

INTEGRATING ICT-BASED EDUCATION SYSTEMS IN EARLY CHILDHOOD LEARNING IN RURAL INDIA

ANIRBAN BERA¹ AND SOUVIK BERA^{1*}

Information and Communication Technologies (ICT) integration in the early childhood education is regarded as one of the most revolutionary methods of educating the rural areas of India on the basics. Despite some growth in digital infrastructure, rural schools and anganwadi centres are still characterized by the lack of a trained teacher, age-relevant learning materials, and a traditional approach of teaching. When used effectively, ICT will advance early literacy and numeracy, improve the level of engagement with learners, as well as help teachers with interactive and language-appropriate material. The review is a synthesis of ongoing policy and empirical research, where ICT has been indicated to be the most efficient when combined with play-based pedagogy, community involvement, ongoing teacher learning as well as long-term financial investment and policies that facilitate safe and inclusive digital ecosystems.

Introduction

Early Childhood Education (ECE) is the foundation of the lifelong learning as it impacts on linguistic, cognitive and socio-emotional growth of children. However the village India continues to struggle with the lack of teachers, infrastructure and learning facilities shortage¹. ICT based learning as one of the tools has been proposed to provide structured interactive and curriculum based digital tasks that augment learning outcome of early childhood learners. On the national level, ICT is formally recognized as part of the frameworks of national policy in ICT in School Education (2012), and NEP 2020, as a means of eliminating rural-urban disparities in education, as well as expanding access to basic education². Stress on using technologies however is not adequate like it is emphasized in literature but impact depends on the linguistic accessibility, the suitability of the pedagogic implementation and also the preparedness and sustainability of teachers.

Evolution of ICT Use in Rural Early Education

Use of ICT in early learning has evolved considerably over the past two decades: Broadcast-based learning Radio and television Study was initially used to deliver early-grade literacy and numeracy education in remote areas. Satellites based classroom- EDUSAT programme entailed presenting two way virtual classroom so as to assist the schools lacking professionals in the subjects. National online learning programs: Programs, such as DIKSHA, SWAYAM and NME-ICT, provided organized material and online trainer-training programs³. Mobile and offline-first-learning: The growing smartphone traffic generated dynamic learning software, which targets the base competencies. Hybrid learning community-based learning: Joint access to digital resources in low-income settlements was provided in Village ICT centres and intelligent classes⁴. These transformations are a pointer to the development of a process in which passive knowledge had been extended to active digital pedagogical, and the degree of interaction between the learner and the pedagogical material was to be enhanced⁵.

¹ Assistant Professor, Brainware University, Kolkata, India

* Corresponding Author: berasouvik77@gmail.com

ICT Modalities in Early Childhood Education

Studies point to some of the applications of ICT in facilitating basic learning in early childhood education. These are multimedia storytelling, animated phonics, numeracy exercises to improve conceptual clarity⁶, low-connectivity mobile learning applications. Audio-visual information also supports the retention of information and vocabulary⁷ and teacher-training courses empower blended learning units to facilitate teaching competences³. The role played by community ICT hubs is also very important, as it will provide access to those children whose households do not own devices. Researchers note that these interventions can be effective only in the case of application of the local-language content, culturally relevant examples, and children-targeted interface designs based on the cognitive development levels⁸.

Learning Outcomes and Pedagogical Effects

It is found that this proper application of ICT in early childhood education results in a number of positive results. These are greater phonemic awareness, vocabulary learning, and early numeracy due to the exposure to visually rich and repeated learning, higher learning engagement, and collaborative learning with peers in rural classrooms. The use of ICT-enabled professional development further supports teacher confidence in planning the lesson, and additional digital tools contribute to the minimization of the learning disadvantages of children in families with low literacy levels. It is stressed that ICT can most efficiently be combined with play-based pedagogy, teacher facilitation, and peer interaction, and not used as an alternative to such conceptually important methods⁹.

Key Barriers to ICT Adoption in Rural Early Education

Despite positive results, several structural and social

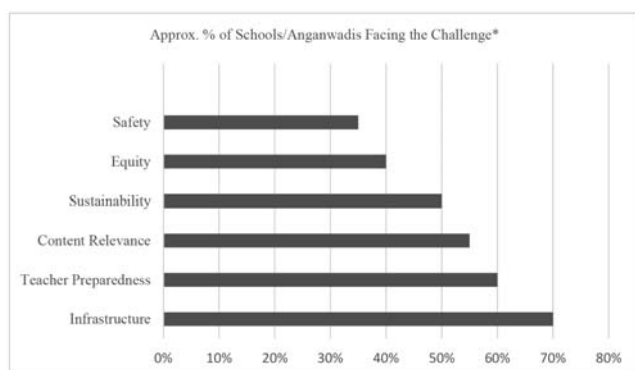


Figure 1: Key Barriers to ICT Implementation in Rural Early Childhood Education

challenges hinder effective implementation which is shown in Table 1 and Fig 1.

Table 1: Key Barriers and Challenges in Implementing Digital Education in Rural Areas

Barrier Category	Major Challenges
Infrastructure	Limited electricity, unstable connectivity, insufficient devices
Teacher Preparedness	Lack of ICT-pedagogy training and continuous mentoring
Content Relevance	Lack of local-language, age-appropriate digital content
Sustainability	Short-term pilot models without maintenance budgets
Equity	Gender imbalance in access to digital devices
Safety	Limited digital awareness and supervision for young learners

These findings emphasise that ICT must be supported by **policy, infrastructure, resourcing and capacity-building**, not implemented as a stand-alone intervention.

Recommendations

According to the synthesis of the research and policy evidence, one can recommend several measures that can be taken to improve the process of ICT integration in early childhood education. They include creating multilingual and culturally-grounded digital curriculums¹⁰; ongoing teacher education programme that can be mentored and supported by networks, peer learning¹⁰; making offline-first applications and educational platforms that need lower bandwidth to ensure inclusivity; creating learning communities to reduce device-access inequality and better parental engagement; allocating continuous budgets to maintenance and upgrades and content updating instead of just buying the device.

Conclusion

ICT-enabled pedagogy has a robust potential of improving the foundational learning in rural India by improving teaching delivery, facilitating student interaction and equitable rights of access to quality teaching materials. It has been shown that the implementation process needs to be coordinated with age-related and play-based pedagogy, active teacher instruction and inclusive technology design to be successful. The sustainable impact is based on systems approach which involves integration of digital safety, community involvement, policy cohesion

and long-term resource provision. When used wisely, ICT can be used to close educational inequalities that have plagued India for a long time and dramatically change the outcome of early childhood learning in the rural areas. □

References

1. N. Agarwal and P. Singh, *International Journal of Educational Technology and Development*, **14(2)**, 41–53, (2022).
2. R. Ahir and V. Shah, *Journal of Learning and New Media*, **9(1)**, 12–27, (2021).
3. S. Bhattacharya, *Asian Journal of Education and Training*, **6(4)**, 523–530, (2020).
4. R. Bose, *Education and Information Technologies*, **24(5)**, 3175–3195, (2019).
5. K. Chowdhury, *Journal of Rural and Remote Education*, **35(3)**, 115–128, (2022).
6. A. Das, *Children and Media Studies Review*, **8(2)**, 99–109, (2020).
7. Government of India. (2012). *National Policy on ICT in School Education*. Ministry of HRD.
8. Government of India. (2020). *National Education Policy (NEP 2020)*.
9. S. Gupta, *British Journal of Educational Technology*, **49(7)**, 118–133, (2018).
10. M. Hussain and A. Jain, *Early Childhood Education Journal*, **51(1)**, 87–101, (2023).