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USE OF INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEMS FOR DELIVERY OF ENVIRONMENTAL LITERACY EDUCATION IN NIGERIA: OPPORTUNITIES, CHALLENGES AND PROSPECTS

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ABSTRACT: *The purpose of this paper is to examine the opportunities, challenges and prospects of using Information and Communication Technology Systems (ICTS) for delivery of Environmental Literacy Education (ELE) in Nigeria. The paper begins by providing a brief but concise definition of Environmental Literacy (EL) and the attributes of an environmentally literate person. It goes on to establish the need for ELE in Nigeria, using empirical evidence that clearly reveals a high level of Environmental Illiteracy among all segments of the Nigerian citizenry and its adverse consequences of wide spread backwardness and poverty in the country. The paper also defines the concept of ICTS and their role in education with particular reference to Nigeria. After further clarification of the focus and content of Environmental Literacy (EL) as the foundation of ELE, and in view of the pervasiveness of the Environmental Illiteracy syndrome in Nigeria, the paper establishes that ELE needs to adopt Formal, Non-Formal, and Informal forms/modes of delivery in order to involve all concerned segments of the Nigerian population and illustrates, in an annotated manner, what ICTS are needed to deliver ELE in Nigeria. The opportunities, challenges and prospects of using the ICTS to deliver the ELE programmes are succinctly highlighted, conclusions drawn, and appropriate recommendation made, specifying that the Federal Government of Nigeria should harness features of the opportunities and prospects to minimize the challenges and promote use of ICTS for delivery of the highly needed ELE in Nigeria.*

KEYWORDS: Environmental literacy, Environmental literacy education, Information and communication technology systems, Opportunities, Challenges, Prospects.

INTRODUCTION

Need for Environmental Literacy Education (ELE) in Nigeria

The term *Environmental Literacy* (EL) refers to the acquisition of the attributes of an environmentally literate person which include basic awareness, knowledge and understanding of the human environment, its fundamental processes as an aspect of life-support systems and its associated challenges. It also refers to possession of rudimentary skills, ability and positive attitudes by individuals and groups to deal with environmental challenges and to protect and preserve the environment as the resource base for sustainably meeting human needs (Roth, 1992; NAAEE, 1999). In effect, an ***environmentally illiterate***

person would not have the necessary awareness, knowledge, skills, understanding or the requisite positive predisposition or commitment to control, manage or respond to environmental challenges effectively. Such a person would thus remain ignorant, poor and in a protracted state of backwardness (Ibikunle-Johnson, 1986).

The level of environmental illiteracy in Nigeria was empirically and eclectically addressed recently in a publication by the author of this paper (Eheazu, 2019). In that publication, the author analyzed the results of relevant research studies on and documented practical manifestations of the prevalence of environmental illiteracy in Nigeria. The analysis revealed that the environmental illiteracy syndrome was rife among various segments of Nigeria's population "including graduating university students, secondary school teachers, rural and urban dwellers and business entrepreneurs" and contributed greatly to the overall endemic backwardness, poverty and underdevelopment in the country (Eheazu, 2019, pp 154-159). In the light of this exposé and others related to it (cf. for example, The Leadership Newspaper, July 4, 2018; The Vanguard Newspaper, September 21, 2017), there is no gainsaying the fact that there is need for Environmental Literacy Education (ELE) in Nigeria.
The purpose of this paper is to examine the challenges, opportunities and prospects of using Information and Communication Technology Systems (ICTS) in the delivery of ELE in Nigeria.

Information and Communication Technology Systems (ICTS): Definition and Use in Education

The term Information and Technology Systems (ICTS) is generally applied to all devices, networking components, applications and systems that, combined, allow people and organizations (including educational agencies) to enter into and interact in the digital world (Rouse, 2019). Accordingly, components of an ICT system encompass both the internet-enabled sphere (including personal computers, laptops, tablets and cellphones) powered by wireless networks. They also include such earlier technologies as analogue land line telephones, radio and television which are still largely used today in less developed countries alongside more advanced digital pieces like mobile smartphones and robots.

With regard to education, ICTS have the potential to accelerate, enrich and deepen teaching, learning and research skills as well as to motivate and engage students to help relate school experience to work practices and to create economic viability for tomorrow's worker's (Davis and Tearle, 2010; Yusuf, 2011). The need for ICTS in schools cannot be overemphasized, especially in the present technology-driven age where ICT competence is becoming essential for personal progress and survival. This situation calls for early acquisition of ICT skills by students (Dankor, Irinyang & Haruna, 2015). In Environmental Literacy Education (ELE) in particular, a wide variety of ICT tools have been introduced for both indoor (within classroom) and outdoor (outside classroom) uses in the formal educational institutions with a range of target audiences from elementary to higher education to cover a number of goals of ELE which include to help individuals and social groups acquire the following (NAAEE, 2014):

i. Awareness of and sensitivity to the global environment and its allied problems.

ii. Attitude – a set of values and feelings of concern for the environment as well as the motivation to actively participate in environmental improvement and protection.
iii. Skills for identifying and solving environmental problems.
iv. Participation – an opportunity to be actively involved at all levels in working towards resolution of environmental problems.

Inside the classroom (indoor), ICT tools are said to offer potential alternatives to field trips and outdoor learning experiences where financial, time and security challenges pose constraints against real field trips and direct experiences. For example, using "Google Earth" as ICT, students could be guided to gain visual experience of the aftermath of several oil spills on marine ecology, soil degradation and environmental destruction that adversely affect peoples' livelihood in several parts of the world, including Nigeria. Outside the classroom (outdoor), on the other hand, ICT tools like portable computers and mobile phones have been found useful in generating outdoor learning experiences, including creation of environmental awareness and fostering of necessary attitude of concern for the environment and acquisition of relevant skills for identifying and solving environmental problems (NAAEE, 2014).

THE CONCEPT OF ENVIRONMENTAL LITERACY EDUCATION (ELE)

For one to understand the aims, structure and processes of ELE, one would first need to be familiar with the concept and content of **Environmental Literacy** (EL) which is fundamental to the provision of Environmental Literacy Education (ELE). Although some basic reference has been made in the introductory section of this paper to the attributes inculcated by EL in its beneficiaries, nonetheless, there is need to further clarify the concept and its content in order to facilitate more indepth understanding of the ensuing discourse on the topic of this paper as follows immediately.

Environmental Literacy (EL): Its Focus and Content

As has been explained elsewhere (Eheazu, 2013), the term Environmental Literacy has come to be seen as one of the literacies which have emerged as a result of the felt need to apply and internalize the streams of developments in human knowledge, science, technology and human experiences over time, which have necessitated expansion of the meaning of the term, literacy, beyond its original recognition as the ability to read and write and enumerate in any language. Specifically, the notion of EL has been and continuous to be promoted through creative and intensive discourse from a diversity of perspectives. In summary, however, environmental literacy is generally seen as focusing on the creation of awareness of and concern about the environment and its associated problems, as well as the knowledge, skills and motivations to work towards solution of current problems and the prevention of new ones (NAAEE, 1999).

Roth (1992:16) succinctly described the content of Environmental Literacy (EL) as consisting of:

> ... a set of understandings, skills, attitudes and habits of mind that empowers individuals to relate to their

> environment in a positive fashion and to take day-to-day and long term actions to maintain or restore sustainable relationships with other people and the biosphere ... The essence of EL is the way we respond to the questions we learn to ask about our world and our relationship with it; the ways we seek and find answers to those questions; and the ways we use the answers we have found.

Roth further organized the content of EL in three levels as follows:

i) Environmental Literacy Level One (ELL_1), referred to as '***Nominal Level',*** which indicates ability to recognize many of the basic terms used in communicating about the environment and to provide rough, unsophisticated, working definition of their meanings.

ii) Environmental Literacy Level Two (ELL_2), called the '***functional level',*** which shows a broader knowledge and understanding of the nature and interactions between human social systems and other natural systems; and

iii) Environmental Literacy Level Three (ELL_3), the '***Operational Level',*** depicting progress beyond functional literacy in both the breadth and depth of understandings and skills. Persons at the operational level routinely evaluate the impacts and consequences of actions, gathering and synthesizing pertinent information, choosing among alternatives, advocating action positions and taking actions that work to sustain or enhance a healthy environment.

Environmental Literacy Education (ELE): Definition, Outcomes and Structure

Environmental Literacy Education (ELE) could be defined as the process of disseminating the above contents of EL in order to develop in beneficiaries, as outcomes, environmental responsible behaviour expected of environmentally literate persons which, according to Hungerford et al. (1994) include:

i. Confidence in their ability, both individually and collectively, to influence decisions on environmental problems and issues; such as waste management and pollution control.
ii. Assumption of responsibility for personal actions that would positively influence or avert environmental disasters.
iii. Personal and/or group involvement in environmentally responsible behaviours such as afforestation and reforestation to minimize the environmental effects of deforestation.
iv. Persuasion – e.g. using informal discussion to encourage one another to support a positive environmental position such as involvement in processes of environmental protection and preservation.

From the above expected outcomes of ELE, it stands clear that ELE has a multi-faceted structure which begins with basic environmental knowledge inculcation and acquisition.

This basic knowledge component is based on the idea that before an individual can act on an environmental problem, that individual must first understand the problem (Pooley & O'Connor, 2000). The next step is training of the individual towards the application of his/her acquired knowledge to investigate and evaluate environmental issues and apply appropriate solutions. Finally, the individual must be equipped to be able to choose which course of action is best in a given situation. The said multi-faceted structure, if appropriately designed, would involve every level of education, including basic, formal and non-formal as well as higher education. This presupposes that ELE could take place through every form or mode of education – formal, non-formal and informal, with considerable attention paid to stressing the importance of viewing the environment within the context of the human influences and environmental literacy as a vital goal for society (UNCED, 1992, United Nations, 2002).

ELE for the Nigerian Citizenry

From the above analysis of the structure and expected outcomes of ELE, and, given the already highlighted pervasiveness of Environmental Illiteracy (EI)) syndrome in Nigeria, it becomes mandatory that ELE for the entire citizenry of the country adopts Formal, Non-Formal and Informal Forms/Modes of delivery in order to involve the various segments of the Nigerian populace under relevant objectives and using appropriate Information and Communication Technology Systems (ICTS) as illustrated in table 1 below.

Table 1. Illustration of Programmes and Objectives for Formal, Non-Formal and Informal Forms/Modes of ELE for Nigerians and the Corresponding Methods and ICTS for their Delivery

Form/Mode of ELE	**Beneficiaries**	**Relevant Programmes and Objectives of ELE**	**Delivery Methods and ICTS for Achieving the ELE Objectives**
A. Formal ELE (FELE). This takes place within formal institutions like schools or higher institutions at various Environmental Literacy Levels; ELL_1, ELL_2 and ELL_3 (cf. Eheazu, 2017)	1. Primary School Pupils/Adult Basic Literacy Education Learners.	Provision of Environmental Literacy Level 1 (ELL_1) with the objective to develop the pupils' and adult learners' ability to recognize many of the elements of the human environment (air, water, land, forest and so on) and the need to ensure preservation and maintenance of the elements by such simple actions as avoiding their	Pedagogical and andragogical approaches would be used for the pupils and adults respectively. ICTS to be used should include films/ videotapes/ multimedia systems to illustrate processes and advantages of environmental protection and pollution control, and to create awareness as well as develop needed skills, attitudes and responses at the ELL_1 Level.

		depletion or degradation "through proper adaptation" (FRN, 2004, p. 11).	
	2. Secondary School Students/ Adult Post-Basic Literacy Education Learners.	Environmental Literacy Education Level 2 (ELL_2) – the functional level – with the intent to broaden the beneficiaries' knowledge and understanding of the nature of interactions and symbiotic relationship between human social systems and other natural systems and what attitudes, behaviours and practical approaches should be adopted to create harmony in the relationship for mutual sustainability. Here, objectives to be covered with special reference to Nigeria would include reduction in deforestation and control of air, water and land pollution.	Adoption of pedagogical/andragogical methods to promote/ facilitate learning among the secondary school students and adult post-basic literacy learners respectively. Use of multimedia facilities (including computers, video machines, film strips as well as projectors and screens) for demonstrating the essence of and processes for maintaining and preserving the ecosystem (including man).
	3. Tertiary/Adult Continuing or Further Education Students.	The Operational Level of ELE (ELL_3) is adopted at this stage to promote progress beyond functional ELE in both depth and breadth of understandings, skills and actions for environmental protection and preservation. This would include	i. Use of video tapes and films to illustrate required activities in the formal, non-formal and informal modes of ELE; ii. Use of power point presentations on ecological, geographic, political and other processes that impact on livelihood assets/economic activities and what

		choosing from among alternatives, advocating action positions and taking actions that would lead to sustenance or enhancement of a healthy environment. This level would involve training of experts to implement the non-formal and informal aspects of ELE as may concern industrial workers and private institutions in relation to issues about environmental degradation in Nigeria and its limiting consequences on national and personal growth and development.	actions could be taken to reach out for assistance from local (Nigerian) sources as well as external ones.
B. Non-Formal ELE (NFELE) (Operated Outside formal institutional settings)	Beneficiaries of the non-formal mode of ELE in Nigeria will include various categories of adults in the Nigerian population – market men and women, traders, industrial workers, entrepreneurs, farmers, artisans and so on.	The objectives of the NFELE programme include i. Creation of awareness among beneficiaries of the various prevailing environmental challenges and issues within their (the beneficiaries') communities and their place to address and solve the challenges. Specific issues to be tackled here would include, for example,	NFELE here would take the form of awareness creation seminars, workshops, conferences and short training programmes organized by relevant government agencies using multimedia facilities, including demonstration films and video clips showing pollution control and waste management processes and techniques for skills development in conservation farming, sustainable fishing and so on. As most of the beneficiaries may not be able to leave their places of domicile or employment

		deforestation arising from unbridled quest for wood as fire fuel, bush burning, air and water pollution through inadequate waste disposal habits, environmental disaster management and so on. ii. Provision of learning opportunities for the adult population to develop skills for and commitment to the solution of environmental problems facing them and prevention of imminent ones.	for the awareness creation and skills development processes, there would be need to use proximal places like town halls, village squares, market squares, school halls, fishing ports, college or modern industries and so on. ICT systems to be used would include film strips, video machines and tapes as well as projector screens for demonstrating appropriate methods of conservation farming, sustainable fishing and management/disposal of liquid, gaseous and toxic (industrial) wastes. The demonstrations would include how to produce and use "clay stoves" to minimize dependence on wood fuel for heating and domestic use and thus reduce deforestation (Eheazu, 2016, p. 23). During discussion periods, beneficiaries will be encouraged to reach the organizers through cell phones to send feedback and make enquiries on how to cope with challenges that may emerge as they practice the skills.
C. Informal ELE (IELE) (Non-institutionalized)	Beneficiaries of the IELE are mainly community members who engage in various forms of	The focus of the IELE programme is on helping the beneficiaries to acquire, through spontaneous learning outside an institutional setting,	Methods and ICTS to be adopted in IELE would be situation-specific for imparting/inculcating the necessary knowledges and skills. The radio, television, bill boards and mobile mega phones and

	livelihood activities that may impact on the environment within urban and rural areas. These may include grocers, artisans, farmers and market men and women.	knowledge and skills they need to participate in effective management of their environment and the solution of environmental challenges, especially in their communities of residence or employment.	loud speakers are important ICTS for imparting the necessary IELE. Well-structured radio jingles and dramas are presented through the radio, while audio-visual versions are presented in the television. Large educative pictures are also presented on bill boards located in strategic places for spontaneous awareness creation regarding local environmental issues and requisite actions for their solution.

Summary of ICTS required for Environmental Literacy Education (ELE) in Nigeria
Table 1 above succinctly shows that in addition to application of relevant methodologies, various ICTS are required for delivery of ELE at the Formal, Non-Formal and Informal levels in Nigeria. In summary, the ICTS include video machines and tapes; computers with internet facilities; film stripes and projectors; mobile projector screens; mobile/smart phones; mobile megaphones and loudspeakers; the radio, the television and so on. In line with the topic of this paper, it would be pertinent to examine, at this juncture, the opportunities, challenges and prospects of using the ICTS in the delivery of ELE in Nigeria.

OPPORTUNITIES, CHALLENGES AND PROSPECTS OF USING ICTS FOR DELIVERY OF ELE IN NIGERIA

The Opportunities

Nigeria has, over time, recognized the need for ICTS in education, especially at the formal level. In 2001, the country enacted an ICT policy, and the subsequent creation of an ICT Department in the Federal Ministry of Education in 2007 paved the way for introduction of ICT in Nigeria's schools. Of special relevance to the topic of this paper is the approval by the then Federal Executive Council of Nigeria, alongside the enactment of the ICT policy in 2001, of a National Information Technology Development Agency (NITDA). The NITDA was further strengthened in 2007 through an Act of Government (NITDA Act) which expanded the Agency's mandatory responsibilities for the development of Information Technology (IT) practices, activities and systems in Nigeria. Expectedly, the NITDA Act led to accelerated efforts to introduce several ICT components into primary, secondary and tertiary education in Nigeria. As recorded by Agyeman (2007), the primary school level has witnessed efforts to, among other things, provide laptops with internet facilities for pupils. At the secondary and tertiary levels, there have also been initiatives

from ICT Companies like SchoolNet Nigeria, Zinnox Computer and Microsoft in collaboration with education Ministries in some states and Universities in Nigeria to establish computer laboratories and Cybercafés in the institutions. These developments, obviously, provide some opportunities for the use of ICTS in the delivery of ELE, especially at the three tiers of formal ELE in Nigeria.

Again, the Federal Government's funding provision since 2015 for the National Information Technology Development Agency (NITDA) to provide access to ICT facilities to "underserved" and "unserved" locations and education programmes (FG-Pulse, Nigeria, 2015) should also be seen as an opportunity for progress in the provision/sponsorship and use of ICTS for delivery of ELE in Nigeria at the hitherto "underserved" Non-Formal and Informal Levels.

The Challenges

In spite of the above noted opportunities for use of ICTS in the delivery of Environmental Literacy Education (ELE) in Nigeria, there are still some challenges. The challenges, which have been identified by a number of researchers (including Agyeman, 2007; Bosah, 2013; Eheazu, 2017), could be summarized as follows:

i. Low percentage of teachers who have ICT skills or even the necessary knowledge to deliver ELE as a result of the inadequate provision for Environmental Education in the Teacher Training Institutions (including the university).
ii. The absence of electric power grids in many Nigerian rural and sub-urban areas to drive the telecommunication infrastructure required for many of the ICTS. This is despite Nigeria's establishment of a Rural Electrification Agency (REA) in 2006 to provide rural electrification in the country (Imoke, 2000).
iii. Following challenge No. (ii) above, there is inadequate provision of tele-communication infrastructure capable of transmitting multi-media messaging through the wireless network to remote beneficiaries of the ELE, especially at the Informal level.
iv. Government's inability to extend ICT infrastructure to many rural, sub-urban and even urban areas (the presence of the NITDA notwithstanding) for reasons of financial and budgetary constraints.
v. Uneasy access to computer equipment and other ICT accessories in the rural and sub-urban areas due to location of cybercafés in commercially profitable urban and other built-up communities. This adversely affects the use of the computer for delivery of ELE in the rural and sub-urban areas.

The Prospects

Despite the above challenges, one could still identify some prospects on the use of ICTS for delivery of Environmental Literacy Education (ELE) in Nigeria. The prospects are hinged on some significant positive developments that promote the chances of enhanced application of ICTS in Nigeria's education system in general and ELE in particular. Such developments, which Agyeman (2007, p. 11) has described as "enabling features" of ICT adoption in Nigeria, include, among others,

i. The launching of Nigeria's telecommunication Satellite (NIGCOMSAT-1) on 13th May 2007 and its connection to the SAT-3 submarine cable to reduce

telecommunication and internet connection rates in the country. Although the satellite was de-orbited in November 2008 due to observed malfunction of its Solar Array Deployment Assembly (SADA), nonetheless, its replacement with another satellite (NIGCOMSAT-1R) in August 2011, ensured continued achievement of the initial purpose for launching the satellite facility.

ii. Investment by private mobile telephone companies, like the Mobile Telephone Network (MTN), and the Global Communications Limited (GLO), in fibre optic networks to enhance the deployment of internet services in Nigeria.

iii. Involvement of tertiary institutions and other schools in Nigeria as well as the NITDA (as indicated earlier in this paper) in widening access of computer technology and knowledge.

iv. Agreements/Memorandum of Understanding (MOU) between Nigeria's Federal Government and Microsoft since 2003 to help Nigeria build her software development industry; and between Microsoft and the then Educational Trust Fund (now the Tertiary Education Trust fund) to, among other things develop the ICT skills of teachers (Taiwo, 2004).

SUMMARY AND CONCLUSION

The established high level of environmental illiteracy among various segments of Nigeria's population seriously craves provision of Environmental Literacy Education (ELE) to the country's citizenry. In view of the proven advantages of applying Information and Communication Technology Systems (ICTS) in the process of education generally, this paper has incisively examined the opportunities, challenges and prospects of using ICTS for delivery of ELE in its formal, non-formal and informal modes in Nigeria. The result of this indepth exposé invariably supports a corollary conclusion that while the challenges (such as absence of electricity grids to drive the ICT infrastructure in many Nigerian rural and sub-urban areas) are obvious limiting factors, nonetheless, they are not insoluble. To expatiate, the opportunities provided in the establishment of the National Information Technology Development Agency (NITDA) and the Rural Electrification Agency (REA), if properly harnessed by Nigeria's Federal Government, could greatly outweigh the related challenges. Additionally, the prospects provided by the "enabling factors" outlined above (such as launching of the telecommunication satellite, investment in fibre optic networks by mobile telephone companies, the contributions of Microsoft, and so on) if taken maximal advantage of by government, will further reduce the challenges to insignificance and enhance the use of ICTS in the delivery of ELE in Nigeria.

Recommendation

In the light of the foregoing discussions on the topic this paper and the conclusion arrived at, it is pertinent to recommend that the Federal Government of Nigeria should, as a matter of priority, harness the features of the opportunities and prospects highlighted above to minimize the challenges and promote the effective use of desirable ICTS for delivery of the much needed Environmental Literacy Education in Nigeria.

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