RURAL-URBAN DISPARITIES IN SENIOR SECONDARY SCHOOLS CHEMISTRY TEACHERS' PREPAREDNESS TO USE DIGITAL LEARNING TECHNOLOGY

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Abstract
This study investigated the disparities between urban and rural senior secondary schools teachers' preparedness in using digital learning technology (DLT). One research question and one hypothesis guided the study. A descriptive survey research design was adopted. 410 chemistry teachers in Anambra State, South East of Nigeria were used in the study. Data were collected using questionnaire on teachers' preparedness to use digital technology (QOTPUDT) validated by experts in chemistry education. QOTPUDT had reliability index of 0.89 as determined using Cronbach's alpha reliability coefficient. Findings of the study revealed that teachers of both urban and rural schools were not well prepared in using DLT to teach chemistry and the difference between urban and rural chemistry teachers' preparedness to use DLT was not significant. Recommendation made include school owners to provide resources and support for chemistry teachers' use of DLT in both urban and rural locations.

Keywords: Digital learning technology; teacher preparedness; urban and rural locations

Introduction

The united nations 2030 Agenda for Sustainable Development Goals are anchored on education piloted by effective use of digital technology (UNO, 2024; Igboanugo and Oyalede, 2025). The world activities and output are currently under the influence of digital technology. This is to the extent that the measure of the effectiveness of a classroom teaching and learning could be determined by the teacher's level of preparedness to use digital learning technology (DTL) (Hanell, 2018; Verma, 2018; Viberg, Mavroudi, Khalil & Bälter, 2020; Lembens et al., 2022). DLT is the use of electronic gadgets to enhance teaching and learning. The chemistry teacher's productivity depends on his/her ability to use appropriate teaching methods and resources currently influenced by digital technology (King and Henderson, 2018; Ramírez-Montoya, Mena & Rodríguez-Arroyo, 2017; Chukwu, Aroh, Ogbueghu & Ugwonna, 2022). FME (2009) pointed out the need to embrace radical change in the society due to global digitalization through effective chemistry curriculum implementation. This demands for regular appraisals of teachers' abilities and dispositions in adopting and using DLT in teaching and learning (Bohne, Eicker & Hasellof, 2017). Teachers' preparedness could affect the teachers' attitude in teaching (Ibourk and Mathis, 2024).

Supplementing chemistry pedagogy with digital technology has been found efficacious in enhancing instructional outputs (Brown, Bernholt & Parchmann, 2018; Finkestaed-Quinn et al., 2018). On the other hand, the introduction and use of digital technology in the society has not been free from some academic, health and social vices. Authors such as Wajcman (1991); Nzewi (2010); Spitzer (2018) reported that such vices as health issues, social criticisms and gender divides which can culminate into decline in academic activities of the young citizens are associated with the use of digital technology in the society. Therefore, the teacher if well trained and prepared in using DLT stands the chance to not only enhance teaching and learning using DLT but direct the learner on how best to use the DLT for optimal benefit (Igboanugo, 2024).

However, researchers reported concerns about teachers' usage and application of digital technology in pedagogy. Carter and Akerson (2024) discovered that elementary teachers' problems in using digital online tools include technology difficulties, appropriate usage and technology access. This is in line with Eya and Okebanama, (2022) who decried chemistry teachers' lack of skills to use digital technology in teaching. This keeps in doubt about chemistry teachers' adequate equipment and preparedness to use DLT in teaching which is expected to alleviate the problem of perennial students' poor performance in chemistry (Rossett, 2013) Researchers report about existence of disparity in the third world countries like Nigeria and other African countries in provision of resources and opportunities required for teachers' use of DLT at different school locations (Adejoh and Ityokyaa, 2012; Ukah and Nworgu, 2015; Okorie and Ezeh, 2016).

School locations can be classified into urban or rural based on the physical space in relation to other places where schools are found (Ntibi and Edoho, 2017). Weeks (2010) refers to urban location as a place where lives and spatial concentration of people are organized around non- agricultural activities. Weeks points out that an urban location is determined by its outstanding size, population density, social, economic organizations and transformation of the natural and agricultural environment into buildings. There is disparity in distribution of social amenities and opportunities in different locations of the society which might affect the distribution of teachers with different experiences and qualifications in schools (Adejoh and Ityokyaa, 2012; Ahamba, 2021).

Consequently, school location becomes an important factor that has influence on teaching and learning out comes. Ukah and Nwogu (2015) posit that the disparity in the distribution of social amenities and teaching resources in favour of urban locations might as well affect the efficiency and productivity of teachers in favour of urban schools. School location and its physical characteristics might have variety effects on students, teachers and the entire teaching-learning process (Akinyele, 2011; Macmillan, 2012; Ahamba, 2021).Teachers might resist attempts to be posted to rural location where there are lack of social amenities and teaching resources or become down-casted to work in rural location. Disparity in availability of teaching and learning resources such as internet facilities, computer, experts in Information Communication and Technology (ICT) at different school locations might lead to difference between urban and rural school teachers' choice and use of DLT for instruction (Akinyele, 2011; Eya and Okebanama, 2022). This could cause variations on the level of teachers' use, zeal and productivity between urban and rural schools. Disparity on students' performance due to school location dichotomy which implies difference in teachers' capacity and preparedness for effective teaching has been reported (Njoku and Akwali, 2016; Ntibi, and Edoho, 2017). Osuafor and Osisioma (2014) discovered that ICT knowledge of urban students was significantly higher than that of their rural counterparts. Existence of urban-rural dichotomy in schools might lead to the feeling among parents/guardians that students in urban schools perform better than students in the rural schools (Achimugu, 2016). However, Obi and Newen (2016) reported no significant difference in the mean scores of urban and rural first year students on the extent of utilization of STEM education. Likewise, Ukah, Ukwuoma & Omugo (2019) found no significant difference between the mean creativity identification instrument scores of pupils in urban and rural schools. There seems to be inconclusive report on urban-rural dichotomy on issues in teaching and learning sciences.

Thus it might be pertinent to investigate the urban-rural disparity in teachers' preparedness in using DLT in the senior secondary schools at this era of digital technology. This will sensitize the stakeholders in education on the need for adequate preparation, support and even distribution of teachers in the society assuring availability of quality education for all.

The theoretical base of this study is the Technological, Pedagogical, and Content Knowledge (TPACK) model by Koehler and Mishra (2009). The model maintains that teachers' preparedness to use digital technology is dependent upon effective integration of knowledge of the content, pedagogy, and technology needed for instruction. Thus the urban or rural teacher should be exhibit preparedness to use the digital learning technology through adequate knowledge and integration of the content, pedagogy and the technology.

The need for teachers' preparedness in using digital technology in the present digital age cannot be overemphasized. The use of DLT should span throughout the breath of the society for even development. However, literature has shown a disparity in provision of educational resources and dividends between urban and rural schools. An evaluation of teachers' readiness in using DLT in both urban and rural locations might help stake holders in education to address the problems associated with school location dichotomy. Thus the problem of this study was: To investigate the disparities between rural and urban senior secondary schools chemistry teachers' pedagogy.

The purpose of this study is to determine the disparities between rural and urban chemistry teachers' preparedness in using DLT.

Research Question

The study was guided by the following research question:

1. What is the difference between urban and rural chemistry teachers' preparedness in using DLT?

Hypothesis

The following null hypothesis was formulated and tested at 0.05 level of significant:

Ho$_1$: There is no significant difference between urban and rural chemistry teachers' preparedness in using DLT.

Methods

Descriptive survey research design was considered most appropriate in this study because it is useful in accurately documenting a person's thoughts and opinions about an area under investigation (Garraway-Lashley, 2019). Chemistry teachers of senior secondary school 1 to senior secondary school 3 covering rural and urban locations were used for the study. Four hundred and ten (410) in-service chemistry teachers assembled at Onitsha National Examination Council (NECO) marking centre, Anambra State, South East of Nigeria were used for the study. Stratified sampling technique was used to select two hundred and eighty (280) urban school teachers and one hundred and thirty (130) rural school teachers. The instrument used to collect data for the study was a structured questionnaire on teachers' preparedness to use digital technology (QOTPUDT) adapted from Viberg, Mavroudi, Khalil & Bälter (2020). The original instrument by Viberg, Mavroudi, Khalil & Bälter comprised 38 items with reliability index range of 0.64 to 0.84. However, QOTPUDT comprised sections A and section B. Section A included the bio data of the respondents. Second B consisted twenty items selected from the original 38 items from Viberg, Mavroudi, Khalil & Bälter (2020) to suit the present study. A 4-point response scale was used in the instrument. Each respondent was instructed to indicate his/her views about each item by conscientiously ticking against 'strongly disagree' (SD);

'disagree' (D); 'agree' (A) or 'strongly agree' (SD). In a positive statement, the rating was Strongly Agree (SD) = 4, Agree (A) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1. While the rating was in reverse other in a negative statement. The instrument was face validated by two experts in chemistry education, an expert in computer science education and an expert in Measurement and Evaluation. Comments of the validators helped to modify the instrument to suit the study. A trial test of the validated instrument was done using thirty chemistry teachers in an area outside the area of research. Using the scores got from the trial test, the internal consistency of the instrument was determined using Cronbach Alpha method and found to be 0.89. This is a high reliability index confirming the adequacy of the internal consistency of the instrument for the present study. QOTPUDT was distributed to the respondents at the NECO marking venue by the researchers on the permission of the NECO chemistry subject officers. The participants willingly responded to the QOTPUDT items and returned them to the researchers the same day. Thus all the questionnaires distributed were collected back and used for analysis.

Analysis of the data was done using the statistical package for social sciences (SPSS) version 25.0. The average ratings of each items were used to answer the research questions. By the rating scale, an average item rating below 2.50 was considered teachers' unpreparedness while the average rating of 2.50 and above was considered teachers' preparedness. The hypothesis was tested using the independent samples t-test at 0.05 value of significant.

Results

The results from Table 1reveals that the aspects both urban and rural teachers indicate unpreparedness to use DLT in teaching chemistry include items 3, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18,19 and 20. These aspects are: extra effort and time to use of digital technology to teach chemistry; no sufficient knowledge to be able to use digital technology in teaching chemistry; do not know where to get help if encountered a problem with digital technology in teaching chemistry; no plan to use digital technology in teaching chemistry in the coming year; believe that there are limitations to what digital technology can be used to teach in chemistry; believe that some choices of knowledge content cannot limit the type of digital technology to use in teaching chemistry; do not understand the potential of digital technology and how this can be used differently depending on the purpose and course content in chemistry; not aware of the possibilities and limitations of digital technology in teaching and how it may affect the pedagogical design in chemistry topic; cannot use digital technology effectively in teaching chemistry; cannot influence which digital tools to use in teaching; the digital tools that introduced to shall support teaching; insufficient skills to teach students to use digital technology as a tool for knowledge search, communication, creativity and learning. Whereas the areas urban and rural teachers indicate preparedness to use DLT in teaching chemistry include items both 1, 2, 5, and 16. These areas are: knowledge of the digital technology that is useful in teaching chemistry, awareness that improvement on the use of digital technology will increase the probability of delivery the chemistry content in the class; actively looking for digital technology that can be used to facilitate student learning; and the knowledge that digital tools would not facilitate the way to assess students' learning. Table 1 further indicates that only the urban teachers show preparedness to use DLT in teaching chemistry on items 4, 6 and 7. These areas are: can find digital technology easy to use in teaching chemistry, have the conduit (e.g., government and school authorities) supported to use digital technology; and have access to the necessary resources to be able to use digital technology in teaching chemistry.

Table 1: Mean (Ẋ) and Standard Deviation (SD) Ratings of Urban and Rural Chemistry Teachers' Preparedness to use Digital Technology in teaching chemistry

S/N	Items	Urban (N=280) Ẋ	SD	DE	Rural (N=130) Ẋ	SD	DE
1	I have known the digital technology that is useful in teaching chemistry	2.81	1.16	P	2.69	1.08	P
2	If I improve my use of digital technology the probability of delivery the chemistry content in the class as a teacher increases	2.70	1.23	P	2.63	0.70	P
3	My use of digital technology to teach chemistry as a teacher will require extra effort and time	2.00	1.22	NP	1.74	1.24	NP
4	I cannot find digital technology easy to use in teaching chemistry	2.57	1.17	P	2.47	1.18	NP
5	I am actively looking for digital technology that I can use to facilitate students' learning	2.91	1.32	P	2.85	1.24	P
6	The conduit (e.g., government and school authorities) has not generally, supported the use of digital technology	2.75	0.92	P	2.41	1.27	NP
7	I have access to the necessary resources to be able to use digital technology in teaching chemistry	2.61	1.14	P	2.11	1.25	NP
8	I have sufficient knowledge to be able to use digital technology in teaching chemistry	2.14	1.02	NP	2.13	0.95	NP
9	I cannot know where to get help if I encounter a problem with digital technology in teaching chemistry	2.00	1.02	NP	1.68	0.98	NP
10	I have no plan to use digital technology in teaching chemistry next year	2.42	1.09	NP	1.96	1.04	NP
11	I believe that there are limitations to what digital technology can be used to teach in chemistry	2.28	1.09	NP	1.72	0.90	NP
12	I believe that some choices of knowledge content cannot limit the type of digital technology I can use to teach chemistry	2.14	0.98	NP	2.11	1.08	NP
13	I believe that digital technology can limit representations of knowledge content in chemistry	1.85	0.95	NP	2.01	0.52	NP
14	I do not understand the potential of digital technology and how this can be used differently depending on the purpose and course content in chemistry	2.28	1.27	NP	1.58	0.45	NP
15	I am aware of the possibilities and limitations of digital technology in teaching and how it may affect the pedagogical design in chemistry topic	2.00	0.96	NP	2.06	0.53	NP
16	The digital tools would not facilitate my way to assess the students' learning	2.71	1.09	P	2.57	0.57	P
17	I can use these digital tools effectively in teaching chemistry	2.17	1.08	NP	2.10	0.46	NP
18	I can influence which digital tools I use in teaching	2.16	1.24	NP	2.12	0.80	NP
19	I think the digital tools that I have been introduced to shall support my teaching	2.16	0.70	NP	1.68	1.37	NP
20	I do not have sufficient skills to teach students use digital technology as a tool for knowledge search, communication, creativity and learning	2.25	1.22	NP	2.00	1.08	NP

On Table 1, 'DE' stands for decision, 'NP' stands for not prepared.

Table 2: Mean and standard deviation of ratings of urban and rural teachers' responses on preparedness in using DLT to teach chemistry

Groups	N	Mean	SD
Urban	280	36.00	1.23
Rural	130	32.10	1.22

Hypothesis: There is no significant difference between urban and rural teachers' preparedness in using DLT to teach chemistry.

Table 3 shows that a t-test value of 1.780 associated with a probability value of 0.048 was obtained (t (408)=*1.780, p=0.048*). Since the associated probability value of 0.048 is less than 0.05, the null hypothesis was rejected. Thus, the researcher concluded that there was significant difference between urban and rural teachers' preparedness in using DLT to teach chemistry in senior secondary schools.

Table 3: Independent sample t-test Analysis of mean responses of urban and rural teachers' on preparedness in using DLT to teach chemistry.

Groups	N	Mean	SD	df	t-value	p-value
Urban	280	36.00	1.23	408	1.780	0.048
Rural	130	32.10	1.22			

Discussion

The results of this study as revealed on Tables 1 and 2 show that although there was difference in urban and rural senior secondary school chemistry teachers' preparedness to use DLT, both urban and rural teachers were not well prepared in using DLT to teach chemistry. Therefore teachers irrespective of the school location have gross challenges of unpreparedness to use the DLT in teaching chemistry. Thus, by the Technological, Pedagogical, and Content Knowledge (TPACK) model of teachers' preparedness to use digital technology by Koehler and Mishra (2009), the chemistry teachers generally cannot effectively integrate knowledge of the content, pedagogy, and technology in teaching chemistry. The findings of the present study further agree with Eya and Okebanama, (2022) who disclosed that chemistry teachers lacked skills to use DLT. Table 3 results reveal that the difference between urban and rural senior secondary school chemistry teachers' preparedness to use DLT was significant. The difference could be majorly because the urban teachers received more support from the government and the school authorities, digital infrastructures were made more accessible to the urban teachers than the rural teachers. This conforms to the assertion by Okorie and Ezeh (2016) that the disparity in distribution of social amenities might affect chemistry teachers' readiness and effectiveness in favor of urban location. The result however disagrees with Adigun (2016); Ntibi and Edoho (2017) who reported no significant difference between urban and rural teaching outcomes. By this study, chemistry teachers from urban and rural locations are not at the same level of preparedness to use DTL in teaching senior secondary school chemistry but preparedness is in favor of teachers in the urban location. Results of this study also suggest that the use of digital technology is location biased thereby reflecting and perpetuating the existing power and social dynamics as in line Akinyele (2011) and Eya and Okebanama (2022) who reported existing disparity in availability of teaching and learning resources at different school locations which might lead to a dichotomy between urban and rural school teachers' exposure and readiness to use DLT.

This in turn might create the dichotomy in students' performance in favor of the urban location students to the neglect of the rural students. The in balance in the use of technology at different locations is also in line with Spitzer (2018) who reported high correlation between decline in students' performance and use of digital technology among the more developed countries favored with the digital technology than the less developed countries less favored with the digital technology. Furthermore, the imbalance in teachers' preparedness to use digital technology as revealed in this study supports Osuafor and Osisioma (2014) and Achimugu (2016) who respectively discovered that ICT knowledge of urban students was significantly higher than that of their rural counterparts and that the existence of urban-rural dichotomy in schools lead to the feeling among parents/guardians that students in urban schools perform better than students in the rural schools which can lead to rural-urban migration.

Conclusion

Currently, most activities are globally becoming digitalized including more importantly school instruction. It is mainly through the school instruction that most of the young citizens are well exposed to digitalization. Teachers' use of digital technology at both urban and rural locations in the present digital age will ensure relevance of digital technology and improvement in the teaching and learning outcomes across the society. This makes it necessary for teachers irrespective of the school location to be prepared to use DLT in teaching and learning chemistry. Therefore, teachers from both urban and rural locations should be well equipped and encouraged to embrace DLT. Results of this study revealed that although chemistry teachers in both urban and rural schools locations are unprepared to use DLT in chemistry instruction, the urban teachers are better favoured in preparation. This calls for stakeholders in chemistry education to show serious concern about teachers' preparedness to use digital tools in teaching chemistry irrespective of school location. Recommendations made based on the findings of the study if implemented could alleviate the problem teachers' unpreparedness in using DLT in teaching.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. School owners should provide adequate infrastructures to support chemistry teachers' use of DLT at both urban and rural locations. This will enhance even development in the society.
2. Trainings through workshops and conferences on use of DLT in instruction should be organized for both urban and rural senior secondary school chemistry teachers by school owners and professional bodies such as the Science Teachers Association and the Ministries of Education.
3. Teacher educators should include adequate DLT training in teacher education programs.
4. Well trained teachers should be distributed and retained across different locations. While a refresher programs should be organized for the in-service teachers from different locations for an upgrade in the use of DLT in teaching chemistry.

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