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Impact of ICT on Basic Science Delivery in Junior Secondary Schools

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Abstract
This study is focused on the impacts of information and communication technology as an impetus in the effective delivery of Basic Science in the Junior Secondary Schools. Fundamentally, education is an important aspect of man, life must not be excluded in this global technological development of it has to compete with the test of time. It is on this premises that this paper looks into the concept of information and communication technology; the concept of integrated science Information and Communication Technology (ICT) and Integrated Science ICT tools and resources for Integrated Science Education. This paper further emphasized the importance of training academic and professionally competent Basic Science teachers with an in-depth capability in Technological Pedagogical Content Knowledge (TPCK) as a framework that will enable teachers to deliver effective classroom instruction and drive innovation through research and practical applications aimed to produce science teachers that will propel sustainable development in scientific and technological breakthrough. This paper recommends that regular professional development programs should be implemented to enhance teacher's ICT skills and confidence among others.

Keywords: ICT Teaching, Learning, Basic Science, Students Secondary School

Introduction

Information and Communication Technology means the utilization of computer Systems and Telecommunication gadgets in information processing. It is made of three basic components, namely; electronic processing using the computer transmission of information in MULTI- media Information and Communication Technology can simply be defined as the acquisition processing, storing and dissemination of vocal textual pictorial and numeric information by a microelectronic Combination of Computer and telecommunication (Charles 2021). Information Communication and Technology (ICT) refers to the diverse set of technological tools and resources used to transmit, store, process, and retrieve information. This broad term encompasses various forms of communication technologies such as computers, software applications telecommunication devices and networks. ICT plays a crucial role in enabling individuals, organizations, and actives to efficiently create, access and share information thereby facilitating communication collaboration and innovation across different platforms and mediums ultimately ICT serves as a catalyst for driving progress, improving connectivity and enhancing overall productivity in today's digital age. ICT, according to Ibe-Bassey (2021) is regarded as a critical tool for preparing and educating students with the required skills for the global workplace. ICT is a diverse set of technological tools and resources used to communicate and manage information. More so, now that ICT has become, within a very short time, one of the basic building blocks of modern society. Nation all over the world now regards its understanding and mastery of basic skills and concepts as crucial in education is because it adds value to the process of learning and to the organization and administration of learning institutions (Eze & Uwadileke, 2023).

Delphonso et al. (2023) opined that the traditional teacher-centred teaching approach which favours passive reception of knowledge is still in vogue in most of our secondary schools all over the country and such an approach has been criticized for its neglect of students' learning from a variety of sources. Hence the integration of ICT is critical in improving pedagogy in classroom delivery is not that fashionable in America, Europe, Asia and other advanced worlds, but they have moved beyond it. They are into Artificial Intelligence (AI). Therefore, a wide range of digital tools and resources should be integrated into science education in Nigeria in order to significantly enhance teaching and learning experiences in a classroom. ICT in science education refers to the integration of information and communication technology tools and resources into the teaching and learning of science subjects by incorporating technologic such as computers, software applications, interactive simulations, multimedia resources, and online platforms, educators can create more engaging and effective learning

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experience for students (Arukaroon & Krairit, 2017). ICT allows teachers to present complex scientific concepts in interactive and visually stimulating ways, making it easier for students to understand and retain information. Virtual laboratories and stimulators provide hands-on experience without the need for physical equipment enhancing student, practical skills and critical thinking abilities.

ICT and Integrated Science

ICT refers to the infrastructure and tools that facilitate the communication and processing of information, including computers, mobile devices, software applications and telecommunication networks (Baldwin, 2020). Integrated Science is a multidisciplinary approach that combines various scientific disciplines to provide a holistic understanding of natural phenomena. It encompasses fields such as biology, chemistry, physics and mathematics. ICT (Information Communication Technology) and integrated science are two key areas in the field of technology and science.

Integrated Science, on the other hand, is a holistic approach that combines different branches of science such as physics, chemistry biology and earth Science. By integrating this discipline, students can develop a comprehensive understanding of the natural world and how various scientific principles interact with one another. Studying ICT and integrated science can offer numerous benefits including enhancing problem-solving skills and preparing students for careers in technology research or other scientific fields additionally, the integration of ICT tools and principles in the teaching of integrated science can help students better grasp complex scientific concepts and engage in hard on interactive learning experiences. The combination of ICT and integrated science provides a powerful foundation for students to develop essential skills and knowledge to succeed in an increasingly digital and technological society. Information and communication Technology (ICT) has become an integral part of modern education including the teaching and learning of integrated science in junior secondary schools. Therefore for effective utilization of ICT in teaching and learning integrated science, the following ways are relevant:

- **Access to Information:** ICT provides students and teachers with access to vast amounts of information from various sources including educational websites, online libraries, databases and scientific journals. Madronio (2023) opined that ICT improves the management and operation of educational institutions, as well as the processes of learning. This allows them to gather relevant and accurate information to enhance their understanding of integrated science concepts.
- **Interactive Learning:** ICT tools such as educational software, simulations and visual materials provide more interactive and engaging learning. Students can actively participate in virtual experiment visualizations and simulations which help them comprehend complex scientific concepts better. The idea that teaching and learning can successfully take place through the application of electronic communication facilities between teachers and learners is one which has been generated. Sometimes, hope and dismay and at other times, excitement and fear. Hope that many more learners can be reached at a more convenient pace than had erstwhile been the case, dismayed that the infrastructure necessary for deploying an effective ICT platform is lacking in low—income countries like Nigeria. (Olakulehin, 2007).
- **Multimedia Resources:** ICT provides resources such as graphics, videos and animations that can be used to explain abstract scientific concepts more effectively. Visual representations can enhance students' understanding and retention of integrated science topics. Computers and networks, hardware and software, cell phones, televisions, radios, audio-visual systems and satellite systems, as well as various services and applications associated with them, such as videoconferencing and distance learning, are part of ICT (Nazim et al., 2022).
- **Collaboration and Communication:** ICT enables students to collaborate with peers, teachers and experts from around the world using various communication tools. Online forums, discussion boards, and video conferencing facilitate interaction and collaboration enhancing active learning among students.
- **Real-World Connection:** ICT allow students connect their learning to real life situations. They can access scientific data, case studies and real-time information, enabling them to apply scientific knowledge to solve problems in the context of the real world. Madronio (2023) asserted that for educational administrators and institutions to keep up with the rapid advancements in ICT. The use of ICT in the curriculum has been created to aid in adjusting to these advancements and situational changes (Andoh, 2012).
- **Personalized learning:** ICT tools provide opportunities for personalized learning experiences designed for the learning needs of the individual students and learning styles. Adaptive learning software can provide immediate feedback customized learning paths and additional resources to support student

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understanding of integrated science. Hence, transformation in the education sector in general is necessary to adapt to the digital transformation, in order to better respond to the needs and challenges of a constantly changing environment (Tamer, & Knidiri, 2023).

- **Assessment and feedback:** ICT tools enable teachers to assess students learning progress through online quizzes assignments and tests immediate feedback can be provided to students allowing them to identify their strengths and weaknesses and focus on areas that require improvement. Liwanag (2015), found that teacher's use of ICTs in teaching is seen as an important predictor of student performance and there is an important relationship between the use of ICT in the classroom and student academic performance. The grades of computer science students are from 88.18% to 87.80% and most of them receive very satisfactory results.
- **Professional development:** ICT provides teachers with opportunities for continuous professional development through online platforms, webinars and educational resources. This helps teachers stay updated with the latest scientific advancements and teaching strategies, enhancing the quality of science education.

Information and Communication Technology plays a crucial role in the effective teaching and learning of integrated science. It provides access to information, promotes interactive learning, facilitates collaboration and communication, connects learning to real-world situations, allows for personalized learning, aids in assessment and feedback, and supports teachers' professional development (Nazim et al., 2022)

ICT Tools and Resources for Integrated Science

Schools and other educational institutions which are supposed to prepare students to live in "a knowledge society" need to consider Information, Communication, and Technology (ICT) integration in their curriculum. Integration of ICT in education refers to the use of computer-based communication (Rachmawati, 2019).

In the realm of science education, the integration of Information and Communication Technology (ICT) has revolutionized teaching and learning experiences (Liu & Gee, 2017).

ICT tools offer a dynamic approach to engage students with scientific concepts, making the learning process more interactive and effective. Here are some key ways ICT enhances science education:

- **Transformative Power of ICT in Science Education:** ICT tools significantly enhance teaching and learning experiences by providing innovative technological applications that complement traditional methods from virtual experiments to data modelling. ICT tools create opportunities for students to engage deeply with scientific concepts. This approach allows students to be more organized and efficient in which they can obtain notes from the computer, submit their work by email from home as long as they meet the deadline, and look for information from various sources provided online to fulfil the task given to them (Swarali, 2022)
- **ICT Skills for Teachers: A Cornerstone for Implementation:** Educators need to be proficient in using ICT tools before they can effectively integrate them into their teaching practice. Continuous professional development is essential for teachers to acquire and refine their ICT skills enabling them to select appropriate tools and guide students in their use. ICT can be used in various ways where it helps both teachers and students to learn about their respective subject areas. Technology-based teaching and learning offer various interesting ways which include educational videos, stimulation, storage of data, the usage of databases, mind-mapping, guided discovery, brainstorming, music, World Wide Web (www) that will make the learning process more fulfilling and meaningful (Ghavifekr & Rosdy, 2015).
- **Virtual Labs and Simulation: Bridging Theory and Practice:** Virtual labs and simulators allow students to conduct experiments and explore scenarios that may be impractical in a physical lab setting. These tools provide a safe environment for hands-on learning, helping students visualize complex theoretical concepts. The finding of Swarali (2022) indicates that teachers' well-equipped preparation with ICT tools and facilities is one of the main factors in the success of technology-based teaching and learning. Professional development training programs for teachers also played a key role in enhancing students' quality of learning.
- **Data Analysis and Modelling Software:** ICT offers powerful data analysis and modelling software that helps students collect, analyse, and interpret data. By visualizing and manipulating data using software tools, students develop critical analytical skills crucial for understanding scientific processes.
- Ndukwe et al. (2023) advised that there is a need to embrace a new approach like the Computer Assistant Instruction (CAI). CAI is a learner-centred approach that makes use of logical devices such as phones, I-pad, laptops and computer desktops which the students are familiar with and can access.

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With the CAI learning moves from the group spaced to the individual space and is not limited by location.

Challenges and Limitations of ICT in Integrated Science Education

While ICT has the potential to enhance students learning outcomes in integrated science education, there are several challenges and limitations associated with its use:

- **Digital Divide:** The digital divide refers to the disparity between individuals who have access to ICT and those who do not. Bhaskar (2021) opined that there was racial inequality in ICT in America according to his investigation; he discovered that nearly half of Americans without at-home internet were from black and Hispanic households in comparison with the white community with appreciable households equipped with sophisticated ICT gadgets. This disparity may exacerbate existing educational inequalities and limit the potential benefits of ICT for disadvantaged students.
- **Lack of Teacher Training:** Effective integration of ICT into integrated science education requires teachers to have adequate training and support in using technology effectively for teaching and learning purposes. This situation serves as a reminder that schools should use pertinent specialized support services as extensively as possible. When appropriate, school principals and ICT coordinators should encourage subject and classroom teachers to communicate with such services (Madronio, 2023).
- **Cost:** Implementing an ICT infrastructure course is costly, requiring significant investments in hardware, software and network infrastructure, Sincere observation shows that the majority of school administrators just store broken machinery or equipment in a corner. Sometimes a technician may be called in to fix the problem (Education World, n.d.). However, because no one at the school knows how to fix the computer, the technician will overcharge the institution, or worse, the technician will simply suggest that the institution buy a new one (Ten things about computer use in schools that you don't want to hear but I'll say them anyway, 2012). This situation serves as a reminder that schools should use pertinent specialized support services as extensively as possible. When appropriate, school principals and ICT coordinators should encourage subject and classroom teachers to communicate with such services. (Madronio, 2023). These costs may be profitable for some schools or institutions, limiting their ability to integrate technology into their practices.
- **Technical Support and Maintenance:** Challenges related to technical support services, system maintenance, troubleshooting procedures and software updates can disrupt the smooth operation of ICT systems within educational institutions. Many schools lack internet access, and the majority of their equipment is broken and useless. Therefore, the question is how such circumstances can be avoided. Programs addressing the upkeep and support of ICT resources, particularly for elementary schools, should therefore exist to achieve this as asserted by Johnson et al, 2016
- **Distraction:** The use of technology for non-academic purposes using class time can be distracting for students and may detract from their learning. Hence, the use of ICT devices in the classroom can have serious negative consequences on students learning, teaching, and classroom management (Goundar, 2014). Therefore, it is important for teachers to manage the use of technology during class time to ensure that it is used for educational purposes only.

Conclusion

From the foregoing, therefore, it could be concluded that advanced information and communication technology has greatly enhanced the effective features and learning in our schools. Also, through the use of ICT, the student's academic achievement has been improved. This academic improvement has been reflected in the junior category. However, there is a need for CAI collaboration in and outside of the classroom for meaningful learning among students. Conclusively, it is pertinent at this juncture based on the aforementioned genuine reasons highlighted above to conclude that an integration of ICT will assist teachers in the global requirement to replace traditional teaching methods with technology-based teaching and learning tools and facilities.

Suggestions

The following suggestions are hereby made:

1. Government should employ qualified and experienced ICT teachers to initiate and encourage the use of ICT tools in a Basic Science classroom.
2. Science curriculum designers should make recommendations to the Government to infuse the study of ICT in the science curriculum.
3. There should be well-equipped and furnished computer laboratories in our schools for effective teaching and learning to take place.
4. Integrated science teachers should be trained in the use of its tools and facilities.

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5. Government should make available the ICT tools and facilities in our school to enhance effective teaching and learning.
6. CAI should be inculcated into the teachers' training programme as a teaching method to enhance performance among students.

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