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Bridging the Digital Divide: A Study of Digital Education among Rural Students in Coastal Karnataka

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Abstract

Digital transformation has significantly reshaped the education sector by creating new opportunities for teaching, learning, and knowledge sharing. The widespread adoption of digital technologies has enhanced accessibility to educational resources; however, unequal access to digital infrastructure continues to widen the digital divide, particularly among students from rural communities. Although several initiatives have been undertaken to promote digital education in India, disparities in internet connectivity, affordability of digital devices, digital literacy, and institutional support continue to affect the effective participation of rural students in technology-enabled learning. The present study examines the status of digital education among rural students in Coastal Karnataka with special reference to Dakshina Kannada, Udupi, and Uttara Kannada districts. The study aims to analyse students' access to digital learning resources, their perceptions towards digital education, and the major barriers that contribute to the digital divide in rural educational settings. An empirical research design has been adopted using both primary and secondary data. Primary data were collected from 130 rural students through a structured questionnaire and personal interactions, while secondary information was obtained from books, research journals, government reports, and credible online sources. The findings indicate that rural students possess a favourable attitude towards digital education and recognise its potential to improve learning outcomes. Nevertheless, inadequate digital infrastructure, inconsistent internet connectivity, language barriers, limited digital literacy, and insufficient institutional support continue to restrict the effective utilisation of digital learning platforms. The study concludes that bridging the digital divide requires coordinated efforts from educational institutions, government agencies, and other stakeholders to strengthen digital infrastructure, enhance digital competencies, and ensure equitable access to quality digital education for rural learners.

Keywords: Digital Divide, Digital Education, Rural Students, Coastal Karnataka, Digital Inclusion, Digital Literacy, ICT Infrastructure.

Introduction

Education has undergone remarkable transformation over the past few decades owing to rapid advancements in information and communication technologies. The integration of digital technologies into the teaching-learning process has revolutionised the way knowledge is created, disseminated, and accessed. Digital classrooms, online learning platforms, educational applications, virtual laboratories, learning management systems, and artificial intelligence-based educational tools have become integral components of contemporary education. These technological developments have expanded learning opportunities beyond the traditional classroom and have enabled learners to access educational resources anytime and anywhere. In India, initiatives such as Digital India, the National Education Policy (NEP) 2020, SWAYAM, DIKSHA, PM eVIDYA, and various state-level digital education programmes have accelerated the adoption of technology-enabled learning. The COVID-19 pandemic further reinforced the importance of digital education by making online learning the primary mode of instruction across educational institutions. While these developments have transformed the education sector, they have also exposed significant inequalities in access to digital resources, particularly among rural students.

The concept of the digital divide refers to the gap between individuals or communities that have adequate access to digital technologies and those who do not. This divide extends beyond the ownership of digital devices and encompasses internet connectivity, digital literacy, affordability, technological skills, availability of digital content, and institutional support.

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Students residing in rural areas often encounter multiple barriers that limit their participation in digital learning despite increasing smartphone penetration. Coastal Karnataka, comprising the districts of Dakshina Kannada, Udupi, and Uttara Kannada, has witnessed considerable progress in educational development. Nevertheless, many rural pockets continue to experience infrastructural and technological constraints that affect students' ability to fully benefit from digital education. Limited internet connectivity, inadequate ICT infrastructure, language barriers, inconsistent electricity supply, and socio-economic disparities continue to influence the quality of digital learning experiences.

Against this backdrop, the present study seeks to examine the extent of digital education among rural students in Coastal Karnataka and identify the factors contributing to the digital divide. The study also analyses students' perceptions towards digital learning and explores the challenges that hinder equitable access to digital education. The findings are expected to provide useful insights for policymakers, educational institutions, and other stakeholders in designing effective strategies to promote digital inclusion and strengthen rural education.

Objectives Of the Study:

1. To examine the level of access to digital education among rural students in Coastal Karnataka.
2. To analyse the factors contributing to the digital divide in rural educational settings.
3. To study the perceptions of rural students towards digital education and technology-enabled learning.
4. To identify the major challenges faced by rural students in accessing and utilising digital learning resources.
5. To suggest suitable measures for promoting digital inclusion and strengthening digital education among rural students in Coastal Karnataka.

Significance Of the Study:

Digital education has become an indispensable component of modern educational systems and plays a crucial role in promoting inclusive and equitable learning opportunities. However, the benefits of technological advancements cannot be fully realised unless disparities in access to digital resources are addressed effectively. Rural students continue to face numerous challenges, including inadequate digital infrastructure, limited internet connectivity, affordability issues, and insufficient digital literacy, all of which contribute to widening educational inequalities.

The present study assumes significance as it examines the digital education scenario among rural students in Coastal Karnataka, a region characterised by diverse socio-economic and geographical conditions. Understanding the nature and extent of the digital divide is essential for developing evidence-based policies aimed at strengthening digital

infrastructure and enhancing students' digital competencies. The findings of this study will be useful for educational institutions, policymakers, government agencies, researchers, and other stakeholders involved in promoting technology-enabled education.

Review Of Literature

- J.M. del Campo, V. Negro and M. Núñez (2012) in their article titled "Traditional Education vs. Modern Education: What is the Impact of Teaching Techniques' Evolution on Students' Learning Process?" examined the evolution of teaching methods from traditional classroom instruction to technology-enabled education. The study concluded that teaching methods continue to evolve with technological advancements, and educational institutions must adapt innovative approaches to meet changing learner needs.
- Ghanshyam and Inder Singh Thakur (2013) in their research article "IT Enabled Teaching over Traditional Classroom Teaching" analysed the role of Information Technology in higher education. The study found that integrating ICT with conventional teaching enhances students' learning experience and recommended a balanced combination of traditional and digital teaching methods.
- Government of India (2020) in the National Education Policy (NEP) 2020 emphasised the integration of digital technology into education through online learning platforms, digital content, virtual laboratories, and teacher capacity building. The policy highlighted digital inclusion as an essential requirement for providing equitable and quality education to all learners.
- UNESCO (2021) in its report "Reimagining Our Futures Together: A New Social Contract for Education" observed that unequal access to digital technologies has widened educational disparities across the world. The report recommended strengthening digital infrastructure, improving digital literacy, and ensuring inclusive access to technology-enabled education, particularly for rural and disadvantaged students.
- NITI Aayog (2024) in its report "India's Digital Transformation: Enabling Inclusive Growth" highlighted the importance of expanding broadband connectivity, improving digital infrastructure, and enhancing digital skills to bridge the digital divide. The report emphasised that strengthening digital education is essential for achieving inclusive and sustainable educational development in rural India.

Research Gap

The review of literature indicates that several studies have examined digital education, ICT-enabled learning, and technology integration in education. However, limited empirical research has specifically investigated the digital divide among rural students in the coastal districts of Karnataka. The present study attempts to fill this gap by examining

students' access to digital education, their perceptions towards technology-enabled learning, and the challenges affecting digital inclusion in Coastal Karnataka.

Research Methodology:

The present study adopts an empirical research design to examine the status of digital education among rural students in Coastal Karnataka and to identify the factors contributing to the digital divide.

Sources of Data:

Primary Data:

Primary data were collected through a structured questionnaire administered to 130 students from rural areas of Dakshina Kannada, Udupi, and Uttara Kannada districts. Personal interviews were also conducted with selected respondents to obtain qualitative insights regarding their experiences with digital learning.

Secondary Data:

Secondary information was collected from books, peer-reviewed journals, government reports, policy documents, research articles, conference proceedings, websites of educational institutions, and other authentic online sources.

Sampling Technique:

Convenience sampling technique was adopted for selecting the respondents due to accessibility and time constraints.

Sample Size:

The study is based on responses obtained from 130 rural students pursuing higher education in various educational institutions across Coastal Karnataka.

Area of the Study:

The geographical scope of the study is confined to the rural regions of Dakshina Kannada, Udupi, and Uttara Kannada districts of Karnataka.

Statistical Tools Used:

The collected data were analysed using SPSS (Version 20). Statistical techniques employed include Percentage Analysis, Mean, Standard Deviation, Weighted Mean, Chi-square Test. These statistical tools were used to analyse students' perceptions regarding digital education and to identify the challenges contributing to the digital divide.

Hypotheses Of The Study:

Hypothesis I:

H₀: Rural students of Coastal Karnataka do not perceive digital education as an effective means of enhancing learning opportunities.

H₁: Rural students of Coastal Karnataka perceive digital education as an effective means of enhancing learning opportunities.

Hypothesis II:

H₀: There is no significant difference between male and female rural students regarding their perceptions of the challenges associated with digital education.

H₁: There is a significant difference between male and female rural students regarding their perceptions of the challenges associated with digital education.

Limitations Of the Study:

The study is confined to 130 rural students from Dakshina Kannada, Udupi, and Uttara Kannada districts of Coastal Karnataka. The use of convenience sampling limits the generalisation of the findings to the entire rural student population. Time and resource constraints restricted the sample size and geographical coverage. In addition, the study is based on respondents' perceptions at a particular point in time, which may change with future technological developments and improvements in digital infrastructure.

Data Analysis and Interpretation:

Table 1: Demographic profile of Respondents

Demographic factors	Classification	Number of Respondents	Percent
Gender	Male	68	52.3
	Female	62	47.7
Age group	Less than 18	15	11.5
	18 to 20years	56	43.1
	20 to 22 years	45	34.6
	22 years to 26 years	14	10.8
Monthly income of the family	Less than Rs. 15,000	28	21.5
	Rs.15,000-20,000	37	28.5
	Rs. 20,000-25,000	38	29.2
	25,000 & above	27	20.8

Source: Primary data

Table 1 presents the demographic profile of the respondents selected for the study. Of the 130 respondents, 68 (52.3%) are male and 62 (47.7%) are female, indicating an almost equal representation of both genders. The majority of respondents (43.1%) belong to the age group of 18–20 years, followed by 34.6% in the age group of 20–22 years. Only 11.5%

of respondents are in the age group of less than 18 years. Thus, the respondents are suitable participants for assessing digital education and technology-enabled learning.

About family income, 29.2% of the respondents belong to families earning between ₹20,000 and ₹25,000 per month, while 78.5 belong to households earning above ₹15,000 per month. This

suggests that although the respondents largely belong to middle-income families, economic factors may still influence their ability to access quality digital devices, stable internet connectivity, and other digital learning

resources. The demographic profile therefore provides an appropriate basis for examining the digital divide among rural students in Coastal Karnataka.

Table 2: Distribution of respondents on the basis of their perception regarding the education system

Modern digital education system is superior to traditional classroom education system	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree	Mean/SD	%Mean
	00 (0%)	00 (0%)	00 (0%)	88 (67.7%)	42 (32.3%)	4.32 ± 0.47	86.5%

Source: primary data

Students' Perception towards Digital Education:

The responses presented in Table 2 indicate a highly favourable perception towards digital education among rural students. None of the respondents disagreed with the statement that digital education enhances learning opportunities, while 67.7% agreed and 32.3% strongly agreed. The overall mean score of 4.32 with a percentage mean of 86.5% clearly reflects a positive attitude towards technology-enabled learning. The findings suggest that rural students recognise the educational benefits of digital platforms, including flexibility, easy access to learning materials, and opportunities for self-directed learning. However, a positive perception alone does not necessarily imply equal access to digital education. The effectiveness of digital learning depends largely on the availability of digital infrastructure, internet connectivity, and digital competencies, which continue to vary across rural communities.

Testing of Hypothesis I:

H₀: Rural students of Coastal Karnataka do not perceive digital education as an effective means of enhancing learning opportunities.

H₁: Rural students of Coastal Karnataka perceive digital education as an effective means of enhancing learning opportunities.

The percentage mean of 86.5%, together with the mean score of 4.32 (SD = 0.47), indicates a strong positive perception of digital education among the respondents. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted.

The findings demonstrate that rural students perceive digital education as an effective medium for enhancing learning opportunities. This reflects an increasing acceptance of digital technologies in education despite the infrastructural and socio-economic challenges experienced in rural areas. The result also indicates that rural students are willing to adopt technology-enabled learning when adequate digital facilities are available.

Table 3: Perceptions of respondents regarding their expectations from Present day education system

SI No	Expectations of Respondents from the present-day education system
1	Traditional classroom lectures should be complemented with modern, technology-enabled teaching methods in higher education.
2	The conventional chalk-and-talk approach, in which students remain passive listeners, may limit classroom interaction and engagement. Teaching methods should emphasize interactive and technology-enabled learning rather than relying solely on the conventional lecture approach. Providing lecture notes and reference materials through digital platforms can enhance accessibility and support effective learning.
3	Educators should recognise that today's students are digitally proficient and encourage the online submission of assignments and project reports instead of relying solely on hard-copy submissions.
4	The academic curriculum should incorporate topics related to digital technologies, emerging electronic systems, and modern technological innovations.
5	Mandatory classroom attendance requirements should be made more flexible to encourage self-directed learning and foster students' creativity and innovation.
6	Teachers should integrate digital tools such as computers, tablets, and smartphones into the teaching-learning process to meet the evolving learning needs of students.

Source: Primary data

Table 3 highlights the expectations of rural students regarding the future of digital education. The respondents expressed a preference for interactive and technology-enabled learning environments rather than relying solely on conventional classroom instruction. They favoured the use of digital tools, online submission of assignments, electronic sharing of study materials, and curriculum integration of emerging technologies.

The responses also indicate that rural students expect educational institutions to adopt innovative pedagogical practices that encourage flexibility, creativity, and independent learning. These expectations demonstrate that rural students are not resistant to technological change; rather, they seek better access to digital learning opportunities. Meeting these expectations requires strengthening digital

infrastructure and improving institutional readiness,

thereby contributing to bridging the digital divide.

Table 4: Respondents' consent level regarding some of the challenges of Modern Digital Education system

Sl. no.	Challenges	Total Number of Respondents	Weighted Sum	Average Level of consent
1	Lack of Individual attention and motivation from teachers	130	488	3.754
2	Limited physical interaction and motivation	130	492	3.785
3	Lack of reliable electricity and internet connectivity and insufficient technological resources	130	478	3.677
4	language barriers and insufficient computer knowledge	130	491	3.777
5	Inadequate ICT infrastructure in rural areas	130	489	3.762
6	Inadequate teacher preparedness to integrate ICT into classroom teaching	130	494	3.800

Source: primary data

Table 4 presents the major challenges encountered by rural students in accessing digital education. The average level of agreement for all the identified challenges exceeds the neutral value of three, indicating that the respondents experience significant barriers while participating in digital learning.

The most prominent challenges include inadequate teacher preparedness to integrate ICT into classroom teaching (3.800), limited physical interaction and motivation (3.785), language barriers and insufficient computer knowledge (3.777),

inadequate ICT infrastructure in rural areas (3.762), lack of reliable electricity and internet connectivity and insufficient technological resources. (3.677). These findings reveal that the digital divide extends beyond access to smartphones or computers. Effective digital education also requires reliable digital infrastructure, skilled educators, quality digital content, language accessibility, and supportive institutional ecosystems. Unless these barriers are addressed, equitable access to digital education cannot be achieved in rural areas.

Table 5: Gender wise distribution of respondents regarding their perceptions about Challenges of Modern Digital education system:

Statement	Gender	Neither agree nor disagree	Agree	Strongly agree	Pearson Chi- square value 48.97
Modern digital education system poses certain challenges for rural students	Male	00	30	38	
	Female	00	62	00	

Source: Primary data

Table 5 examines whether male and female students differ in their perceptions regarding the challenges associated with digital education. The calculated Chi-square value (48.97) is greater than the corresponding table value at the 0.001 level of significance, indicating a statistically significant difference between male and female respondents. While a majority of male respondents strongly agreed that digital education presents significant challenges, female respondents generally agreed with the same statement. Although both groups recognised the existence of barriers, the intensity of their perceptions differed. This suggests that gender-based experiences and access to digital resources may influence students' perceptions of the digital divide in rural educational settings.

Testing of Hypothesis II:

H₀: There is no significant difference between male and female rural students regarding their perceptions of the challenges associated with digital education.

H₁: There is a significant difference between male and female rural students regarding their perceptions of the challenges associated with digital education.

Since the calculated Chi-square value (48.97) exceeds the table value at the prescribed level of significance, the null hypothesis is rejected, and the alternative hypothesis is accepted.

The analysis indicates that male and female students differ significantly in their perceptions regarding the challenges associated with digital education. This finding suggests that strategies aimed at bridging the digital divide should adopt a gender-sensitive approach while designing digital education policies and support mechanisms for rural learners.

Findings:

- Rural students in Coastal Karnataka have a positive perception towards digital education and recognise its potential to enhance learning.
- Inadequate ICT infrastructure, unreliable internet connectivity, and limited digital literacy remain major barriers to effective digital learning.
- Language barriers and insufficient teacher preparedness further contribute to the digital divide.
- A significant difference exists between male and female students regarding their perceptions of the challenges associated with digital education.

Suggestions:

- Strengthen digital infrastructure and ensure reliable internet connectivity in rural educational institutions.
- Organise regular digital literacy and ICT training programmes for both students and teachers.
- Develop multilingual digital learning resources to improve accessibility and inclusiveness.
- Promote government and institutional initiatives that provide affordable digital devices and equitable access to technology-enabled education.

Conclusion:

Digital education has created significant opportunities for improving access to quality education among rural students in Coastal Karnataka. Although students demonstrate a favourable attitude towards technology-enabled learning, infrastructural deficiencies, limited digital skills, and connectivity issues continue to widen the digital divide. Bridging these gaps requires collaborative efforts from educational institutions, policymakers, and other stakeholders to strengthen digital infrastructure, enhance digital competencies, and ensure inclusive and equitable access to digital education. Such initiatives will contribute to reducing educational disparities and promoting sustainable rural development.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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