and civic life. It integrates media literacy with information literacy, emphasizing scepticism toward misinformation and the ability to verify sources across multimodal formats. This could help in maintaining individual's academic high achievement (Santos et al., 2022).

Empirical evidence like Fanfeng (2025) who carried out a study on the relationship between digital literacy and college students' academic achievement: the chain mediating role of learning adaptation and online self-regulated learning, and reported that digital literacy significantly and positively predicted college students' academic achievement. While Okigbo and Anikelechi (2025) who investigated digital literacy as a predictor of basic education students' academic achievement in Basic science in Ebonyi State found that academic achievement in Basic Science was significantly predicted by digital literacy. Similarly, the study of Supratman, et al., (2025) who investigated on Digital literacy and academic performance: the mediating roles of digital informal learning, self-efficacy, and students' digital competence and reported that digital competence, digital informal learning, and digital self-efficacy serve as partial mediators in the relationship between digital literacy and academic success not minding gender type.

Ofosu-Koranteng, et al., (2025) investigated on gender-driven variations in digital competence among economics students in a Ghanaian higher education institution and reported that a significant gender difference was observed in DIL, with females outperforming males. Furthermore, Leyla and Berna, (2024) who investigated gender differences in various dimensions of digital literacy, including ethical responsibility, general knowledge and functional skills, daily usage, professional production, privacy and security, and social dimensions and found that male students scored higher in general knowledge and functional skills than their female counterpart. Thus, this study focused on digital literacy as predicator of secondary school student's academic achievement in chemistry.

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Statement of the Problem

Digital literacy has become an essential skill for students navigating the modern learning environment, where technology is deeply embedded in every aspect of education. Students who possess strong digital literacy skills are better equipped to engage with digital content, access information efficiently, and harness online tools to deepen their understanding of complex subjects. In Chemistry, where concepts are often abstract and visually demanding, digital literacy can play a crucial role in helping students grasp difficult topics, conduct virtual experiments, and connect theoretical knowledge to real-world applications. One would expect, therefore, that students with higher digital literacy would demonstrate improved academic achievement in the subject.

Despite the undeniable importance of Chemistry to humanity and national development, students' academic achievement in the subject has remained persistently poor. This worrying trend is well documented. The West African Examination Council (WAEC) Chief Examiners' Reports from 2015 to 2024 reveal consistent and recurring weaknesses across Chemistry papers. Evidence from WAEC results over this same period shows that the percentage of students achieving passes between C6 and A1 has never reached 70%. Such below-distinction performance is alarming, particularly given that Obikezie et al., (2023) argued that for any nation to achieve technological growth, at least 70% of students must attain credit passes in science subjects like Chemistry.

Researchers have attributed these persistent weaknesses to a range of factors, including cognitive load, gaps in prior knowledge, ineffective instructional strategies, limited hands-on experimentation, language and communication barriers, anxiety, low chemistry self-efficacy, inadequate feedback, and cultural relevance. While digital literacy has received some attention in the literature, most related studies were conducted independently and in developed regions such as Europe and America, leaving a gap in understanding within the Nigerian context and in secondary school chemistry. More importantly, despite the growing integration of technology in education, the specific role of digital literacy as a predictor of students' academic achievement in Chemistry remains underexplored. Could it be that the consistently fluctuation in achievement of secondary school students in Chemistry in Enugu State is linked to their level of digital literacy? This study, therefore, investigated digital literacy as a predictor of secondary school students' academic achievement in Chemistry in Enugu State.

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Purpose of the study

The purpose of the study was to examine digital literacy as predicator of secondary school student's academic achievement in Chemistry in Enugu State. Specifically, the study determined:

1. Predictive strength of Chemistry digital literacy on secondary school student's academic achievement in Chemistry.
2. Predictive strength of Chemistry digital literacy on male and female secondary school student's academic achievement in Chemistry.

Research Questions

The following research questions guided the study:

1. What is the predictive strength of chemistry digital literacy on secondary school student's academic achievement in Chemistry?
2. What is the predictive strength of chemistry digital literacy on male and female secondary school student's academic achievement in Chemistry?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. Students' digital literacy is not a significant predictor of academic achievement of students in Chemistry.
2. Students' digital literacy is not a significant predictor of academic achievement of male and female students in Chemistry.

Method

This study adopted correlation design. The area of study was Enugu State, Nigeria. The population of SS2 Chemistry students is 4934 with males totaling 1830 and the females totaling 3104. The sample size of the study consisted of 347 SS2 Chemistry students (186 male and 161 female). The sample was drawn using multistage sampling procedure involving different techniques was used in the study. First, using purposive sampling technique, the zones were drawn according to areas where smart schools are found (Agbani and Enugu). This was to take care of digital literacy environment which is the major independent variables under study. Secondly using purpose sampling, co-educational government own schools were drawn. Reason was to ensure equal representation of male and female students because gender is a variable under consideration in this study as a sole moderating variable. Finally, using proportionate sampling technique, four

co-educational schools each were drawn from each of the education zones making it a total of eight schools. Reason is to ensure equal number of school representation in these education zones and also to ensure that sample reflected population proportions.

Instrument

Two instruments were used for data collection. They are Digital Literacy Inventory (CDLI) and Chemistry Achievement Test (CAT). Chemistry Digital Literacy Inventory (CDLI) developed by the researchers with 26 items. The CDLI has two sections A and B. Section A elicited respondents' personal information while Section B elicited responses from the respondents on their Chemistry Digital Literacy with 26 item questions based on the recommendations by validators. The second instrument was Chemistry Achievement Test (CAT) which was a multiple-choice objective questions containing 40 questions with options A – D. It covered four topics – organic chemical equations, rate of reactions, energy changes, and chemical equilibrium. The two instruments were validated by three experts, two from Department of Science Education and one from Department of Educational Foundation all from Nnamdi Azikiwe University, Awka. Social Digital Literacy Inventory (CDLI) generated 0.77 consistency value using Cronbach alpha while Chemistry Achievement Test (CAT) generated 0.77 using Kuder-Richardson 20 formula after try testing the instruments in another area that is not the place of the study.

Data generated from the study was analysed using r and R^2 to answer research questions. In interpreting the correlation coefficients, the rule posited by Abonyi, et al., (2022) about the interpretation was adopted for the interpretation of the study using the range of scores as thus: ±0.80 to ± 1.00 was assigned to high positive or negative predictive value, ±0.31 to ± 0.79 was assigned to moderate positive or negative predictive value, ±0.00 to ± 0.30 was assigned to low positive or negative predictive value. In interpreting the null hypotheses, the decision rule is that when P-value is less than or equal to 0.05 ($P \leq 0.05$) the null hypotheses was rejected. On the other hand, when P-value is greater than the alpha level 0.05 ($P \geq 0.05$), the null hypotheses was not rejected (accepted).

Research question 1

What is the predictive power of digital literacy on secondary school student's academic achievement in Chemistry?

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Table 1: Predictive Matrix of Students CDLI scores and CAT scores in chemistry

Scores	N	r	R^2
Chemistry Digital Literacy Achievement	347	0.793	0.629

Number of Cases = 347

As shown in Table 1, the computed 'r' between the students' chemistry digital literacy and achievement scores in chemistry was 0.793 which falls within the range 0.31 – 0.79. Thus, the computed 'r' value indicated a moderate positive predictive value of chemistry digital literacy scores on the students' academic achievement scores in chemistry. The coefficient of determination (R^2) for the computed (r) which was 0.629 indicated that 62.9% of the variation in students' achievement scores in chemistry was explained by their chemistry digital literacy scores.

Research question 2

What is the predictive power of digital literacy on secondary school student's academic achievement in Chemistry?

Table 2: Predictive Matrix of Male and Female Students CDLI scores and CAT scores in chemistry

Gender	N	r	R^2
Males	186	0.825	0.681
Females	161	0.753	0.567

Number of Cases = 347

As shown in Table 2, the computed 'r' between the male and female students' chemistry digital literacy scores and achievement scores in chemistry were 0.825 and 0.753 respectively which falls within the range 0.80 – 1.00 and 0.31 – 0.79 respectively. Thus, the computed 'r' values indicated high and moderate positive predictive value of chemistry digital literacy scores on the male and female students' interest scores in chemistry. The coefficient of determination (R^2) for the computed (r) which were 0.681 and 0.567 indicated that 68.1% and 56.7% of the variation in male and female students' achievement scores in chemistry was predicted explained by their chemistry digital literacy scores.

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Ho_1: Students' digital literacy is not a significant predictor of academic achievement of students in Chemistry.

Table 3: Significance of the prediction between the students' chemistry digital literacy scores and the achievement scores of the students in Chemistry

Computed r	R-square	Adjusted R-square	Std. Error	Beta	t. cal.	Sig. t
0.348	0.121	0.120	4.96274	0.034	29.627	0.0000

As indicated in Table 3, the calculated't' value of 29.627 was greater than the significance of 't' value 0.0000. The researcher therefore rejected the null hypothesis and conclude that there was significant prediction of the students' chemistry digital literacy scores on their achievement scores in Chemistry.

Ho_2: Students' digital literacy is not a significant predictor of academic achievement of male and female students in Chemistry.

Table 4: Significance of the prediction between the male and female students' digital literacy scores and the achievement scores of the students in Chemistry

Gender	Computed r	R-square	Adjusted R-square	Std. Error	Beta	t. cal.	Sig. t
Male	0.825	0.681	0.680	3.46598	0.082	7.182	0.000
Female	0.753	0.567	0.566	3.36764	0.075	6.571	0.000

As indicated in Table 4, the calculated 't' values of 7.182 and 6.571 were greater than the significance of 't' value 0.0000 respectively. The researcher therefore rejected the null hypothesis and conclude that there was significant prediction of male and female students' chemistry digital literacy scores on their academic achievement scores in Chemistry.

Discussions

Predictive Strength of Chemistry Digital Literacy on Secondary School Student's Academic Achievement in Chemistry

The study found that the students' chemistry digital literacy scores positively predicted their achievement scores in chemistry. This result was equally reinforced with the findings that showed that the prediction between the students' digital literacy and their academic achievement in chemistry was significant. Thus, implying that students' chemistry digital literacy skill is a strong predictor of their academic achievement in chemistry. The result is in tandem with that of

Fanfeng (2025) who carried out a study on the relationship between digital literacy and college students' academic achievement: the chain mediating role of learning adaptation and online self-regulated learning, and reported that digital literacy significantly and positively predicted college students' academic achievement. Equally, the result aligns with that of Okigbo and Anikelechi (2025) investigated digital literacy as a predictor of basic education students' academic achievement in Basic science in Ebonyi State and found that academic achievement in Basic Science was significantly predicted by digital literacy. Similarly, the result is in agreement with that of Supratman et al., (2025) who investigated on Digital literacy and academic performance: the mediating roles of digital informal learning, self-efficacy, and students' digital competence and reported that digital competence, digital informal learning, and digital self-efficacy serve as partial mediators in the relationship between digital literacy and academic success. The result of this study under this theme and the evidences in literature shows that with improved digital literacy skill, students' academic can be enhanced including science and chemistry students in particular.

Predictive Strength of Chemistry Digital Literacy on Male and Female Secondary School Student's Academic Achievement in Chemistry.

The study found that male and female students' chemistry digital literacy scores positively predicted their interest scores in chemistry. This was also advanced by the findings which showed that there was significant prediction between the students' digital literacy and academic achievement in chemistry. Implying that students' digital literacy is a strong predictor of their academic achievement in chemistry. This is in agreement with Ofosu-Koranteng et al., (2025) who investigated on gender-driven variations in digital competence among economics students in a Ghanaian higher education institution and reported that a significant gender difference was observed in DIL, with females outperforming males. Although significant gender difference was observed in Ofosu-Koranten et al. study, the fact that digital literacy positively predicted academic achievement is testament that it has a strong predictive value on students learning outcome. Furthermore, the findings align with that of Leyla and Berna, (2024) investigated gender differences in various dimensions of digital literacy, including ethical responsibility, general knowledge and functional skills, daily usage, professional production, privacy and security, and social dimensions and found that male students scored higher in general knowledge and functional skills than their female counterpart. However, the female students demonstrated higher scores in

ethical responsibility and daily usage dimensions. The varied results notwithstanding, digital literacy skills of students should be given serious attention by the teachers as it has proven a strong predictor of students' improved academic achievement.

Conclusions

In line with the findings, the researcher concluded that chemistry digital literacy potential of the students, is a strong predictor of their academic achievement in chemistry. Furthermore, chemistry digital literacy skills of male and female strongly predicted their academic achievement in Chemistry. Implying that, encouraging students to develop strong chemistry digital literacy skills by their classroom teachers can enhance and improve their academic achievement in Chemistry.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The Federal Ministry of Education should ensure that only professionally trained and qualified teachers are recruited to teach chemistry so as to be able to foster the students' chemistry digital literacy potentials.
2. Chemistry teachers should improve on their instructional behaviour to ensure proper identification of the students' chemistry digital literacy potential in instructional practice in order to enhance and improve students' achievement in chemistry.
3. Secondary school teachers across Nigeria should at intervals access the influence of chemistry digital literacy of the students' achievement in chemistry.

Limitation of the study

The following limitations were observed during the study.

There were no notable limitations beyond the researcher's control encountered in the course of carrying out this study.

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