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RE-ENFORCEMENT OF ICT PRACTICES IN STEM TEACHERS IN THE RURAL SECONDARY SCHOOLS IN NIGERIA

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ABSTRACT

Rural areas are underdeveloped suburbs that the people leaving around it are specifically illiterates, farmers and people of low income earners. The schools located there are more of public schools where a large number of less privileged parents register their wards to acquire sound education. This paper explores the strengthening of ICT to heighten science, technology, engineering and mathematics (STEM) subjects for easy understanding so as to increase the number of students offering STEM; and also the constraints that hinder ICT reinforcement to boost STEM subjects with regards to students and their teachers in the rural areas. The need for training the teachers in using ICT in the classroom was highlighted. Also, the widening gap in urban and rural schools as regards ICT was discussed including the constraints that prevent full ICT implementation in the rural school to enhance easy understanding of STEM subjects. The author concluded that there is urgent need to train teachers in using ICT in teaching and learning STEM subjects in the rural secondary schools in other to increase the number of students that will be offering STEM courses as a career in the higher institution for the development of nation's economy. Also, there is need for government to consider improving the standard of living by giving social amenities like power supply; good roads, drinkable water, workshops and regular remuneration for the teachers to enable them compete with their counterparts in the developed cities.

Keywords: Stem education, Teachers, ICT, digital gaps, rural dwellers

Introduction

Technology is a significant component of all the innovative processes required in education. This is a reality especially if we search for "holistic education transformation in a digital era". With the rapid advancement in science and technology, there is available information age that has exposed the society with various processes of technological changes. An important requirement to take into explanation: much of what can be understood about ICT in STEM education is applicable also to education in many other fields of curricular. For example, graphic software or spreadsheet usage in STEM is also applicable in economics or geography. Many educational experiments applied with technology in other areas such as history, music for example mandatorily have elements of potential authenticity in STEM subjects.

Using multiplicities of ICT tools in teaching STEM subjects results advancement, better

learning and good skills for students. With the help of ICT accessibility, reliability and various applications, students can be comfortably educated in STEM subjects in such a way and a step that suits their capabilities. Students can achieve this development by the provision of mobile devices like laptops, smartphones, cloud applications and many others (Barak and Ziv, 2013) There is urgent need to ponder on the cautious implementation of information and communication technology (ICT) in Science, Technology, Engineering and Mathematics (STEM) in schools to face the competitive global market including changes in economic trends and technology innovations. There is need for teachers to effectively and efficiently utilize ICT in the classrooms especially in the rural area to acquire a better standard. Olanrewaju, Adebayo, Omotosho and Olajide (2021) reported that high level of poor socioeconomic status, poor internet connectivity and lack of electricity in the remote areas has resulted to great digital divide gaps in schools in the rural areas; these have negatively affected the educational status of rural schools and the environs. There is need to give full attention in addressing the digital divide gaps in the rural areas in order to attain the targeted objectives of sustainable development goals.

The term "digital divide" occurred due to the emergent ICTs innovations in the 21st technological boom. It has been globally adopted term that explains unequal accessibility to and utilization of ICT (Olanrewaju, *et al* 2021). OECD (2000) described digital divide also as a gap disparity amid individuals, businesses, areas with different geographical socioeconomic levels with regards to accessibility to digital tools or internet for various purposes. The disparity exists as both social and physical obstacles such as lack of electricity, computer, connectivity, qualified and competent ICT staffs among others.

Digital divide gaps in education can be reduced by training the teachers in the rural schools on how to use these innovative electronic technologies to meet up with the 21st century technology boom. Savec, (2019) is observed that ICT inclusion in teaching and learning has many potential transformative outcomes.
A place is considered to be urban when it consists of population that ranges from 2,500 to 50,000 or more people; while a school is considered to be rural or remote if it is outside the urban and its surrounding clusters (Harris and Hodges, 2018).

Classroom practices bring about encouragement to student learning and it is important to study and understand in what way ICT can improve STEM education. Importance of ICT for students could be indefinite, especially assuming they become active producers, capable to participate in the learning process. ICT easily promotes understanding of Science education with even complex concepts, simplifies analyses with the processes of modernization, and creative STEM facilitating processes that are prevailing (Napal, 2020). Again, ICT creates awareness and heighten information as regards socio scientific matters, and

facilitates the enhancement of 21st century knowledge/skills acquisition for education sustainability development goal. ICT boosts innovation, allows global access to knowledge, thereby making long life both extensive and comprehensive training possible, thereby enhancing equity and stabilized development (Napal, 2020). The application of ICT to education especially to STEM subjects like physics, chemistry, biology, mathematics and others in the secondary schools in the rural areas; is very sensitive to sustainability matters which might embrace science programmes of citizens, creative designs, investigative tasks and asynchronous learning platforms for modular as well as life-long initiatives (Maris, Maris, Cojocariu, and Humita, 2018). ICT tools have a major influence in various facets of STEM education, like adding to teacher competencies, expanding the learning resources, increasing students' and teachers' motivation.

Teachers and students in STEM subjects in the rural areas like their counterparts in the urban schools are needed to be provided with ICT facilities as well as training the teachers to enable them utilize ICT in the classroom in order to make teaching and learning of STEM subjects easier, interesting and understandable. Many students especially the female folks refuse to choose science subjects with the reason that STEM subjects are very difficult. This has drastically reduced the number of female folks in science which has immensely contributed to gender bias in STEM subjects particularly in the rural/remote schools. For the next Nigerian generation to be ready to contest in these careers, their STEM education must be instilling in Nigerian students at young age to enable proficiency in the youths. Though STEM is contained Nigerian curricula, there is a serious widening gap in the accessibility of educational benefits for students and teachers that are domicile in the rural areas. The consequences of not providing equal STEM education prospects to all students is hazardous for a society that hopes to expand and recapture its economic and intellectual toehold amongst other developed countries (Harris & Hodges, 2018).

The question now is what skills/knowledge does the teachers in the rural secondary schools needed so as to effectively and efficiently utilize ICT in the classroom to enhance easy understanding of these STEM subjects? May look at the existing ICT resources for teachers' use to enhance STEM subjects we asked also "what kind of ICT resources are there for teaching-learning in the rural schools? Then, what are the constraints that have been preventing the enforcement of these innovative technologies in the classroom for easy understanding of STEM subjects in the remote or rural schools?

According to Technology and Innovation Report (2018) that shared the geographical STEM graduate distribution which showed unequal percentages as follows with Asian countries like India has 29% of STEM students; China 26%, Latin America 5.6% and African STEM students 1% respectively. This reveals how STEM in tertiary education

well above the global normal in Asia, especially China.175 As it is observed that Africa has the lowest STEM students, it is very essential that the application of ICT is fantastically decided in the educational sector to improve on this poor outcome.

There are numerous ICT resources for teaching like computers, copiers, overhead printers, projectors, scanners, the Internet, display screens, and many other online resources. Though, computers and internet resources are more pronounced for teaching and learning practices. ICT facilities are such as the Google classroom apps, zoom, voice notes, Edmodo, YouTube, animation videos and many others could be deployed to help improve the teaching of STEM subjects in the secondary and even higher institutions. These can be combined with face-to-face teaching which results to blended learning. With blended learning, there is every tendency for clear understanding of STEM subjects especially to girls who have developed fear in offering STEM subjects and taking the examination during West African Examination Council (WAEC) in the rural school.

Rural schools are those schools which are found in rural areas like villages that are assumed to be backward in development with regard to amenities, life quality, education, technological facilities and many others (Hasin and Nasir, 2021). Rural schools need teaching and learning driven to enhance education quality in these areas so as to make sure that both rural and urban students' success are academically balanced. Frequent obstacles to teaching and learning are associated with rural schools such as non-availability of basic facilities to heighten teaching and learning when compared with the schools in the urban areas (Andin, Ambotang, Kamin, & Hamzah, 2019).These facilities include standard laboratory, electricity or stand-by generators, ICT computer laboratory, good environment with standard classrooms, qualified science teachers, ICT competent teachers, good roads and among others. The unavailability of these facilities in the rural schools will continue to draw backwards the aims and objectives of STEM and widens the digital divide gaps in the various schools which slow down the development of science and technology in education.

These inadequacies do correlate per the student in rural schools not performing well academically in STEM subjects. It should be stressed that the rural teaching and learning styles is obsolete due to the fact that the teachers do not receive adequate training when there is transformation or changes in the curriculum or when a new subject is introduced. The quality of the general school curriculum is weakened by the commonly low quality of teachers who implement it, which transforms into low levels of learning outcomes (Centre for Public Impact, 2017).

The schools in the rural areas should be heightened and be well equipped with ICT and other modern teaching technologies as well as training the teachers to effectively use these facilities in the classroom for teaching STEM subjects; since these students in the rural areas face the same external

examinations with the equivalents in the cities and all of them are in the same country and pursuing the same goal with their counterparts in the urban/developed cities. There is urgent need for Nigerian government to consider rural schools by providing comfortable atmosphere, effective ICT facilities to enhance the teaching and learning of STEM courses such as medicine, engineering, pharmacy, computer science and others for easy understanding and better performance in both external and internal examinations. This is very necessary since the country is in dire need of improving science and innovation technologies the country for better economic development. Education for All (EFA) policy must be put into practice and encompass rural schools in reality.

Nigerian educational system has been influenced with some primary education programmes initiatives such as Universal Primary Education (UPE), Universal Basic Education (UBE), adult literacy, Education Sustainable Development (ESD), Education for All (EFA), Early Children Care Development Education (ECCDE), special education to encourage girls and women, perception of the knowledge economy crusades and many others with revised educational policies the Ministry of Education, yet the standard of education in Nigeria is low due to poor approachability to all these sound initiatives (Centre for Impact, 2021). This low standard has also accrued to the poor performance of STEM subjects examinations in the secondary levels while the STEM courses in the tertiary/higher education lacks students especially female folks.

According to Buraimo, Yusuf, Olusanjo, Ajijola and Aladesusi (2020) the next level after primary or elementary school training for human development is secondary education. This secondary stage is where pupils from primary schools are being prepared to gain admitted to higher education thereby preparing individuals to attain professionalism as well as worthwhile living in the society (FRN, 2013). If there was inadequate proper training for secondary education students in the rural schools, then the goals and objectives of education in the higher echelon is defeated. It is at the secondary education level that STEM subject is well pronounced in the life of the students. Secondary education is starting point of career and long life learning development at adolescent stage where qualified and competent teachers are required to add more efforts to every student's educational future career development.

Rural Teachers' Challenges

Teachers are one of the vivacious tools to be considered in acquiring quality education since it has been globally noted that is education is one of the principal catalyst for social change and sustainable development (Abioye, 2021). Rural dwellers where teachers are posted to assume duties in Nigeria are associated with peculiar features with unique conditions that affect education quality when compared to teachers in the urban/metropolitan areas. These features include inadequate deployment of vibrant

qualified teachers, lack of amenities such as good roads, electricity, power supply, lack of decent equipped ICT modern classroom, inadequate equipped laboratory for STEM and amongst others that assist in receiving quality education. These constraints are the reasons why teachers find it difficult to teach in the rural areas including poor remuneration system and lack of professional development programmes. Due to government inability to live up to expectations, many teachers in the rural areas have abandoned teaching profession; and this action has direct effect on the ability of children in those areas to receiving quality education (Abdullahi, 2019; Olaniyi & Omotoyinbo, 2019).

Eno-Abasi and Kanayo (2021) reported that many rural schools have not received quality education; while their teachers have not experienced any innovative technology in teaching even during the time of COVID-19 where over forty six million primary and secondary students were denied learning by closure of school including the internally displaced camps. These authors clear the air by saying that the parity between the urban and rural areas in terms of online teaching technology are widening. This is seriously affecting STEM and long life learning development. Teachers who have never been technologically competent were forced to use online to teach these children which are herculean task due to technological lacuna in those teachers (Eno-Abasi and Kanayo, 2021).

Since every daily routine activity is internet enabled convergence, which means every human action is dependent on the internet utilization including education. ICT is actively utilized in all levels of education to improve quality. In order to meet up with the current global era of technological empowerment especially in education, teachers in the rural areas ought to be seriously trained to use ICT in the class especially in STEM for better understanding of the subjects. This will help to meet up or represented in the technological global demands. According to Abdullahi (2019), majority of teachers in the rural schools are ICT incompetent, as a result many students with high intelligent quotients (IQ) are perishing in the remote areas (untapped potential).

Also it is seen that many students in the secondary levels find it difficult to choose STEM subjects as their choice of careers with the assumption that the subjects are very difficult. This is as a result of shortage of competent high quality STEM teachers within the rural schools. Clarkson University (2021) concluded that teachers in the rural areas are only allocated with few resources to work in the remote settings. This has drastically contributes to the reduction of the number of students that offer science as a course or choice of career like medicine, science courses, engineering and others in the tertiary institutions. This scenario is possible to be corrected if teachers in the remote areas are trained online on how to use ICT to blend the students' learning for easy understanding.

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It is the duty of the government and the stakeholders to create proactive measures to make STEM subjects interesting by providing the required ICT learning facilities for rural dwellers in order to curb the widening disparity gap between the urban and rural teachers and schools. Successful sustainable career development program has an optimistic impact on teachers' employment, retention, and job satisfaction which will result to student advancement (Mangi, Kanasro & Burdi, 2015). This can only be possible when the young and dynamic 'digital natives' are placed in the top echelon of government; that is people who have benefited much by using online mode of learning (Eno-Abasi and Kanayo, 2021).

Constraints of STEM Teachers in the rural schools

Inadequacy of Funds for Provision of ICT Facilities: There is paucity of funds for acquiring ICT facilities. This is very expensive in nature including internet connectivity. Most of the projects that concerns education is recently handled by the age grades, alumni, donor agencies, non-governmental organizations and many other. Due to the economic meltdown which Nigeria have plunged into, there was little or no fund to assist education. Salaries are being owned by many institutions with incessant strikes all over the nation.

Limited Number of STEM Teachers: Rural schools always get less number of good quality teachers especially in STEM subjects Clarkson University, (2021). This reason always result to the teachers to carry excess workload that is more than required in the sense that a teacher can teach many STEM subjects in more than three classes with the minimum population of 45 students in each class. The same teacher will examine and mark all the STEM subjects in different classes, prepare lesson notes with a little or no encouragement from the government and with poor remuneration which is not paid regularly as at when due.

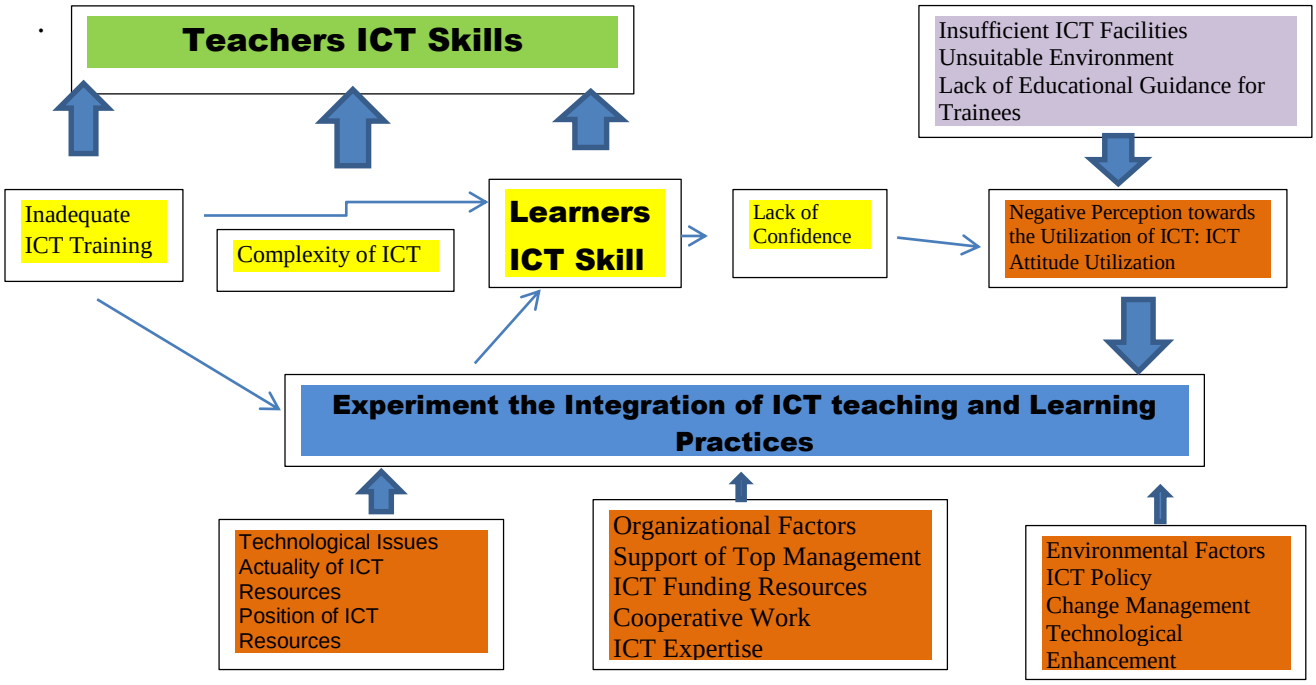
Absence of Standard Social Amenities: Many teachers are reluctant to live in the rural communities as a result of lack of social amenities especially with regards to drinking water which is always fetch from the surface running water or the stream which is infected with animal faeces and other bacteria. Also, there is no power supply that helps the teachers effectively carry out their teaching responsibilities. Poor road network, marketing strategy location and many others pose problems to teachers in the rural communities unlike their counterparts in the urban areas.

Poor ICT Policy: There is need for the government to establish a serious ICT policy. This will determine the goals and objectives which will trigger greater achievement in education especially in the teaching and learning using ICT to enhance STEM subjects. Woyo, Rukanda, & Nyamapanda (2020) reported that the academic administrators, policy makers, educators ought to reconsider ICT application in education by revisiting the previously stated ICT policies for amendment since the goals and objectives have not been met.

Teachers' ICT incompetency: The teachers have proficiency deficiencies to use ICT in their education, thus ICT turn out to be complex for the users. Therefore, inadequate training and ICT complexity results to lack of self-confidence to integrate ICT into the teaching and learning practice in Nigerian secondary schools. Ghavifekr and Rosdy (2015) reported that teachers knowing how to operate ICT tools is the paramount stride for effective utilization of ICT for teaching and learning; and to implement ICT step by step the top stakeholders of the education system ought to provide support. Public school teachers that is keen to learn how to use ICT for teaching and learning can use simple and basic packages like Microsoft, Google classroom and Zoom for the task ahead. Many public teachers are not competent in the use of ICT in the classroom, yet it is necessary to remember that teachers are the real implementers of any programme in the curriculum. That is, they are the first point of call as regards curriculum transformation. This has posed problems to the STEM and other subjects that needed to use ICT to blend learning for easy understanding of the subjects. Teachers ICT incompetency has contributed immensely to the poor implementation of ICT in the rural schools which in other wards brought backwardness in education.

Nugroho (2017) stated that the ideal model for information technology adoption for better education, identified that lack of effective training, deficiency of ICT infrastructure, ICT resources unreachability, organizational culture, the dynamicity of technology, lack of ICT policy, globalization, computation, and complication of the technology amongst others are the factors affecting the full integration and implementation of ICT into education. The 21st century education in the rural communities cannot be effectively fruitful and quality wise without squarely addressing these constraints in teaching and learning ((Henriksen, Mishra, & Fisser, 2016). The diagram below explains the factors that combat against full incorporation of ICT in the rural communities.

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Ergado, Desta and Mehta, (2022) A Theoretical Framework to Indicate Contributing Factors for ICT Integration into Nigerian Rural Secondary School

The above diagram summarizes many constraints that combat the ICT integration and effective usage in the teaching and learning which also affects the rural schools. Teachers' level of ICT skill including that of the learners are with the ICT tools complexity contribute largely to the constraints to ICT integration in the education and STEM teachers specifically. Hence, they develop a adverse perception towards ICT usage in education and ICT integration becomes a challenge.

Further challenges facing ICT integration in the rural schools that will assist to enhance STEM subjects include globalization, technology dynamicity, lack of confidence, culture, computation and amongst others are the constraints that militate against ICT integration in teaching and learning in the rural schools. (Alemu, 2017; Asabere et al., 2017) point out that ICT implementation in African universities is pitiable, lacks technical backing, funding allocated for ICT development for teaching- learning is small, and the skills expected to integrate ICT into teaching and learning is limited.

How to Overcome the Constraints that Militate using ICT in Teaching-Learning in the Rural Secondary Schools

1. Provision of ICT competent teachers
2. Mandating ICT education in every pre-teachers programme in all tertiary institution
3. Provision of adequate ICT facilities and encouraging students to learn how to operate and use it for learning

4. Provision of increased qualified STEM teachers
5. Teachers should be motivated and pay their salary as at when due to enable them buy laptops. Also, education courses for pre-service teachers should be free and attracts some incentives
6. Providing social amenities to enhance the life of the rural community dwellers
7. Mapping out enough funds to manage the rural schools. This can also be achieved by involving non-governmental and other donor agencies
8. Policy makers should revisit the education curriculum and implement all policies that will improve on educational standards in the rural schools like their counterparts in the urban
9. Computer education shall be mandatory to all the students in secondary and tertiary institutions to enable every student to be computer literate

Conclusion

Teachers anywhere including those in the rural communities are the hub, propagator and implementers of any transformative programme universally including that of using ICT to enhance STEM in the rural communities. Every government should consider the remote areas as one their priorities knowing the fact that there are great potential IQ students that supposed to contribute to the development of the economy; but they are left perishing due to negligence of the right attitude. STEM teachers in the rural should be encouraged by training them on how to use ICT in the classroom. There are many existing options but the easiest option is to learn how to use Google Classroom, Microsoft Teams and ZOOM in the classroom. Teachers could start training themselves by self-learning on how to teach with these simple packages. Teachers should be paid their remuneration to enable those who can afford the price of obtaining in many certified computer training institutes for certification courses though this option is somehow expensive. The earlier the involvement of ICT in STEM in the rural schools the better for the number of students offering STEM subjects increases which on the other hand determines greater number of students offering professional science courses to advance on the economy.

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