

## ***Instructional Systems Technology for Teaching and Learning Environmental Education***

**<sup>1</sup>Benjamin A. Ambe, Ph.D**  
[\*benjamin.a.ambe@unical.edu.ng\*](mailto:benjamin.a.ambe@unical.edu.ng)

**<sup>1</sup>Udumo Basse Obeten, Ph.D**  
[\*basseyobeten9@gmail.com\*](mailto:basseyobeten9@gmail.com)

**<sup>1</sup>Eneyo Eyo Okon, Ph.D**  
[\*eneyoeyo15@gmail.com\*](mailto:eneyoeyo15@gmail.com)  
<sup>1</sup>*Department of Environmental Education*  
*University of Calabar, Calabar*



### **Abstract**

*This paper set out to investigate instructional systems technology for teaching and learning Environmental Education (EE). The researchers lamented the lack or dearth of use of instructional systems/media technology by teachers in Environmental Education classes, the seemingly slow pace of dissemination of Environmental Education knowledge across the globe despite the over forty years since the first conference on Environmental Education held. The library survey approach was adopted to obtain literature. Computers, the internet, CD-ROM, intranet and other software, television, radio, video, multimedia projectors, cameras, electronic whiteboards were all identified as instructional media for EE lessons while cooperative learning, games, simulations, programmed instructions, broadcast course, web-based instructions, teleconferencing, video conferencing were identified as instructional systems suitable for Environmental Education lessons. It was recommended, among others, that teacher education curricula should be reformatted to make EE topics compulsory for all teacher training programmes, and such topics should be taught using instructional systems technology; and that UNESCO and UNEP should consider making Environmental Education a school subject of its own to deepen the process of teaching and learning EE.*

**Keywords:** environmental, education, instructional, learning, teaching, technology.

### **Introduction**

To instruct is to guide, to lead and to direct a learner to acquiring a skill or skills that the instructor already has based on laid down objectives. It is a two-directional or multidirectional activity that requires not just the presence of a learner and the instructor but also the message and a medium of instruction without barriers. This instructor could be in human form or a machine such as a computer with some human guidance. Instruction could occur in several formats amongst them are: instructor-to-learner directly as in face

to face contact, computer-to-learner as is the case with computer assisted instructional software and print-to-learner as could be exemplified in programmed instruction.

An instructional system derives from the general systems theory as propounded by Ludwig Von Bertalanfy in 1969 which focuses on the premise that organization as an open system transforms inputs into outputs. Assache, Vladislav and Verschraegen (2019) see a system as the interactions within systems and between systems which produce transformation as those interactions take place. Technology as pertains to instructional systems is defined by Kurtis (2017) as “the theory and practice of design, development, utilization management and evaluation of processes and resources for learning”. This goes to indicate that when technology is deployed for instructional purposes, it is referred to as instructional technology.

Makki and Makki (2012) analyzed the evolution of instructional systems technology over the years to include the following steps: The first step was obtaining and putting together the tools and equipment necessary for the lesson; the second step involved organizing relevant teaching resources, arranging the curricula, integrating the teaching/learning infrastructure, and infusing societal norms into the process. Mainstreaming instructional systems technology (IST) into Environmental Education is a conscious process where the teacher deliberately plans and incorporates these technologies for ease of the teaching/learning process.

Individual teachers’ abilities, beliefs, self-efficacy, and value system have been identified by Makki and Makki (2012) as the points affecting teacher’s consideration of the adoption of instructional technologies. They concluded that “since the ultimate goal of instruction technology is to influence teachers’ ability and willingness to use technology effectively in their teaching careers, it is worthwhile to first consider factors associated with teachers’ instructional use of computers” (p.277). Leask (2003b) observed also that a teachers’ personality and personality style influence his/her effectiveness on the job. Many skills like instructional technology skills can be learned and practiced until they become part of one’s professional repertoire.

“Instructional technology does, indeed, hold a remarkable promise for changing the quality of teaching and learning in our schools” (Earle, 2002:10). The author referred to Instructional Technology (IT) as a “catalyst for transformation,” adding that it does not mean that teachers and students do require so many computers for their lessons. Technology also involves process. Earle in Eshetu (2015) advised that “Technologies are valuable resources, but only when used in a systematic process for developing human competence” (p.27).

This paper is motivated by the observed lack or dearth of use of instructional systems/media technology by teachers in Environmental Education classes, coupled with the seemingly slow pace of dissemination of Environmental Education knowledge across the globe despite the over forty years since the first conference on Environmental

Education held. Moreover, it is pertinent to put this opinion paper together because many educators misconstrue the prescribed integration approach as a stereotyped method of teaching environmental education. Whereas in the real sense, the approach allows for infusion of various approaches and media technology in the teaching and learning of Environmental Education. Being an interdisciplinary subject with formal and informal settings to its process, instructional systems technology are the best methods and approach to the proper teaching and learning of EE. UNESCO - Tbilisi Intergovernmental Conference on Environmental Education, (1977) instructed that environmental education:

is not to be added to educational programs as a separate discipline or a subject for special study, but as a dimension to be integrated into them. Environmental education is the result of a reorientation and re-articulation of the various disciplines and of various educational experiments (natural sciences, social sciences, arts and letters, etc.) providing an integrated perception of the environment and fostering more rational environmental action replying appropriately to social needs (p.1).

This instruction does not by any means limit the implementation of the EE programmes but broadens its implementation to all fields of human endeavour. The problem here is, how qualified and competent are the teachers implementing this curriculum? Are they properly trained? Are they versed with the skills of instructional systems technology to be able to fully and adequately plan for and deliver their lessons to achieve behavioural and attitudinal change as well as create the needed awareness in the populace of the world interacting with the environment in the environment?

This article comes in handy for those willing to teach Environmental Education because it outlines and highlights various instructional systems technologies appropriate for the teaching and learning of EE as well as suggests possible strategies for achieving these objectives. This paper is bringing the constructivist perspective to bear in teaching and learning whereby the students are engaged in hands-on practical can-do learning activities to facilitate the educational process. In the words of Smaldini, Russel, Heineich and Molenda (2005), “this presents a shift from passive transfer of information to active problem solving and individual self-discovery” (p.6). Before now, learning could occur in the form of rote, discovery or active learning. In any of these cases, instructional systems technology can be appropriately applied.

Teaching and learning of Environmental Education can occur in a variety of ways, which could be formal or informal, indoor or outdoor; the bottom line is awareness creation and attitudinal/behavioural change. Smaldini, Russel, Heineich and Molenda (2005), posited that following the broad goals of Environmental Education, in addition to the specific objectives of the particular lesson, target messages and learning activities are pre-selected to match up with relevant methods and media technologies which are deployed within the environment to enable the teaching/learning process to achieve its aim.

With instructional systems technology, the teacher becomes the facilitator of knowledge acquisition as teachers and textbooks are no longer the only sources of knowledge

especially now that instructional technology has impacted heavily on classroom activities. According to Leask (2003a), teaching requires an individual to transform the knowledge he/she has acquired into step-by-step activities which can result to learning. It is the job of the teacher to strive to acquire novel and up to date information in his/her field and information and communication technology (ICT), to be able to adequately apply same for the transformation of his learners' behaviour.

Jonassen (1990), while writing on instructional systems technology (IST), advocated for the necessity for this new model of instruction. The author stressed the need for change in learning psychology from the old models of behaviourism to cognitivism, then the constructivism to instructional systems technology. By doing this, the learner takes centre stage in the learning cycle. Ukwetang, Nja, Eneyo, Ambe, and Bisong (2021) advocated that the instructional designer must know crucial factors that affect students' learning and build a bridge between goals and students' performance; identifying these factors will help to utilize limited resources and time more effectively.

### **Types of instructional media useful for EE lessons**

Over the years, teachers have made use of six basic media types to help them teach. Among these media are text, audio, visuals, motion media, manipulatives and people. With the advancements in technology, instructors have a variety of materials and procedures to choose from for teaching/learning. The products of these newer technologies include the "use of computers, compact discs, digital video discs (DVDs), satellite communications and the internet" (Smaldini et al., 2005:9). Leask (2003c) quoted Teacher Training Agency's (TTA) definition of ICT as including "computers, the internet, CD-ROM, intranet and other software, television, radio, video, multimedia projectors, cameras and other equipment".

Adegbija and Fakomogbon (2012) researched on media use in classrooms from a Nigerian perspective and lamented that although, instructional media have been in existence for some time now, many lecturers and teachers now use only lecture method with its attendant drawbacks because of neglect by government in funding the educational sector. The authors discussed sources of instructional media for teaching/learning to include real equipment, simulator, training device, computers, interactive multimedia, virtual reality, radio or TV broadcast, motion picture, and programmed text. They recommended that the Nigerian government should procure and ensure the use of instructional media through training and retraining, workshops, conferences to keep teachers abreast of instructional systems techniques. But the neglect of the use of instructional technology does not end with government's inability alone but that of the teachers as well. This is so because they are some instructional systems technologies at the disposal of the teachers of Environmental Education that are inexpensive and do not require so much money to utilize for lessons.

a) **Computers:** Computers are now at the centre of all instructional systems technology. Smaldini et al. (2005) observed that "the potential of computers in educational settings go far beyond instructions, they perform both administrative and

service functions”. For instructional purposes, computer applications are classed into four broad categories: “as an object of instruction, as a tool, as an instructional device and as a means of teaching logical thinking” (Smaldini et al., 2005:111) especially as it concerns Environmental Education. Leask (2003c) posits that computers have since the 1990s provided a medium of instruction that combines the qualities of disc video machines, telephones, televisions, radio cassette players and transistor radios to accomplish a wide range of instructional tasks. Computers are provided with software and hardware that appeal to all the basic senses involved in teaching/learning such as sight, sound, vision and even touch. Asian School (2019) agreed that “professors in colleges and teachers in schools make use of audio-visual techniques made available by computers to prepare lesson plans for children.

The ability to manipulate a computer and apply it to educational activities is therefore a must for all Environmental Education teachers as with all other subject teachers. Computer skills necessary for EE lessons include skills in word processing, desktop publishing, databases, spreadsheets, email, internet use, amongst others. The US Department of Education (2020) noted that computer technology is relevant in supporting the processes of “teaching and learning, it merges classrooms with instructional media tools, such as computers and hand-held devices; expands course offerings, experiences, and learning materials”.

b) **Internet technology:** The arrival of the internet technology or better still the popularization of same, especially the relative affordability of access to internet facilities in the late 20<sup>th</sup> century has helped to make computers more common to the developing world especially. While internet makes use of the world wide web (WWW) which is an effective tool in accessing materials and information outside of the classroom, the intranet shares information between computers of the same organization. The internet, according to Smaldini et al. (2005), is a collection of computer networks. It is a worldwide system for linking smaller computer networks together. Apart from the services paid to the internet service provider (ISP) by the individual internet user, the services are almost free to all users regardless of the device being used by the individual. An EE teacher can utilize the electronic mail services, information search capabilities and access to highly specialized computer programmes to reach out to his learners either individually or as a group.

Teachers can equally utilize the live communications provided by the internet which allows for real time talk or chat between users; they can as well use audio communication facilities as well as video-based communication such as iChat, AOL, instant messenger, ICQ, and MSN messengers (Smaldini et al., 2005). The teacher at this point just needs to locate the appropriate web addresses of zoos, national geographic, wildlife parks and several documentaries and draw the student’s attention to it with specific objectives of what students should look out for. A virtual field trip is very easy to accomplish at this point.

A local area network (LAN) connects computers within a limited area normally a school, an office, or a laboratory. Through a LAN, all the classes in the school could have access to the Environmental Education lectures prepared by the expert in the field. The wide area network (WAN) works in the same way except that it covers more area than the LAN. An EE teacher can connect his computer to the departmental computer and share his lessons to his target audience with just the click of a button. According to Leask (2003c), the use of wireless technology has given teachers flexibility in their use of ICTs in educational programmes.

According to Leask (2003c), several ways exist by which teachers can use the capability of the internet for pedagogy. The internet provides environmental education teachers and researchers with access to a myriad of information and published works in their field of study. Teachers equally have the advantage of publishing their research findings and networking on best teaching strategies through the internet. Learners equally have the unfettered opportunity of publishing their research works on the internet. Through the internet, teachers can engage with their students virtually without face-to-face contact. Leask (2003c) noted further that pupils' progress can be monitored by parents through the internet by just requesting for information from the teachers or the school authorities. Government and institutional authorities can remotely monitor schools'/students' performance through the internet.

The US Department of Education (2020) confirms that internet technology has presented a "new model of connected teaching which links teachers to their students and to professional content, resources, and systems to help them improve their own instruction and personalize learning." At the end, educational productivity is enhanced while cost of producing instructional materials is reduced to the barest minimum,

c) **Electronic whiteboards:** In using electronic whiteboards for Environmental Education instructional delivery, images and texts stored in or assessed using the computer, according to Leask (2003c), can be projected on to a large screen and manipulated by the teacher to emphasize points made during the lesson. While teaching a topic like climate change, video snippets of causes, and consequences of climate change like emission of soot from a factory, automobiles which causes changes in weather, rainfall, air quality, and so on, can be shown on the e-whiteboards while the teacher explains the various points and may even allow the learners to explain what they have personally observed in the video.

McCarthy (2018) sees electronic whiteboard as an interactive smart board or as an instructional resource that projects texts, inscriptions and images from a computer screen to be displayed onto a board using a digital projector. The teacher or a student can manipulate the projected write-ups directly on the screen using a tool or even a finger.

Leask (2003c) identified elements of ICT in various subject areas; and for humanities where Environmental Education falls, the author proposed the following as shown in table1.

**Table 1:** Elements of ICT in Environmental Education

<b>Area of ICT</b>	<b>Application Area in EE</b>
Applications	Weather stations, archiving, museums, nuclear power stations
Communicating	Multimedia, word processing, posters, projects related to culture and beliefs, health and safety, events leaflets, translation services.
Modelling	Spreadsheet modelling, building design packages, simulations
Handling data	Surveys, database, internet, experiment control, teletext, email.
Measurements	Recording, Climatic Elements-Weather, wind, pressure, humidity, rainfall

Source: Adapted from Leask, (2003c).

The table is not comprehensive but brings one closer to what and where ICT can be applied in the instructional systems technology process for teaching/learning.

d) **Textual materials:** Alphanumeric characters displayed in any format whether in a book, poster, chalk/flannel/slides/electronic boards, computer screens and so on, according to Smaldini, Russel, Heineich and Molenda, (2005), are called textual instructional materials. The authors noted that there is also the hypermedia in which a computer software is programmed to “use elements of text, graphics, videos and audio connected in such a way that the user can easily move within information”. It is designed in such a way as to create a relationship between ideas learners hold and the environment they are about to study.

e) **Audio, visuals, and audio-visual technology for EE lessons:** Instructional technologies that appeal to the sense of hearing alone constitute audio materials. Smaldini, Russel, Heineich and Molenda (2005) listed some to include a teacher’s voice projected on a micro or megaphone, EE rhymes composed as music, noise pollution, radio broadcasts, and audio cassettes recorders. Environmental Education lessons could also be recorded on compact discs digital audio, MP3, MP4 recordings among others. This may be recorded or beamed live to the listening learners who learn directly from the audio messages.

Instructional technologies that appeal to the sense of vision or sight are referred to as visual materials. Such materials may include cartoons, poster diagrams, motion, and slides. Young EE learners are easily captivated by what they see especially if such visuals are captured in bright colours.

Audio-visual technologies otherwise known as motion media are most useful in teaching and learning of Environmental Education. Smaldini, Russel, Heineich and Molenda (2005) opined that these media show motion and sound at the same time. These media include videotapes, animations, DVDs, T-cards/SD cards among others. Features of a National Park, a conservation centre or a botanical/zoological garden could be recorded with accompanying audio explanations attached for students to watch/listen to rather than embark on an actual field trip which consumes so much instructional time and resources, although, field trip is relatively high in concreteness of learning. The National Geographic

channel uses this method to provide Environmental Education to the entire world using this media.

Analyzing the use of computer software in Environmental Education, Smaldini et al. (2005), stated that:

A combination of CD-ROM, videotape, and printed materials can virtually put students' imagination in the middle of a tropical rainforest for an Environmental Education class. Learners can be grouped to work together as a team of scientists and through collaborative problem solving explore the mysterious web of life in the rich ecosystem. Students work in cooperative teams of four each taking the role of a chemist, ethnobotanist, taxonomist and ecologist (p.144).

The authors further instructed that teams should watch a video tape and use onscreen displays to guide them in analyzing information, collaborating and making decisions.

Ashaver and Igyuve (2013) researched on the use of audio-visual materials in the teaching and learning processes in Colleges of Education in Benue State, Nigeria. The researchers sought to evaluate how the library meets the needs of the teachers in supply of audio-visual materials; the types and quality of audio-visual materials available in the college, their frequencies of use and inhibitions, what steps the librarian has taken in promoting or creating an awareness of the available audio-visual resources in the library. Copies of structured questionnaire were administered. Results revealed that collection of audio-visual materials is fairly adequate, the lecturers rarely use audio-visual resources in teaching; the results showed that lack of supporting infrastructures and human factors are hindrances to the use of audio-visual aids in the colleges. This present research notes that if audio-visual materials are properly integrated into lessons, the rate of students' achievements would considerably improve, and objectives would be better achieved.

### **Forms of instructional systems useful for EE lessons**

Instructional technology provides support for teachers to adequately deliver their lessons. Among the forms of instructional systems are:

1) **Cooperative learning:** Cooperative learning for EE topics is a teaching strategy by which students are divided into small teams and groups with varying abilities to learn specific EE topics for ease of understanding. Johnson and Johnson (2018) defined cooperative learning as "the instructional use of small groups so that students work together to maximize their own and each other's learning". The strategy is most helpful because individual students are involved in contributing their abilities to the overall understanding and achievements of the entire group. Education Research Consumer Guide (1992) noted that "group investigations are structured to emphasize higher-order thinking skills such as analysis and evaluation. Students work to produce a group project, which they may have a hand in selecting". In Environmental Education lessons, cooperative learning helps to facilitate students' change in behaviour and ensure students' attendance, engendered self-confidence and has motivated learners to act collectively with concrete independent results, and increased love for school and colleagues in school and

class. Education Research Consumer Guide (1992) emphasized that “cooperative learning is also relatively easy to implement and is inexpensive in cost even if it requires advanced technology”.

Ted, McDaris, and Roseth (2018) opined that “Cooperation is not having students sit side-by-side at the same table to talk with each other as they do their individual assignments”. Students could connect via their blog post to share ideas or via skype or any other instructional technology device to make their contributions to a specific topic and submit their reports to a team leader who does the collation.

Brame and Biel (2015) noted that “cooperative learning can be formal or informal, but often involves specific instructor intervention to maximize student interaction and learning. It is infinitely adaptable, working in small and large classes and across disciplines, and can be one of the most effective teaching approaches available to college instructors”.

2) **Games:** Using games in the instructional process allows the learners to follow pre-determined process and rules to achieve a particular task. This requires the teacher or an expert game designer to create such a game and pre-test it well in advance before presenting it to the learners. In Environmental Education, manual games such as snake and ladder have been popular in teaching appropriate forest/resources conservation attitudes. In this game, a wrong move will mean the learner has degraded the environment and such a player will have to fall down the lowest rung of the ladder and/or were “bitten by a snake”. No player will want to be bitten by a snake upon climbing the ladder. The teacher’s role will be to bring out the salient points by way of explanations as to why such a drastic action should be taken about a player who has defaulted.

Smaldini et al. (2005:30) argued that “games can incorporate the common features of behaviourism, cognitivism, constructivism, and social psychology and that games may be paper based, or computer based”. The advantage is that games attract learner’s attention, they learn even without being conscious of it. Games are a novel way of teaching, they are attractive, they present a pleasant and less-tensed atmosphere and they place students’ time on the task at hand.

3) **Simulations:** Teaching, according to Leask (2003b), is not the same as learning. Ishiekwen and Ambe (2014) also agreed that a teacher could teach Environmental Education ineffectively without the students learning anything suitable for attitudinal change. Teaching means organizing experiences and activities which cause learners to engage actively with the materials provided by the teacher and thus learn. In the instructional system of simulation, the teacher prepares either a dramatized version of reality or uses computer so as to create an environmental scenario like volcanism, landslides, rock formation, tsunami, earthquake and makes it available to the learners via videos, still/motion pictures with background voice explaining the concepts or phenomena.

4) **Simulation games:** Simulation games are based on realistic contexts, just like in simulation proper. The phenomenon to be taught is shot in form of games in which the

environmental education students all participate in it and at the end, winners emerge through which lessons objectives are drawn and explained to the learners. A good example of using this type of instructional system is described by Smaldini et al. (2005) in “save the whales” as produced by Animal Town Country and covering content areas of ecology and social development. In the game, players are trained to act in cooperation with one another while trying to address man-made environmental problems like “oil spills, radioactive waste, and whaling ships”. As they progress, gamers achieve “survival points” and make joint environmental change decisions.

5) **Programmed instruction/programmed tutoring:** Programmed instruction according to Molenda (2008:53) refers to “learning done by an individual using printed materials or computers whereas programmed tutoring involves a human tutor working one-on-one with a learner”. Programmed instruction is a practical application of B. F. Skinner’s operant conditioning or reinforcement theory in which students kept on learning new things by displaying the knowledge being taught by using knowledge of the correct response as the reinforcer. This method is very good in asking subjective questions in which a learner answers one question then the next one presents itself. EE concepts could be built into the computer for students to respond to progressively, while learning is going on.

6) **Distance education:** In traditional distance learning programmes, Environmental Education books and paper-and-pencil texts were used but these days, a variety of instructional technologies are employed. Because of the separation physically between teachers and learners, Smaldini, Russel, Heineich and Molenda (2005) noted that instructional media must be used to deliver course content using instructional technologies such as audio cassettes, video tapes, video discs, T-cards, Universal Serial Buses (USBs) and other storage facilities, radio broadcast, television and teleconferences, networking, podcasts and webinars are utilized.

7) **Thematic instructions:** These kinds of instructions are based on themes and support interdisciplinary activities and include various instructional technologies. The teacher breaks down the course content into various themes and chooses various instructional technologies to apply to teaching them. Such themes as solar systems, geochemical cycles, ecosystems, among others, are applicable.

### **Categories of instructional systems and technologies applied**

To incorporate all the various categories of instructional systems into teaching and learning, media technology should be adopted. Some of these are hereby discussed:

1) **Classroom course:** This involves live, face-to-face interactions between the tutor and the learner. In this situation, teachers can make use of projectors, microphones, megaphones, interactional boards, and computers to deliver their lessons with deep environmental contents.

2) **Synchronous lessons:** Teachers can raise a discussion group with learners based on a preselected topic. The teacher either decides for the discussion to come up with the aid of online group chats like telegram, WhatsApp, YouTube videos and Facebook messaging; or could decide for video conferencing using these same instructional technologies (social media). The difference is in video conferencing; here the teacher and

pupils have the advantage of watching one another while the discussion is going on. This helps the teacher in virtual classroom management and the students to as well keep up concentration on the topic and class.

3) **Asynchronous lessons:** In asynchronous communications for instructional technology, ICT resources such as emailing, blog posts, posters, short message services could be used to instruct single or multiple audiences with the advantage of quick responses and feedbacks not minding where the participants are. The synchronous and asynchronous instructional style equally have the advantage of allowing experts in the field on environmental education to equally participate in these lessons thereby increasing the depth of knowledge for the learners and even the teachers.

4) **Broadcast course:** This comes in the form of television and radio broadcast in which selected topics are prepared by the teacher and presented on the radio or television station where the learners learn. They can participate in the class through phone in channels if provided by the station or through SMS.

5) **Self-instructional packs:** This is the self-study approach. In this approach, instructional technology is employed where students-directed learning occurs without necessarily having a teacher around. Carefully designed technologies can make independent learning more effective.

6) **Web-based instruction:** In this case, the intranet and the internet are made use of. Izuagba, Afurobi and Ifegbo (2016) observed that the use of web instructional technologies in e-learning especially for Environmental Education classes, is further enhanced with the arrival of Web 2.0 tools. These technologies may include “blogs, wikis, Facebook, twitter, bing, multi-media sharing services, content syndication, podcasting and content tagging services” (Izuagba, Afurobi & Ifegbo, 2016:149). This method of instruction could be likened to web conferences in which case group classes, virtual classes, online conferences and the opportunity for recording classes are available.

7) **Blog:** Blogging is another opportunity where teachers can use instructional technology to teach Environmental Education Content. Most teachers now have their personal blog pages which helps them interact with their students. Assignments, notes, references etc can be posted on the teachers’ blog page while the students can as well participate by asking questions and contributing their experiences as well to the lecture.

8) **Computer course ware:** This includes computer-based training/desktop media. Carefully designed instructional technology, according to Smaldini et al. (2005), will enhance students’ learning depending on “how the instructor integrates technology and media into the lesson. This is the most important factor in successful learning”.

9) **Teleconferencing:** This includes live or electronic chat rooms. This is achievable through the use of telephones; in this case, the teacher engages in a live telephone chat with his learners, armed with his already prepared lesson. The students are all connected via conference facilities in the phones and they can as well ask questions and participate in the class.

10) **Video conferencing:** Teachers with video conferencing-receiving capabilities, according to Smaldini et al. (2005), can take their students to any location with video conference-sending capabilities. By so doing, students get to interact with zookeepers, participate in environmental awareness seminar/talkshop, and the students learn from

there. Izuagba, Afurobi and Ifegbo (2016) posited that in video conferencing as a tool for teaching and learning, two or more participants living in different locations can see and hear each other using instructional technology. Video conferencing can be a two-way (point-to-point) or multi-point linking three or more sites with sound and video. Electronic white boards can be introduced where Environmental Education illustrations may be made for all participants to sight. Most of these conferencing tools have a “back-channel” facility in which students can quietly interact with themselves for clarification without interrupting the teacher.

11) **Electronic portfolios:** Portfolios as a teaching strategy, as reported by Smaldini et al. (2005:14), “allows learners to gather, organize and share information, analyze relationships, test hypotheses, communicate results, effectively record a variety of performances, reflect on their learning and activities, emphasize their goals, outcomes and priorities, demonstrate their creativity and personality”. Electronic portfolios, according to Smaldini et al. (2005), allows students to learn and practice computer and other instructional technology skills. “Technologies such as computer workstations with video and digitizing cards, printers, scanners and digital cameras allow students to produce digital portfolios”.

A teacher might plan a lesson on the topic “population growth and environmental degradation;” such a teacher may task the students to approach the topic using electronic portfolios and submit same electronically to the teacher. What the teacher needs do is to reflect or develop rubrics or criteria for evaluating students’ work based on the stated objectives for the lesson, which the students should know in advance, like some sort of terms of reference.

12) **Skype:** This web-based facility enables teachers to use voice over internet services to interact virtually with their learners while delivering Environmental Education lessons. Izuagba, Afurobi and Ifegbo (2016) noted that both teacher and learners must download the skype software, open an account and be sure that they have a high-speed internet service as well as video camera and microphone attached to their PC.

Instructional technologies cannot just be used in teaching EE haphazardly. Smaldini et al. (2005) outlined some basic principles necessary for effective incorporation. These include active participation and interaction which should be effective between the learner and the teacher of Environmental Education. Others, according to the authors, are “practice, individualized instruction, reinforcement or feedback, realistic content, and cooperative groups formation”.

### **Using the ASSURE Model for instructional systems technology in EE**

In preparing Environmental Education lessons and incorporating the use of multimedia, the ASSURE model is the most helpful design to use. In this case, the teacher, according to Smaldini, Lowther and Mims (2019:43), must first “Analyze learners, State objectives, Select methods, media and materials, Utilize media materials, Require learner participation, and finally Evaluate and revise the lesson to check for understanding and achievements of stated objectives”.

### **Problems of incorporating instructional systems technology in teaching EE**

a) **Cost of procurement/financing:** It is quite expensive to set up a computer laboratory or even purchase a complete computer system with original software. This is very difficult for teachers of Environmental Education who require so much field work and research without any incentives or sponsorship. Talk less of students or learners of Environmental Education, especially those of developing or underdeveloped world. Even when one manages to obtain a smart phone with internet facilities, subscribing to networks owned by internet service providers (ISPs) who charge subscribers per bandwidth, per second, per megabytes used is not cheap at all. This has resulted to less patronage by the not too well to do teachers and learners. Low, expensive or absence of broadband internet services in some communities has posed to be another problem of incorporating instructional technologies to teach EE.

b) **Poor power supply:** Most instructional technologies require power to operate but many nations, especially the underdeveloped ones, do not have constant power supply while some do not have at all. This inadequacy or lack has constituted itself to be the greatest bane of instructional system development and use today, especially in relation to teaching and learning of Environmental Education lessons.

c) **Inadequate computer knowledge:** Like all Learning Management Systems, an appreciable level of expertise is required from both the teachers and the learners. Whether in the area of instructional design, lesson presentation and delivery or feedback and evaluation, adequate knowledge is required.

d) **The problem of quacks in the profession:** Another major problem of incorporating instructional technologies into EE courses lies with the multi-disciplinary approach to teaching the course. The approach assumes that everyone can teach EE topics, but this has not proven to be effective over the years as many teachers tend to skip EE topics in their syllabuses or do not have the expertise to teach such topics even if they are found in the syllabuses. In this circumstance, Environmental Education faces both “obligate quacks” and “facultative quacks”. Obligate quacks are those without any teacher training but are in the field teaching while facultative quacks are those with teaching qualifications but no Environmental Education bias. Both groups will at the long run produce semi or full-fledged environmental illiterates.

### **The way forward**

Schools, universities and colleges should as a matter of urgency establish e-learning facilities in each department, train or re-train their Environmental Education teachers so as to keep them abreast with modern day technologies in teaching of EE. Power supply should be improved, especially in developing nations, so as to enable proper adoption of instructional technology in the teaching and learning of EE.

If Environmental Education must remain to be taught as a multi-disciplinary subject, it should be included as a compulsory course for all teacher education programmes so as to give all teachers ample opportunity to be trained on the basics of teaching the course and the key components of EE. This approach will help in minimizing the challenge of quackery in the field.

## **Conclusion**

Instructional systems technologies have been found to be the very effective means of teaching EE in both formal and informal settings. This implies that learners' academic achievements in Environmental Education would be greatly enhanced if instructional systems technologies are applied in teaching and learning. Although, instructional systems technologies are not cheap to come by nor are they easily implementable without appropriate training, it behoves on the institutions and the teachers to make these technologies and trainings available to the learners.

## **Recommendations**

It is recommended among others that:

1. broadband internet facilities should be provided for free in all campuses of institutions of learning where Environmental Education is taught so as to make for ease of teaching and learning of the subject through technology.
2. Teachers should be trained on how best to utilize instructional systems technology for their lessons.
3. Curricula should be reformatted to make EE topics compulsory for all teacher training programmes. UNESCO and UNEP should reconsider making Environmental Education a school subject of its own to deepen the process of teaching and learning EE and to instill Environmentally positive behaviours early in the learners.

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**Benjamin A. Ambe, Ph.D; Udumo Bassey Obeten, Ph.D & Eneyo Eyo Okon, Ph.D**

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