RE-ENGINEERING BRIDGING DIGITAL GAPS IN EDUCATION FOR SOCIETAL TRANSFORMATION: A SYNERGY FOR SUSTAINABLE TECHNOLOGICAL INNOVATIONS IN TEACHING AND LEARNING

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Abstract

This study focused on bridging digital gaps in education as a synergy for sustainable technological innovations in teaching and learning in secondary schools in Cross River State. The specific objectives of the study was to ascertain:(1.) the availability of digital tools used in teaching and learning, (2.) technological competences of teachers. Two research questions and two null hypotheses were formulated to guide the study. The descriptive survey research design was adopted for the study. The population of the study comprised 31,151 teachers in all the 309 secondary schools in Cross River State. The stratified random sampling technique was used to select 300 teachers from the three (3) Education Zones in Cross River State including both urban and rural schools. The questionnaire was the instrument used to collect data. The 4-point likert type scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) was used for data collection. The data was analyzed using the descriptive statistics and Pearson Product Moment Correlation Analysis. The findings of the study revealed that there were inadequate technological tools in most schools in the study area. Also majority of the teachers were technologically incompetent thus use of technological tools was rare. In conclusion, it was observed that teaching and learning occurred with less impact of technological activities in the classrooms and laboratories. It was recommended among others that both government and school heads should ensure provision of digital facilities and the training of teachers for the enhancement of digital competencies in teaching and learning.

Keywords: *Re-imagining Bridging Digital Gaps, Education, Sustainable Technological Innovations, Teaching and Learning.*

Introduction

Education is a systematic process through which knowledge, skills, competencies, experiences and sound attitudes are acquired for all round development. Education remains a sure method for the enhancement of economic growth and the transmission of societal values. Education is highly valued and seen as a social service and a tool for change and growth. According to Joshua (2018), quality education in modern society is synonymous with technologically based education where learners are

motivated during instructional procedures with the use of technology. Anashie and Uko (2018) stated that in Nigeria, the importance of education is embedded in the National Policy on Education (2004), where it is stated that education is an instrument "per excellence" aimed at effecting national development. The National Policy on Education (2004) also made provision for the establishment of educational support resource centers, provision of distance learning, use of education for broadcasting as a feature of educational support system, development and use of appropriate innovative materials and provision of infrastructure for the promotion of ICT at all levels. The policy also stipulated that government shall provide necessary infrastructure and training for the integration of ICT into schools. The educational goals stated in the National Policy on Education are as follows: i.) to develop and improve educational programmes ; ii.) to enhance teaching and improve competences of teachers; iii.) to make learning experiences more meaningful for children as well as develop and promote effective use of innovative materials in school. These goals can be achieved through effective integration of educational technology.

Globally, the educational system has been transformed for over two decades to meet the 21st century standards and societal challenges. The integration of internet- based teaching and learning is aimed at facilitating, improving and increasing the quality of teaching and learning for educational and societal transformation. It is the role of government and institutional heads to ensure the provision of varied educational resources that will aid in solving educational and societal problems in this digital age. They are also responsible for the training and exposure of both teachers and students to the various processes and practices that facilitate and improve teaching and learning. According to the Association for Educational Communication and Technology (AECT, 2004), Educational Technology has to do with ethical practices that facilitate learning and improve performance by providing, creating, designing and managing appropriate technological resources and processes. This means by ensuring support for both the teacher and learner and exposing them to the use of appropriate strategies, activities and tools for optimal teaching and learning.

The introduction of technology all over the world has resulted to a shift from the use of traditional methods of solving problems to digital methods. The study of Abdullahi (2019) revealed that technology is the pillar on which the development and progress of nations and individuals depend. According to Rosen and Wolf (2011), Educational Technology aids the educational institutions in providing the necessary knowledge, skills and environment needed in the 21st century for achievement of educational goals. In the same vein, Luppicini (2005) stated that Educational Technology utilizes tools, theories and techniques from multiple domains to effectively design, develop and evaluate mechanical and human resources for the enhancement of all aspects of learning. It also enhances the change agencies to transform the educational system for the betterment of the society. In support of the above, Nwabueze (2011) stated that ICT provides knowledge acquisition, knowledge incubation, knowledge amplification and knowledge dissemination. Educational technology offers the use of innovative tools and processes in solving educational problems and bridging educational gaps. On the contrary Olaore (2014) states that Facebook, Youtube, Twitter, Instagram and other social media sites could be a distraction to learning and living in the real world.

According to Offem, Anashie and Agunwa (2017) "no educational institution or organization can still rely on the traditional printed information resources to perform effectively". Furthermore, they added that "digitalization has become a practical necessity and reality with technological interventions to improve access to information sources, preservation and dissemination required at any time and any place. Anashie, Kelechi and Edeh (2023) stated that the use of internet-based teaching has become an integral aspect in teaching especially as both teachers and learners spend greater time surfing and browsing the internet. They added that there are various outlets where teachers and learners can meet to exchange ideas and collaborate. To a great extent technology has taken over the operations in the world and the traditional methods of face - to - face teaching and learning in most advanced countries.

The pace at which the society is changing due to technological advancements as it affects all spheres of life makes it very expedient to embrace technological applications and activities in the educational system. This has led to government and educational institutions providing training opportunities and facilities to support the digital change for the facilitation of teaching and learning.

Hughes (2004), define technology as a "creative process involving human ingenuity". Implying technology has to do with creativity and the application of complex technological innovative approaches by humans. Proper application and utilization of digital tools aids in bridging digital gabs in education. The findings of Ojo et al. (2023) revealed among others that the use of mobile technology has positive effect on students' entrepreneurial development. In another study by Edeh et al. (2020) it was revealed that Mobile Learning platforms (MLP) provide students with opportunities to learn at their own pace, promote experimental and enquiry – based learning and enhance entrepreneurial spirit.

Innovation means to change from old to new ways of doing things or to improve on the old methods. It can also imply invention of new ideas to enable people do or see things differently. Matlali (2021) stated that researchers have found out that exposure to innovations has significant effect on the kinds of innovations youths pursue and the likelihood of them being innovators. The study of Alonge and Onukwu (2021) revealed that there is low level of technological innovations in the management of university education in Bayelsa State. New approaches are needed for the integration of technology into the educational institutions. Studies have shown that globally, the use of modern technology in different spheres of life have yielded high productivity by saving cost, reducing human labour among others. The study of Main et al. (2022) revealed that innovations reduce unemployment among students and E- Education programmes have significant effect on unemployed graduates. It has also contributed to increased economic growth, improved business performance, improved customer satisfaction to mention but a few through innovations such as revision of processes, teamwork, changes in work practices and a variety of other innovative practices. Usani et al (2024) stated that current researches emphasize that the use of effective teaching methods are essential for creating assessment environment that accommodate different learner needs.

Brynjolfsson and Hitt (2000) observed that situations where lack or no organizational changes are being made to complement technology investment, it may lead to significant productivity losses due to the fact that the benefits from investment may outweigh the existing negative interactions in the organizational practices. Meaning, the use of modern technology depends on the organizational climate, policies, people, practices, processes etc. it is unfortunate that many schools around the world especially in African countries still continue to use the traditional methods or practices without complementing it with modern tools.

The benefits of integrating technology into classroom teaching cannot be over emphasized in today's digital age. Teaching and learning is evolving beyond the walls of the classroom. This has made education more interesting as teachers can connect with students anywhere, anytime using innovative approaches of teaching. The use of technology enhances teaching methods and foster students' participation in class activities. Online tools enhance students' engagement, streamline assessment and feedback, personalize learning, expand access to resources boost communication and collaboration among others. Technology offers interactive features such as games, simulation, and quizzes. It enables collaborative learning between teachers and students and among students. The utilization of digital tools could be very beneficial to the educational system. It could be used to deliver lessons, post and submit assignments, assign tasks, carry out researches among others. Anumni (2008) stated that ICT could assist the teacher in a number of ways such as: preparation of lesson plan, retrieval and storing of data, writing of students' reports, collection and analysis of students' achievement reports. Nwabueze and Ukaigwe (2015) listed the following as ICT facilities needed for academic purposes: computers, CD ROMs, laptops, DVD ROMs, scanners, Ipad, television sets among others. Others are Web camera, video machines, camcorder, flash drives and MP3 -9.

The following are some innovative interactive digital tools that can be used to bridge digital gaps in teaching and learning:

Interactive White Board: this displays anything that can be seen on the computer screen. Students can manipulate images. This interaction aids in visual learning.

Gamification: On-line media: these are streamed video websites that are used to enhance learning in the classroom.

Mobile Devices: these include- smart phones, tablets etc. they enable both teachers and students get immediate responses.

LCD Projectors:
Video Cameras:
WIFI: these are internet connectivity around the school that could be used free by teachers in their offices and students
Computers:
Blogs: students could submit assignments through Blogs.
Blended teaching:
Social media: Tufts Universities (2021) in Anashie, Kelechi and Edeh (2023) refer to social media as the means of interactions among people by which they create, share or exchange ideas in virtual communities and network such as face book, twitter, WHATSAPP among others.
Pizza: this is a question-and-answer platform where students learn by leveraging the power of community
Pear Deck: this is used to access students' progress, present differentiated instruction etc.
Zoom: students could present term papers through Zoom.
WhatsApp: This can be used to post lessons, homework and discuss important issues with students.
Storybird: this can be used to select artwork or styles from extensive list
to inspire students.
Socrative: this can be used to test and grade students' performance.
Flipgrid: this is a website that can used to create grids to facilitate video discussions.
Google Slides: this could be used to incorporate interactive presentation
during lesson plans for virtual learning.

On-line examination and up-loading of students' results

The 21st century education is driven by skill acquisition, competitiveness and competences, thus educational institutions need to act accordingly for the achievement of goals. This involves employing of modern approaches at all levels which include- provision of necessary tools, training of teachers and students and effective utilization of tools in teaching and learning. Educators and classroom experts need to possess certain level of competences to qualify them for the teaching responsibility. Technological competence refer to the ability to use technological skills, methods or techniques to operate technological related machines or appliances. It can also refer to proficiency and effectiveness in the utilization of technological or digital tools. Technological competences in teaching and learning enables the teacher and learner to effectively incorporate technology into the classroom.

In Nigeria today, teachers are considered as role models because of their influence over students' performance. Lack of competent teachers in the usage of technological tools has affected the ability of students to excel in their academics. Kadel (2005) found out that simply having ICT facilities in schools does not guarantee their effective use, regardless of the quality and quantity placed in the classroom. Kadel further maintained that the use of ICT tools depends on the teachers' competence. Kynikidou, Chrisotomou and Bank (2000) in their study found out that successful integration of ICT in the school system depends largely on the competence and attitude of teachers towards the role of modern technologies in teaching and learning. Smith et al. (2018) in Usani et al (2024) found out in their study that digitalizing the school environment leads to increased students' participation and engagement in classroom activities. In another study by Johnson and Brown (2020), it was revealed that students who used digital platforms turn to perform better in examinations as a result of interactive inclusive features provided.

Unfortunately, today most schools still do not use digital tools in teaching and learning which has affected the digital competences of both teachers and students. In most schools especially in rural areas, internet facilities are lacking. This has affected the rate of development in the educational sector in such areas. Even in schools where some exist, most teachers and students cannot effectively access or use them due to lack of equipped laboratories to accommodate them, lack of internet connectivity, lack of electricity among others. Some digital facilities are piled up in an office where they cannot be utilized. In some cases, the facilities are used only by the school or not used at all at the expense of the students. Teachers are sometimes encouraged by the government through the provision of personal

computers but are not given proper training needed to make them competent in other to meet with the current educational and societal challenges. These are the major challenges faced by the educational system in Nigeria.

Digital gaps can also be referred to as digital divide. The term digital gaps was first introduced in the mid 1990s. This refers to the gap that exist between those that have access to information and communication technology and those who do not have. It is the disparity between those who have access to the internet and those who do not have. Digital gap or divide remains an issue of concern in developing nations. It has become an extremely important issue to many societies especially in rural areas. This is supported by the study of Dei (2018) which revealed that there were disparities in the provision of computers and ICT facilities between urban and rural areas to secondary schools in Southern Ghana as those schools in the urban had some facilities but observed some challenges like- lack of ventilation, lack of space and poor lighting system among others. The causes of digital divide include the following: poor education or lack of proper training, lack of funds, poverty, poor knowledge of technology, lack of availability of power supply, lack of digital devices, lack of access to digital devices, lack of infrastructure, lack of continuity in government, political instability, lack of proper planning among others. The study of Edeh (2019) revealed that the integration of emerging technologies in teaching and learning faced some challenges which includes: funding, insufficient skills, epileptic power supply, inadequate professional development and issues of non - availability and accessibility to internet and internet connectivity. These are some major challenges affecting the integration of technology in teaching and learning.

This study seeks to examine the extent of availability of digital tools in teaching and learning and the digital competences of teachers in the utilization of digital tools in teaching and learning.

Purpose of the study

The purpose of the study was to examine bridging digital gaps in education for societal transformation and sustainable technological innovations in teaching and learning. Specifically, the study intents to investigate: 1.) the availability of digital tools in secondary schools in Cross River State. 2.) the digital competences of teachers in the utilization of digital tools in teaching and learning.

Research questions

The following research questions were raised to guide the study:

What are the available innovative digital tools utilized for sustainable teaching and learning in secondary schools in Cross River State?

What is the impact of teachers' competences in the utilization of digitals tools on sustainable teaching and learning in secondary schools in Cross River State?

Statement of hypotheses

The following hypotheses were formulated to guide the study:

Availability of innovative digital tools has no significant impact on sustainable teaching and learning

Digital competences of teachers in the utilization of innovative digital tools has no significant impact on sustainable teaching and learning.

Conceptual framework

This has to do with the interactions between availability of digital tools in secondary schools in Cross River State, digital competencies of teachers, utilization of digital tools for societal transformation and sustainability of technological innovations in teaching and learning.

Methodology

The study adopted a descriptive survey design. The population of the study comprised 31,151 teachers in all the 309 secondary schools in Cross River State. The stratified random sampling technique was used to select 300 teachers from the three (3) Education Zones in Cross River State. While the simple random sampling technique was used to select ten (10) teachers each from thirty (30) schools. These teachers were selected from both urban and rural schools. The questionnaire was the instrument used for data collection. The questionnaire was titled: "Use of Technological Innovations in Teaching and Learning Questionnaire" (TIITLQ). The 4-point likert type scale of Strongly Agee (SA), Agee (A), Disagree (D) and Strongly Disagree (SD) was used for data collection. The instrument was developed based on the variables under study. The instruments were validated by two experts in the University of Calabar. The test - retest method was used to ascertain the reliability of the instrument and it yielded a reliability index of 0.94. The questionnaire was administered by the researchers with the aid of the research assistants in the various school selected for the study.

Presentation of results and analysis of data

Research question one:

What are the available interactive innovative digitals tools utilized for sustainable teaching and learning in secondary schools in Cross River State?

Table 1: Mean Ratings and Standard Deviation scores of the available interactive innovative digital tools utilized for sustainable teaching and learning in secondary schools in Cross River State.

S/N	ITEMS	N	MEAN	STD. DEV.
	AVAILABILITY OF DIGITAL TOOLS			
1.	There is a computer laboratory in my school	300	2.82	0.73
2.	There are adequate facilities in the laboratory	300	2.45	0.52
3.	WhatsApp is used in teaching and learning	300	2.53	0.61
4.	You Tube is used in teaching and learning	300	2.52	0.56
5.	WIFI is connected in strategic areas in my school	300	2.62	0.68
6.	There are LCD Projectors in my school	300	2.80	0.72
7.	Use of Facebook is encouraged in my school	300	2.75	0.75
8.	Use of Twitter is encouraged in my school	300	2.59	0.65
9.	Use of Zoom is encouraged in my school	300	2.44	0.50
10.	Teachers are provided with laptops in my school	300	2.48	0.56
	Valid N (listwise)	300	23.48	61.22

Result on table 1 showed the mean and the standard deviations of the responses on the available interactive innovative digital tools utilized for sustainable teaching and learning in secondary schools. The items were measured on 4-point scale, making the highest obtainable score in an item to be 4 and the least to be 1. However, the cut off mean value is 2.50 obtained by finding the mean of the highest score obtainable score and the lowest obtainable score. The least obtained mean is 2.44 which is the mean value of the item second to last item while the highest obtained mean is 2.82 which is mean score to the first item. The overall mean responses were found to be 23.44. This showed that the respondents mostly agreed that availability of innovative digital tools has a significant impact on sustainable teaching and learning.

Research question two:

What is the impact of teachers' competences in the utilization of innovative digitals tools on sustainable teaching and learning in secondary schools in Cross River State?

Table 2: Mean Ratings and Standard Deviation scores of the impact of teachers' competences in the utilization of innovative digitals tools on sustainable teaching and learning in secondary schools in Cross River State.

S/N	ITEMS	N	MEAN	STD. DEV.
	UTILIZATION OF DIGITAL TOOLS			
11.	I use interactive white Board while teaching	300	2.86	0.74
12.	I use online media to stream video websites in the classroom while teaching.	300	2.50	0.54
13.	I allow students to present term papers through Zoom.	300	2.74	0.70
14.	I allow students to submit assignments through Blogs.	300	2.49	0.52
15.	I use WhatsApp to post lessons, homework and discuss important issues with my students	300	2.67	0.66
16.	I stream class activities live in the classroom.	300	2.42	0.48
17.	I use Storybird to select artwork or styles from extensive list to inspire students.	300	2.52	0.56
18.	I use Socrative to test and grade students' performance.	300	2.49	0.58
19.	I use Flipgrid Website to create grids to facilitate video discussions.	300	2.56	0.62
20.	I use Google Slides to incorporate interactive presentation during lesson plans for virtual learning.	300	2.54	0.67
	Overall N (listwise)	300	28.37	6.07

Result on table 2 showed the mean and the standard deviations of the responses on the impact of teachers' competences in the utilization of innovative digitals tools for sustainable teaching and learning in secondary schools. The items were measured on 4-point scale, making the highest obtainable score in an item to be 4 and the least to be 1. However, the cut off mean value is 2.50 obtained by finding the mean of the highest score obtainable score and the lowest obtainable score. The least obtained mean is 2.42 which is the mean value of the item second to last item while the highest obtained mean is 2.86 which is mean score to the first item. The overall mean responses were found to be 28.37. This showed that the respondents mostly agreed that there is impact on teachers' competences in the utilization of innovative digitals tools for sustainable teaching and learning in secondary schools.

Hypotheses

Ho 1: Availability of innovative digital tools has no significant impact on sustainable teaching and learning. The calculate result is presented in Table 3.

Table 3: Summary of correlation analysis of the relationship between availability of innovative digital tools and sustainable teaching and learning (N=300)

Variables	Mean	Std. Dev.	r.cal.	p-value
Availability of innovative digital tools	17.08	2.790	.910*	.000
Sustainable teaching and learning	16.50	2.460		

*Significant at .05 level; df= 298; p-value = .000

The result in Table 3 reveals that the calculated R-value of .910* was found greater than the E value of R .000 value of .113 when tested at .05 level of significance with 298 degrees of freedom. Therefore, the null hypothesis was rejected while the alternative hypotheses were accepted. This implies that there is a significant relationship between availability of innovative digital tools and sustainable teaching and learning in secondary school.

Ho 2: Digital competences of teachers in the utilization of innovative digital tools has no significant impact on sustainable teaching and learning. The calculate result is presented in Table 4.

Table 4: Summary of correlation analysis of the relationship between digital competences of teachers in the utilization of innovative digital tools and sustainable teaching and learning (N=300)

Variables	Mean	Std. Dev.	r.cal.	p-value
Digital competences of teachers	17.48	2.780	.820*	.000
Sustainable teaching and learning	16.50	2.460		

*Significant at .05 level; df= 298 p- value = .000

The result in Table 4 reveals that the calculated R-value of .820* was found greater than the E value of R .000 value of .113 when tested at .05 level of significance with 298 degrees of freedom. Therefore, the null hypothesis was rejected while the alternative hypotheses were accepted. This implies that there is a significant relationship between digital competences of teachers in the utilization of innovative digital tools and sustainable teaching and learning in secondary school.

Discussion of findings

The result of hypothesis one showed that there is a significant relationship between availability of innovative digital tools and sustainable teaching and learning in secondary school. The result finding is in agreement with the results of Nwabueze (2011) who study stated that ICT provides knowledge acquisition, knowledge incubation, knowledge amplification and knowledge dissemination. Educational technology offers the use of innovative tools and processes in solving educational problems and bridging educational gaps.

Also, the result of hypothesis two showed that digital competences of teachers in the utilization of innovative digital tools has a significant impact on sustainable teaching and learning. The result finding is in agreement with the results of Kynikidou, Chrisotomou and Bank (2000) and Johnson and Brown (2020), whose study revealed that teachers' digital competences in the utilization of innovative digital tools has a significant impact on sustainable teaching and learning. Also, digital platforms help student to perform better in examinations as a result of interactive inclusive features provided. Smith et al. (2018) in Usani et al (2024) found out in their study that digitalizing the school environment leads to increased students' participation and engagement in classroom activities.

Conclusion

Based on the findings of the data collected and analyzed, the study concluded that there is a significant relationship between availability of innovative digital tools and sustainable teaching and learning in secondary school. Also, digital competences of teachers in the utilization of innovative digital tools has a significant impact on sustainable teaching and learning.

Recommendations

Based on the findings and conclusion of the study, it was recommended that:

- The management should make available those innovative digital tools in order to enhance sustainable teaching and learning.
- Teachers should develop themselves to acquire digital knowledge in the utilization of innovative digital tools.

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