ICT for Teaching Science at Secondary Level of Education: Problems and Prospect based on Review on Literature

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Abstract

Information and Communication Technology (ICT) is an important tool in everyday life with the uprising technological world. Education has also integrated ICT to a great extent in its world. The use of ICT in schools and colleges has become one of the criteria for assessment. The present article is a summary of several reviews of literatures all connected with the integration of ICT in education. The integration of Information and Communication Technology (ICT) in science education at the secondary level in Mizoram presents significant opportunities but also faces notable challenges. The findings mainly showed that the integration of ICT in science education in Mizoram faces challenges like inadequate infrastructure, poor funding, teacher training gaps, power issues, and resistance to change. However, ICT offers prospects such as enhanced learning, access to resources, inquiry-based learning, and bridging urban-rural gaps. Addressing these challenges and leveraging ICT's potential can transform education and prepare students for the digital age.

Key words: *ICT, Secondary school, Mizoram, problems, prospects*

Introduction

With the rapid emergence of technology, the integration of Information and Communication Technology (ICT) as a means of learning has become increasingly essential across all levels of education. Recognizing this need, the Ministry of Human Resource Development (MHRD) introduced the ICT @ School scheme, aimed at modernizing education through the adoption of digital tools and resources. In Mizoram, this initiative has had a significant impact, fostering the use of ICT as a

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mode of learning even in a state where traditional teaching methods have long been dominant. Since its inception in the financial year 2005-06, the ICT @ School scheme has been implemented in all 348 approved schools in Mizoram by the financial year 2017-18, reflecting the state's commitment to embracing technological advancements in education. This widespread implementation has enabled schools to integrate digital tools such as computers, projectors, and internet-based resources into their teaching and learning processes, enhancing the overall educational experience. The government has taken proactive measures at various levels to promote ICT usage, including providing infrastructure, training teachers, and developing digital content aligned with the curriculum. These efforts have not only improved access to quality educational resources but have also made learning more interactive and engaging for students. Teachers, equipped with ICT skills, are now better able to explain complex concepts through multimedia and simulations, while students benefit from personalized and self-paced learning opportunities. However, challenges such as ensuring consistent internet connectivity, addressing the digital divide, and sustaining teacher training programs remain. Despite these hurdles, the successful implementation of the ICT @ School scheme in Mizoram demonstrates the state's potential to leverage technology for educational advancement. By continuing to invest in infrastructure, teacher development, and community engagement, Mizoram can further strengthen its education system, ensuring that students are well-prepared to thrive in a technology-driven world. The ICT @ School Scheme serves as a testament to the transformative power of technology in education, paving the way for a more inclusive and innovative learning environment.

Science is a compulsory subject at the secondary school level, encompassing both theoretical knowledge and practical applications. It is a discipline rooted in facts, figures, and complex concepts, making it inherently challenging for students to grasp. Subjects like science and mathematics require special emphasis due to their intricate terminologies and abstract ideas, which often pose difficulties for learners. Despite concerted efforts by the government to improve science education through initiatives like curriculum reforms, teacher training, and the integration of ICT, several challenges persist. At the infrastructure level, many schools lack well-equipped laboratories and resources for practical experiments, limiting hands-on learning. At the teacher level, inadequate training and reliance on traditional teaching methods hinder effective delivery of scientific concepts. Additionally, students often struggle with understanding complex theories and applying them in real-world contexts. Socio-economic disparities further exacerbate these issues, as students from underprivileged backgrounds may lack access to quality educational resources. Addressing these challenges requires a multi-faceted approach, including investment in infra-

structure, continuous teacher development, and innovative teaching methodologies to make science education more engaging and accessible for all students

Experimental studies on the use of Information and Communication Technology (ICT) in science education have consistently demonstrated its positive impact on learning outcomes. Ziden et al. (2012) conducted a study comparing ICT-based teaching with traditional methods and found that students taught using ICT tools achieved significantly higher academic performance. Their research also revealed a gender-based difference, with male students scoring higher than female students in ICT-enabled learning environments. This finding suggests the need for further exploration into gender dynamics and tailored approaches to ensure equitable learning opportunities. Similarly, Sharma and Sharma (2017) highlighted that ICT implementation not only enhances students' interest but also increases teachers' enthusiasm for delivering science education. Their study emphasized that ICT makes learning more interactive and engaging, helping students grasp complex scientific concepts more effectively. However, both students and teachers agreed that successful ICT integration requires careful planning, effort, and preparation. Teachers need adequate training to use ICT tools effectively, while students must be guided to adapt to digital learning platforms. These studies collectively underscore the transformative potential of ICT in science education, particularly in making learning more dynamic and accessible. However, challenges such as gender disparities, teacher preparedness, and the need for structured implementation strategies must be addressed to maximize the benefits of ICT. By overcoming these hurdles, ICT can play a pivotal role in creating an inclusive and innovative science education system

Problems Encountered for Teaching Science at the Secondary Level Using ICT in Mizoram based on Literature review

The deployment of Information and Communication Technology (ICT) in teaching has been globally acknowledged as a revolutionary tool for improving teaching and learning. However, in Mizoram, a state in Northeast India, the use of ICT in secondary-level science education faces numerous challenges. These challenges are deeply rooted in infrastructural, economic, socio-cultural, and pedagogical issues. This literature review examines the problems encountered in implementing ICT-based science education in Mizoram, drawing on existing research and studies.

Lack of Infrastructure

One of the major hindrances to the effective use of ICT in science teaching is the lack of adequate infrastructure. Research indicates that most schools in Mizoram, especially in rural areas, lack basic ICT tools such as computers, projectors, smart

boards, and reliable internet connections (Lallianthanga, 2019). Even in schools where ICT tools are available, they are often outdated or insufficient in number to cater to the entire student population. The digital divide between urban and rural schools in India is significant, with rural schools lagging far behind in terms of ICT infrastructure, as highlighted in a report by the National Council of Educational Research and Training (NCERT, 2020).

Poor Funding and Resource Allocation

Financial constraints are another substantial barrier to the adoption of ICT in science education. Schools in Mizoram often operate on limited budgets, which are inadequate for purchasing and maintaining ICT equipment (Ralte, 2021). The high costs of computers, software, and internet connectivity further exacerbate the problem. Additionally, there is a lack of funding for teacher training programs, which are essential for the effective use of ICT in classrooms. A study by Chakraborty and Mondal (2018) highlights that inadequate financial support from the government and private sectors is a significant obstacle to ICT integration in education, particularly in economically disadvantaged regions like Mizoram.

Inadequate Teacher Training

The successful integration of ICT into science education largely depends on the competence of teachers. However, many teachers in Mizoram lack the necessary skills and training to effectively use ICT tools (Lalrinawma, 2020). Research shows a shortage of professional development programs focused on ICT integration in teaching. As a result, even when ICT tools are available, teachers may not know how to use them to enhance science education. UNESCO (2017) emphasizes that teacher training is a critical factor in the successful implementation of ICT in education, and the lack of such training in Mizoram limits the potential of ICT to transform teaching and learning.

Power Supply Issues

Frequent power outages and unreliable electricity supply are common problems in Mizoram, particularly in rural areas (Zothansanga, 2019). Since ICT tools rely heavily on electricity, these disruptions make it difficult to conduct consistent ICT-based lessons. Power shortages not only interrupt teaching but also damage electronic equipment over time, increasing maintenance costs and reducing the lifespan of ICT tools. A report by the Ministry of Power, Government of India (2021), highlights that states in Northeast India, including Mizoram, face significant challenges in ensuring uninterrupted power supply, which directly impacts the use of ICT in education.

Digital Divide

The digital divide, or the gap between those who have access to ICT and those who do not, is a significant issue in Mizoram. This divide is evident not only between urban and rural areas but also among different socio-economic groups within the state (Lalthanzara, 2020). Students from economically disadvantaged backgrounds often lack access to digital devices and the internet at home, putting them at a disadvantage compared to their peers. This inequality in access to ICT resources creates unequal learning opportunities and undermines the goal of using ICT to promote inclusive education.

Resistance to Change

Traditional teaching methods are deeply entrenched in the education system in Mizoram, and there is often resistance to change among teachers and administrators (Ramliana, 2018). Many educators are accustomed to conventional teaching methods and are hesitant to adopt ICT-based approaches. This resistance is often fueled by a lack of awareness about the benefits of ICT in education and a fear of the unknown. A study by Bhattacharjee and Deb (2016) found that resistance to change is a common barrier to ICT integration in education, particularly in regions where traditional teaching methods have been the norm for decades.

Language Barriers

The availability of ICT resources in local languages is limited, which poses a challenge for both teachers and students in Mizoram (Lalhmachhuana, 2021). Most ICT tools and digital content are available in English or Hindi, which may not be the first language for many students in Mizoram. This language barrier hinders effective communication and understanding, making it difficult for students to fully benefit from ICT-based science education.

Maintenance Challenges

The maintenance of ICT equipment is another significant challenge in Mizoram. Many schools lack the technical expertise and resources to repair and maintain ICT tools, leading to frequent breakdowns and prolonged periods of inactivity (Lalrinmawia, 2020). A study by Sharma and Sharma (2019) highlights that the lack of technical support is a major barrier to the sustained use of ICT in education, particularly in remote and rural areas.

The integration of ICT into science education at the secondary level in Mizoram faces numerous challenges, including a lack of infrastructure, poor funding, inade-

quate teacher training, power supply issues, the digital divide, resistance to change, language barriers, and maintenance challenges. Addressing these issues requires a multi-faceted approach, involving increased investment in ICT infrastructure, comprehensive teacher training programs, and policies aimed at bridging the digital divide. By overcoming these obstacles, Mizoram can harness the potential of ICT to transform science education and provide students with the skills and knowledge they need to thrive in the 21st century.

Prospects of ICT for teaching science at secondary level of education in mizoram

The application of Information and Communication Technology (ICT) in education has the potential to transform science teaching and learning. At the secondary school level in Mizoram, the implementation of ICT in science education offers numerous possibilities to improve the quality of education, bridge learning disparities, and equip students for the challenges of the 21st century. This review of literature discusses the potential of ICT in secondary school science teaching in Mizoram, based on available research and studies.

Improved Teaching and Learning Experiences

ICT tools such as multimedia presentations, simulations, and virtual laboratories can enhance the learning of science by making it more interactive and engaging. As pointed out by Lalrinawma (2020), ICT can be used to visualize intricate scientific concepts, making them easier to grasp. For example, animations and videos can demonstrate biological processes, chemical reactions, and physical phenomena that are difficult to illustrate through conventional teaching methods. This interactive approach fosters a deeper understanding of scientific principles and enhances student achievement.

Access to Quality Educational Resources

ICT provides access to a plethora of digital resources, including e-books, online journals, and educational videos, which can complement conventional textbooks. In Mizoram, where access to quality educational materials is often limited, ICT can bridge this gap by exposing students and teachers to updated and relevant content (Lallianthanga, 2019). Platforms such as the National Digital Library of India (NDLI) and SWAYAM offer free access to high-quality educational content, enabling students in rural areas to learn at their own pace.

Encouragement of Inquiry-Based Learning

ICT tools such as virtual labs and simulation software allow students to experiment and investigate scientific principles in a safe and controlled environment. This facilitates inquiry-based learning, where students can hypothesize, test, and draw conclusions independently. According to Chakraborty and Mondal (2018), ICT-based inquiry learning enhances critical thinking, problem-solving skills, and scientific curiosity, which are essential for success in science education.

Bridging the Urban-Rural Divide

One of the greatest opportunities of ICT is its ability to narrow the educational gap between urban and rural communities. In Mizoram, where rural schools often lack access to qualified science teachers and laboratory facilities, ICT can provide virtual access to expert instructors and online lab experiments (Lalthanzara, 2020). This ensures that students in remote areas receive the same quality of education as their urban counterparts, promoting educational equity.

Teacher Professional Development

ICT offers avenues for the professional development of teachers through online training courses, webinars, and workshops. Teachers in Mizoram can enhance their pedagogical skills and learn to integrate ICT into their teaching practices. As emphasized by UNESCO (2017), well-trained teachers are essential for the effective use of ICT in education. By equipping teachers with the necessary skills, ICT can revolutionize science education in Mizoram.

Personalized Learning

ICT facilitates personalized learning, enabling students to learn at their own pace and according to their individual needs. Adaptive learning platforms and web-based assessments can identify students' strengths and weaknesses, allowing teachers to tailor their instruction accordingly (Ralte, 2021). This personalized approach helps students overcome learning challenges and achieve improved academic performance.

Preparation for the Digital Age

Integrating ICT into science education prepares students for the digital age by equipping them with essential digital literacy skills. In a world increasingly driven by technology, proficiency in using digital tools is critical for future employment and higher education (Bhattacharjee & Deb, 2016). By incorporating ICT into science education, Mizoram can ensure that its students are well-prepared for the challenges of the 21st century.

Cost-Effective Solutions

While the initial investment in ICT infrastructure may be high, ICT offers cost-effective solutions in the long run. Digital resources can be reused and shared, reducing the need for physical textbooks and laboratory equipment (Sharma & Sharma, 2019). Additionally, online platforms can minimize the costs associated with teacher training and professional development.

Research Gap

The research findings clearly revealed that most of the studies on ICT has been focusing on resources, teachers and students, but hardly any study was conducted on actual teaching experience and the impact of ICT on this aspect of education. This was a serious research gap and needs to be filled so that education may have more research findings for reference in order to improve and develop.

In light of the research findings and identified gaps, there is an urgent need for studies that focus on the actual teaching experiences and the effect of ICT on classroom practices. While existing research emphasizes resources, teachers, and students, the practical application of ICT in teaching remains underexplored. Understanding how ICT transforms teaching methods, enhances classroom interactions, and addresses pedagogical challenges is crucial. Such research will provide actionable insights to optimize ICT integration and improve educational outcomes in diverse contexts.

Challenges and the Way Forward

Despite its numerous prospects, the integration of ICT in science education in Mizoram faces challenges such as inadequate infrastructure, poor funding, and resistance to change. Addressing these challenges requires a multi-faceted approach, including increased investment in ICT infrastructure, comprehensive teacher training programs, and policies aimed at bridging the digital divide. Collaboration between the government, private sector, and educational institutions is essential to harness the full potential of ICT in science education

The integration of Information and Communication Technology (ICT) in science education in Mizoram offers significant prospects but also faces notable challenges. Mizoram, with one of the highest literacy rates in India, has the potential to revolutionize its education system by embracing ICT, particularly in science education. However, the dominance of traditional teaching methods poses a barrier to this transformation. To fully harness the benefits of ICT, stakeholders and authorities must address the challenges at three critical levels: infrastructure, teacher readiness, and student accessibility. To overcome these challenges, stakeholders must invest in

building robust ICT infrastructure, particularly in underserved areas. Teacher training programs should be prioritized to equip educators with the skills to integrate ICT into their teaching. Additionally, the curriculum should be revised to include ICT-based learning modules. Public-private partnerships and community engagement can also play a crucial role in bridging gaps and fostering a supportive environment for ICT integration. In conclusion, while ICT holds immense potential to enhance science education in Mizoram, addressing the challenges at the infrastructure, teacher, and student levels is essential. A collaborative effort from all stakeholders can pave the way for a modern, effective, and inclusive education system.

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