
EDUCATIONAL TECHNOLOGY IS NOT A LUXURY IN THE 21ST CENTURY, IT IS A NECESSITY.

Nyamundundu V.A., Biningu H.
Pedagogical Research Advisor-TTC GACUBA II
Pedagogical Research Advisor -TTC ZAZA

Correspondences: alicenyamundundu@yahoo.com, hbininguu@mail.com

ABSTRACT

Educational technology is no longer a luxury, but an important component of the 21st century education system. Modern societies have hinged their socio-political and economic development on technology. This has made use of technology in teaching and learning processes indispensable. Thus, there is need for both teachers and learners to access educational technology to support teaching and learning, improve access to quality education and make learning more inclusive and effective. Many African countries, including Rwanda, are investing in educational technology to modernize their education systems and align their human resource development to National economic demands. However, the question is; to what extent is educational technology being employed by teachers in the classroom. This study investigated the extent to which teachers in Rwandan Teacher Training Colleges use educational technology in the teaching and learning processes. The study employed case study approach at TTC Gacuba II. Qualitative desktop research approach was used. Results highlight the need for use of educational technology in the teaching and learning processes.

Keywords: Educational technology, indispensable, luxury, access, quality education, inclusive, necessity socio-political development, economic development.

INTRODUCTION

Modern Educational technology is no longer a luxury, but an indispensable component of the 21st century education system. The world of schooling has been revolutionized by technology and that the reliance and dependence on technology cannot be dispensed [1]. Educational technology has thus provided solution to problems in education, making it indispensable in the teaching and learning processes [2]. Elsewhere, it has been asserted that information and communication technology has become a way of life that children have adopted [3]. Mishra et al (2024) [4] observed that despite the negative perceptions about educational technology, no one has seriously disagreed with the fact that it has become an important factor in education. Consequently, educational technology is here to stay owing to the critical role it plays in the teaching and learning processes.

The global investment in educational technology was projected at USD404 billion in 2025^[5, 6]. This deliberate positive policy formulation and massive investment in educational technology is evident that there is no turning back on use of technology in education. Thus it is globally accepted that quality of education depends on the extent to which technology is used in the teaching and learning processes. Rwanda, like the other countries of the globe is making huge investments premised on their conviction that technology is central in driving Rwanda's transformation to a knowledge-based economy. To this end, the government has crafted strong policies and strategy framework for integration of technology in education supported by implementation of several policies to promote the integration process. For instance, the 2015 ICT in Education Master Plan and 2016 ICT in Education aimed at achieving educational transformation [7]. Rwanda thus became one of the first countries in Africa to implement the One Laptop per Child and to date, there is massive computerization of schools in Rwanda through provision of ICT tools to support teaching and learning processes.

In the Curriculum Framework for Teacher Training Colleges, REB (2020) clearly states the need for intensive integration of ICT in education. The 2020 Teacher Professional Standards further asserts adequate knowledge in the use of ICT as one of the general learning outcomes (exit profile) of a student teacher. To date, use of technology has become a norm in the teaching and

learning processes in Rwanda. However, the question is; to what extent is educational technology being employed by teachers in the classroom. It has been pointed out that the potential of technology cannot be realized by mere provision of computers in schools, hence the need to enquire the extent to which technology is being employed in the classroom setting [8].

Purpose of the research

This study investigated the extent to which teachers in Rwandan Teacher Training Colleges are using educational technology in the teaching and learning processes and TTC teachers' perception and appreciation of the role played by these technologies in the teaching and learning processes.

Research Objectives

1. To identify factors which promote use of technology in teaching and learning.
2. To establish use of technology in teaching and learning in TT'Cs.
3. To make recommendations on how technology in teaching and learning can be improved.

Methodology

The study applied a qualitative research design through sampling of students and teachers at Gacuba TTC in Rubavu District, Western Province of Rwanda. Data was collected using questionnaires, interviews and observations. Results are presented in narrative descriptions from which conclusions and recommendations were drawn.

Sampling

Purposive sampling was used in this study based on the characteristics of the population and the objective of the study. The study was carried out at a TTC in Rwanda, namely Gacuba II TTC in the Rubavu District in the Western Province of Rwanda. Both teachers and students gave their views on the questionnaires. Ten of twenty-five teachers were purposively selected based on their cooperation while forty students were selected from different year groups,

namely year 1, year 2 and year 3. The students represented three different categories namely sciences, humanities and languages. The sample had both female and male teachers and students.

LITERATURE REVIEW

Educational technology

Education refers to the process where knowledge, skills, and habits are transferred and transformed from one generation to the next through teaching, training and research ^[9]. While Grubler (2015) ^[10] defines technology as manufactured tools whose practical use enhance human capabilities, Magtibay (2019) ^[11] defines technology as a mix of processes and products used in application of knowledge to accomplish different tasks. Putting this together, educational technology is an organized process of applying modern technology to improve quality of education ^[9, 12]. The technology has evolved from use of simple tools to radio and television progressing to digital platforms like databases, e-books and other computer programs. In the 21st century, educational technology has transformed by maximizing and perfecting digital inventions culminating in, inter alia; e-learning programs, artificial intelligence and machine learning ^[13]. Thus, the technology in its modern form, refers to use of ICT tools and digital platforms to enhance teaching and learning processes.

The indispensability of educational technology

Educational technology has made learning more liberal, democratic and exciting as teachers, learners interact easily with each other and with content. Thus, before introduction of Education technology, teachers dictated the way learners learnt and the end of the school day and closure of the school library signaled the end of learning. Educational technology has thus brought a new dimension in terms of how, where and when should learning take place. The technology appeals to learners' different learning styles as it interfaces the learning and social life of the learner. Hoge et al (2017) ^[14] stated that technology enhances learning, socialization and creativity among learners. Thus, in the age of technology, there is no labour in explaining education to children because it has become part of their daily lives which they do not wish to

miss. Technology has also provided solutions to many educational challenges such as distance, time, facilities, teaching and learning materials. That teaching and learning can take place anywhere at any time even beyond the classroom and school timetable is plausible. Verma (2019) ^[15] asserted that computer technology has removed time, distance and cost constraints in processing educational information. Equally, students can receive instructions and ask for clarity through phone calls, emails, social media, and different education platforms. They can also source learning materials and illustrations on the internet while at the same time addressing challenges related to classroom shortages through use of technology.

Educational technology has made the processes much simpler enabling authors to bypass publishing houses, connecting directly with editors and with just a few clicks, readers can access libraries and books of their choice while students and teachers can access the latest information on the internet through electronic books, research articles, online libraries and other online platforms that provide information related to desired subject content. Whereas, use of smart boards, projectors and computer-generated teaching aids has made lesson delivery much easier than before, use of spreadsheets and other computer-based programs has brought much more precision in computation and presentation of quantitative data.

It is also worth noting that the current industrial changes, dubbed industry 4.0, have made technology occupy a special place in education making use of educational technology critical in teaching and learning processes. In the Rwandan curriculum, ICT is considered a cross-cutting tool empowering students with communication and technological skills required in the country's development programs. The implication is that technology has to be taught and technological approaches have to be used for learners to grasp the concepts. For students to have good grasp of the subject matter, there is no way a teacher can teach about how to use a computer without using the computer itself as media, making inclusion of technology as content in the school curriculum unavoidable.

The nurturing and cultivation of 21st-century skills in learners require modern educational technologies targeting skills, knowledge, competencies that would enable learners to acquire skills including information, media, and technology, creativity, critical thinking, innovative thinking, problem-solving, research, communication and collaboration and citizenship as well as global awareness of civil rights and global trends ^[16]. Ramalia and Molwele (2022) ^[17] emphasized the role played by digital technologies in driving innovation and fostering creativity which are crucial life skills.

Factors that promote use of technology in teaching and learning.

Whilst use of educational technology in the 21st century cannot be questioned or avoided; several factors determine its full employment in teaching and learning. Firstly, policies can either promote the use of educational technology or do otherwise. In many cases, there are government policies and school-based policies, both of which determine use of technology in schools. These include budget allocation, security and cultural factors. Thus, in the Rwandan case, implementation of policies encouraging use of technology in education are included in National budget and in their education master plan and Curriculum framework ^[7]. However, in all societies across the globe, adequacy and effective implementation of these policies may need scrutiny. Both National and school policies define restriction of such items as use of smart telephones by students at school.

Because use of educational technology depends so much on availability and accessibility of relevant infrastructure and digital tools, furnished smart rooms and digital tools like computers, projectors, smart boards and internet connectivity are essentials in the use of educational technology. There is therefore a need for a strong foundation which includes internet enabled classrooms, strong Wi-Fi signal, continuous supply of electricity and a wide range of ICT tools. In Tanzania, it was revealed that lack of or insufficient infrastructure and other resources such as poor electricity supplies in the rural areas posed a great challenge to implementation of educational technology ^[18]. Thus, successful use of educational technology depends on how much authorities invest in provision of relevant facilities and resources.

Teachers and students constitute an important factor in that they determine how educational technology is used in teaching and learning. Harrell & Bynum (2018) ^[19] observed that despite increasing access to technology in schools, teachers are usually portrayed as hesitant users being accustomed to the old standards of teaching and their lack of relevant skills creating frustration as they try to shift to new technology driven teaching and learning processes. Students on the other hand, tend to have a positive attitude toward integration of technology in education ^[20]. Consequently, assessing use of technology in the classroom should consider perceptions and attitudes of both students and teachers.

RESULTS

Results of this study demonstrate consensus among teachers and students regarding definition of educational technology. Participants demonstrated a shared understanding of technology, with the majority identifying it as utilization of modern tools and digital media – such as laptops, tablets, projectors, headphones, smartphones, and internet connectivity – to facilitate and enhance teaching and learning processes. The study noted that both students and teachers have a general awareness of the fundamental components and applications of technology in education.

Table 1. What do you understand by educational technology?

Sample	ICT tools	Media	Other
Students	26	10	4
Teacher	10	5	-

The data presented on table 1 indicate that 26 students defined educational technology as the use of Information and Communication Technology (ICT) tools, such as laptops and projectors, to enhance learning ^[21]. Ten students associated technology with media, specifically referring to use of the Internet. However, the remaining four students described educational technology in terms of research and analysis. Thus, while technology indeed facilitates

research and analytical processes, student responses suggest to a certain extent a misunderstanding of the core focus of the question by some students.

Table 2. Are you/your teachers using technology in the classroom?

	YES	NO	SOMETIMES
TEACHERS	6	-	4
STUDENTS	12	-	28

A significant proportion of both teachers and students acknowledge use of technology in teaching and learning. However, its application is not consistent due to a shortage of necessary equipment. Thus, while projectors are used for PowerPoint presentations, the institution had less than five projectors for 25 staff members. Equally, there were insufficient laptops for students use. Consequently, teachers and students shared and rotated access to these resources. No participant reported complete absence of technology for use in teaching and learning processes.

Table 3. In what ways do you use technology in teaching and learning?

	LESSON PREPARATION	RESEARCH	ASSESSMENTS
TEACHERS	11	2	2
STUDENTS	3	37	

The data presented on table 3 indicate that technology is used for various purposes at the Teacher Training College (TTC). It was observed that while some individuals used technology primarily for research, teachers frequently used it for lesson preparation, with computers and internet access being the most commonly used tools. These findings underscore the essential role of technology in modern education, highlighting its necessity in contemporary academic and professional settings.

Table 4. What are the advantages and disadvantages of using technology in teaching and learning?

Advantages	Disadvantages
It helps in research	It is time-consuming
It improves knowledge retention	
It enhances creativity and innovation	
It provides up-to-date information	
Enables access to information	
It is more interesting and encourages individual learning.	
It makes learning easier	
Develops digital literacy	
It improves collaboration and communication	
It creates new ways to learn	

Teachers and students came up with the advantages and disadvantages presented on the table above

Both teachers and students acknowledge benefits of technology in education, particularly in facilitating lesson preparation, enhancing student motivation, and increasing engagement in the learning process. Given its transformative impact on teaching and learning, technology is not merely a luxury but an essential component of modern education.

Table 5. What factors can promote use of technology in the classroom within your TTC?

Statement	Number of Participants
Good administration	25
Skilled tutors	28
Availability of technology tools	18
Learner's attitude	14
High-speed internet	30
Curriculum	6
ICT LAB	14
E-learning courses	10
English proficiency	8

The aforementioned factors were identified by participants as key contributors to integration of technology in the classroom. Among the most significant factors are effective administration, skilled educators, and high-speed internet, followed by availability of technological tools. This suggests that when an institution possesses strong administrative support, qualified instructors, and reliable internet connectivity, alongside adequate technological resources, it is more likely to successfully implement technology in educational settings. Additionally, it was observed that well-developed infrastructure, such as ICT laboratories, facilitate students' use of technology [22]. However, the Teacher Training College (TTC) in this study had only one ICT laboratory serving approximately 300 students and was staffed by only two ICT instructors, thereby limiting students' access to technological resources. Students' attitudes and socioeconomic backgrounds hindered effective utilization of technology in the classroom since majority of students come from low-income families that cannot afford technological gadgets and most schools in the village rarely engage in

technology. This means that a number of students come to TTC with limited technological skills thereby developing a negative attitude towards use of technology. The fact that ICT is not an examinable subject in secondary schools in Rwanda making it more of an option than a compulsory examinable subject leads to poor preparation among students from rural secondary schools. Many students in TTC Gacuba have limited English proficiency which further affects their use of technology in learning. Although the TTC is doing well, improvement on the highlighted factors can improve technology in teaching and learning immensely.

Table 6. What challenges do you face in using technology in the teaching and learning process?

Challenges	Number of participants
Lack of enough time	20
Unstable internet connection	16
Lack of skills in learners	18
Lack of enough infrastructure	10
Inadequate technological tools	12

Both students and teachers expressed concerns regarding the limited time available for using technology in the learning process. Students, for instance, have a maximum of two lessons per week in the ICT laboratory, which is insufficient for full integration of technology in their studies. Teachers, on the other hand, face challenges related to students' limited digital literacy, hindering effective delivery of instructional content when using technology. As a result, educators often resort to traditional teaching methods, which are perceived as more time-efficient. Additionally, unstable internet connectivity disrupts planned technology-based lessons. These and other challenges, as presented on the tables above present significant barriers to full-scale integration of technology in teaching and learning processes.

RECOMMENDATIONS

There is need to;

- (i) Provide more ICT laboratories and infrastructure in the teacher training colleges to cater for expanded technological needs.
- (ii) Motivate teachers and students to use technology.
- (iii) Allocate more time in the teaching timetables to cover computing and ICT related lessons.
- (iv) Provide Institutional online assignments in every subject to enable students get used to using technology.
- (v) Provide regular ICT Training workshops for both teachers and students as a way of integrating technology in teaching and learning.
- (vi) Ensure un-interrupted access to internet access and employment of ICT trained teachers.

REFERENCES

1. Arvindham, M. (2019). "A Research Paper on Modern Technology" in JETIR, January 2019, 6(1) (www.jetir.org,ISSN-2349-5162)
2. Etesike, C. N. (2019). Indispensable roles of educational technology resources in achieving education for all: Implications to sustainable peace and security in Nigeria. International Journal of Educational Policy Research and Review, 6(1):15-20.
3. Murati, R., Ceka, A. (2017). The use of Technology in Educational Teaching" in Journal of Educational and Practice 8(6)
4. Mishra, P., Oster, N., Henriksen, D. (2024). Generative AI, teacher knowledge and educational research: Bridging short-and long-term perspectives. TechTrends, 68(2), 205-210.
5. North, C., Trucano, M. (2024). "The Rise of Technology for Education: Launch of the Global Reference Group" retrieved from <https://www.globalpartnership.org>
6. HolonIQ. (2021). (2021). Global Education Outlook. HolonIQ. <https://www.holoniq.com>
7. UNESCO 2023, "Global Education Monitoring Report, Rwanda Technology" <https://educationprofiles.org>
8. Rubagiza, J., Were, E (2011). "Introducing ICT into Schools in Rwanda: Educational Challenges and Opportunities, International Journal of Educational development, 31(1): 37-43

9. Budhwar, K. (2017). "The Role of Technology in Education", *International Journal of Engineering Applied Sciences and Technology*, 2(8): 55-57
10. Grubler (2015). "Technology: Concepts and Definitions" in *Technology and Global Change* retrieved from <https://www.cambridge.org>
11. Magtibay, C. L. (2019). "What is Technology?" retrieved from <https://www.scribid.com>
12. Stoistic (2015). "The Importance Educational technology in Teaching", retrieved from *International journal of Cognitive Research in Science, Engineering and Education*, 3(1)
13. Maduka, C. (2024). "Why Educational Technology is Important? The importance of educational technology in 2024" retrieved from learnwithpride.co.uk
14. Hodge, S., Lieberman, L., & Murata, N. (2017). *Essentials of teaching adapted physical education: Diversity, culture, and inclusion*. Routledge.
15. Verma, A. (2019). "Use of Information Technology in Research" *JETIR*, June 2019, Volume 6, Issue 6; www.jetir.org(ISSN-23-5162) rdb.rw (2025)
16. Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). *Assessment and teaching of 21st century skills*. Assessment and teaching of 21st century skills, 17-66.
17. Ramalia, S. and Molwele, A. J. (2022) "The Role of Science and Technology Education" in the *International Journal of Higher Education* Vol. 11. No.5. 2022 <http://ijhe.scidupress>
18. Mwinyi H. (2024). "Challenges and Opportunities of Implementing Education Technology in Rural and Underserved Areas of Tanzania: Assessing the Sustainability and Educational Impact of Such Initiatives" in *African Journal of Education and Practice* 10(4): 27-39
19. Harrell, S. Bynum, Y. (2018). "Technology Integration in the Classroom" in *Alabama Journal of Educational Leadership*, 5, 12-18,
20. Ubaidiallah, N. Z. Baharuddin, N. N (2020). *Students' Perception of the Use of Technology in Education*, in *Environment Behaviour Proceedings Journal* 5(15). 117-122
21. Parveen, D. S., Ramzan, S. I. (2024). *The role of digital technologies in education: benefits and challenges*. *Int. Res. J. Adv. Eng. Manag*, 2, 2029-2037.
22. Mpuangnan, K. N. (2024). *Teacher preparedness and professional development needs for successful technology integration in teacher education*. *Cogent Education*, 11(1), 2408837.