

DIGITAL TRANSFORMATION AND STEM EDUCATION IN UNIVERSITY INSTITUTIONS IN ENUGU STATE

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Abstract

This study aimed at investigating digital transformation and stem education in university institutions in Enugu State. Survey research design was adopted in this study. The population of the study consisted of 80 respondents selected randomly from UNN and ESUT. The study used questionnaire for data collection. Descriptive statistics of mean and standard deviation was used to analyzed the data. T-test was conducted to test the hypothesis at 0.05 level of significance. The result showed that there is significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State. The study concluded that integration of digital transformation is important in the promoting STEM education in University institutions. Despite of the importance of digital transformation in STEM education, insufficient infrastructure, poor funding, lack of technical experts, inadequate access to data and high cost of digital transformation technologies e.g AI hindered its effective integration into STEM education in Universities in Nigeria and Enugu state in particular. Hence, this study recommended that government should increase fund allocation for procurement of digital transformation infrastructures to effective implementation of STEM education. Also, government should prioritize the recruitment of digital transformation technologies experts to train STEM educators, empowering them to harness AI in their teaching practices. Transforming teachers into tech-savvy facilitators will maximize AI's potential to create engaging, individualized learning experiences, enhancing STEM education.

Keywords: Digital, transformation, STEM education, university, institutions.

INTRODUCTION

The value of education in human lives cannot be overemphasized in this modern society as it enhances development in all sphere. Education over the past centuries was obtained based on one-on-one through direct face-to-face contact with teaching and learning between the teacher and the learner using chalkboard. In this traditional system instructional resources became inadequate to support teachers in carrying their primary task of teaching. During this time, teachers and students made every effort to make teaching and learning practicable, accessible and unlimited. However, the emerging digital technology in today's education has transformed everything especially the materials, resources and method of education delivery (Kataria, 2018; Raja & Nagasubramani, 2018). The digital transformation of the Fourth Industrial Revolution (4IR) brought about the

urgency to adopt the use of technology among employees in University education institutions (HEIs) (Mpungose, 2020a; Masinde & Roux, 2020).

In the word of Kimberling (2021a) digital transformation is defined as “shift in connectivity”, “going online”, “virtual”, “change”, “switch”, “evolution”, and “reshaping” of traditional methods of execution of duties. A digital transformation is a technological approach to all aspects of the organization, ranging from business frameworks to clientele encounters to processes and performance (Verhoef, et al. (202). Digital transformation is defined as the reshaping and conversion of the organization’s framework which results in innovation and technological success (Muro, Maxim & Whiton, 2019). Digital transformation refers to information technology (IT) modernization (like cloud computing), technological effectiveness, and the innovation of new communicative business configurations using virtual initiatives such as learning or working online (Kohli & Melville, 2019). Kosciejew (2021) maintained that digital transformation is typically associated with 4IR and the use of technology through the incorporation of AI, virtual realities, quantum physics, robotics machines, and augmented realities within the business. The adoption of digital transformation in Nigeria education is somewhat accepted with reservation (Mpungose, 2020a; Mishra, Gupta & Shree, 2020). However, in 2020, the use of such technologies in university education for teaching, learning, assessing and working was the only viable means as the COVID-19 pandemic ravaged every segment of society globally due to that the closure of almost all institutions globally (Mpungose, 2020b; Mhlanga, 2021), and University education was not exceptional in these disruptions. Today digital transformation has become an essential resource instrument and component of the education sector. According to UNESCO (2021), fifty percent of worldwide organizations have incorporated artificial Intelligence into their day-to-day functions. Similarly, educational and training institutes teach their teachers and students the skills of digital technology. In this regard, the university institutions in Nigeria are not left out in incorporating digital transformation in the field of Science, Technology, Engineering, and Mathematics (STEM) education.

However, Science, Technology, Engineering, and Mathematics (STEM) education is defined as education programs that are primarily intended to provide support for or to strengthen science, technology, engineering, or mathematics education at the elementary and secondary through postgraduate levels, including adult education (United States Department of Education (2007). Chute (2009) defined STEM education as an educational exploration that guarantees learning; real-world challenges and possibilities that are explored to pursue innovation. The National Governors Association (2009) claimed that STEM education is essential to nations to ensure that their economic competitiveness is maintained and strengthened. For this reason, STEM was transferred to the education system as it was seen as a critical and crucial educational tool to fill the demand for human capital (Chiu & Duit, 2011). According to the STEM Task Force Report (2014), STEM education’s interdisciplinary approach results from the joint efforts of scientists, technologists, engineers, and mathematicians who aim to increase their political influence. The National Science and Technology Council (2013) further supports this notion, stating that the future workforce will consist of STEM professionals because these fields continue to drive innovation and influence various occupational domains.

The STEM education serves as the backbone of technological advancement and economic prosperity in the 21st century. It equips individuals with critical thinking,

problem-solving, and analytical skills essential for navigating and addressing complex global challenges. Nations that prioritize STEM education often experience accelerated innovation, improved industrial capacity, and sustainable socioeconomic development. STEM education is a science-oriented programme. David, Dallatu & Yusuf (2018) pointed out that education is in this regard that in the framework of the New Partnership for Africa's Development (NEPAD), African leaders recognized that Science and Technology will play a major role in the economic transformation and sustainable development of any nation. STEM education is used in research, policy issues, teaching for innovation, problem-solving and prospects. STEM is needed towards globalization demands. The complexity of today's world requires all people to be engaged with a new set of core knowledge and skills, to solve difficult problems like the novel coronavirus pandemic, gather and evaluate evidence and make sense of the information they receive from varied print and increasingly digital media. It is therefore clear that the learning and doing of STEM helps develop skills and prepare students for a workforce where success results not just from what one knows but from what one can do with the knowledge. STEM education is important in meeting societal needs like food, shelter, shelter, clothing, water, energy, employment, basic education, healthcare, defense and security, governance, etc.

STEM has been the critical instrument used to uplift not only the standard of living but also the economy of any nation. Developed nations such as the USA, China, Japan and the UK are not unconnected to the type of science and technology available to them (Wasagu, 2019). Olorundare (2010), the inclusion of engineering into STEM Education can be justified by the mere fact that young children tend to be engineers first; building, making and doing projects long before they can explore scientific principles that allow their buildings to stand or “canals” between puddles to carry water. STEM is a tool for the economic, social, and political development of a nation. The contribution of STEM to the social, industrial and economic life of the world in general and Nigeria in particular has been felt in all phases of human life (Ikeobi, 2010). The knowledge of STEM has enabled the provision of good water, food, and healthcare delivery, various materials for construction in industries, roads, automobiles, and houses. STEM-related subjects are used in solving problems resulting from human interaction with the environment like water and pollution (Ugo & Akpoghol, 2016).

Mpungose (2020a) advocates that an era of digital transformation has arrived to get rid of operational strategies used in previous revolutions in the current context. The current era of digital transformation delivers a better perspective to align university institutions in Nigeria with advanced technological engagements which enables creative ways for policymakers including employees of university institutions to incorporate digital technologies and progressive digitalization in departments and units for a transformed working approach (Caballero-Morales, 2021). However, Popenici and Kerr (2017) posited that digital transformation is advancing faster in the services and educational systems. It is geared toward automated individualized education to support students of all levels of education through virtual engagement at the student's convenience and time. Raja and Nagasubramani (2018) added that it is much more interactive, making knowledge transfer easy and convenient. they also, demonstrated that reliance and dependency on this technology make life easier and smoother, among other things.

Digital transformation has infiltrated every aspect of human activity, including education, and hence, the areas of science, technology, engineering, and mathematics

(STEM) are not left out. UNESCO (2022) asserted that the increasing advancement in digital transformation in University education in conjunction with STEM has greatly assisted in learning robotics, cloud computing, transforming disciplines, economies, and industries through human/machine collaboration. UNESCO believes that STEM courses are critical in preparing youth for the future. Belland., Weiss and Kim (2020) argued that digital transformation impacts on STEM students in the following areas; providing instructional tools, suggestions or ideas that aid in knowledge acquisition, providing a guide to the students on how to use the available instructional resources. Causing the students to reflect on things as they engage in the learning process, helping and guiding the students to solve real world problems. Olatunde-Aiyedun (2024) opined that incorporating digital transformation into STEM curricula in Nigerian universities, can enhance teaching methodologies and research capabilities. By leveraging digital transformation, universities in Nigeria and Enugu state in particular can foster innovation in addressing local challenges, thereby promoting sustainable development and economic growth. Through community service, university institutions in Nigeria and Enugu state can significantly impact areas such as public health, literacy rates, and environmental sustainability. These efforts not only address immediate societal needs but also contribute to the long-term development and progress of the nation, reflecting the transformative potential of digital technologies in driving positive change across communities through STEM education (Ogunode, et al., 2022c).

However, as digital transformation applications are already a part of our daily lives, but many countries of the world especially in Nigeria, lack basic computer science courses and curricula, let alone applying digital transformation technologies like Artificial Intelligence (UNESCO, 2022). Fomunyan (2019) opined that governments in Nigeria supported STEM education in the twenty-first century as it improves critical thinking, creative skills, and analytic skills, among other things which helped a country's industrial revolution. In the same vein, Adeola (2017) added that STEM education would be the new basic features and needs that support learning in the twenty-first century. This is because students who can acquire STEM education skills in University can always fit in any job in today's labour market. This is because STEM education equips people with skills such as interactive and productive tasks, assisting in information interpretation, developing skills for team collaboration and improving logical reasoning. But despite of these impacts, Adeola (2017) maintained that the penetration of digital transformation technology in STEM education in Nigeria is slow. Again, there is no reliable data on the percentage usage of digital transformation technology in Nigeria and in STEM education leading rapid interest and demand of the technology.

In other words, the use of digital transformation technologies in STEM education in Universities in Nigeria is properly affected by lack of finance, insufficient infrastructure, scarcity of technical skills, limited access to data. Additionally, there is still scarcity of technological experts who can apply their knowledge of algorithms and technology. As a result, many universities in Nigerians and Enugu state struggle to use digital transformation technologies such as artificial Intelligence to teach STEM education. Hence, this study aimed at investigating digital transformation and STEM education in university institutions in Enugu State.

Purpose of the Study

The general purpose of the study is to investigate digital transformation and STEM education in university institutions in Enugu State. The specific aim of the study is to;

1. Examine the contribution of digital transformation on the growth of STEM education in Universities in Enugu State.
2. Identify the factors affecting digital transformation in STEM education in Universities in Enugu State.
3. Examine the possible solution to the problems affecting digital transformation in STEM education in Universities in Enugu State.

Research Questions

1. What are the contributions of digital transformation to the growth of STEM education in Universities in Enugu State?
2. What are the factors affecting digital transformation in STEM education in Universities in Enugu State?
3. What are the possible solution to the problems affecting digital transformation in STEM education in Universities in Enugu State?

Hypothesis

H₀: There is no significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State.

METHODOLOGY

This used primary and secondary data. The primary data was collected using the instrument of questionnaire while secondary data was collected from the review of scholarly works on the related field. Survey research design was used to survey population of all the lecturers in STEM departments in Universities of Nigeria (UNN), Nsuka and Enugu State Science and Technology (ESUT). Purposive sample technique was employed to draw the sample while random sampling technique was used to select 50 lectures from UNN and 30 lectures from ESUT giving the total sample for the to be 80 STEM lectures. The response key to the questions was; strongly agree (SA), agree (A), Disagree (D), strongly disagree (SD), very high extent (VHE), high extent (HE), low extent (LE) and very low extent (VLE). Two experts validated the instrument. One expert from the Department of Technology/ Vocational Education and the other expert was from the department of business education, faculty of education, Nnamdi Azikiwe University, Awka.

Pilot study was conducted on 6 STEM lectures in Ebonyi state University (ABSU) which is not part of the study area. Coach Alpha statistics was employed to test the data collected. The result was 0.89 which proved that the instrument was reliable to carryout the study. The researchers distributed 80 copies of questionnaire to the respondents in the study areas with the help of tw research assistants. Out of 50 copies distributed to respondents in UNN, 40 copies were retrieved while out of 30 copies distributed to respondents in EBSU, 25 copies were retrieved. This gave total of 65 copies retrieved which was used for data analysis in this study. The study descriptive statistics of mean and standard deviation were

used to analyzed the data collected. The rating point for accepting the mean was set 2.5 or reject the mean if less than 2.5. T-test was employed to test the hypothesis at 0.05 level of significance.

Results and Discussion

RQ1: What are the contributions of digital transformation to the growth of STEM education in Universities in Enugu State?

SN	Items	UNN SA	A	D	SD	ESUT SA	A	D	SD
1	Digital transformation provides STEM students with instructional tools.	20	15	0	0	16	9	0	0
2	It proffers ideas that aid in knowledge acquisition by STEM students.	21	18	1	0	15	10	0	0
3	It provides guide to the STEM students on how to use the available instructional resources.	22	18	0	0	13	12	0	0
4	Digital transformation like AI causes STEM students to reflect on things as they engage in the learning process,	25	14	0	1	18	6	1	0
5	It helps and guides STEM students in solving real world problems.	24	16	0	0	20	5	0	0

Table 1 Descriptive Statistics

	N	Mean	Std. Deviation
UNN	0		
Strongly Agree	5	22.4000	2.07364
Agree	5	16.2000	1.78885
Disagree	5	.2000	.44721
Strongly Disagree	5	.20000	.447214
ESUT	0		
Strongly Agree	5	16.4000	2.70185
Agree	5	8.4000	2.88097
Strongly Disagree	5	.0000	.00000
Disagree	5	.2000	.44721
Valid N (listwise)	0		

Table 1 above analyzed data on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State. The showed that the grand mean of the respondents in UNN is 7.8 while those in ESUT has a grand mean of 4.9 which are greater than 2.5. With result, it is accepted since 7.8 and 4.9 are greater than 2.5. So digital transformation promote STEM education by provides STEM students with instructional tools, proffers ideas that aid in knowledge acquisition by STEM students, provides guide to the STEM students on how to use the available instructional resources, causes STEM students to reflect on things as they engage in the learning process and helps and guides

STEM students in solving real world problems. This is true as the computer mean of the respondents that said strongly agree in UNN is 22.4 while in ESUT is 16.4

RQ2: What are the factors affecting digital transformation in STEM education in Universities in Enugu State?

SN	Items	UNN				ESUT			
		SA	A	D	SD	SA	A	D	SD
6	Insufficient funds to procure digital transformation technologies such Artificial intelligence.	30	10	0	0	18	7	0	0
7	Insufficient infrastructural to implement STEM programme.	26	14	0	0	20	5	0	0
8	Limited access to data.	21	19	0	0	14	11	0	0
9	Scarcity of technological experts who can apply their knowledge of algorithms and technology.	22	18	0	0	18	7	0	0
10	High cost of digital transformation technologies.	2	16	0	0	20	5	0	

Table 2: Descriptive Statistics

	N	Mean	Std. Deviation
UNN	0		
Strongly Agree	5	20.2000	10.77961
Agree	5	15.4000	3.57771
Disagree	5	.0000	.00000
Strongly Disagree	5	.00000	.000000
ESUT	0		
Strongly Agree	5	18.0000	2.44949
Agree	5	7.0000	2.44949
Strongly Disagree	5	.0000	.00000
Disagree	5	.0000	.00000
Valid N (listwise)	0		

In table 2 analyzed data it was discovered that the grand mean of the respondents in UNN is 7.12 while those in ESUT has a grand mean of 5.0 which are greater than 2.5. With this result,

it is accepted that insufficient funds, insufficient infrastructural, limited access to data, scarcity of technological experts and high cost of digital transformation technologies are the factors affecting digital transformation in STEM education in Universities in Enugu State. This is confirmed by the mean of individual respondents at 7.12 in UNN and 5.0 in ESUT which are also greater than 2.5.

Hypothesis Test

H₀: There is significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State.

Table 3: One-Sample T-Test

	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Male	5.097	14	.000	13.00000	7.5298	18.4702
Female	4.571	14	.000	8.26667	4.3876	12.1458

Table 3 above showed the result of t-test statistics conducted to find out whether there is significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State. The was done at 2 tailed and obtain 0.00 level of significance. Decision rule is reject null hypothesis at H_0 if $p\text{-value} < 0.05$ or accept alternative hypothesis at H_1 if $p\text{-value} > 0.05$ level of significance. Thus, since $p\text{-value}$ at $0.00 < 0.05$, we reject null hypothesis and accept that at 95% confidence interval of difference with 18.47 that there significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State.

Discussion of Findings

The result of the t-test conducted showed that there is significant difference in the mean and standard deviation of male and female teachers' opinions on the contributions of digital transformation to the growth of STEM education in Universities in Enugu State. It was discovered that digital transformation in the field of STEM education is affected insufficient infrastructure, poor funding, lack technical experts among others. This findings are supported by Belland., Weiss and Kim (2020) who opined that digital transformation provides STEM students with instructional tools, proffers ideas that aid in knowledge acquisition by STEM students, provides guide to the STEM students on how to use the available instructional resources, causes STEM students to reflect on things as they engage in the learning process and helps and guides STEM students in solving real world problems.

Conclusion

This study aimed at investigating digital transformation and STEM education in university institutions in Enugu State. The study adopted survey research design. The population of the consisted of STEM lecturers in UNN and ESUT Enugu State. The sample of the study was 50 STEM lectures in UNN and 30 from ESUT giving the total population to be 80 STEM lectures. Questionnaire was used as the instrument of data collection. Mean and standard deviation were employed to analyzed the data. Hypothesis was tested with t-test statistics. This study concluded that integration of digital transformation is important in the promoting STEM education in University institutions. Despite of the importance of digital transformation in STEM education, insufficient infrastructure, poor funding, lack of technical experts, inadequate access to data and high cost of digital transformation technologies e.g AI hindered its effective integration into STEM education in Universities in Nigeria and Enugu state in particular.

Recommendations

The following recommendations are made based on the outcomes of the data analysis in this study.

1. Government should increase fund allocation for procurement of digital transformation infrastructures to effectively implement STEM education.
2. Government should prioritize the recruitment of digital transformation technologies experts to train STEM educators, empowering them to harness AI in their teaching practices. Transforming teachers into tech-savvy facilitators will maximize AI's potential to create engaging, individualized learning experiences, enhancing STEM education.
3. There should be an increase in investment in research and development.

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