ICT Integration in Rwandan Education: A Scoping Review of Opportunities and Challenges

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https://doi.org/10.51867/ajernet.6.1.21

ABSTRACT

This review paper examines the opportunities and challenges of integrating Information and Communication Technology (ICT) into Rwanda's education system. It aims to identify the potential benefits of ICT in teaching and learning, while also addressing the barriers that impede its effective use. Using the Diffusion of Innovation Theory, the study analyzes 17 publications from Google Scholar, ERIC, and Scopus, highlighting Rwanda's efforts to transition to a knowledge-based economy through substantial ICT investments. The review identifies key opportunities such as improved teacher professional development, enhanced learning outcomes, increased access to educational resources, better school administration efficiency, and support for inclusive education. However, challenges remain, including limited internet access, a shortage of skilled human resources, inadequate project governance, and insufficient maintenance of ICT equipment. To overcome these issues, the paper recommends increased funding for ICT device maintenance, expanded ICT training for teachers and students, enhanced regulatory frameworks for emerging technologies, and greater equity in access and awareness. These measures aim to close existing gaps and optimize ICT integration in Rwanda's education system.

Keywords: Information and Communication Technology (ICT), ICT Integration, Rwanda's Education System, Teaching and Learning

I. INTRODUCTION

Information and Communication Technology (ICT) has become a pivotal element in modern education systems, significantly impacting teaching and learning processes (Bibakumana & Niyibizi, 2024). There is a need to regulate the ICT environment and costs that facilitates competition in the ICT sector in Africa as well as increase the innovative approaches to fix the issues related to line telephony and fixed wireless access (Esselaar et al, 2006).

Though the developments and announcements related to ICT in education occur frequently across the African continent, the integration of ICT in education remains in its early stages across most countries in sub-Saharan Africa and in most countries, progress is uneven and often slow due to challenges such as inadequate policies, limited infrastructure, insufficient financial resources, and a lack of teacher training. Consequently, the selective introduction of ICT in a minority of schools risks worsening the digital divide, with disparities influenced by factors such as gender, geographical location, and socio-economic status (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015).

In Rwanda, as stated by the International Labor Organization (ILO), the integration of ICT in education is seen as a critical factor toward achieving Vision 2050, which aims to transform the country into a knowledge-based economy (ILO, 2023). Rwanda's commitment to integrating ICT in education is reflected in various programs and documents. For instance, the 2016 Rwanda ICT in Education Policy outlines the government's vision to harness the potential of ICT to improve the quality of education and training at all levels (Ministry of Education [MINEDUC], 2016). The policy highlights key areas such as infrastructure development, teacher training, and curriculum integration. The Education Sector Strategic Plan (2018-2024) also emphasizes the role of ICT in achieving educational objectives and improving learning outcomes (Ministry of Education, 2018). As well, several other studies have explored the status of the integration of ICT in Rwanda's education system. Munyengabe et al. (2017) examined primary teachers' perceptions of ICT integration through the One Laptop per Child program and found that though teachers recognized the potential benefits of ICT, challenges such as lack of training and inadequate infrastructure hindered effective implementation.

Similarly, Byungura et al., (2016) conducted a critical discourse analysis on ICT capacity building in Rwanda and highlighted that there are issues related to infrastructure, training, and sustainability of ICT.

This scoping review article explores the opportunities and challenges associated with the use of ICT in teaching and learning in Rwanda within the last ten years to synthesize the evidence and devise recommendations to inform policy and practice accordingly. It aimed to conduct a comprehensive review of existing literature on the use of ICT in education. Particularly, the focus is put on studies and reports relevant to the Rwandan context to identify diverse opportunities and challenges of the integration of ICT in teaching and learning process. Examining the potential presented by ICT is an important win because it provides a quick overview of the role that ICT plays within schools so that educators, learners, and other partners in the classroom can see its importance and take advantage of it to improve student performance and learning. On the other hand, investigating the obstacles to ICT usage in schools effectively offers suggestions for different approaches to improve technology integration and promote its effective use.

1.1 Statement of the Problem

Information and Communication Technology (ICT) has been widely recognized as a powerful tool for enhancing education, fostering teacher development, and promoting student engagement and critical thinking. Many developing countries, including Rwanda, have invested heavily in ICT integration within their education systems, in alignment with national initiatives such as Vision 2050 and the SMART Rwanda Master Plan (Laterite, 2023).

However, despite these ambitious goals, Rwanda faces significant challenges in effectively implementing ICT in education. According to the Ministry of ICT and Innovation (MINICT), these barriers hinder the full realization of ICT's potential in schools, creating a gap between policy intentions and actual outcomes (MINICT, 2020). If these challenges remain unaddressed, they could limit students' ability to acquire essential digital skills needed for future success in a knowledge-based economy.

While numerous studies on ICT integration in Rwanda's education system have been conducted, no comprehensive scoping review has been undertaken to date. A scoping study is crucial, as recommended by Zeitlin and Bower (2018), to better understand the role of ICT in education. Moreover, Kano and Toyama (2020) suggested that further research should explore these challenges from broader perspectives and in different geographical contexts.

Given this, it is essential to regularly assess both the opportunities and challenges surrounding ICT integration in Rwanda's education system. Without a clear understanding of these dynamics, future ICT investments may fail to achieve their goals or exacerbate existing educational inequalities. This research aims to conduct a scoping review to identify the opportunities and challenges of ICT integration in Rwanda, providing policymakers, educators, and stakeholders with critical insights and recommendations to align policy with practical implementation.

1.2 Research Objectives

This research was geared by the following objectives:

(i) Identify various opportunities that the integration of ICT presents in the teaching and learning processes in Rwanda.
(ii) Examine the challenges that hinder the effective use of ICT in education in Rwanda.
(iii) Devise recommendations for heightening of the ICT usage in Rwandan education.

1.3 Research questions

This review sought to answer the following questions:

(i) What are the opportunities that the integration of ICT presents in the teaching and learning processes in Rwanda?
(ii) What are the challenges that hinder the effective use of ICT in education in Rwanda?
(iii) How can the hampering challenges be alleviated to heighten the ICT usage in Rwandan education?

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Diffusion of Innovation (DOI) Theory

This theory explains how, why, and at what rate new ideas, processes, and technology spread through a population or community (Weil, 2018). In the context of this scoping review, it helped to highlight insights on various factors affecting adoption rates and offered understanding of potential approaches for overcoming the challenges that educators and policy makers may face in integrating ICT in educational settings.

Through a thematic review approach, various themes have led the revision, synthesizing and providing comprehensive focus for future interventions and policy adjustments. They include the enhancement of learning outcomes, access to educational resources, professional development of teachers, improving the overall efficiency of school administration as well as the support for inclusive education.

2.2 Empirical Review

The empirical review in this paper highlights key opportunities that were summarized in various studies and reports as well as impeding challenges that still emerge in the journey for effective implementation of various projects aiming at improvement of ICT penetration and integration in teaching and learning. It also includes the devised recommendations for enhancing the use of ICT in education in Rwanda. That review is summarized in the following table.

Table 1

Summary of Selected Studies

SN	Authors and year of publication	About the study
1	Bibakumana & Niyibizi (2024)	This study investigated the role of ICT in fostering inclusive education within the College of Business and Economics at the University of Rwanda, where it focused on the experiences, challenges, and outcomes associated with ICT integration. It found positive outcomes, including improved accessibility, enhanced student engagement, and the importance of teacher training but some challenges like addressing diverse learning styles, digital literacy, and ongoing adaptation were acknowledged as well.
2	Bizimana, (2018)	This paper examined the extent of educational transformation in Rwanda through ICT focusing on progress and challenges and it shows that various programs, projects, plans and policies to promote ICT infrastructure were put in place but this there are still inconsistencies in access, awareness and skills between rural and urban areas, among levels of education and among different clusters of users.
3	Byungura, et al. (2016)	The study dealt with the investigation of the articulation of ICT capacity building strategies from both national and institutional ICT policies in Rwanda, focusing on the higher education. It has found that strategies for building ICT capacities are evidently observed from national level policies and only in two institutional policies (former KIST and former NUR).
4	International Labor Organization (2023)	This is a background paper on teaching and the teaching profession in a digital world–Rwanda which highlights key issues on how teaching is done in a digital world. It shows that technology provides access to a broader range of learning resources and knowledge, as well as opportunities to improve communication and digital skills, which can help in developing a positive attitude to using technology to resolve issues, developing course materials and using new ways to share material and knowledge, such as cloud platforms.
5	MINECOFIN (2020)	*Republic of Rwanda VISION 2050 is a national document that a*rticulates the long-term strategic direction for "the Rwanda we want" and the enabling pathways to achieve this ambition of transforming its economy and modernize the lives of all Rwandans including a youthful population, a fertile agricultural landscape, natural resources and a good foundation of ICT.
6	MINICT (2019)	ICT Hub Strategy work describes the ICT vision for Rwanda where it outlines the overall vision and proceeds to elaborate the vision and mission down into the distinct goals that Rwanda needs to attain in order to transform into a leading ICT hub. It also describes the Implementation and Management Framework of the ICT HUB Strategy.
7	MINICT (2019)	It is a report that records the achievements of implementation the Smart Rwanda Master Plan (SRMP), which was approved by the cabinet on November 3rd, 2015. This strategic plan towards the knowledge-based economy focuses on the digital transformation in seven key sectors. In order to achieve the transformation in these sectors, it relies on three key enablers including ICT governance and management, digital talent development, and broadband for all through shared ICT infrastructure.
8	Ministry of Education (2016)	This is a national ICT in education policy that shows the key targets of the government, like increasing the access to basic education for all using ICT as one of the major tools for learning, teaching, searching and information sharing as well as contributing to the development of a workforce equipped with the ICT skills needed for employment and use in a knowledge-based economy.

9	Ministry of Education (2018)	This is a document that highlights the Rwandan Education Sector Strategic Plan 2018-2024. It shows that the education sector aims to promote access to education at all levels, improve the quality of education and training, strengthening the relevance of education and training in order to align with labor market.
10	Ministry of Education (2023)	This comprehensive report presents detailed information on the status of education for the school year ended in July 2022. It highlights an informative data insight on various aspects of education, including available school infrastructure and materials, access to education, enrolment, retention, gender parity, school staff, ICT in education and school textbook.
11	Munyengabe et al. (2017)	The research summarized primary teachers' perceptions on ICT integration for enhancing teaching and learning through the implementation of one Laptop Per Child program in primary schools of Rwanda and it found that the integration of ICT through implementation of OLPC program requires to help teachers to acquire skills related to TPACK.
12	Njiku et al. (2022)	The researchers explored the level of mathematics teachers' technology integration self-efficacy. It showed that gender and teacher training in technology integration are both important in influencing teachers' self-efficacy in teaching with technology.
13	Ntawiyanga et al. (2020)	The authors sought to examine the key determinants of school performance in selected public secondary schools in Rwanda and it found that those schools are not sufficiently provided with educational inputs, and more investment should be made on the key determinants for greater output among secondary schools in the country.
14	Tikly & Milligan (2017).	This was a report that summarized the overview of the 26 innovations for education (IFE) projects that were initiated in Rwandan educational institutions, classrooms and communities between March 2013 and March 2015. They concerned improving learning for all; effective teaching and learning (including through ICT); improving access and retention; leadership and accountability as well as skills development. The e-teacher training at Teacher Training Colleges introduced techniques for using ICT across the curriculum and built the capacity of pre-service teacher trainers to train teachers in using ICT effectively was one of the results reveled.
15	UNESCO (2021)	This report from UNESCO-KFIT Project is about ICT Transforming Education in Africa. It highlighted the ICT initiatives produced, and the teachers who were trained on various pedagogical use of ICT as well as e-assessment system creation.
16	VVOB (2019)	This is a joint concept note from UR, VVOB and REB that focused on the integration of ICT in continuous professional development. It summarizes the practices on how ICT is integrated within CPD training programs and how it is introduced in professional learning networks to aid in the monitoring and evaluation, and to give teachers and school leaders access to multimedia resources for facilitation of such networks. It shows that it gave 3 key benefits: cost effectiveness, flexibility and personalized learning.
17	Wallet & Kimenyi (2019).	The study aims to showcase Rwanda's customized approach to the integration of ICT in classrooms adapted to meet the needs of the Rwandan education system. It demonstrates that although there have been several challenges encountered during the various phases of implementation, more than half of all schools across the country are now equipped with ICT devices and many teachers have undergone various capacity-building initiatives to make better use of ICT in teaching and learning. However more work is required to develop a fully functioning ICT in education ecosystem in Rwanda; regardless of the progress made.

Opportunities

The integration of ICT in education in Rwanda presents numerous opportunities for enhancing teaching and learning processes and improving access to education. Enhancing learning outcomes is the leading opportunity presented by the integration of ICT in education in Rwanda. Several studies have highlighted various strategies and interventions that contribute to improved educational outcomes. One of those strategies is the integration of ICT in education which has the potential to significantly enhance learning outcomes. ICT facilitates personalized learning, which allows students to learn at their own pace and according to their individual needs. It is one the ways that educational software and digital

resources make learning more interactive and engaging, leading to improved understanding and retention of information (Munyengabe et al., 2017).

Another research reveals that Rwanda has initiated various programs and projects which led to the improvement of learning outcomes. Some of those projects include but are not limited to Emergent Literacy and Maths Initiative, Language Supportive Textbooks and Pedagogy, Rwanda Children's Book Initiative, among others (Tikly & Milligan, 2017). Additionally, ICT tools can provide immediate feedback, helping students to identify and address their weaknesses promptly. Through personalized learning, as found in a study conducted by Vlaamse Vereniging voor Ontwikkelingssamenwerking en Technische Bijst (VVOB), a Flemish Association for Development Cooperation and Technical Assistance; learners can go more into depth in topics they find relevant to engage further with and it can create ownership over their own learning which can increase the effectiveness of learning and increases learning outcomes (VVOB, 2019). On this point of enhancing learning outcomes, studies have clearly shown how ICT provides various tools that facilitate learning through providing instant feedback and make learners more interactive in their lessons; but they have to add that ICT fosters global collaboration and networking since learners cannot learn in isolation and they are not islands. Through the use of ICT, learners can exchange with peers and experts across the world using various channels of communication or even access/attend to online classes.

Another key opportunity of ICT in education is the expansion of access to educational resources. The internet provides vast amounts of information that can be utilized for educational purposes. In Rwanda, from a report by the Ministry of ICT and innovations (MINICT); physical resources such as textbooks may be limited, ICT tools has come to help bridge this gap by providing digital textbooks and online learning materials (MINICT, 2019). This access is particularly crucial in remote and underserved areas, ensuring that all students have equal opportunities to quality education. Talking about access to educational resources, especially in some remote and hard-to-reach areas, was a key aspect to note. However, it's worth pointing a finger that ICT removes all the geographical as well as economic obstacles and encourages a flexible and collaborative learning environment where learners can even get affordable learning applications like Quizlet, cahoots and many others, all aiming at the improvement of their learning.

Besides the educational resources, another opportunity that was raised by research on ICT integration in education is the enhancement of professional development of teachers. Online courses, webinars, and digital communities of practice provide teachers with continuous learning opportunities, helping them stay updated with the latest educational trends and pedagogical techniques. Additionally, ICT facilitates collaborative learning among teachers, allowing them to share best practices and resources, thereby improving their teaching effectiveness (Byungura et al., 2016). Within the recent years, Rwandan education has welcomed a good number of partners that contributed much to the development of education, especially on the side of professional development of teachers. For instance, a project was introduced to enhance teachers' abilities to integrate ICT in the classroom, by supporting the development of frameworks, the validation of certification standards and the piloting of training programmes such as the ICT Essentials for Teachers and the Advanced ICT Essentials for Teachers.

Similarly, there was an establishment of e- assessment system in blended mode of delivery for both secondary and higher education. (UNESCO, 2021); but all leading to the a main theme that there is a big role played by professional development programmes in technology integration because it may also influence teachers' self-efficacy as they continue to work and integrate technology in various courses that they teach (Njiku et al., 2022).

Furthermore, digital records are easier to manage and retrieve, improving the overall efficiency of school administration. ICT can streamline administrative tasks in educational institutions, making processes such as grading, attendance tracking, and communication more efficient. This allows teachers to focus more on teaching and less on administrative duties (Ministry of Education, 2023). At this point of school management, there is a need to add the way ICT allows not only administrators but also teachers to track student progress, analyze their performance and use data to adapt lessons for more productive use.

ICT has also brought support for inclusive education by providing tools that cater to the needs of students with disabilities. Assistive aids to inclusive education technologies such as screen readers, speech-to-text software and adaptive learning platforms help ensure that all students have equal access to education (Bibakumana & Niyibizi, 2024). These technologies can significantly improve the learning experiences of students with disabilities, by enabling them to participate fully in educational activities where they got improved accessibility, positive outcomes in student engagement, and play a crucial role of teacher training as well (Bibakumana et al., 2024). The focus here has been on the assistance of students with disabilities, yet inclusive education goes beyond that. It caters also for the multilingual and culturally diverse students, students of different abilities as well as marginalized/disadvantaged students like refugees and others. So those categories of students are supported by ICT since it offers peer and collaborative support and inclusive assessment and feedback. In addition, students can easily use ICT tools to access educational resources in their language and at any time they wish to.

The above discussed opportunities are due to efforts made by the government of Rwanda and its partners especially in the field of education by investing a lot in the ICT infrastructure, teaching and learning resources as well

as in the training of teachers. However, some gaps still emerge and need more interventions from concerned stakeholders to join hands and support students and teachers in achieving their objectives as well as achieving the goals of the country at large.

Challenges

One of the significant challenges in integrating ICT in education in Rwanda is the lack of adequate infrastructure and connectivity. While there have been efforts to improve internet access, many rural areas, as shown by the Ministry of ICT and innovations (MINICT), still suffer from poor connectivity and limited access to computers and other digital devices (MINICT, 2019). Such digital divide poses a barrier to the effective integration of ICT in education, Students and teachers in these areas cannot fully benefit from digital learning resources because internet continues to create a particularly significant challenge for Rwandan schools given the prohibitive commercial costs associated with subscription. The shortage of electricity in schools, particularly in remote regions continues to be a challenge for the introduction of ICT in all of Rwanda's schools (Wallet & Kimenyi, 2019). It is obvious that in some remote schools, it is very hard to get connected to electricity which is a key operator to many of ICT tools including computers, tablets, telephones, televisions, radios. The lack of a reliable internet connection, sufficient and updated devices as well as inadequate electricity supply also make it difficult for schools and students to access equitable technology-enhanced learning opportunities. However, those conditions are not the same in urban areas as they are in rural ones. For example, in some inaccessible rural areas where basic infrastructures like roads are hard to travel, it is difficult to deliver some ICT equipment which makes it more impractical for schools to have them.

Pupil-teacher ratios, especially in primary education in the region (about 58:1 and beyond) is another reported challenge. Indeed, classroom sizes can be very large and possibly impede effective use of ICT in education (Wallet & Kimenyi, 2019). This issue is considerably related to the high number of learners who come to school as it affects teaching. The high number of students leading to high pupil-teacher ratios, complicates ICT integration by limiting individual attention, overstretching resources, increasing teacher workload and making classroom management difficult because it overburdens teachers who are required to monitor what learners are doing which seems very hard in overcrowded classes. Teachers are therefore discouraged from using technology consistently in the classroom. That situation constitutes a limitation to regular feedback since teachers cannot easily manage students' behaviors while troubleshooting technical issues like login problems, device malfunctioning then provide instant constructive and timely feedback to learners' attempts. All these reduce the effectiveness of ICT based lessons.

Besides, the teacher's low capacity and skills have been previously noted too as one of the causes for poor ICT usage in learning. This has brought the attention of the government and it has led to, in addition to the recent teacher salary increase, effort by the government to allocate resources aimed at improving teacher quality where a good amount of budget has been allocated to cater for training teachers especially in teacher pedagogical capacity building and teaching-learning materials as well as improving teacher proficiency in English (MINEDUC, 2023). Teacher's low capacity and skills is one thing, but we cannot ignore that it is mostly accompanied or associated by the lack of confidence and/or reluctance since teachers will not be sure of how to operate some ICT tools, educational software or solve some technical issues. This brings doubts and fear of making mistakes in a belief that things might not work and therefore shame the teacher in front of his learners.

The cost of ICT implementation is another critical challenge to note. Procuring hardware, software, and ensuring regular maintenance requires substantial financial investment. Additionally, there is a need for continuous funding to update technology and provide training for teachers (Ministry of Finance and Economic Planning [MINECOFIN], 2020). Such challenge can be a significant burden for a developing country like Rwanda, with limited resources often allocated to various competing needs. Most ICT projects are initially donor funded with operational and though the budgets for ICT are inadequate but rising, the funding (capital and human resource requirements) ends with the project phase (MINICT, 2019). This unravels the government's struggle to upkeep the projects started by those donors when the project timeline ends. There is therefore a need to reallocate some funds for such projects to sustain. However, the cost of implementation discussed here must be extended to initial training costs and upskilling as technology keeps evolving, the trainings need to always be updated as well because the trainers and other costs incurred are demanding and become difficult to many developing countries to afford.

Integrating ICT into the curriculum requires careful planning and development of relevant content. There is a need for digital educational resources that are aligned with the national curriculum and tailored to the local context. Developing such resources can be time-consuming and costly (MINICT, 2019). This is true because ICT is not merely limited to hardware, curriculum development and creation as well as reshaping the existing contents is of paramount to fit within the evolving technologies but it is not a straightforward action since it requires all the procedures of curriculum change, experts in the domain and the costs allied to such a long process. Therefore, ensuring that these resources are culturally relevant and linguistically appropriate is essential for effective learning.

Not least, the ongoing technical support and maintenance which is crucial for the sustainability of ICT initiatives is still challenging as well. As it was highlighted in Byungura et al., (2016); schools need to have access to technical expertise to address issues such as software updates, hardware repairs, and network problems because the Ministry of education supplies computers without the provision of additional funds for maintenance, which requires huge payments to private technicians for repair (Bizimana, 2018). However, the availability of such support is limited, especially in rural areas without proper maintenance and technical support, the effectiveness of ICT tools can be compromised. This technical support mentioned here requires trained technical staff who can effectively follow up the daily upkeep of the technological tools used at school and not every school in Rwanda is readily prepared or financially fit enough to regularly pay those technicians. Therefore, it remains a hindering challenge to many schools even if they may have purchased or been donated various ICT tools.

The challenges discussed, among others, hinder the effectiveness of ICT integration and the achievement of teaching and learning objectives as required. That's why joint responsibilities of all educational institutions and stakeholders, including educational policy makers, are mandatorily required to invest in solving the identified challenges.

III. METHODOLOGY

This paper is a scoping review that adopted a qualitative desk review method. The researchers conducted a primary search through the published research articles and reports. The review is concerned with a critical examination of 38 studies and reports as published on ICT in education in Rwandan context within the scope 2014 to September 2024 when the researchers conducted the review. The examined materials were written in English language and were retrieved from the electronic database mainly google scholar, ERIC and Scopus. The researchers recovered reviewed peer reviewed journals (both empirical and theoretical) and reports during the initial search and selected the literatures that were focusing on education in Rwanda.

Based on the purpose of this scoping review, the published papers that were not related to ICT in education were excluded. After an analysis of the consulted works, the studies and reports that remained were 17. Researchers adopted a systematic analysis to review the existing literature grounded on the construct of the recent review, and the findings were presented. Figure 1 shows the systematic reviews used in this article.

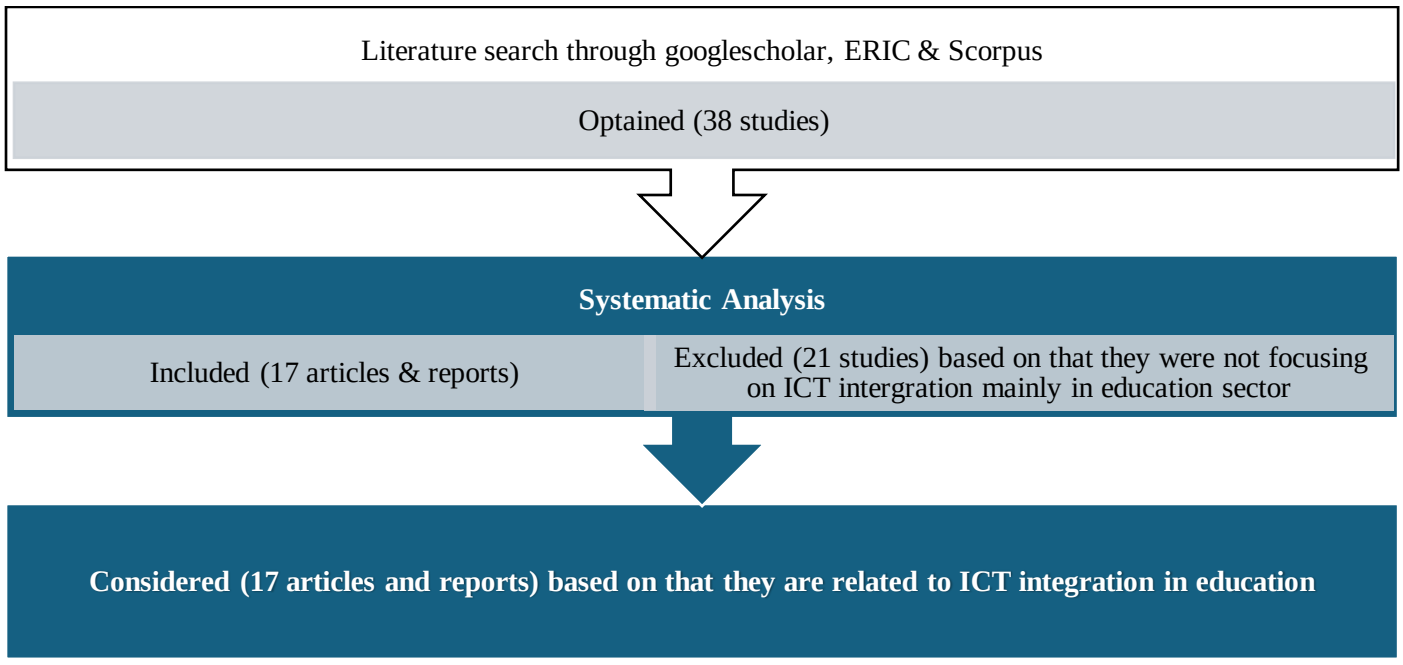

Figure 1
Diagram Showing the Selection Process of the Reviewed Articles

IV. FINDINGS & DISCUSSION

The integration of Information and Communication Technology (ICT) in education in Rwanda represents a transformative opportunity to enhance learning experiences and outcomes. However, it also presents significant challenges that require thoughtful and collaborative solutions.

This paper discusses the opportunities and challenges of ICT integration in Rwandan education and outlines strategies to ensure successful implementation. We find that ICT integration in Rwanda offers numerous opportunities for improving education, such as enhancing learning outcomes, expanding access to resources, and supporting teacher professional development, however, significant challenges remain. These include infrastructure gaps, teacher capacity, the high cost of implementation, and a lack of technical support. Addressing these challenges will require coordinated efforts from the government, education institutions, and stakeholders to ensure the successful integration of ICT and achieve the country's educational goals.

One of the most significant opportunities presented by ICT in Rwandan Education is the enhancement of learning outcomes. With personalized learning facilitated by educational software and digital resources, students can learn at their own pace, leading to better engagement, understanding, and retention. This approach has been supported by various initiatives established by the Rwandan government, which aim to improve educational outcomes by providing immediate feedback and addressing students' weaknesses effectively (Zeitlin & Bower, 2018). Additionally, ICT facilitates access to educational resources, particularly in rural areas where physical resources such as textbooks are limited. By removing geographical and economic barriers, ICT makes learning more accessible and flexible (Sharma, (2022). Digital platforms provide students and teachers with a wealth of resources, enabling them to access up-to-date information and materials that would otherwise be unavailable in their immediate environment. This accessibility contributes to reducing the educational disparities between urban and rural areas.

In the same vein of thinking, ICT also supports professional development of teachers through online courses, webinars, and digital communities of practice. These platforms allow teachers to stay updated with the latest methodologies and subject-specific advancements. That opportunity also adds to ICT helping to streamline administrative tasks like grading, attendance, and communication, improving the overall efficiency of school administration like allowing teachers to track student progress, adapt lessons, and reduce the burden of administrative duties (Pérez et al., (2024).

Inclusivity is another critical benefit of ICT in education. Tools such as screen readers, speech-to-text software, and adaptive learning platforms support students with disabilities, ensuring they can participate fully in educational activities. ICT also benefits multilingual, culturally diverse, and marginalized students by providing educational resources in various languages, fostering a more inclusive learning environment (Global Partnership for Education, 2023) by addressing the diverse needs of learners, ICT contributes to creating a more equitable education system in Rwanda.

Despite these opportunities, significant challenges hinder the effective integration of ICT in education. Limited infrastructure and connectivity issues remain key barriers, especially in rural areas. Poor internet connectivity, a lack of digital devices, and inadequate electricity supply hinder the consistent use of ICT in classrooms. These challenges are exacerbated by high pupil-teacher ratios and overcrowded classrooms, which limit teachers' ability to provide individual attention and manage technical issues effectively (ILO, 2023).

Teacher capacity and skills also pose challenges. Some teachers lack the necessary ICT skills and confidence to incorporate technology into their teaching. This reluctance is often compounded by fears of technical issues, such as device malfunctions, which discourage consistent ICT use. Additionally, the poor alignment of digital educational resources with the national curriculum limits the relevance and effectiveness of ICT in improving learning outcomes (ILO, 2023).

The high cost of ICT implementation and the lack of technical support further impede progress. Procuring and maintaining ICT infrastructure, including hardware and software, is expensive, particularly for schools in remote areas. Many donor-funded projects face budget limitations after the initial phase, resulting in slow or incomplete implementation. Moreover, the lack of trained technical staff to repair and maintain ICT tools adds to the challenge, leaving schools unable to sustain their ICT initiatives (Zeitlin & Bower, 2018).

To address these challenges and maximize the benefits of ICT in education, a coordinated effort is required by the government, educational institutions, and stakeholders. Investments in infrastructure, such as reliable internet connectivity and electricity, are essential to support ICT integration in schools, particularly in rural areas. Expanding access to affordable digital devices and ensuring their equitable distribution will also help bridge the digital divide.
Teacher training programs should be prioritized to build capacity and confidence in using ICT effectively in the classroom. These programs should focus on both technical skills and pedagogical strategies for integrating technology into teaching. Additionally, aligning digital resources with the national curriculum will ensure that ICT tools are relevant and useful for achieving educational goals.

Sustainable funding models are necessary to address the high costs of ICT implementation and maintenance. Partnerships between the government, private sector, and international organizations can help secure the resources needed to support long-term ICT initiatives. Establishing regional technical support centers can also provide schools with access to trained personnel for repairing and maintaining ICT tools, ensuring their consistent use.

Finally, fostering a culture of innovation and collaboration is vital for the successful integration of ICT in education. Encouraging schools to share best practices, promoting research on ICT in education, and engaging stakeholders in the decision-making process will create a more inclusive and effective system. By addressing these challenges and leveraging the opportunities, Rwanda can hitch the full potential of ICT to transform its education sector and achieve its development goals.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The integration of Information and Communication Technology (ICT) into Rwanda's education system offers significant benefits, including enhanced learning outcomes, broader access to educational resources, and stronger support for teachers. This review highlights both the promising opportunities and persistent challenges associated with ICT adoption in Rwandan education. While substantial investments in ICT infrastructure and training programs have facilitated improvements in teacher professional development, access to resources, school administration efficiency, and inclusive education, challenges such as low internet penetration, a shortage of skilled human resources in science and technology, weak governance, and inadequate maintenance of ICT equipment continue to hinder its effective use. Addressing these challenges is crucial to realizing the full potential of ICT integration in Rwanda's education system.

5.2 Recommendations

Based on a thorough review of the literature, several suggestions are made to improve ICT integration in Rwanda's education system:

The government, in partnership with stakeholders, should work to improve internet connectivity and consider off-grid energy solutions like solar power for schools, especially in rural areas. Additionally, efforts to make internet subscriptions more affordable could help close the connectivity gap.

Collaboration with the private sector and international organizations to secure funds for ICT investments would be beneficial, ensuring a system for technical support and staff training in maintenance.

Teacher training programs, focusing on both technical skills and teaching methods, are crucial to boost teachers' confidence and ability to use ICT effectively.

More classrooms and additional teachers are needed to improve teacher-learner ratios and support better learning outcomes.

Curriculum developers and educators should work together to create digital content tailored to Rwanda's national curriculum, making it engaging and accessible.

Finally, further research on ICT tool usability and training needs would help ensure the successful integration of ICT into education in Rwanda.

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