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Chemistry Teachers' Accessibility and Applicability of Artificial Intelligence in Secondary schools in Rivers State

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Abstract

This study investigated the accessibility and applicability of Artificial Intelligence (AI) among chemistry teachers in secondary schools in Rivers State. This study adopted descriptive survey research design. Using purposive sampling technique to select 81 (45 males and 36 females) chemistry teachers in Rivers State from 76 senior secondary schools as the respondents of this study. Two (2) research questions and three (3) hypotheses guided the study. The instrument used for data collection was a questionnaire. The questionnaire consists of three parts. Part A consists of the demography of the participants. Part B was titled "Chemistry Teachers Accessibility of Artificial Intelligence (CTAAI)" and was used to ascertain the level of accessibility of Chemistry teachers to AI resources, while Part C was titled "Chemistry Teachers Perception of Applicability of AI (CTPAAI)" and was used to determine the perception of Chemistry teachers towards AI applicability in the Chemistry classroom. Both A and B parts consist of twelve (12) items giving a total of 24 items structured using four-point modified Likert scale. The research instrument was face and content validated while Kuder-Richerson's Formula-21 was used to obtain a reliability index of r = 0.87. Data obtained from the administered questionnaire were analyzed using mean, standard deviation, percentage, chart, Pearson product moment correlation and t-test. The results of this study revealed that there is low accessibility of AI resources amongst chemistry teachers in Rivers State and that there are still reservations held by some of the chemistry teachers about the applicability of AI resources in secondary school chemistry classes in Rivers State. The study also shows that a negative relationship exists between chemistry teachers' accessibility to AI and their perception of applicability of AI, as the correlation returned a correlation coefficient of -0.0635. But the t-test analysis showed no significant effect of gender on chemistry teachers' accessibility to AI and perception of applicability to AI as the P-values (.3213 and .1326) was greater than the alpha value (0.05). However, it was also discovered that irrespective of these reservations held, chemistry teachers are completely prepared to accept and utilize AI resources in the teaching and learning of chemistry in secondary schools in Rivers State. Thus, it was recommended that government and stakeholders should organize workshops, conferences, and seminars in each local government area in Rivers State for proper orientation and integration of AI into secondary education and curriculum planners should revise the science curriculum to incorporate AI into it.

Keywords: *Accessibility, Applicability, Chemistry teacher, Artificial Intelligence.*

Background of the Study

Since the arrival of Artificial Intelligence (AI) it has created waves around the world, during the Corona (COVID-19) Pandemic when schools and universities were shut down. This triggered significant demand for the inclusion of AI applications in the teaching and learning process (Hwang & Tu, 2021).

Chemistry which investigates the composition, properties, behaviours, and changes of matter is not left out from the impact of AI. Notwithstanding that chemistry is more of an abstract subject made up with facts, theories, laws, principles, chemical formulae, equations, elements, and compounds which students consider as a complex field of study (Dewi et al, 2021; Ural, 2016 & Zudonu, 2013). The world of AI has revolutionized chemistry classes in the form of Virtual Laboratory, Intelligent Tutoring Systems (ITSs) and Adaptive Learning among other AI-tools in use today.

The chemistry teacher is now faced with the challenge of measuring up to the fast-growing AI world in other to function appropriately in the classroom. Despite the success stories of AI in chemistry education, it however, does not guarantee the chemistry teacher's accessibility and utilization in the classroom nor does it also guarantee effective teaching by the chemistry teacher, as the chemistry teacher may not be fully skilled and competent to carry out AI-based teaching in chemistry lessons (Harry, 2020; United Nations Educational, Scientific and Cultural Organization, 2019).

Hebert et al (2021) and Tallvid (2016), pointed out that there are still chemistry teachers who hold a negative perception of the utilization of AI in their chemistry classes in other words, they prefer the traditional method of teaching chemistry classes. Furthermore, data available shows significant gender difference in AI access, applicability, and perception (Ofosu-Ampong et al, 2020; Highet et al, 2017; Treuthart, 2019; Bryant, 2022). As Treuthart (2019) reports that in Africa 25% of men have more assess to AI and internet resources than their female counterpart. Put in another way, male and female chemistry teachers interact with AI tools differently, and as such, the inclination to access and use of AI tools may differ among gender as well as their perception. While females interact more with AI-tools, men are more ready to make use of them (Eccles, 2015). This study on one hand will want to determine if gender affects AI accessibility and applicability among secondary school chemistry teachers in Rivers State.

Ongoing forward, regardless of the benefits of integration of AI into chemistry education, its success depends upon the readiness of the chemistry teachers to use it effectively in the classroom. Hence, workshops and seminars are needed to fully train and equip the chemistry teachers to be able to access and as well effectively utilize these AI-tools in the classroom to bring about changes in the level of understanding of chemistry concepts by the chemistry students. Some researchers have revealed changes in chemistry students' understanding and achievement because of

utilization of Virtual Laboratory to carry out complex chemistry experiments which ordinarily could not have been done using traditional laboratory due to high cost of material and none-conducive environment (Gambari et al, 2018; Mutlu & Acar Sesen, 2016; Tuysuz, 2010; Ali & Ullah, 2020). Therefore, it is vital for chemistry teachers to learn about these AI-based tools to ensure adequate and ethical utilization in the classroom. However, there have been limited research in Rivers State in chemistry teachers' accessibility and applicability of AI in secondary schools.

Statement of the Study

Although, there have been some reports in the Western world that utilization of AI-based tools in teaching and learning process significantly affect students' achievement (Al Khateeb, 2021; Palla & Sheikh, 2021). On this ground, chemistry teachers must have to step-up their instructional stratagem and methodology to incorporate AI-tools in their chemistry classes in other to achieve their learning objectives. It is upon this premise that, the study seeks to investigate the accessibility and applicability of Artificial Intelligence among chemistry teachers in secondary schools in Rivers State.

Purpose of the Study

The purpose of this study is to explore the level of accessibility to AI technology and resources among chemistry teachers and examine their perceptions of the applicability of AI in their classroom delivery. The study specifically aims to,

1. determine the level of accessibility of AI technology and resources among secondary school chemistry teachers in Rivers State.
2. examine the perception of the applicability of AI technology and resources among secondary school chemistry teachers in Rivers State.

Research Questions

1. What is the level of accessibility to Artificial Intelligence (AI) technology and resources among chemistry teachers in secondary schools in Rivers State?
2. How do chemistry teachers in secondary schools in Rivers State perceive the applicability of Artificial Intelligence in their classroom delivery?

Hypotheses

1. There is a significant relationship between the level of accessibility to AI technology and resources and chemistry teachers' perceptions of its applicability in secondary schools in Rivers State.
2. There is a significant difference in gender in the level of accessibility to AI technology and resources among chemistry teachers in secondary schools in Rivers State.
3. There is a significant difference in gender in the perception of the applicability of AI technology and resources among chemistry teachers in Rivers State.

Literature Review

AI Application in Chemistry Education

AI is a computer system fashioned with human intelligence and with the ability to self-learn (Stone et al, 2016; Kok et al, 2009). At present, the world of education cannot stand without the strong hands of AI-based tools, as it changes the role of the teacher, boosts the learning ability of the student, and make feasible the achievement of educational goals (Cukurova et al, 2021).

Science Education has witness tremendous benefits from AI-tools and chemistry education is not left out of it. AI-based application has impacted the teaching and learning of chemistry. AI utilization in chemistry includes,

Virtual Laboratory

Virtual laboratory has been integrated into chemistry education. A virtual laboratory is a laboratory that does not physically exist but appears to exist using computer software (Babateen, 2011). Virtual laboratory experiment involves chemistry students interacting with build-in behaviours. This allows the chemistry students to be exposed to laboratory procedures and apparatus, preparing them even for real time experiments (Barney et al, 2003). The provisions of Virtual laboratory by-cuts the constraints and limitations of traditional laboratory. Furthermore, experiments which are costly and hazardous can be carried out at ease while the chemistry teacher guides the students and observes the ways and method they interact with the equipment, apparatuses, and chemicals.

Several research have reported the benefits of virtual laboratory. Bakar and Zama (2007) in their study observed that utilization of virtual laboratory increased students' success as well as teachers planning and teaching. Also, Tuysuz (2010) observed that virtual laboratory positively affects students' attitude, motivation, and conceptual understanding. Furthermore, he reported that virtual laboratory is a good replacement for traditional experiment. On the other hand, in Bilek and Skalicka (2010), it was revealed that students stated that they would rather carry out experiment in the traditional way. While in the study of Oloruntegbe and Alam (2010), students stated that virtual laboratory are attractive and pleasant. Benefits of virtual laboratory in teaching and learning of chemistry includes, low cost, immediate feedback, flexibility, improved safety and easy to access and use amongst others.

Virtual Reality

Virtual Reality like virtual laboratory is used to create a feeling or sense of a real world in a simulated environment. This is made possible by looking on a screen, or a heads-up display or a headset designed for Virtual Reality. Through Virtual Reality, the chemistry teacher can make real the molecular level to enhance adequate comprehension of chemistry concepts as chemistry students' view chemistry as being too nonrepresentational, requiring them to move from the macro level to the sub-atomic level as well as symbolic level consisting of chemical equations and symbols. Chemistry teachers can use Virtual Reality to make students experience different kinds

of reactions that would be unsafe to carry-out in real life situations (Winkelmann et al, 2017; Bibic et al, 2019; Bennie et al, 2019; Georgiou et al, 2007).

Intelligent Tutoring System (ITS)

Intelligent Tutoring System (ITS) is a class of AI-tools that promote personalization at a certain level. These AI-tools (ITSs) adjust teaching strategies and instructional methods to suit the students learning abilities having identified the strengths and weakness of the student (Dogan, 2006). Intelligent Tutoring System is built in four parts. The Knowledge Module (which contains the subject matter), the Student Module (which contains information collected about the user), Instruction Module (which makes decisions for each user), and Interface Module (which gives both input and output to user). Mousavinasab et al (2021) and Theis (2020) reported utilization of ITS in-chemistry education. Shute and Zapata-Rivera (2010) also revealed that ITSs are good in monitoring and keeping track of students' academic process and ascertain the competence level of students.

Adaptive Learning System (ALS)

Adaptive Learning System (ALS) is an Al technology that is capable of tailoring and fitting subject content to fit students' abilities. The purpose of Adaptive Learning Systems is to improve students' academic performance. Adaptive Learning provides students with learning environment that sustains and promotes their interest and goals. (Capuano and Caballe, 2020). Researchers contend that Adaptive Learning improve students' knowledge and conceptual understanding as it adapts to the goals and interest of each student (Herold, 2017; Capuano and Caballe, 2020).

Additionally, Chatbot and ChatGPT are also AI-tools used in the chemistry classroom. Chatbot is an AI application that can generate human like conversation to users queries without human intervention in any language. It is a flexible AI-tool, and it provides immediate feedback to the user. This feature has made it usable across many fields of study including chemistry education. Also, ChatGPT is a prototype of Chatbot using generative Open AI models to simulate and produce different responses upon the data it receives. These AI-tools are known to help the teacher in the classroom, providing instant answer to students' questions (Borji, 2023; Kim, 2023; Van Dis et al, 2023; Zhai, 2022; Goda, 2014).

Accessibility of AI for Chemistry Teachers

The accessibility of AI to teachers depends upon many factors of which the literature review discloses. Sanchez-prieto et al (2019) reported that teachers find AI challenging to use and as such do not utilize it. Several research reveal among others that lack of adequate AI resources is a factor affecting AI use among teachers (Beri & Sharma, 2019; Pima & Mtui 2017; Kafyulilo et al, 2015). Also, lack of time to access AI-tools due to workload; lack of seminar and workshop affects teachers' use of AI-tools (Ahmad et al, 2017; Dougherty, 2015; Boettcher & Conrad, 2016; Asiri et al, 2012).

Other research works carried out also points to the fact that nervousness and practical worth; lack of technical knowhow and resistance to change also affect the adoption of AI-tools by teachers

(Chocarro et al, 2021; Teo, 2019; Bari & Sharma, 2019; Lawrence & Tar, 2018; Pima & Mtui, 2017). Furthmore, Deo et al (2020) and Hellings and Haelermaus (2020), in their respective study reported improved achievement in students' overall performance when AI was used in chemistry education. This is also true in the research of Buenano-Fernandez et al, (2019) and Zabriskie et al (2019), as they reported improved performance of Computer Science and Physics students' schoolwork because of teachers' utilization of AI-tools. From the literature put forward, it is glaringly imperative that chemistry teachers need to adopt AI-tools and resources in the teaching and learning of chemistry in secondary schools in Rivers State. Notwithstanding the many benefits of adoption of AI in teaching and learning, the question remains, are the chemistry teachers truly ready to adopt and utilize AI-tools in their chemistry lessons? Hence, the need to investigate chemistry teachers' accessibility and applicability of AI in secondary schools in Rivers State.

Methodology

This study adopted descriptive survey research design. Using purposive sampling technique to select 81 (45 males and 36 females) chemistry teachers in Rivers State from 76 senior secondary schools as the respondents of this study. The selected chemistry teachers were those from secondary schools presenting students in West Africa Senior School Certificate Examination (WASSCE) and must possess five years and above teaching experience in the field of chemistry education. The instrument used for data collection was a questionnaire. The questionnaire consists of three parts. Part A consists of the demography of the participants. Part B was titled "Chemistry Teachers Accessibility of AI (CTAAI)" and was used to ascertain the level of accessibility of chemistry teachers to AI resources, while Part C was titled "Chemistry Teachers Perception of Applicability of AI (CTPAAI)" and was used to determine the perception of chemistry teachers towards AI applicability in the chemistry class. Both parts (B and C) consist of twelve (12) items giving a total of 24 items structured using four-point modified Likert scale of Strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD). The responses were scored as SA = 4, A = 3, D = 2 and SD = 1. The research instrument was administered physically and through e-mail using Google Forms. The research instrument was face and content validated by two experts in the field of chemistry education and AI respectively to ensue validity. While Kuder-Richerson's Formula-21 was used to obtain a reliability index of r = 0.87. Data obtained from the administered questionnaire were analyzed using mean, standard deviation, percentage, chart, Pearson product moment correlation and t-test. Decision making was based on; accept mean score of 2.50 and above as high for research questions and reject the hypothesis if the calculated p-value is greater than the alpha value, 0.05.

Results

Research Question 1: What is the level of accessibility to Artificial Intelligence technology and resources among chemistry teachers in secondary schools in Rivers State?

Table 1: Showing Chemistry Teachers' Accessibility to Artificial Intelligence Technology and Resources in Rivers State.

S/N	Statement	SA	A	D	SD	$\bar{x}$	SD
1	There is available and reliable internet access, devices and electricity in my school and community to access and utilize AI tools.	3	12	30	36	1.78	0.83
		3.7%	14.8%	37.0%	44.5%		
2	I can afford AI technologies and related resources for the teaching of chemistry lessons.	5	14	24	38	1.83	0.93
		6.2%	17.3%	29.6%	46.9%		
3	I have adequate knowledge and implications in utilization of AI technologies in the classroom.	10	24	15	32	2.09	1.04
		12.4%	29.6%	18.5%	39.5%		
4	I understand the languages utilized in AI technologies and related resources.	9	25	20	27	2.20	1.02
		11.1%	30.9%	24.7%	33.3%		
5	Seminars and workshops have been held in my LGA for effective integration of AI into classroom teaching and learning.	0	7	38	36	1.86	0.86
		0.0%	8.6%	46.9%	44.5%		
6	AI is suitable and relevant to provide educational content for different learners in my chemistry classes.	16	25	20	20	2..46	1.07
		19.7%	30.9%	24.7%	24.7%		
7	The policies and regulations of the government support and promote utilization of AI in classroom teaching and learning of chemistry.	9	24	21	27	2.19	1.02
		11.1%	29.7%	25.9%	33.3%		
8	I have reservations about the collection and utilization of chemistry students' data by AI systems.	12	27	15	27	2.30	1.08
		14.9%	33.3%	18.5%	33.3%		
9	AI could adapt to the learning style of chemistry students in my class.	11	30	19	21	2.38	1.01
		13.6%	37.0%	23.5%	25.9%		
10	Parents and community members support AI use in teaching and learning of chemistry.	7	17	29	28	2.04	0.95
		8.6%	21.0%	35.8%	34.6%		
11	I receive educational support in other to implement and utilize AI effectively in the teaching and learning of chemistry.	0	6	28	47	1.49	0.63
		0.0%	7.4%	34.6%	58.0%		
12	There is effective investment in research to improve accessibility and	10	32	19	20	2.40	1.00
		12.4%	39.5%	23.4%	24.7%		

	utilization of AI resources in teaching and learning of chemistry.						
	Overall Percentage, Mean and Standard Deviation	**9.5%**	**25.0%**	**28.6%**	**36.9%**	**2.08**	**0.95**

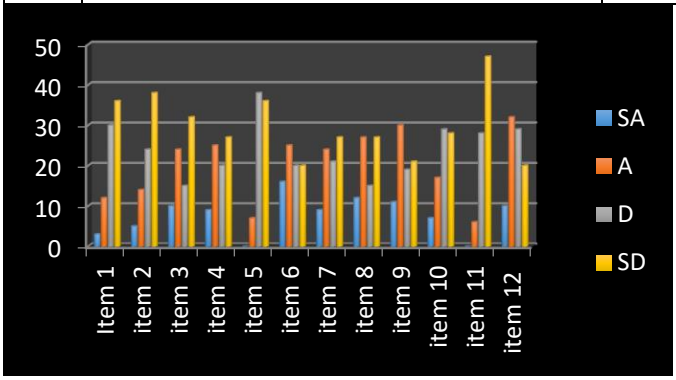


Figure 1: Showing Column chart of Chemistry teachers' responses.

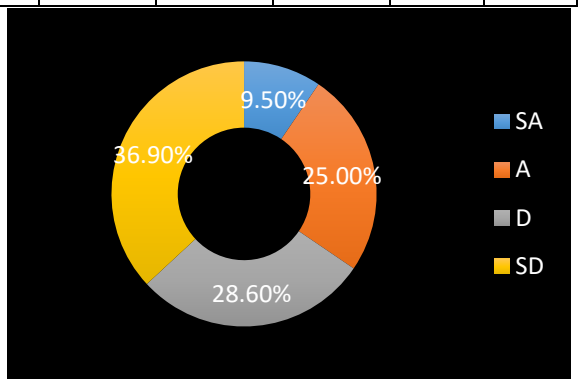


Figure 2: Showing overall percentage responses of Chemistry teachers.

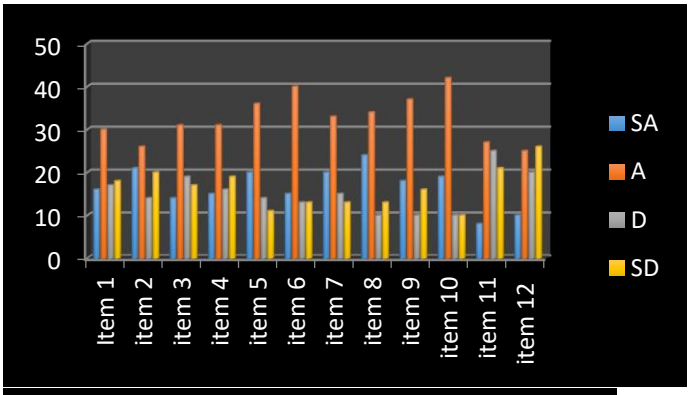
From the results represented, research question 1 contains 12 items. 44.5% and 46.9% of the respondents strongly disagreed with item 1 and 2 respectively. Indicating that there is no available and reliable internet access, devices and electricity in their school and community for them to access and utilize AI resource, and they are also not able to afford AI technologies and related resources for the teaching of their chemistry classes. Also 39.5% strongly disagreed with item 3 against 29.6% who agreed that they have adequate knowledge and implications in utilization of AI-tools in the classroom, while 33.3% strongly disagreed with item 4 contrary to 30.9% who agreed that they understand the languages utilized in AI technologies. Remarkably, 46.9% disagreed and 44.5% strongly disagreed with item 5 indicating that no seminar or workshops have been held in their local government area for effective integration of AI into the teaching and learning of chemistry. Furthermore, 30.9% agreed with item 6 that AI is suitable and relevant to provide educational content for their chemistry students. The respondents strongly disagreed that government policies and regulation fail to promote the use of AI technologies in the classroom as indicated by 33.3%. Oddly, 33.3% and 33.3% both agreed and strongly disagreed with item 8, indicating that some of the chemistry teachers have reservations about the collection and utilization of student's data by AI systems. 37.0% agreed that AI could adapt to the learning style of students, while 35.8% disagreed that parents and community members support AI use in teaching and learning of chemistry. More than half of the respondent (58.0%) strongly disagreed that they received educational support to implement AI effectively in the classroom which hinders their access to AI tools. Meanwhile, 39.5% agreed that there is effective investment in research to improve accessibility and utilization of AI resources in teaching and learning of chemistry. However, data in table 1 shows an overall mean of 2.08 and SD of 0.95. The mean of 2.08 is less than 2.50, hence the accessibility and utilization of AI resources among chemistry teachers in Rivers State is low as confirmed by figure 2 showing that 36.9% strongly disagreed with the 12 items in accessibility of chemistry teachers to AI resources.

Research Question 2: How do chemistry teachers in secondary schools in Rivers State perceive the applicability of Artificial Intelligence in their classroom delivery?

Table 2: Showing Chemistry Teachers' Perception on Applicability of Artificial Intelligence Technology and Resources in Rivers State.

S/N	Statement	SA	A	D	SD	$\bar{x}$	SD
1	I believe AI will destroy both chemistry teachers and students natural thinking ability.	16	30	17	18	2.54	1.04
		19.8%	37.0%	21.0%	22.2%		
2	I feel AI will replace human teachers in the chemistry classroom, leading to loss of jobs.	21	26	14	20	2.59	1.11
		25.9%	32.1%	17.3%	24.7%		
3	I believe AI will be more useful in educational research than in teaching and learning of chemistry.	14	31	19	17	2.90	3.42
		17.3%	38.3%	23.5%	20.9%		
4	AI-technologies are new and changing constantly, thus, should not be used in teaching and learning of chemistry.	15	31	16	19	2.52	1.04
		18.5%	38.3%	19.7%	23.5%		
5	I believe I can get reliable feedback to improve my teaching methods without the help of AI- tools.	20	36	14	11	2.78	1.01
		24.7%	44.4%	17.3%	13.6%		
6	I am open to integrate AI-powered tools to enrich my chemistry classes.	15	40	13	13	2.69	0.94
		18.5%	49.3%	16.1%	16.1%		
7	I am convinced that teaching and learning of chemistry will become easier with the integration of AI into chemistry classes.	20	33	15	13	2.74	1.00
		24.7%	40.7%	18.5%	16.1%		
8	I believe AI will be useful in teaching and learning of difficulty chemistry topics and concepts.	24	34	10	13	2.85	1.02
		29.6%	42.0%	12.3%	16.1%		
9	I think using AI-tools will help reduce workload for the chemistry teacher.	18	37	10	16	2.70	1.02
		22.2%	45.7%	12.3%	19.8%		
10	I feel that the knowledge and utilization of AI-resources will make me more competent in and out of the classroom as a chemistry teacher.	19	42	10	10	2.86	0.91
		23.5%	51.9%	12.3%	12.3%		
11	Utilization of AI-tools in the teaching and learning of chemistry is time consuming and stressful, thus, should be left out of chemistry classes.	8	27	25	21	2.27	0.96
		9.9%	33.3%	30.9%	25.9%		
12		10	25	20	26	2.22	1.02

	AI-technologies are expensive to implement in secondary school chemistry classes; hence, it should be utilized in higher institution of learning.	12.3%	30.9%	24.7%	32.1%		
	Overall Percentage, Mean and Standard Deviation	**20.6%**	**40.3%**	**18.8%**	**20.3%**	**2.64**	**1.21**



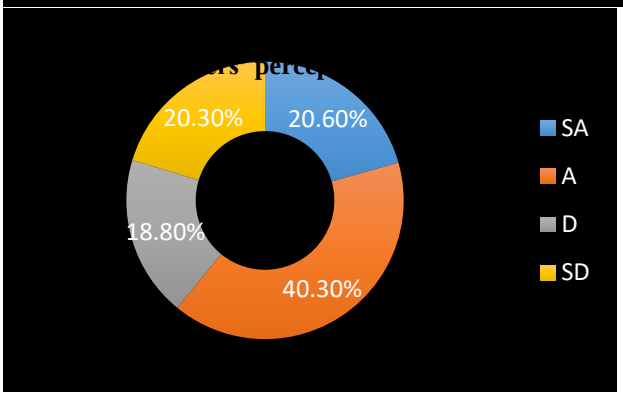


Figure 4: Showing overall percentage responses of Chemistry teachers' perception.

Moreover, data in table 2 about the perception of applicability of AI resources by chemistry teachers' reveals that 37.0% is of the opinion that AI will destroy the natural thinking ability of students and teachers. While 32.1% feels that AI will replace human teachers, thus leading to loss of jobs. 38.3% believe that AI will be more useful in educational research than teaching and learning and that AI technology are changing constantly and should not be used in teaching and learning. The respondents believe they can get reliable feedback to improve their teaching methodology with the help of AI as shown by the percentage of 44.4%. Also 49.3% was convinced that teaching and learning of chemistry will be easier with the integration of AI into chemistry classes. Similarly, 45.7%, 51.9%, 33.3% and 30.9% believe that AI will reduce the workload of chemistry teachers (item 9), that AI will make them more competent in and out of the classroom (item 10), that AI is time consuming and stressful (item 11) and that AI technologies are expensive

to implement in secondary schools (item12) respectively. Meanwhile, table 2 shows an overall mean of 2.64 and SD of 1.21. This mean is greater than 2.50, thus it is considered as high as established by figure 4 showing an overall percentage of 40.3% who agreed with the 12 items of research question 2.

Hypothesis 1: There is a significant relationship between the level of accessibility to AI technology and resources and chemistry teachers' perceptions of its applicability in secondary schools in Rivers State.

Table 3: Showing Pearson Correlation Analysis between Chemistry Teachers' Accessibility and Perception of Applicability of AI Resources.

Variable	*Accessibility to AI*	*Perception of Applicability to AI*
Accessibility to AI *Perception of Applicability to AI*	*1* *-0.0635* *N=81*	*-0.0635* *1* *N=81*

Additionally, the Pearson product moment correlation in table 3 shows a negative relationship between accessibility to AI resources and perception of applicability of AI resources by chemistry teachers, as the correlation yielded a correlation coefficient of -0.0635. This reveals that as the accessibility to AI resources decreased, perception of applicability of AI resources increased. This was confirmed by their respective overall mean of 2.08 (low) for accessibility to AI resources and 2.64 (high) for perception of applicability of AI resources.

Hypothesis 2: There is a significant difference in gender in the level of accessibility to AI technology and resources among chemistry teachers in secondary schools in Rivers State.

Table 4: Showing Independent Sample t-test of Significant of Chemistry Teachers' Accessibility to AI Resources Based on Gender

Variable	*($\bar{x}$)*	*SD*	*N*	*df*	*P-Value*	*t-Crit.*	*Result*
Male	*25.33*	*3.50*	*45*	*79*	*.3213*	*1.9905*	*Rejected*
Female	*24.61*	*2.93*	*36*				

Furthermore, on the case of gender, the t-test data analysis on table 4 and 5 reveals that there is no significant difference in accessibility of AI resources as well as perception of applicability of AI resources based on gender. As table 4 displays a P-value of .3213 and a t-critical value of 1.9905 which is greater than the alpha value of 0.05, hence the hypothesis was rejected.

Hypothesis 3: There is a significant difference in gender in the perception of the applicability of AI technology and resources among chemistry teachers in Rivers State.

Table 5: Showing Independent Sample t-test of Significant of Chemistry Teachers' Perception of Applicability of AI Resources Based on Gender

Variable	*($\bar{x}$)*	*SD*	*N*	*Df*	*P-Value*	*t-Crit.*	*Result*
Male	*32.42*	*3.77*	*45*	*79*	*.1326*	*1.9905*	*Rejected*
Female	*30.75*	*4.19*	*36*				

Also, table 5 represents a P-value of .1326 with a t-critical value of 1.9905 which is greater than the alpha value of 0.05; consequently, the hypothesis was also rejected. Therefore, chemistry teachers' accessibility to AI resources and perception of applicability of AI resources did not differ based on gender.

Discussion

From the results represented, research question 1 contains 12 items. 44.5% and 46.9% of the respondents strongly disagreed with item 1 and 2 respectively. Indicating that there is no available and reliable internet access, devices and electricity in their school and community for them to access and utilize AI resource, and they are also not able to afford AI technologies and related resources for the teaching of their chemistry classes. This finding is in line with those of Beri & Sharma, (2019) and (Pima & Mtui 2017) who found that lack of adequate internet facilities and electricity affected teachers' access to AI resources as well as the cost of these AI devices. Also 39.5% strongly disagreed with item 3 against 29.6% who agreed that they have adequate knowledge and implications in utilization of AI-tools in the classroom, while 33.3% strongly disagreed with item 4 contrary to 30.9% who agreed that they understand the languages utilized in AI technologies. Remarkably, 46.9% disagreed and 44.5% strongly disagreed with item 5 indicating that no seminar or workshops have been held in their local government area for effective integration of AI into the teaching and learning of chemistry. This agrees with the findings of Ahmad et al, (2017) and Asiri et al, (2012), that lack of training affected teachers access and utilization of AI technologies. Furthermore, 30.9% agreed with item 6 that AI is suitable and relevant to provide educational content for their chemistry students. The respondents strongly disagreed that government policies and regulation fail to promote the use of AI technologies in the classroom as indicated by 33.3%. Oddly, 33.3% and 33.3% both agreed and strongly disagreed with item 8, indicating that some of the chemistry teachers have reservations about the collection and utilization of student's data by AI systems. This agrees with the result of Ezekiel and Akinyemi (2022) who found no clear disparity on reservation of lecturers towards adoption of AI technologies. 37.0% agreed that AI could adapt to the learning style of students, while 35.8% disagreed that parents and community members support AI use in teaching and learning of chemistry. More than half of the respondent (58.0%) strongly disagreed that they received educational support to implement AI effectively in the classroom which hinders their access to AI tools. Meanwhile, 39.5% agreed that there is effective investment in research to improve accessibility and utilization of AI resources in teaching and learning of chemistry. However, data in table 1 shows an overall mean of 2.08 and SD of 0.95. The mean of 2.08 is less than 2.50, hence the accessibility and utilization of AI resources among chemistry teachers in Rivers State is low as confirmed by figure 2 showing that 36.9% strongly disagreed with the 12 items in accessibility of chemistry teachers to AI resources.

Moreover, data in table 2 about the perception of applicability of AI resources by chemistry teachers' reveals that 37.0% is of the opinion that AI will destroy the natural thinking ability of students and teachers. While 32.1% feels that AI will replace human teachers, thus leading to loss of jobs. This agrees with Ezekiel and Akinyemi (2022) who found that 68.1% strongly disagreed that they will prefer education without AI. 38.3% believe that AI will be more useful in educational research than teaching and learning and that AI technology are changing constantly and should not be used in teaching and learning. The respondents believe they can get reliable feedback to improve their teaching methodology with the aid of AI as shown by the percentage of 44.4%. Also 49.3% was convinced that teaching and learning of chemistry will be easier with the integration of AI into chemistry classes. This is in line with the result of Tuysuz (2010) who reported improved achievement of chemistry students because of utilization of AI resources. Similarly, 45.7%, 51.9%, 33.3% and 30.9% believe that AI will reduce the workload of chemistry teachers (item 9), that AI will make them more competent in and out of the classroom (item 10), that AI is time consuming and stressful (item 11) and that AI technologies are expensive to implement in secondary schools (item12) respectively. Meanwhile, table 2 shows an overall mean of 2.64 and SD of 1.21. This mean is greater than 2.50, thus it is considered as high as established by figure 4 showing an overall percentage of 40.3% who agreed with the 12 items of research question 2.

Additionally, the Pearson product moment correlation in table 3 shows a negative relationship between accessibility to AI resources and perception of applicability of AI resources by chemistry teachers, as the correlation yielded a correlation coefficient of -0.0635. This reveals that as the accessibility to AI resources decreased, perception of applicability of AI resources increased. This was confirmed by their respective overall mean of 2.08 (low) for accessibility to AI resources and 2.64 (high) for perception of applicability of AI resources. Furthermore, on the case of gender, the t-test data analysis on table 4 and 5 reveals that there is no significant difference in accessibility of AI resources as well as perception of applicability of AI resources based on gender. As table 4 displays a P-value of .3213 and a t-critical value of 1.9905 which is greater than the alpha value of 0.05, hence the hypothesis was rejected. Also, table 5 represents a P-value of .1326 with a t-critical value of 1.9905 which is greater than the alpha value of 0.05; consequently, the hypothesis was also rejected. These findings agree with the results of Ezekiel and Akinyemi (2022) who found no effect of gender on the perception of University of Ibadan lecturers on the applicability of AI resources but disagrees with Treuthart (2019) who found gender difference in accessibility and applicability of AI resources. Therefore, chemistry teachers' accessibility to AI resources and perception of applicability of AI resources did not differ based on gender.

Conclusion

In conclusion, this study investigated the accessibility and applicability of Artificial Intelligence among chemistry teachers in secondary schools in Rivers State. The findings of this study showed that there is low accessibility of AI resources amongst chemistry teachers in Rivers State. Furthermore, this study also makes certain that there are still reservations held by some of the chemistry teachers about the applicability of AI resources in secondary school chemistry classes in Rivers State. Nevertheless, it was also discovered that irrespective of these reservations held,

chemistry teachers are wholly ready to accept and utilize AI resources in the teaching and learning of chemistry in secondary schools in Rivers State.

Recommendations

Considering the findings of this study, the following recommendations were put forward.

1. The government and stakeholders should organize conferences, workshops, and seminars in each local government area in Rivers State for proper orientation and integration of AI into secondary education.
2. Curriculum planners should revise the science curriculum to incorporate AI into it, to enhance the achievement of its objectives.
3. School administrators and parents should be made aware of the benefits of integration of AI into secondary school education to assists and encourage the teachers into using AI-tools.
4. Government should provide adequate internet facilities and reliable electricity to encourage the utilization and implementation of AI resources in secondary schools in Nigeria.
5. The results of this study when made known to all science teachers should take cognizant of the fact that not all chemistry teachers' data and information was utilized. For example, the study did not consider chemistry teachers' highest academic qualification, marital status, salary grade level etc. thus these call for further research in these areas.

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