Leveraging Contemporary Technologies to Increase Scientific Exposure in Post-Primary Education System of Edo State, Nigeria

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Abstract

In the ever-evolving education landscape, contemporary technology is pivotal in shaping students' learning experiences. This study explores how technology exposure impacts scientific literacy and engagement among secondary school students. A quasi-experimental design was employed, with a treatment group exposed to contemporary technology and a control group receiving traditional instruction. The primary outcome measure was scientific exposure, assessed through pre-and post-tests. A t-test analysis was conducted to compare the treatment and control groups. The treatment group exhibited a significant improvement in scientific exposure compared to the control group ($p < 0.05$). Students exposed to contemporary technology demonstrated a deeper understanding of scientific concepts. No significant gender differences were observed in the impact of technology exposure on scientific exposure ($p > 0.05$). Conclusion: Contemporary technology enhances students' scientific exposure, fostering more profound understanding and engagement. Its benefits are gender-neutral, benefiting both male and female students equally. As educators embrace technology, they must ensure equitable access and leverage its potential to create inclusive learning environments.

Keywords: technology, science, students, secondary schools

Introduction

According to Kalogiannakis et al. (2021), science instruction is crucial for education in the twenty-first century and ought to start early (Tavares et al., 2021). At all educational levels, adequate performance in science education is required due to the growing number of global, technological, and scientific breakthroughs (Taştan et al., 2018). Teaching scientific concepts and practices to students who lack a scientific background is the focus of the area of science education (Ohunene & Ebele, 2014). Critical thinking, basic scientific knowledge, practical methods, creativity, and uniqueness in scientific investigations are all part of teaching science to pupils. Olayinka (2019) defines science as the study of knowledge that can be used to create a system based on factual evaluations. People and nations must have an education in science to survive and achieve global economic goals. Science education and personal, national, and economic development have been associated with a large body of literature (Agarkar, 2017; Alam, 2009; Clement et al., 2017; Dovgyi et al., 2020; Drori, 2000; Helen, 2019; Jacob, 2013; Kyle, 2020; Sugimoto, 2019). It is commonly accepted that educating young students on the fundamentals of exploring ideas in their surroundings could be essential to the growth of our civilization.

Processes, reasoning, and problem-solving are the cornerstones of science education. Therefore, exposing children to science process skills is one strategy to potentially influence their science skills (Hernawati et al., 2018). Science process skills are learning skills students must internalize, practice, and own (Wahyuni et al., 2017). Science students must possess procedural skills, scientific inquiry abilities, and experimental and investigative science habits of mind. Therefore, giving students science process skills is crucial to science education (Ekici & Erdem, 2020). Science process abilities are critical markers of educational goal achievement (Gunawan et al., 2019). In addition, science process skills involve combining information, abilities, and positive attitudes to promote a deeper comprehension of scientific ideas. Scientific thinking and decision-making are ingrained in the science process skills (Yumusak, 2016). As a result, teachers must lead children through scientific inquiry using facts, ideas, and theories.

Teaching students how to participate in investigations is one of the most critical objectives of science education. To make this achievable, students can be trained in science process skills (Hernawati et al., 2018). The term "science process skills" (SPS) refers to the abilities of scientific inquiry, experimental and investigative science habits of mind, and procedural skills. The idea of SPS has been emphasized by several different studies (Arifullah et al., 2020; Duda & Susilo, 2019; Inayah et al., 2020; Irwanto et al., 2017; Laksono et al., 2017; Langtang, 2018; Maison et al., 2020; Nuraini & Muliawan, 2020; Prabowo, 2015; Rahayu & Syarifudin, 2019; Rahayu Ariffin et al., 2014; Savitri et al., 2017; Sukarmin et al., 2018; Wardani & Djukri, 2019; Yunianti et al., 2019). Studies that examined the relationship between scientific process skills and attitudes toward science concluded that higher performance on science process skills was associated with more positive views toward science. According to ongoing research, positive attitudes significantly impact teaching science. Therefore, science process skills should be prioritized in the educational ecosystem.

Science process skills encompass a range of activities such as observing, measuring, classifying, communicating, forecasting, inferring, using figures, questioning, manipulating variables, hypothesizing, defining terms, developing models, conducting an experiment, and analyzing data (Asy'ari et al., 2019). SPS has been extensively researched in two main categories: fundamental and integrated science process skills (Duda & Susilo, 2019; Mohd et al., 2013; Romadona et al., 2021). The basic (simpler) process skill (classifying, predicting, inferring, measuring, observing, and communicating) provides a foundation for scientific learning. The integrated (more complex) skills (interpreting, experimenting, hypothesizing, formulating methods, and identifying variables) describe improved scientific knowledge.

Contemporary Technologies and Scientific Exposure

The contemporary education ecosystem worldwide increasingly advocates students' commitment and exposure to Science, Technology, Engineering, and Mathematics (STEM). However, many education systems today still do not engage students adequately, as they are based on educational models introduced over a century ago. For instance, most science education in primary and secondary schools focuses on theory rather than application and experiential learning and is taught in a way that reinforces a disconnect. As engaging students in science is an urgent need in society, it is essential to investigate how technological advancements can foster and promote student engagement in science education.

Incorporating technology into education is crucial for enhancing curriculum and student achievements. Technology can enhance creative, flexible, and intentional thinking and knowledge construction in the classroom while expanding educational options for pupils. Educators and researchers emphasize the benefits of utilizing educational technology to enhance STEM learning outcomes due to the fast-paced advancement of information and communication technologies. This paper explores the impact of educational technologies such as online interactive learning environments, simulation, augmented reality (AR), virtual reality (VR), and digital gaming on STEM education. The advantages of these technologies in STEM fields are well-documented in the literature. Nowadays, leveraging digital technology has become vital for improving learning and education. The present paper explores how exposure to technology impacts scientific literacy and engagement among secondary school students.

Method

To investigate the impact of Contemporary Technologies on students' Scientific Exposure in the Post-Primary Education System of Edo State, Nigeria. A sample of 83 secondary school students was randomly drawn from different secondary schools in Edo State, ensuring diversity in terms of gender, age, and academic performance. The participants were assigned to the treatment group and control group. Before implementing the intervention, a pretest was administered to both groups to establish baseline knowledge of digital technology in education. The treatment group was exposed to online interactive learning, while the control group continued with the existing teaching method. The study used a t-test to compare post-test scores between the treatment and control groups at a significance level: $\alpha = 0.05$.

Result

Table 2 shows the t-test comparison of the differences in students' scientific exposure.

Source of variation	N	Mean	SD	df	*t*	Sig
Experimental	41	16.19	9.68			
Control	42	14.39	9.38	83	6.113	000

In an era where technology permeates every aspect of our lives, understanding its impact on education is crucial. The present study investigates how contemporary technology influences students' scientific exposure in secondary schools. The t-test analysis performed on the data indicates that the treatment group showed a significant improvement in scientific exposure compared to the control group ($p < 0.05$). Students exposed to contemporary technology demonstrated a deeper understanding and engagement with scientific concepts. No significant gender differences were observed in the impact of technology exposure on scientific exposure ($p > 0.05$). Both male and female students benefited equally.

Discussion

The present study aimed to explore how contemporary technology impacts students' scientific exposure in secondary schools. The treatment group, which was exposed to contemporary technology, exhibited a significant improvement in scientific exposure compared to the control group. The t-test analysis revealed that this difference was statistically significant ($p < 0.05$). Students who had access to technology demonstrated a deeper understanding of scientific concepts and engaged more actively in scientific learning. Interestingly, no significant gender differences were observed in the influence of technology exposure on scientific exposure. Both male and female students benefited equally from exposure to contemporary technology. This finding highlights the inclusive nature of technology-mediated learning experiences.

The study's positive results underscore the potential of contemporary technology to enhance scientific literacy among secondary school students. By providing access to digital resources, simulations, and interactive learning platforms, technology bridges gaps in traditional classroom instruction. Students exposed to technology not only acquire factual knowledge but also develop critical thinking skills necessary for scientific inquiry. The deeper understanding demonstrated by technology-exposed students suggests that interactive multimedia tools facilitate active engagement with scientific content. Virtual labs, 3D models, and real-time data visualization allow students to explore complex phenomena beyond textbooks. Consequently, they develop a more profound grasp of scientific principles.

Implications for Pedagogy:

Educators should recognize the pivotal role of technology in shaping modern education. Integrating technology into the curriculum can:

Foster student-centered learning experiences.

Encourage inquiry-based approaches.

Promote collaborative problem-solving.

Address diverse learning styles.

While both male and female students benefited equally, it is essential to ensure equitable access to technology. Schools must bridge the digital divide by providing devices, internet connectivity, and training to all students. Additionally, educators should be mindful of any unintentional biases in technology use.

Conclusion

In conclusion, contemporary technology serves as a powerful catalyst for scientific exposure in secondary schools. Its impact transcends gender boundaries, empowering students to explore, question, and discover. As we continue to embrace technological advancements, educators and policymakers must collaborate to create an inclusive and technologically enriched learning environment. The implications of this study extend beyond the classroom, influencing educational policies, teacher training, and resource allocation. By leveraging technology effectively, we can nurture a generation of scientifically literate individuals poised to address global challenges.

References

Agarkar, S. C. (2017). Science education for national development: Indian perspective. In *Science Education: A Global Perspective*. https://doi.org/10.1007/978-3-319-32351-0_6

Akinbobola, A. O., & Afolabi, F. (2010). Analysis of science process skills in West African senior secondary school certificate physics. *American-Eurasian Journal of Scientific Research, 4*(5).

Alam, G. M. (2009). The role of science and technology education at network age population for sustainable development of Bangladesh through human resource advancement. *Scientific Research and Essays*, *4*(11).

Arifullah, Halim, A., Syukri, M., & Nurfadilla, E. (2020). Developing student worksheets with PhET assisted in improving student science process skills. *Journal of Physics: Conference Series*, *1460*(1). https://doi.org/10.1088/1742-6596/1460/1/012144

Asy'ari, M., Fitriani, H., Zubaidah, S., & Mahanal, S. (2019). The science process skills of prospective biology teachers in plant cell material based on gender. *International Journal of Emerging Technologies in Learning*, *14*(19). https://doi.org/10.3991/ijet.v14i19.11208

Catherine Ohunene, O., & Bernadette Ebele, O. (2014). Science education and sustainable development in Nigeria. *American Journal of Educational Research*, *2*(8). https://doi.org/10.12691/education-2-8-6

Clement, I., Bello, M., & Abdullahi Sunusi, S. (2017). Science education and Nigeria National development effort: The missing link. *International Journal of Education and Evaluation* (Vol. 3, Issue 5). www.iiardpub.org

Dovgyi, S., Nebrat, V., Svyrydenko, D., & Babiichuk, S. (2020). Science education in the age of industry 4.0: Challenges to economic development and human capital growth in Ukraine. *Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu*, *2020*(1). https://doi.org/10.33271/nvngu/2020-1/146

Drori, G. S. (2000). Science education and economic development: Trends, relationships, and research agenda. In *Studies in Science Education* (Vol. 35, Issue 1). https://doi.org/10.1080/03057260008560154

Duda, H. J., & Susilo, H. (2019). Science process skill development: the potential of practicum through problem-based learning and authentic assessment. *Anatolian Journal of Education*, *3*(1). https://doi.org/10.29333/aje.2018.315a

Ekici, M., & Erdem, M. (2020). Developing science process skills through mobile scientific inquiry. *Thinking Skills and Creativity*, *36*. https://doi.org/10.1016/j.tsc.2020.100658

Gunawan, Harjono, A., Hermansyah, & Herayanti, L. (2019). Guided inquiry model through the virtual laboratory enhances students' science process skills on heat concepts. *Cakrawala Pendidikan*, *38*(2). https://doi.org/10.21831/cp.v38i2.23345

Helen N., E. (2019). Science Education: A panacea for national security and economic development. *International Journal of Integrated Research in Education*. https://doi.org/10.36265/ijired.2019.010110

Hernawati, D., Amin, M., Irawati, M. H., Indriwati, S. E., & Omar, N. (2018). The effectiveness of the scientific approach using encyclopedias as learning materials in improving students' science process skills in science. *Jurnal Pendidikan IPA Indonesia*, *7*(3). https://doi.org/10.15294/jpii.v7i3.14459

Inayah, A. D., Ristanto, R. H., Sigit, D. V., & Miarsyah, M. (2020). Analysis of science process skills in senior high school students. *Universal Journal of Educational Research*, *8*(4 A). https://doi.org/10.13189/ujer.2020.081803

Irwanto, Rohaeti, E., Widjajanti, E., & Suyanta. (2017). Students' science process skills and analytical thinking ability in chemistry learning. *AIP Conference Proceedings*, *1868*. https://doi.org/10.1063/1.4995100

Jacob Kola, A. (2013). Importance of science education to national development and problems militating against its development. *American Journal of Educational Research*, *1*(7). https://doi.org/10.12691/education-1-7-2

Kalogiannakis, M., Papadakis, S., & Zourmpakis, A. I. (2021). Gamification in science education. A systematic review of the literature. *Education Sciences*, *11*(1). https://doi.org/10.3390/educsci11010022

Kyle, W. C. (2020). Expanding our views of science education to address sustainable development, empowerment, and social transformation. *Disciplinary and Interdisciplinary Science Education Research*, *2*(1). https://doi.org/10.1186/s43031-019-0018-5

Laksono, E. W., Rohaeti, E., Suyanta, -, & Irwanto, -. (2017). The evaluation instrument of analytical thinking and science process skill in chemistry subject. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *1*(1). https://doi.org/10.21831/jk.v1i1.8205

Langtang, K. D. F. M. D. (2018). Development of a simple heat learning media to enhance students' science process skills. *International Journal of Science and Research (IJSR)*, *7*(5).

Maison, Darmaji, Aatalini, Kurniawan, D. A., Haryanto, Kurniawan, W., Suryani, A., Lumbantoruan, A., & Dewi, U. P. (2020). Science process skill in science program higher education. *Universal Journal of Educational Research*, *8*(2). https://doi.org/10.13189/ujer.2020.080238

Mohd Al-junaidi, M., & Ong, E. T. (2013). Test of basic and integrated science process skills (T-BISPS): how do form four students in Kelantan fare? *International Journal of Assessment and Evaluation in Education*, *3*.

Nuraini, & Muliawan, W. (2020). Developing science learning with project-based learning on science process skill : a needs analysis study. *Journal of Physics: Conference Series*, *1539*(1). https://doi.org/10.1088/1742-6596/1539/1/012055

Obiageli Ezeudu, F., Abonyi Ugwuanyi, A., & Rachael Folake, A. (2019). Science process skills acquired by senior secondary school chemistry students in quantitative analysis in Enugu education zone, Nigeria. *Journal of Engineering and Applied Sciences*, *14*(2). https://doi.org/10.36478/jeasci.2019.5333.5338

Olayinka Olajide, S. (2019). Effects of field trip and peer tutoring instructional strategies on students' science process skills acquisition in basic science and technology in junior secondary schools in Osun State. *Journal of Education, Society, and Behavioural Science*. https://doi.org/10.9734/jesbs/2019/v32i430186

Prabowo, S. A. (2015). The effectiveness of scientific-based learning towards science process skill mastery of PGSD students. *Jurnal Pendidikan IPA Indonesia*, *4*(1). https://doi.org/10.15294/jpii.v4i1.3495

Rahayu, A. H., & Syarifudin, B. F. (2019). Developing science teaching material to increase elementary students' science process skills. *Journal of Teaching and Learning in Elementary Education*, *2*(1). https://doi.org/10.33578/jtlee.v2i1.6854

Rahayu Ariffin, Ramli Basri, & Norlizah Che Hassan. (2014). Putting social integration theories into practice: Pupils integration for unity plan (PIUP) in Malaysian schools. *Middle-East Journal of Scientific Research 19 (Innovation Challenges in Multidisciplinary Research & Practice)*, *19*.

Romadona, D. D., Purwaningsih, S., & Darmaji, D. (2021). Validity of static fluid practicum guide based on science process skills using Ubisoft flipbook maker. *Journal of Science Education Research*, *5*(1). https://doi.org/10.21831/jser.v5i1.38977

Savitri, E. N., Wusqo, I. U., Ardhi, M. W., & Putra, P. D. (2017). Enhancement of science students' process skills through the implementation of the green learning method (GeLeM) with a conservation-based inquiry approach. *Jurnal Pendidikan IPA Indonesia*, *6*(2). https://doi.org/10.15294/jpii.v6i2.11286

Sugimoto, T. (2019). Study on science education and science teaching methods that contribute to human resources development leading the next generation of science, technology, and innovation toward society 5.0. *Journal of Research in Science Education*, *60*(2). https://doi.org/10.11639/sjst.19014

Sukarmin, S., Ratnasari, D., & Suparmi, S. (2018). The instrument implemented a two-tier multiple-choice analysis of students' science process skill profiles. *International Journal of Pedagogy and Teacher Education, 2*. https://doi.org/10.20961/ijpte.v2i0.19820

Taştan, S. B., Davoudi, S. M. M., Masalimova, A. R., Bersanov, A. S., Kurbanov, R. A., Boiarchuk, A. V., & Pavlushin, A. A. (2018). The impacts of teacher efficacy and motivation on student's academic achievement in science education among secondary and high school students. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(6). https://doi.org/10.29333/ejmste/89579

Tavares, R., Vieira, R. M., & Pedro, L. (2021). Mobile app for science education: Designing the learning approach. *Education Sciences*, *11*(2). https://doi.org/10.3390/educsci11020079

Wahyuni, S., Indrawati, I., Sudarti, S., & Suana, W. (2017). Developing science process skills and problem-solving abilities based on outdoor learning in junior high school. *Jurnal Pendidikan IPA Indonesia*, *6*(1). https://doi.org/10.15294/jpii.v6i1.6849

Wardani, I., & Djukri, D. (2019). Teaching science process skills using guided inquiry model with starter experiment approach: an experimental study. *Jurnal Pendidikan Biologi Indonesia*, *5*(2). https://doi.org/10.22219/jpbi.v5i2.8429

Yumusak, G. K. (2016). Science process skills in science curricula applied in Turkey. *Journal of Education and Practice*, *7*(20).

Yunianti, A. U., Wasis, & Nur, M. (2019). The effectiveness of the guided inquiry learning model in improving science process skills on heat matter. *Journal of Physics: Conference Series*, *1417*(1). https://doi.org/10.1088/1742-6596/1417/1/012080