

BRIDGING THE DIGITAL DIVIDE: AN EMPIRICAL STUDY OF ONLINE LEARNING INFRASTRUCTURE AND LEARNING OUTCOMES IN INDIAN SECONDARY SCHOOLS UNDER SDG

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Abstract

Digital technology has transforming education worldwide. Online learning is now become a modern aspect of education. In India, the COVID-19 pandemic has made tremendous change in digital learning. The study makes a sincere effort to investigate the differences in internet connectivity and availability of digital devices, arrangement of electricity supply, ICT laboratory facilities, and digital literacy between selected urban and rural secondary schools. A descriptive and analytical design of research has been adopted with the use of a mixed method approach of both quantitative and qualitative techniques. The data was collected using structured questionnaires for students and teachers, interviews with school administrators and direct observation of ICT facilities. Secondary data was collected from government reports, UDISE statistics, research articles and policy documents related to digital education and Sustainable Development Goal 4 (Quality Education). A stratified random sampling was used in government and private schools in both urban and rural areas to collect the data. The urban areas have more digital facilities compare to rural areas which hinders the growth of the students.

Keywords: *Digital Divide, E-Learning, Digital Infrastructure, Educational Technology, SDG 4, Education Equality.*

Introduction

The e-learning and technology both has played a important role in the transformation of education and its impact was seen during the pandemic Covid-19. But there is a unequal distribution of digital facilities. Many urban schools have stable internet services and well-equipped ICT laboratories and modern digital tools. Many rural schools, however, continue to face challenges like poor network connectivity, lack of digital infrastructure, no access to computers or smart phones and intermittent power supply. These challenges reduce students' effectiveness in participating in online learning. In some areas, gender inequality affects access to digital devices further, especially for girl students.

Review of Literature

Digital Learning SDG 4: Transforming Educational Equality in India to Technology Integration

The Covid 19 transformed digital learning from a supplementary in tool into an essential mode of education, revealing persistent inequality in access to technology. In India this disparities contributed to learning poverty define as the inability of children to read and understand.

Trucano (2005) – Knowledge Maps: ICTs in Education

Trucano (2005) examined the contribution of Information and Communication Technology (ICT) to education and concluded that well-developed digital infrastructure, trained teachers, and access to quality digital learning resources significantly improve students' learning experiences. The study also stressed the importance of government support and educational policies in strengthening ICT integration.

Selwyn (2010) – Schools and Schooling in the Digital Age: A Critical Analysis

Selwyn (2010) explored the growing role of digital technology in schools and found that unequal access to technology and differences in digital skills continue to create educational inequalities.

Jintu Gohain, Nilmil Konwar (2025)

This paper analysis how management and technological innovation can collectively bridge the persistent digital divide that undermines the realization the right to education. Open education resources and India's initiatives such as swayam, Swayam Prabha and Deksha – the study explores how digital tools can promote high quality and affordable education.

Sarita Bhawani Malviya 2025

Unlocking the feature classroom ; exploring the LAND SCAPE of digital education in india this research paper has examine how AI ,AR/VR, learning analytics and cloud based platforms are being integrated into India education system and identifies the principle barriers to equitable adoption .

Abinandhan Kulal, Sahana Dinesh, N Abhishek Ajaya Anchan 2024

Digital access and learning outcomes: A study of equity and inclusivity in distance education This study delves into the realm of distance education, exploring the intricate dynamics of digital access, equality and inclusivity, with a particular focus on their influence on learning outcomes.

Research Gap

The research done in the area on digital divide and online learning in India has mainly focused in the pandemic covid 19 and very few studies has researched how higher education institution and digital infrastructure uses the facilitates related to online learning Comparatively fewer studies have investigated how differences in digital infrastructure affect learning outcomes among secondary school students.

In addition, there is a lack of comprehensive comparative research involving urban and rural schools,

government and private institutions, and students from different socio-economic backgrounds.

Another important gap is that only a few studies have linked digital infrastructure with the objectives of Sustainable Development Goal 4 (Quality Education). Therefore, this research attempts to bridge these gaps by examining the relationship between digital infrastructure and online learning outcomes in Indian secondary schools while providing practical recommendations for achieving inclusive and equitable education.

Statement of the Problem

Digital technology has become a important part of a education system still many secondary schools faces an unequal distribution an access of digital infrastructure which restricts the students ability to participate effectively in online learning sessions and to perform and give his best and to grow in his area.

This study seeks to identify the major barriers to digital education and suggest suitable measures to reduce the digital divide in Indian secondary schools.

Objectives of the Study

- To evaluate the availability of digital infrastructure, including internet connectivity, digital devices, electricity, and ICT laboratory facilities.

- To examine the impact of digital infrastructure on students' academic performance and participation in online learning.
- To identify the main factors which effects the online learning outcomes.
- To suggest practical measures for bringing equal online learning facilities and promoting equal distribution of digital facilities for the students.
- Direct observation of ICT laboratories and other digital facilities available in schools.

Survey of the Students and Teachers

Role	Percentage	Approx. No. of Respondents
Student	74.60%	47
Teacher	25.40%	16
Total	100%	63

Research Methodology

Research Design

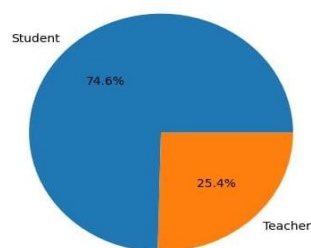
The study adopts a descriptive and analytical research design to examine the relationship between digital infrastructure and learning outcomes among secondary school students. A mixed-method approach has been used by combining quantitative and qualitative research techniques. This approach enables a comprehensive understanding of both the availability of digital resources and their impact on students' educational experiences.

Data Collection Primary Data

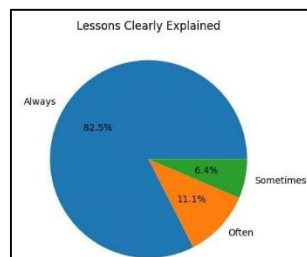
Primary data were collected directly from respondents using the following methods:

- Structured questionnaires administered to students and teachers.
- Personal interviews conducted with school administrators.

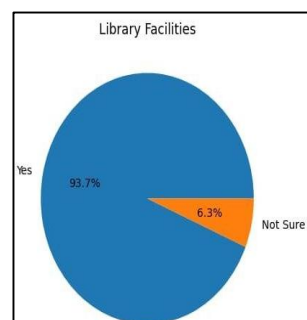
Role of Respondents



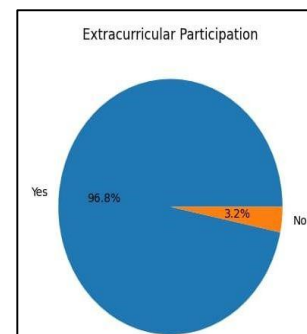
Lessons Clearly Explained

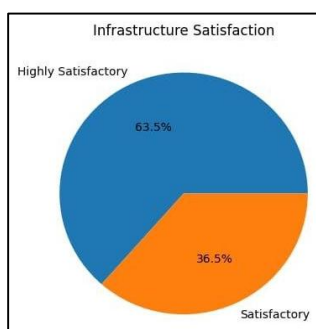
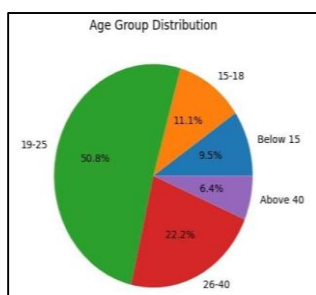


Library Facilities



Extracurricular Participation





Secondary Data

Secondary data were collected from reliable and authentic sources such as:

- Government reports and publications issued by the Ministry of Education.
- UDISE statistics and official educational databases.
- Published reports on digital learning and the digital divide in India.

Scope of the Study

The study focuses on secondary schools which are located in urban and rural areas of India. The research paper has examined availability of digital infrastructure, students'

access to digital resources, and literacy related to digital facilities which effects their performance on academics and engagement in online learning.

Findings

The study examined the relationship between digital infrastructure and online learning outcomes in Indian secondary schools. Based on the analysis of data collected from students, teachers, and school administrators, the following major findings were identified:

- A significant difference exists between urban and rural secondary schools. There is lot of difference in the facilities available to the students as a result of which Urban schools and rural schools continue to face significant infrastructure challenges.
- Many rural schools face poor internet connectivity, an insufficient number of computers and other digital devices and even sometimes there is no proper of supply of electricity
- There is a limited access to Digital Devices Students from backward families often depend on borrowed smart phones or borrowed devices for attending online classes. This hinders their learning ability.
- Lack of electronic devices impacts on Academic Performance
- Gender Differences are also there due to which those students who are in the

category of female gender are not able to utilize their skills appropriately.

Suggestions

- Strengthen digital infrastructure by providing reliable high-speed internet connectivity and uninterrupted electricity, particularly in rural schools.
- Increase the availability of digital devices such as laptops, tablets, and desktop computers through government support and financial assistance programmes.
- well-equipped ICT laboratories should be established in all the rural and urban areas teachers should also be well trained with the electronic devices.
- Promote digital literacy among students and parents through awareness programmes and practical training sessions.

Limitations of the Study

The study has the following limitations:

- The sample size is limited and have not covered all the rural and urban schools.
- The research focuses primarily on digital infrastructure and does not examine the quality of teaching methods in detail.
- The actual situation which exist in rural areas is still not completed more further investigation should be done by the higher authorities which cannot be completed by

small survey which was conducted to this research paper.

- Due to limited time and resources, the study could not analyze the long-term impact of digital infrastructure on academic performance.
- External factors such as parental support, home learning environment, and individual learning abilities were not examined comprehensively.

Conclusion

The research highlights that a sufficient amount of differences are there related to the facilities available in rural and urban areas and people those who don't even have the basic facilities like a power supply, electronic devices and proper facilities which is going to help the students in their growth and development should be provided at the earliest. The government policies should also be framed in such a manner that whether it is public or private school. The basic facilities should be provided equally for the national development.

Acknowledgement

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Annexure Questionnaire

1. How would you rate the overall teaching quality?
2. Are the lessons clearly explained?
3. Do teachers use digital tools (PPT, videos, smart board)?
4. Is the classroom environment comfortable for learning?
5. Are doubts clarified properly?
6. Do you receive regular feedback on performance?
7. Are library facilities adequate?
8. Is internet/Wi-Fi available for academic use?
9. Are laboratory/practical facilities sufficient?
10. Do you participate in extracurricular activities?
11. Are group discussions and activities conducted regularly?
12. Do you feel motivated to attend classes regularly?
13. Is communication between teachers and students effective?
14. How often do you use online resources for study?
15. Do you have access to a personal digital device for learning?