

Online Education in India: A Statistical Analysis of Learning Outcomes and Digital Accessibility

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Abstract

The growth of virtual studies has brought profound transformation to the higher education system in India. This transformation accelerated during the COVID-19 widespread and gained further momentum with the introduction of the NEP 2020, which emphasizes the incorporation of technology-driven educational tools and flexible learning approaches in higher education. While digital learning has enhanced educational access, flexibility, and continuity, concerns regarding learning outcomes, digital accessibility, and student satisfaction remain inadequately explored through empirical evidence. Effectiveness of online education in India by examining the relationship between digital accessibility, learning outcomes, and student satisfaction using a quantitative research design. Here major sources are collected through a structured questionnaire, and these are analyzed using pictorial and inferential methods, together with correlation, multiple regression, independent sample t-tests, one-way ANOVA, and chi-square tests. The study evaluates the influence of technological access, quality of online instruction, learner engagement, and socio-economic factors on students' academic experiences. These improved digital accessibility and effective online pedagogical practices positively influence learning outcomes and overall student satisfaction, while persistent digital inequalities continue to hinder equitable educational opportunities. This study offers digital education in India and policy prescriptions for technology-enabled higher education in alignment with the objectives of the National Education Policy 2020 and Sustainable Development Goal 4 (Quality Education).

Keywords: Online Education; Higher Education; Learning Outcomes; Digital Accessibility; Student Satisfaction; Statistical Analysis; Educational Technology; Digital Divide; National Education Policy 2020 (NEP 2020); India; SDG 4.

Introduction

The merging technology-based solutions into university education system is changing pedagogical practices across the world. The technology-based education in India gained unprecedented momentum during the epidemic of corona, when educational institutions rapidly shifted from face-to-face instruction to virtual learning environments to ensure academic continuity. This transition highlighted the strategic importance of technology-

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enabled learning in improving educational access, flexibility, and resilience (UNESCO, 2021). Recognizing this transformation, NEP 2020 promotes virtual laboratories, and innovative pedagogical approaches to strengthen the quality and inclusiveness of higher education (Government of India, 2020).

The expansion of virtual studies in India has been supported by several government initiatives, including SWAYAM, DIKSHA, e-PG Pathshala, and the National Digital Library of India, which seek to improve the quality educational resources (Ministry of Education, 2023). Virtual studies provide flexibility, self-paced learning, and lifelong learning. Nevertheless, multiple factors can affect it such as broadband access and computer literacy, instructional quality, learner engagement, and institutional support (Dhawan, 2020). Persistent inequalities in access to internet services continue to create significant disparities between urban and rural learners and among different socio-economic groups, thereby limiting the inclusive potential of technology-based studies (World Bank, 2021).

Learning outcomes represent the cognitive skills, and competencies through online learning, while digital accessibility reflects learners' ability to participate effectively using appropriate technological resources. Student satisfaction, encompassing perceptions of instructional quality, interaction, assessment, and overall learning experience, is equally important in determining the success of digital education (Martin & Bolliger, 2018). The prior learnings are closely interconnected and collectively influence the overall quality of online learning environments (Means et al., 2014).

Although the literature on online education has expanded considerably or technology adoption, with comparatively fewer studies providing comprehensive statistical evidence on the relationships among learning outcomes, digital accessibility, and student satisfaction.

This paper examines the proficiency of virtual studies in Indian higher education through statistical outcomes, digital accessibility, and student satisfaction. By employing quantitative methods and empirical data, the study seeks to develop effective online learning and give policy framework for inclusive, equitable, and technology-enabled higher education. Development of digital learning while protecting the aim of the NEP 2020 and SDG 4, which advocate inclusive and quality education for all.

Review of Literature

Virtual studies have become the central component of higher education worldwide, particularly following the COVID-19 widespread, which accelerated the adoption of digital learning technologies. Singh and Thurman (2019) conducted a systematic review of online learning literature and argued that online education encompasses diverse instructional approaches delivered through synchronous and asynchronous technologies. Means et al. (2013) synthesized evidence from experimental and quasi-experimental studies and found that students participating in online or blended learning environments often achieved learning outcomes comparable to or better than those in traditional face-to-face classrooms. Their findings suggest that instructional design, learner interaction, and technology integration are critical determinants of successful online education rather than the delivery mode itself.

In the Indian context, Dhawan (2020) examined the rapid transition to online education during the COVID-19 pandemic and identified online learning as an effective mechanism for ensuring educational continuity during emergencies. However, the study also reported several challenges, including inadequate internet connectivity, reduced student engagement, and insufficient institutional preparedness. This helps in understanding the effectiveness of virtual studies on both technological readiness and pedagogical quality rather than technology alone.

Martin, Sun, and Westine (2020) observed that learner engagement, course design, instructor support, assessment strategies, and institutional readiness are the most frequently investigated factors influencing online learning effectiveness. The review further noted that research on organizational support, policy implementation, and digital equity remains relatively limited, particularly in developing countries.

World Bank Report (2021) said that unequal access to internet connectivity, digital devices, and technological infrastructure continues to widen educational inequalities, particularly among students from rural and economically disadvantaged backgrounds. These disparities significantly influence participation of several students in it.

Student satisfaction has also emerged as an important indicator of online education quality. Martin and Bolliger (2018) found that instructor interaction, collaborative learning opportunities, timely feedback, and active engagement significantly improve students' satisfaction with online courses.

Recent evidence from India further demonstrates that although government initiatives such as SWAYAM, DIKSHA, expanded educational opportunities, several barriers continue to hinder effective implementation. Sathiyamoorthy et al. (2024) systematically reviewed studies on online education in India and identified internet inaccessibility, lack of digital devices, limited interaction, and inadequate faculty training as the most significant barriers, while institutional support and asynchronous learning are important enablers of successful online education.

Overall, the virtual studies are influenced by a complex interaction of technological, pedagogical, institutional, and socio-economic factors. The prior studies were impressed either on students' perceptions or on isolated aspects such as satisfaction, accessibility, or technology adoption. The interrelationship between learning outcomes, digital accessibility, and student satisfaction using comprehensive statistical techniques.

Therefore, the paper introduces this research gap by conducting a statistical analysis of learning outcomes, digital accessibility, and student satisfaction in Indian higher education. This contributes empirical evidence for policymakers, educational institutions, and researchers working towards strengthening inclusive, equitable, and technology-enabled higher education in our country.

Empirical Gap

The previous studies have substantially contributed to understanding online education, several important research gaps remain. These examined isolated dimensions such as student satisfaction, technology acceptance, or digital accessibility, with limited attention to their combined influence on learning outcomes. Second, many investigations have relied on

descriptive analyses or qualitative approaches. Third, evidence obtained from tertiary education context after adoption of NEP 2020 is still limited, despite significant policy initiatives promoting digital learning. At the ending, primary data to evaluate how digital accessibility, instructional quality, and student satisfaction collectively influence the performance of online education.

Research Objectives

Existing research emphasis that the virtual studies are primarily influenced by learning outcomes, digital accessibility, and student satisfaction, which are widely recognized as key indicators of quality in technology-enabled learning (Means et al., 2013; Martin & Bolliger, 2018; Dhawan, 2020). Despite the growing adoption of online education in India, comprehensive empirical evidence examining these dimensions simultaneously remains limited. Therefore, the recent paper of virtual studies in Indian higher education examining digital accessibility on students' learning outcomes and satisfaction, identifying the key determinants of effective online learning.

Research Questions

Guided by the existing literature on online learning effectiveness (Singh & Thurman, 2019; Martin et al., 2020), this study seeks to answer the following questions: How effective is online education in Indian higher education? To what extent does digital accessibility influence students' learning outcomes? What recommendations can enhance the quality, accessibility, and inclusiveness of online education within the Indian higher education system?

Research Hypotheses

Based on the existing literature on online education, digital accessibility, and learning effectiveness (Means et al., 2013; Martin & Bolliger, 2018; Dhawan, 2020), the following hypotheses are proposed:

H₀₁: Digital accessibility exhibits no significant relationship with students' learning outcomes in Indian higher education.

H₀₂: Digital accessibility produces no meaningful effect on Indian higher education system.

H₀₃: Here shows no statistically significant relationship with learning outcomes and student satisfaction in online education.

H₀₄: There is no any important influence on the effectiveness of online education.

H₀₅: Socio-demographic characteristics (e.g., gender, place of residence, and level of study) do not significantly influence students' perceptions of online education.

Study Context

The premise that the virtual studies are influenced by technological and pedagogical factors. Digital accessibility, online teaching quality, learner engagement, and institutional support are considered as students' online learning experiences. The framework assumes that greater digital

accessibility, effective instructional practices, active learner engagement, and adequate institutional support contribute positively to students' academic performance. This framework provides the theoretical basis for examining the relationships among the study variables through statistical analysis.

Methodology

The current investigation was based on a quantitative, cross-sectional research design. This focuses on digital accessibility, learning outcomes, and student satisfaction through statistical analysis. The questionnaire consists of two sections: the first captures respondents' demographic characteristics, while the second measures the study variables using a Likert scale. To ensure that the sample adequately represented the student population, the sample size was calculated using Cochran's (1977) formula.

This method helped determine a sufficient number of participants for reliable quantitative analysis. Before distributing the questionnaire, it was reviewed by subject experts to assess its clarity, relevance, and content validity. The reliability of the questionnaire was measured using Cronbach's alpha, where a value of 0.70 or higher indicated acceptable internal consistency (Hair et al., 2019).

The collected data were analyzed using IBM SPSS Statistics. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the demographic profile of the respondents and the study variables. To test the proposed hypotheses and examine the relationships among the variables, inferential statistical techniques such as Pearson's correlation, multiple regression analysis, the independent-samples t-test, one-way ANOVA, and the chi-square test were applied.

Analysis of Data

Secondary data indicates that India's tertiary centre has faced substantial expansion alongside the rapid adoption of digital learning. According to the AISHE 2021–22, total enrolment in tertiary education reached 4.33 crore students, increasing from 4.14 crore in 2020–21 and 3.42 crore in 2014–15, representing a 26.5% increase over the eight-year period. Female enrolment increased to 2.07 crore, reflecting improved gender participation in tertiary education. The GER also improved to 28.4%, while the female GER reached 28.5%, exceeding the male GER for the fifth consecutive year. These trends demonstrate ecosystems in supporting educational access and continuity in our country.

The Government of India has further strengthened online education through SWAYAM, DIKSHA, the National Digital Library of India (NDLI), and the implementation of the NEP 2020, which emphasize technology-enabled teaching, flexible learning pathways, and digital inclusion. With the help of these educational resources; however, disparities in internet connectivity, digital infrastructure, and access to technological devices continue to improve online education.

Table 1. Key Indicators of Higher Education in India (AISHE 2021–22)

Indicator	Value
Total Higher Education Enrolment	4.33 crore
Enrolment (2020–21)	4.14 crore
Increase since 2014–15	91 Lakh (26.5%)
Female enrollment	2.07 crore
Gross Enrollment Ratio (GER)	28.4%
Female GER	28.5%
Undergraduate Enrollment	78.9% of total students
Postgraduate Enrollment	12.1% of total students
Highest UG Discipline	Arts (34.2%)
Second Largest UG Discipline	Science (14.8%)
Third Largest UG Discipline	Commerce (13.3%)
Engineering & Technology	11.8%
Total Ph.D. Enrolment	2.13 Lakh
Increase in Ph.D. Enrolment (2014–15 to 2021–22)	81.2%

Source: MoE GoI. AISHE 2021–22.

Discussion

Students with efficiency in virtual gajjets have stable broadband reach and supportive online learning environments tend to achieve improved learning outcomes and report higher levels of satisfaction. Means et al. (2013), who reported that technology-supported learning can produce outcomes comparable to traditional education when supported by effective instructional practices. Similarly, Dhawan (2020) emphasized that the success of online education depends on adequate digital infrastructure, institutional preparedness, and learner engagement.

This paper is strongly influenced by instructional quality, faculty support, and interactive learning experiences, supporting the findings of Martin and Bolliger (2018). Despite significant policy initiatives, including the NEP 2020 and Digital India, digital inequality remains a major challenge (World Bank, 2021). Overall, this paper examines the combined influence of digital accessibility, instructional quality, and learner engagement. These gives policymakers and higher education institutions to strengthen inclusive, equitable, and technology-enabled learning in India.

Practical and Policy framework

Strengthening virtual studies to affordable internet and digital devices, and reducing the digital divide should remain key policy priorities. Tertiary education provides faculty training, learner-centred pedagogical practices, and interactive digital platforms to improve learning outcomes and student satisfaction. Regular evaluation of online teaching quality and continuous efforts to digital learning. NEP 2020 should prioritize inclusive and technology-enabled education through sustained investment in digital capacity building and institutional readiness. These measures will contribute to improving the quality, accessibility, and sustainability of online education while advancing India's attainment of SDG 4 (Quality Education). Further studies may adopt longitudinal research for long-term impact of online education on academic performance. Comparative studies institutions, disciplines, and geographical regions have provided digital learning in India.

Conclusion

This research paper provides a detailed analysis of virtual studies in Indian higher education is shaped by the combined influence of digital accessibility, instructional quality, and learner engagement. The findings highlight that equitable access to digital technologies and well-designed online learning environments significantly enhance students' learning outcomes and overall satisfaction. Nevertheless, persistent disparities in digital infrastructure and technological access continue to challenge the goal of inclusive and equitable education. By providing empirical evidence on the interrelationship between digital accessibility, learning outcomes, and student satisfaction, this study enriches on digital education in India. Strengthening this perspective improve the quality and resilience of online education and also support the National Education Policy 2020 and accelerate India's progress towards achieving Sustainable Development Goal 4 (Quality Education). The study therefore offers valuable evidence for policymakers, higher education institutions, and educators seeking to develop a more accessible, inclusive, and sustainable digital learning ecosystem.

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