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Repositioning Physics Education through Educational Information and Engineering Technology in Bayelsa State, Nigeria

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ABSTRACT

This research effort is focused on 'Repositioning Physics Education through Educational Information and Engineering Technology in Bayelsa State, Nigeria'. Today, what is required is effective teaching and learning environments for physics education, an interactive instructional environment that will adapt instruction according to the learner's error rate, speed, interest or some other variables. Various training or learning institutions world over continue to invest in technologies to provide needed support in instructional delivery and learning processes. This is why every responsible government and stake holders in the educational industry strive hard to provide its youths with opportunities to acquire requisite theoretical and practical knowledge in various subject areas including physics education. Physics teachers and students in Bayelsa State not only need a creative and innovative ability, practical knowledge, professional commitment, but also ingenuity which the field of educational information and engineering technology stands to provide in the present information and communication technology era. It, therefore, follows in the present dispensation, teachers and students of Physics have to be responsive and receptive to emerging realities or technologies that are capable of facilitating instructional delivery and ensure that these relevant skills and abilities are developed in the students to be able to study and comprehend nature and sources of energy with investigations of the ways in which one form of energy can be changed to another hence, this article focuses on ways of repositioning physics teaching such that will accommodate unique approach to, and therefore, enhance teaching and learning of science and engineering courses.

Keywords: Physics Education. Educational Information and Engineering Technology.

Introduction

We are in scientific and technological age of which we require to encourage our youths to focus on Science, Technology, Engineering, and Mathematics Education (STEM) if we are to develop as a nation! In other words, Nigerian youths must have to be encouraged to undertake theoretical and practical or applied studies in physics education, among other reasons, to be able to have the mental, physical and emotional resilience necessary to assume command of life, hence the need to ensure that these youths are taught physics properly as part of effort ''to create a student-centered learning environment in which students investigate and engineer solutions to problems related to physics, as this effort will surely aid both teachers and students of physics construct evidence-based explanations of real-world phenomena with a focus on a student's social, emotional, physical, and academic needs through contributions of schools, families, and community partners''; *So to say,* ''to create critical thinkers, increase science literacy and enable the next generation of innovators'', considering that '' innovation leads to new products and processes that sustain our economy (https//www.fldoe.org; https//stemlearning; and

Redecker, 2009). This innovation and science literacy depends on a solid knowledge base in the science, technology, engineering and mathematics areas driven by educational technology, recently known as Educational Information and Engineering Technology.

The overall importance of education cannot be over emphasized. This explains why no nation can afford to neglect education, especially scientific and technological education in the present nuclear age in view of the fact that it is the basis for useful living in any society. This is because it is the center for producing the human resources that are needed for socio – economic, scientific and technological development that contribute immensely to the advancement of any nation (Igbiki, 2021). The educational system of Nigeria is responsible for transmission of cultural knowledge, attitudes and skills of diverse societies into the youth and needy hence the youths are exposed to teaching and learning of various science subjects, including Physics.

Physics is one of the most vital scientific disciplines with concern in making learners to understand how the universe behaves (Maduabum, 2012). Physics is the ‘’the natural science that studies matter, its motion and bahaviour through space and time and that studies the related entities of energy and force’’ (Eminue, 2022). Being an active programme of study, physics concepts are widely applied in all spheres of human endeavor; so relevant to life as it is a most effective means of communicating science ideas, laws and principles. Sunday (2010) posited that, ‘’as part of our teaching strategies, examples of the application of physics concepts are expected to be given, discussed and appreciated in order to increase the understanding of such concepts’’. Physics students require to engage in critical thinking, collaborative, research, problem solving, communication, and creativity skills that students need to be successful in today’s world (https;//www.britanica.com). In this age of information and communication technology (ICT), physics teachers have to key in to the use of technology – enhanced learning, teaching and research, learning design, applications development, and use of interactive media to facilitate teaching – learning encounter. This is necessary because students of physics now have quite high expectations from their teachers, among other things, to:

- Apply the principle of needs analysis in an effort to identify and clarify learners needs in physics
- Utilize well prepared lesson plans during instructional development
- Sequence lesson content properly
- Flow chart instructional activities where necessary to make it possible for students to carry out tasks
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- Apply learning theories during instructional development
- Transmit the instructional content using appropriate instructional medium and strategies
- Present lessons based on instructional objectives bearing in mind Bloom’s taxonomy of educational objectives and domains of learning
- Promote a good learning environment
- Reinforce learner’s academic performance

  Provide good classroom management and administration
- Seek for ways to accommodate students learning style
- Make teaching and learning flexible
- Individualize instruction
- Communicate high expectations from the instructional objectives
- Make judicious use of tests and grades for continuous assessment

- Formatively and summatively evaluate academic performance of students as to monitor their progress,
- Provide learner with feedback and at the right time, hence the need for educational technology or educational information and engineering technology in teaching and learning of physics education (Nkweke, 2010).

Educational Information & Engineering Technology, the new science, deals with the ''broad field of communication, technology and information''. In other words, it deals with educational technology issues more so, as it stands to aid teachers and students improve the quality of the learning process. Most essentially, it helps to enlarge the teaching and learning process as well as facilitate better performance of students in their field of studies. Educational information and engineering technology emphasizes effectiveness and efficiency, goes beyond simple test performance and is committed in developing higher level thinking and application skills by carefully connecting classroom learning to the real world (https:leverageedu>blog>obj…). Physics is an active subject involving theory and practical and its concept is being applied in various aspects of life in this present age of science and technology. On the other hand, most scholars have not been finding it easy to apply physics in problem solving situations as they tend to assert that, its application is not easy to come by (Sunday, 2010).

One of the greatest challenges facing Nigeria in the 21st century is educating its youths in Science and Technology, especially Physics Education. Every realistic effort geared towards harnessing Physics Education to break down the barriers along the paths to global progress and development needs to be encouraged (Agbenyeku, Aminu, and Nuradeen, 2012). In recent times, student's academic performance in physics is low arising from lack of proper understanding of physics concepts or misconceptions of concepts, principles and laws, leading to wrong answers most students write during physics examinations (Ehindero, 1987 and Sunday, 2010). Well packaged instruction in Physics would play a very vital role in an effort to help students better able understand whatever they are being taught. Also, a good teacher needs to communicate effectively in order for students to make attempt at learning. (Sunday, 2010). Educational information and engineering technologists are needed to step in with their acoustic or mechanical devices of instruction and techniques to facilitate effort that would lead to better understanding and effective application of physics concepts. It is on the bases of these that the researcher examines ways of repositioning the teaching and learning of physics through the use of emerging innovative technological means such as educational information and engineering technology) for transmitting curriculum content of physics from the teacher to the learner and, therefore, accommodate learners' peculiarities.

The Concept and Importance of Physics

Physics is a school subject which falls within the umbrella of physical science. Physics has been conceptualized to mean '' the study of forms of energy such as heat, sound, and light''. It is also ''concerned with the nature and sources of energy and with investigations of the ways in which one form of energy can be changed to another''. The main concern of physics is to find unified set of laws governing matter, motion, and energy at small (microscopic) subatomic distances, at the human (macroscopic) scale of everyday life, and out to the largest distances (Amadi, 2019). Physics education ''is an important sub-field within science education, with emphasis on the teaching and learning of physics at school and university levels as well as concern with physics teacher preparation and development and public understanding of physics'' (www.edu.cam.ac.uk).

Physics deals with such major topics like:

1. Concepts of space, time and motion: Motion; position, distance and displacement; time, speed and velocity; rectilinear and derived units; scalars and vectors; equations of uniformity accelerated motion; projectiles; equilibrium of forces and, simple harmonic motion.

2. Conservation principles: Work, energy and power; heat energy; electric charges; linear momentum; mechanical energy; heat energy (temperature and its measurement, heat energy measurement)
3. Waves: Production and propagation of waves; types of waves; properties of waves; light waves; sound waves; application of light and sound waves; electromagnetic waves
4. Fields: Production, description and property of a field; gravitational field; electric field; magnetic field; electromagnetic field and A.C. circuit
5. Quanta: Particulate nature of matter; plastic properties of solids; crystal structure; fluids at rest and in motion; molecular theory of matter; models of the action; the nucleus; energy quantization and wave particle paradox'' (Sunday,2010).

According to Amadi (2019: 197- 199), we also have Research Physics and Applied Physics.

Research Physics; this prepares physicists to be able to carry out research on physical phenomena and to create theories that are based on findings, and develop methods on how to apply physical laws and theories. Examples include:

- Nanotechnology; is a research field in physics that studies about building circuits and machines from single molecules and atoms
- Biophysics; studies about energy in relation to the living processes
- Electricity and Magnetism; studies effects of electricity especially its electromagnetic effects that are used in operating electric generators and motors
- Electronics; is committed in studying and controlling electrons, mostly as it concerns transistors and vacuum tubes
- Heat; this studies about the nature of temperature changes in substance.
- Light; studies the physical characteristics of radiant energy as it affects sight
- Optics; studies about visible light rays and phenomena of electromagnetic waves of wave lengths less than those of microwaves, yet greater than those of X-ray
- Mechanics; a field of study in physics that deals with the effects of forces acting upon bodies in motion or at rest
- Nuclear physics; studies about the physical properties of the atomic nucleus. In other word, it studies particles found in the nuclei of atoms, together with the energy effects produced when the nuclear particles are disturbed by external forces
- Solid state physics, contends with the properties and structures of solid materials
- Particle physics; this dealing with the fundamental particles and the forces of their interaction
- Plasma physics; as it studies about matter in the plasma phase (www.zippia.com> research-physicist-job).

Applied Physics, this is talking about application of physics to the field of engineering that is involved in the materials and power that man uses for survival. Examples include:

- Acoustical Engineering; ventures into controlling sound
- Electronic Engineering; studies about the design and utilization of electron tubes and transistors
- Architectural Engineering; undertakes the design and construction of buildings
- Civil Engineering; is involved in the design and construction of public properties e.g., dams, bridges, transportation systems and reservoirs

- Metallurgical Engineering; is in the area of extraction of metals from ores and together with their purification and alloying properties
- Public Health Engineering; as it has to do with water supply, sewage disposal including rodent control (Amadi (2019: 197- 199).

According to Campbell (2020), teaching physics involve more than formulas on a chalkboard. It involves helping students to really see the world in a new perspective. It involves creating a new environment where students have to have opportunities to try to understand how the physical world functions, and for these students to venture further into connecting large scientific ideas to life experiences. It, therefore, follows that student require both theoretical and practical knowledge of physics as strong physics training would provide students with a wide spectrum of problem-solving skills and also get familiar with a broad range of technologies and understanding of physics principles. This will allow them to adapt easily and contribute to different areas such as electronics, optics, and computational modeling (Amadi, 2019).

The quality of physics teaching is to be developed in such a manner as to achieve its aims and objectives to make for better comprehension of basic principles, to develop problem solving analytical skills and ability to apply them in problem solving situations (Anderson, 2016). In contemporary times, the physics teaching must have to be very innovative and effective and useful to students of our time. Physics teaching in our school system is expected to keep track with the general aims or objectives of science education, which are to: provide knowledge of the facts, principles, concepts and laws of science; develop skills in experimentation, observation, drawing, problem-solving and manipulating apparatus; develop ability to improvise apparatus, organize science exhibitions and fairs, among others. (Omiko, 2012).

Simply put, physics as a school subject has such main objective as to help its students to comprehend and to a large extent, explain various physical phenomena taking place in nature; it provides students opportunities to engage in physics laboratory studies in which students carry out observations, experimentations and formulations of theories. In this way, meaningful learning of physics is acquired through proper planning of physics syllabuses and their relationship to environment.

Physics strives towards an understanding of the material universe. To actually gain this understanding, physicists adopt systematic techniques of questioning nature through carrying out experiments designed in such a way as to challenge certain hypotheses that are already in place and make for far reaching efforts to come up with ideas that would lead to more useful theories which the students will encounter in studies and practice of physics in our society. This means that, experiments are vital in expanding our knowledge of our universe much as it plays a major role in the physics instructional delivery process especially in this era that educational information and engineering technology (i.e. educational technology) is emphasizing, among other things, effective utilization of alternative teaching – learning approaches during lesson presentation for engagement learning, improved learner's performance and problem solving (Nkweke, 2014).

The Concept of Educational Information & Engineering Technology

Educational Information and Engineering Technology (also known as Educational Information Technology or Educational Technology) '' is the process of integrating technology into education in a positive manner that promotes a more diverse learning environment and a way for students to learn how to use technology as well as their common assignments'' (https:en.m,Wikipedia.org). It is all about '' the development, application, and evaluation of systems, techniques and aids to improve the process of human learning (Akaninwor and Nkweke, 2003:5). This field of studies {Educational information & engineering technology or educational technology}, is a new science that ''exposes students to a wide range of emerging technologies'', including the use of educational artificial intelligence because in contemporary times, the machines are learning, and so are the students.

Educational information and engineering technology is also deals with development of information and communication technology as well as related research skills of students in the society. It is '' the

technological tools and media that assist in the communication of knowledge, and its development and exchange''. It is also the practical application of science and engineering to a wide range of real-world problems. Realistic efforts are made by educational information and engineering technologists to apply scientific and engineering knowledge, learning and conditions of learning to improve ways of transmitting instructional content and training, hence they ensure the applications of laws and recent discoveries of Science and Engineering Technology to the process of education (Schindler, l. A.; Burkholder, G. J; Morald, Osama; Marsh, 2017).

Educational information and engineering technology or educational technology ''is combined use of computer hardware, software, and educational theory and practice to facilitate learning'' (en.m.wikipedia.org). For instance, specialists and educators in this field at the University of the Witwatersrand, Johannesburg, in their concerted effort to overcome the 'digital divide', are striving to integrate digital technologies into the South Africa's schools and universities through the effort of the Division or Department of Educational Information & Engineering Technology (EIET). This department ''offers professional consultation, and technical assistance to staff and students on educational technologies and their applications'' and engages in the following academic and research activities:

- Strategic implementation of ICT integration in education
- instructional design and technology
- Enhancing pedagogical practices in engineering graphics and design
- Financial literacy and business fundamentals for educators
- ICT in education for practitioners and policy implementers
- ICT and pedagogical practices, engineering technology and pedagogical practices
- ICT professional development
- Technical vocational education and training (TVET) pedagogical practices
- Gamification and simulation
- Evaluation and assessment using technology
- Learning management systems
- Human computer interaction
- Technological knowledge development
- ICT leadership and management, among other things (wits.ac.za).

Educational information and engineering technology contend with educational information technology issues as: e-learning, instructional technology, information and communication technology (ICT) in education, educational technology (ed tech), learning technology, multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer managed instruction, computer-based training (CBT) (https://en.m.wikipedia.org). It delves into information technologies involving the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware (Richey, 2008).

According to Nkweke and Okafor (2022:97), ''educational technologists are leading the way … in the use of educational information and engineering technology in the 21st century, exploring new science and applications of information engineering / ICT integration principles to keep pace with development efforts in the educational industry''. Thus, the field of educational information and engineering technology, among other things, emerged in recent times, among other aims:

- To understand the role of educational and information technology in teaching and learning; by connecting learning and development theories and practices
- To provide the requisite theoretical and practical knowledge and skills needed for a professional career in educational information and engineering technology
- To produce competent and employable technologists with sound technical knowledge and hands-on skills
- To apply theoretical and practical knowledge for analyzing and designing solutions for educational information and engineering technology
- To produce technologists who shall be engaged in continuing education and professional development
- To produce technologists having effective communication and interpersonal skills with high professional and ethical standards (Kinshuk; Chen, Nian-Shing; Cheng, I.Ling; Chew, Sie, 2016; and Redecker, (2009).

Veteran educational information and engineering technologists, therefore:

- Identify, formulate, carry out research activities and analyze broadly defined information technology problems with a view to reaching reasonable conclusions using appropriate analytical tools relevant to the discipline or area of specialization
- Apply knowledge of science, mathematics and educational information and engineering technology fundamentals and specializations to define and apply educational information and engineering technology procedures, processes, systems or methodologies in problem solving
- Carry out investigations into broadly-defined problems, locate, search and select vital data from codes, data bases and literature, design and carry out experiments to provide useful conclusions
- Design or develop solutions i.e., they design solutions for broadly defined educational information and engineering technology as well as contribute meaningfully to the design of systems, components or processes to be able to meet specified needs with appropriate consideration for public, health and safety, cultural, societal, and environmental considerations
- Select and effectively utilize appropriate techniques, resources, and modern information educational technology tools, in addition to prediction and modelling to broadly-defined educational information and engineering technology problems, with an understanding of the limitations or human engineering factors
- Show understanding of the societal, health, safety, legal and cultural issues and the results relevant to educational information and engineering technology practice and solutions to broadly defined information technology

The Educational Information and Engineering Technologist is a seasoned educational technology consultant, an information technologist, data and system engineering expert with strong experience in:

- Project and programme management, system design and development, software testing and verification, instructional delivery, course development, human resources development and empowerment and faculty training
- Analyzing and conceptualizing policy documents or facility working meetings to produce software or systems' requirements and develops functional system design specifications
- Building technology-enhanced hybrid courses, technology planning and adoption, delivering training and developing training materials

- Self-motivated leadership and results-driven in all aspects of information technology and competent in data analytics interpretation, representation, and analysis
- Effective communication with excellent planning, writing, organizational, negotiation skills and motivate others to perform at optimal level in order to increase productivity, efficiency and resource management
- Providing leadership and technical skills that engage people at various levels in an organization
- Relevant technical knowledge on emerging technologies, communications technology (including line transmission and amplification), content management systems and project management methodologies
- Arranging information and communication technology (ICT) for sustainable development and transparent reporting (Za.linkedin.com).

The field of Educational Information and Engineering Technology offers opportunities for the following job or career prospects for its graduates: Technology teacher, technology policy specialist, content manager, researcher, project manager, instructional designer, technology integration coordinator, distance learning specialist, multimedia creative designer, and digital portfolio manager (wits.ac.za). Various educational information and engineering technology hardware and software are available for use in facilitating physics instruction. Examples of some of these hardware include: Computer equipment, television, AM/FM radio, multimedia projector, closed circuit television, satellite equipment, VCD machine, DVD machine, video machine, video editing machine (character generator), interactive clever board, cine film projector, 35 mm film projector, super 8 film projector, overhead projector, digital camera, opaque projector, photocopying machine, compact disc equipment, slide film projector equipment, GSM and land telephone, epidiascope projector, transistor amplifier, filmscript film projector, line transmission and amplification equipment (Radio/TV transmitter), audio console equipment, home theatre equipment, teaching machine, etc. (Skinner, 1958). Examples of some of the software include: Flash drive, VCD plates, DVD plates, transparencies, slides, star board software, Auto card software, Interactive Video tapes, ISB, Microsoft Access software, Microsoft office suite: Publisher, Microsoft office suites: MS Word, Excel, PowerPoint, Graphic application software: Corel draw, etc.

Also, the educational information and engineering technologist involves instructional development or Instructional system designs, encountering integrated development environments (IDE) in which case they use such software as Visual studio IDE (one of the most popular and best used IDE web development) or NetBeans or Eclipse or IntelliJ IDE for front end and back end development or design jobs (https://websitesetup.org/best-ide-software/).

Repositioning Physics Education through Educational Information & Engineering Technology

Educational information and engineering technology prepares educational professionals and trainers in industries to engage in leading the way in adoption of educational and information technologies. It sees to the philosophical, sociological and psychological study of digital technologies in education, developing teachers to teach and model information technology within any educational context. We require to reposition or revolutionize current physics learning environment to smart physics learning environments that accommodates the following educational information and engineering technology approaches, among others:

- The use of computer in physics teaching: In the present dispensation, we have been witnessing quite exciting changes all around us: The presence of information technology and engineering education have legislated new ways of presenting instructional content to learners. In other words, the microelectronic revolution has brought about new approaches to looking at and solving problems in teaching and learning physics. Educational information and engineering technology specialists need

to collaborate with physics teachers to design effective computer-based instruction involving a wide-range of different instructional strategies and approaches such as: Drill and practice, tutorial, Socratic, and simulation/games (Onuebunwa, 1999). Physics students need to be exposed to **Drill and Practice** way of using a computer technology for instruction, to present physics problems or questions, accepting a student's response, judging the student's response and obtaining feedback as well as branching to another problem or question basing it on the correctness of the answer or the mastery criteria of the instructional package on physics. To use **Socratic computer-based approach** to instructional delivery during physics lesson is to develop proper understanding and problem-solving skills in students hence this method requires the student getting involved in conversation or dialogue with the computer in which case, a question is presented to the student for him or her to provide the desired answer. The **Tutorial method** deals with discussion of a concept or procedure of carrying out a task using interposed questions or rather quiz at the end of the discussion. **Simulation / games approach** can be employed in delivering physics lesson. Both terms are more less the same and their use in this regard are based on a model or process which try to permit a physics student to relate input or makes changes in parameters to output or outcomes. Simulation is required in physics instruction for the fact that it aids decision making or problem - solving skills. Games have certain rules that must be followed by the user (Onuebunwa, 1999:140-150).

- The 21st century requires physics teacher to effectively employ educational information and engineering technologies that deliver text, audio, visuals, animation, and streaming video as well as technology applications and processes involving audio or video – tape, satellite television, CD-ROM, and computer – based learning, as the use of internet and web – based learning. This is necessary for the fact that these materials are: easily accessible, help improve learner's communication skills and performance in the subject, provides a fun and engagement learning experience for physics students, improves learning by expanding students learning opportunities and supporting digitalized teaching processes, etc. (Redecker, 2009). Today, there are videos that can explicitly explain how the physics teacher may go through experiments or support the students to practically complete projects that are required to be carried out or built during class session. All that is important is for the physics teacher to be able to know how to set up or connect technology in their classroom. Video is an exciting educational media resources that present educational material for a topic to be earned by a target audience. It cannot only present information but can also describe a process, clarify, complete concept, time, and affect an attitude in people (Nkweke and Okafor, 2022).
- Students of physics in this 21st century can be exposed to immersive learning and virtual reality experience. This approach to learning is capable of providing the students with a set of virtual reality classroom kits as students stand to benefit from virtual reality's ability to provide theoretical information leading to real life experience (Emma, 2022).
- Expert in the field of educational information and engineering technology will have to train the physics teacher to get acquainted with technology training skills in software and system development; application or skills in applying qualitative, quantitative or mixed research methods in practical situations or real-life experiences.
- IT makes sense to explore alternate instructional design and development models in physics, assessment and evaluation in instructional design and development including performance systems technologies for physics education. These approaches guarantee improved teaching and learning and can be made available by educational information and engineering technologies of our time.
- Physics teachers require to explore applications of digital learning technologies in an effort to delve into and explicate trends and issues to physics students, get into online education, planning and using digital and social media in physics education to facilitate students understanding of concepts, laws

and principles in physics. This is to ensure fast paced online physics programme that emphasizes instructional design and integrating such ideas across different learning context.

- Physics teachers and students need utilize: Blogs and blogging resources, cloud apps; approaches that are capable of helping physics teachers' access their lesson plans and notes, collaboration and brainstorming tools, educational games and gamification, free educational game sites, power point presentation, educational videos and lectures in physics, use of YouTube to aid students in learning physics concepts, flipped classroom resources; great free web resources focused on using the iPad in education, online interactive white boards and physics teaching; and using massive open online courses (MOOCs) to impact the future of physics teaching and learning, among others (Emerging EdTech's 2013; Sara, 2013; and Schindler, Burkholder, Morald, Osama, Marsh, 2017).

Conclusion

Studying physics helps in strengthening quantitative reasoning and problem-solving skills that are essential in human lives. One in the area of physics or engineering physics is trained to work on forefront ideas in science and technology, in academia and the government, or the private sector, etc. Much as technology offers a variety of management and leadership positions in activities involving physics education, Physics teachers, therefore, have to be prepared to work in a variety of environments as facilitators of knowledge, attitude and skills using emerging approaches in teaching and learning. Considering the importance or role of physics in human environment:

- Government and stake holders in education in Bayelsa State should establish functional educational information and engineering technology centers in the state, with necessary facilities and manpower provided to enhance teaching and learning of physics.
- The ministry of education should see urgent need to organize workshop for both teachers and students of physics on the need or requirements for upgrading physics teaching using educational information and engineering technology
- Government of Bayelsa State should enhance salaries and allowances of Physics teachers and instructors to really motivate them further in the job of educating students to learn theory and practical involved in physics
- Government should make concerted effort to provide functional physics laboratory with necessary facilities and equipment put in place to aid studies in physics
- The ministry of education in Bayelsa should provide clinical supervision on the teaching and learning of physics using educational technologists, qualified physics teachers and instructional material technicians
- Electrical power system should be provided in educational information and engineering technology or Ed tech centers and physics laboratories

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