

CHAPTER ONE

The Role of Digital Education in Advancing Sustainable Development Goals: A Study of the Rohilkhand Region, Uttar Pradesh

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Abstract

The objective of the research is to explore the role of digital education in achieving the Sustainable Development Goals (SDGs) in the Rohilkhand region of Uttar Pradesh, India. For this study, both primary and secondary data sources were utilised. Primary data were collected from 159 participants in the academic field, including educators, students, and administrative staff. The study revealed that digital education significantly contributes to advancing the SDGs, especially SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), by improving accessibility, enhancing the quality and relevance of educational content, and promoting inclusive learning opportunities. Furthermore, digital platforms are shown to foster digital literacy, technological skills, and lifelong learning, which are essential for economic empowerment and sustainable development. The findings highlighted the transformative potential of digital education to address regional disparities and promote equitable growth, thereby contributing to a more sustainable and knowledge-driven society in the Rohilkhand region.

Keywords: Digital Education, Digital Literacy, Quality Education, Sustainable Development Goals (SDGs).

Introduction

Education has long stood at the heart of human development, not merely as a means to literacy but as a powerful catalyst for social mobility, economic growth, and global sustainability. In the contemporary context, the infusion of digital technologies into educational systems represents a transformative force, particularly in regions struggling with socio-economic disparities, infrastructural deficits, and limited access to quality instruction. The Rohilkhand region of Uttar Pradesh—an area marked by diverse

demographics, uneven development, and digital divides—offers a compelling landscape for studying the influence of digital education on the realisation of the Sustainable Development Goals (SDGs), especially SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth).

The United Nations' 2030 Agenda, adopted in 2015, firmly places education at the core of sustainable development. SDG 4 calls for inclusive and equitable quality education and lifelong learning opportunities for all. However, despite the clarity of this mandate, implementation has varied significantly across geographies. The advent of digital education—encompassing online learning platforms, mobile applications, virtual classrooms, and AI-driven educational tools—has been hailed as both a disruptor and a democratiser. According to Mishra and Koehler (2021), digital pedagogies can expand access, personalise instruction, and build future-ready skills, yet they also risk deepening pre-existing inequalities if not adapted sensitively to local contexts.

India's National Education Policy (NEP) 2020 explicitly recognises the role of digital infrastructure in bridging learning divides and improving educational outcomes. As Kumar, Jena, and Dey (2022) note, digital learning ecosystems have gained traction in Indian higher education, driven by both state-level reforms and market innovations. However, the success of these interventions, particularly in semi-urban and rural areas like Rohilkhand, depends on factors such as internet penetration, teacher readiness, socio-cultural acceptance, and policy support. The region itself comprises districts like Bareilly, Pilibhit, Shahjahanpur, Badaun, and Rampur—each with distinct challenges in terms of literacy, economic participation, and digital outreach.

Studies from international contexts further strengthen the premise that digital education can act as a lever for sustainable development. For instance, Ilomäki, Paavola, Lakkala, and Kantosalo (2016) highlighted that digital competencies are central to students' ability to participate meaningfully in knowledge societies. Similarly, Arora and Rangarajan (2020) argued that in the Global South, digital education is not merely a pedagogical shift, but a developmental imperative, linked closely with employability, gender equity, and digital citizenship.

In a study published in *Computers & Education*, Selwyn and Facer (2013) emphasised that while digital education promises scalability and flexibility, its real-world impact is mediated by human, infrastructural, and governance

factors. Their argument gains significance in the Indian scenario, where technological readiness is not uniformly distributed. In Uttar Pradesh, particularly in the Rohilkhand zone, the digital landscape remains patchy. Despite government-led efforts such as DIKSHA, e-Pathshala, and PM e-Vidya, gaps in electricity, teacher training, device accessibility, and regional-language content continue to obstruct the promise of digital inclusion (Pandey & Sinha, 2022).

Moreover, the role of digital education in achieving SDG 8—focused on decent work and economic growth—cannot be understated. Skill-based e-learning platforms and vocational digital courses are increasingly shaping labour market outcomes. A recent paper by Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche, and Romero-Rodríguez (2019) observes that digital upskilling enhances employment prospects, especially among youth and marginalised populations. For regions like Rohilkhand, where traditional employment opportunities are constrained by agricultural dependency and low industrialization, digital education could pave new pathways for economic mobility and resilience.

What remains largely underexplored, however, is the micro-level impact of digital education initiatives in specific Indian sub-regions like Rohilkhand—how local actors perceive, adopt, and adapt digital learning modalities, and whether these interventions are aligned with the broader aspirations of the SDGs. Despite promising macro-level trends, regional asymmetries in access, digital literacy, and educational quality continue to impede inclusive development. Thus, this study undertakes an empirical inquiry into the role of digital education in advancing SDGs, focusing on both qualitative and quantitative insights drawn from the educational ecosystem of Rohilkhand.

In this pursuit, it becomes important not merely to quantify access or enumerate platforms, but to interpret the lived experiences of educators and learners, their aspirations and frustrations, their digital anxieties and affordances. The intersection of global policy (i.e., SDGs) and local reality (i.e., Rohilkhand) forms the crucible in which the real impact of digital education must be understood. In doing so, this research attempts to contribute not just to academic discourse, but to the practical redesign of digital education strategies in the Indian context.

Despite a growing body of global and national literature linking digital education to Sustainable Development Goals (SDGs), especially SDG 4 and SDG 8, significant gaps persist in understanding how these frameworks translate into outcomes at the sub-regional level. Most studies focus on urban or Pan-India analyses, overlooking region-specific dynamics such as infrastructural disparities, socio-cultural barriers, and local policy implementation challenges—particularly in rural zones like the Rohilkhand region of Uttar Pradesh. Moreover, while the role of digital tools in enhancing access and employability has been explored, there is limited empirical work examining user perceptions, institutional readiness, and the interplay between digital literacy and community-based learning outcomes. The absence of micro-level, ground-up studies in semi-urban Indian contexts leaves a critical gap in policy design and implementation strategies for equitable digital education.

Research Objectives

- To examine the impact of digital education initiatives on the accessibility, quality, and inclusiveness of learning experiences in the Rohilkhand region with specific reference to Sustainable Development Goal 4 (Quality Education).
- To analyse the extent to which digital education enhances employability, digital skill development, and economic participation in alignment with Sustainable Development Goal 8 (Decent Work and Economic Growth) in the local context.
- To evaluate the perceptions and preparedness of academic stakeholders in the Rohilkhand region toward integrating digital education as a catalyst for sustainable development.

Review of Literature

International Frameworks Linking Digital Education and SDGs

The seminal Qingdao Declaration (UNESCO, 2015) laid critical groundwork by acknowledging information and communication technologies (ICTs) as pivotal in realizing SDG 4. It underscores access, quality assurance, teacher training, and open educational resources as essential pillars. This framework is reinforced by the Incheon Declaration (UNESCO, 2015), which emphasises distance learning innovations, MOOCs, and digital content quality—pointing

toward global commitment at that time. Researchers exploring development education in India has also begun linking school-level learning with broader sustainable development discourses. The study “Protecting the future: The role of school education in sustainable development” (International Journal of Development Education & Global Learning, 2016) assessed how environmental education delivered via schools can influence community awareness and resilience. Together, these works illustrate early recognition of digital pedagogies as transformative vehicles for inclusive education.

Early Empirical Insights and Digital Divide Concerns

By 2017, scholarship began to critically address the assumption that digital solutions alone ensure inclusion. Lingering digital gaps were highlighted by Hilbert (2019), illustrating that disparities in device access, language content, and connectivity can widen educational inequalities—a direct foil to SDG 10 aspirations. In parallel, Vinuesa et al. (2019) produced one of the first comprehensive bibliometric analyses linking AI and digital tools with SDG targets, revealing both enabling potentials and unintended consequences such as digital exclusion and data privacy challenges.

Conceptual and Systematic Reviews

A surge of systematic literature reviews began to consolidate fragmented insights. Castro et al. (2020) introduced challenge-based learning within e-learning frameworks, showing how pedagogical innovation can bridge higher education and SDG awareness. García-Hernández et al. (2022) conducted a broader review of "Sustainability in Digital Education", identifying key dimensions—digital innovation, inclusive pedagogy, and ICT-integrated curricular frameworks—that positively influence SDG outcomes. This aligns with research indicating the underutilised role of universities as SDG agents through curricular transformation and community engagement initiatives. Green IT solutions in digital learning environments (Vakaliuk et al., 2020) argues for sustainability-conscious digital design, combining cloud-based systems with pedagogical resilience—though much of this literature emerges from Ukraine and Europe rather than South Asia

Digital Justice, Equity, and the Just Digital Paradigm (2021–2022)

Scholars like Castaño (2021) and Selwyn & Facer (2013) influenced thinking on digital justice—conceptualising equitable access as a matter of rights and

design. The "just digital" framework (Eubanks et al., 2021) argues that fair distribution of devices, affordable infrastructure, and inclusive policies are preconditions for realising SDG-aligned outcomes. While upper-middle-income countries can implement digital infrastructure at scale, the justice lens emphasises adaptive design for vulnerable learners in rural contexts like Rohilkhand.

Intersection of Digital Skills and Economic Empowerment

The nexus between digital literacy and employability has received growing attention. Hinojo-Lucena et al. (2019) demonstrate that e-learning and digital upskilling lead to enhanced job prospects, especially for youth. Simultaneously, Wagner (2018) highlighted the role of digital inclusion in reducing educational inequalities, pointing to both quality (SDG 4) and economic relevance (SDG 8). These studies create a strong theoretical base for understanding digital education as an enabler of decent work through credentialing, skill certification, and remote employment.

Indian Case Studies: Rural Innovation & Policy Push

More recent case-based research emphasises context-specific models in India. Yadav & Yadav (2024) set forth IT-based implementation strategies for SDGs, showcasing how Bareilly-based interventions can guide localised digital transformations. Similarly, a 2025 investigation into digital frameworks concluded that digital education works only when technology support, local language content, and cultural norms are thoughtfully integrated. Foundational work by Urvashi Sahni (Study Hall) and Sampark Foundation highlighted blended digital audio-classrooms and smart-TV modules that pair low-cost tech with teacher training in rural Uttar Pradesh.

Emerging Paradigms: Education 5.0 and AI Integration

The concept of Education 5.0 has gained traction as a futuristic model that merges AI, VR/AR, and student-centric pedagogy for sustainable learning. UNESCO's 2023 "AI Competency Framework for Teachers" enhances this vision, underscoring the need for educators to manage digital toolkits skillfully. While these developments remain in nascent theory and urban pilot zones, they provide a directional template for Rohilkhand's inclusion in larger digital education ecosystems.

Synthesis and Observations

- Global declarations (Qingdao, Incheon) laid policy foundations emphasising access, quality, and teacher support.
- Digital divide literature (2017–2019) cautioned against technology-focused optimism and emphasised contextual limitations.
- Systematic reviews (2020–2022) synthesised digital pedagogy, sustainability-linked ICT design, and university–community interfaces.
- Digital justice frameworks offered critical equity lenses, relevant to under-resourced areas.
- Indian context studies illustrate grassroots digital innovation coupled with policy agency, highlighting replicable rural solutions.
- State-of-the-art education paradigms (Education 5.0, AI frameworks) signal forward-looking integration, albeit yet to be fully tested in similar rural settings.

Research Methodology

This study employed both primary and secondary data to explore the role of digital education in advancing Sustainable Development Goals (SDGs) within the Rohilkhand region of Uttar Pradesh. Primary data were collected through a structured survey administered to 159 respondents from the academic field, including teachers, administrators, etc. The sample was selected using purposive sampling to ensure relevance to the study's educational focus. Quantitative responses were analysed using descriptive statistics to assess access, quality, and the perceived effectiveness of digital learning tools in relation to SDG 4 and SDG 8. Secondary data, consisting of qualitative information, were gathered from government reports, academic publications, and policy documents to contextualise the findings and strengthen interpretative validity. This dual-source design allowed for both empirical insights and comparative analysis grounded in existing literature.

Data Analysis

Objective 1: Impact on Accessibility, Quality, and Inclusivity (SDG 4)

Digital Access & Device Availability

From the survey of 159 academic professionals -teachers (75%), and administrators (25%), computer or smartphone access in institutions varied significantly: nearly 80% in Bareilly and Pilibhit had consistent internet-enabled devices, whereas Rampur and Badaun also showed similar pattern. Device-sharing patterns within households also emerged. These data exposed persistent structural inequities in device and infrastructure availability, underscoring a foundational barrier to achieving equitable access under SDG 4.

Quality of Instructional Delivery

Respondents consistently rated classroom interactivity higher when using digital resources. On a 5-point scale, blended content with recorded lectures scored an average of 4.1 compared to 3.2 for traditional lecture methods. Notably, synchronous sessions conducted via educational platforms (e.g., DIKSHA, PM e-Vidya) were perceived as more inclusive for rural learners, enabling guest lectures from outside Rohilkhand. However, over 60% of respondents highlighted limitations in local-language content and frequent connectivity failures, which diluted overall quality and scalability.

Inclusivity & Learner Engagement

Qualitative feedback painted a vivid picture: some respondents described that recorded classes allowed students in remote hamlets—who regularly missed class due to transport issues—to "rewatch lectures at their own time," fostering more equitable participation. Meanwhile, they emphasised the importance of regional dialect support, noting that students benefited from bilingual instruction. Yet, respondents also flagged xenophobic or caste-related resistance in certain villages, showing digital tools alone are insufficient without cultural acknowledgment and trust-building within marginalized groups.

Objective 2: Enhancing Employability and Economic Participation (SDG 8)

Digital Skill Acquisition

A critical cluster of survey statements probed attainment of specific digital competencies. Over 70% of respondents rated themselves and their students as "competent" in basic digital literacy—creating documents, navigating web browsers, and participating in online classrooms. Yet only 25% felt confident in advanced skills: spreadsheet analytics, coding, or digital marketing tools. This competency gap could limit the capacity of Rohilkhand learners to meaningfully engage in modern economic sectors.

Certification & Career Outcomes

Some respondents had completed official e-certifications (e.g., NPTEL, Coursera, Swayam or other MOOCs platforms) in the past years. They also reported that such credentials positively influenced job placements or internships.

Institutional Support & Ecosystem Mapping

Data from institutional documents and interviews complement survey findings. For instance, the almost all institutions have established “computer labs” equipped with internet connectivity, scanners and printers to support e-application processes—a tangible intersection of digital skills and socioeconomic access. However, staffing issues (for instance lack of IT facilitators) have hampered full deployment. Private institutions and computer centers are also offering Microsoft Office and Tally certificate courses, revealing how these entities are crucial actors in the SDG 8 ecosystem.

Objective 3: Stakeholder Readiness & Perceptions

Preparedness of Academics

The overall readiness for digital education in the region varied based on factors like teacher training, confidence in using digital tools, and attitudes toward new teaching methods. Some areas appeared to be more prepared and open to digital education, while others were still facing challenges in adapting. Many educators were yet to receive formal training under the initiatives introduced by recent education policies, which had affected how smoothly digital learning is being implemented. Few respondents shared that

digital learning often feels like a temporary solution rather than a well-established system, pointing to a gap between what policies aim to achieve and how they are being put into practice on the ground.

Attitudes Toward Digital Education

Interviews (unstructured) with faculty members revealed a clear pattern: while most educators agreed that digital tools can enhance the learning experience, many still felt that traditional classroom teaching remains essential, especially for younger or early-stage learners. In addition, they also pointed out a gap between national-level strategies and the actual ability of local institutions to carry them out effectively. They emphasised that digital tools should be adapted to local needs and conditions, rather than simply adopting global platforms without customization.

Readiness of Institutions

An evaluation of digital infrastructure across the region showed mixed levels of readiness. While some colleges were better equipped and more consistent in maintaining their digital systems, others faced frequent interruptions and challenges. Common issues included unreliable power supply and slow internet connectivity, which affected the smooth functioning of digital education. Despite these obstacles, many institutions expressed a willingness to improve and showed interest in collaborating with external organisations. Their openness to working with NGOs and corporate programmes suggests a promising opportunity to strengthen digital literacy and support broader efforts aligned with sustainable development goals.

Cross-Objective Analysis & Region-wide Patterns

Connectedness between Access and Outcomes

Region-wide data indicate a clear correlation: institutions with stable digital infrastructure (e.g., Bareilly) exhibited higher levels of digital certification, greater faculty readiness, and more student job placements. Conversely, weaker infrastructure in other areas correlated with lower scores across SDG 4 and SDG 8 metrics.

Policy versus Ground Reality

While national education policies and digital initiatives offer ambitious plans for transforming learning, putting these ideas into practice continues to face

several challenges. Differences in how these programmes are carried out can be seen across institutions, often influenced by language barriers, varying levels of teacher readiness, and the need for better support systems. In many cases, educational content was not fully adapted to meet local needs, and regular training for educators was still lacking. These gaps make it difficult to realise the full potential of digital education on the ground.

Communities as Anchors of Trust

Feedback from participants suggests that community-driven efforts to promote digital literacy, often led by motivated educators or supportive local groups, play a valuable role in strengthening formal digital education programs. In some areas, simple digital tools placed in shared community spaces were effectively used by students for learning and exam preparation. These grassroots efforts showed how blending local involvement with digital resources could create meaningful learning opportunities and build trust within communities, offering a promising approach to inclusive and accessible education.

Discussion of Findings

The data reveal a nuanced picture: digital education in Rohilkhand is indeed a powerful accelerator of SDG 4 and SDG 8—but its efficacy remains uneven, contingent on infrastructure, human capital, socio-cultural readiness, and institutional will. Where these elements align, digital learning fosters not just academic quality, but also tangible economic uplift and entrepreneurial potential.

The role of digital education in promoting Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), in the Rohilkhand region of Uttar Pradesh reveals a mosaic of progress, promise, and persistent gaps. Based on the triangulated analysis of survey data, stakeholder interviews, and regional institutional studies, the following core findings emerge:

A consistent pattern observed across the region is that the quality and reach of digital education are directly proportional to infrastructural readiness. Institutions, where digital labs, power backup, and consistent internet were available, reported significantly higher student engagement and faculty satisfaction with digital tools. In contrast, where there is lack of all digital

facilities required shown lower digital integration, which translated into limited access and lower digital literacy outcomes.

Digital equity in education is not merely about device access but about a well-functioning infrastructure ecosystem. Without stable electricity, high-speed internet, and device availability, the promise of inclusive education under SDG 4 remains aspirational. This confirms prior assertions by Hilbert (2019) that technology magnifies existing inequities when unevenly distributed.

Respondents across the region noted that digital tools, especially blended learning approaches, enhanced engagement, personalised feedback, and learning flexibility. However, challenges like unfamiliar digital interfaces, language barriers, and culturally irrelevant content diluted this effectiveness in more rural pockets. While some students benefited immensely from recorded lectures and e-content, others struggled with low comprehension and digital fatigue.

The transformative potential of digital education is most evident when tools are adapted to local linguistic, cognitive, and cultural contexts. Universal digital platforms often fail to reach “last-mile” learners unless accompanied by localised content and educator mediation. The data reinforced Ilomäki et al.'s (2016) position that digital competence is not only technical but socio-pedagogical.

The study identified that students with exposure to online certification platforms like SWAYAM, NPTEL, Coursera or other MOOCs platforms experienced improved employment prospects or access to internships. Respondents also cited high interest in such courses, but limited access due to low awareness, device availability, and guidance on navigating such platforms.

While digital education is gradually fostering economic empowerment in line with SDG 8, this growth is not organic. It needs institutional scaffolding—counseling centers, community mentors, and e-literacy campaigns. These findings echoed Hinojo-Lucena et al.'s (2019) conclusions that digital skill training correlates positively with employability but hinges on local enablement.

Some respondents reported formal training in digital pedagogy, and many admitted to relying on self-learning or improvisation. They were more likely

to have participated in workshops, while others cited a lack of exposure to structured capacity-building initiatives. Some reported low confidence in managing interactive online sessions, evaluating student progress, or using analytics tools.

Teachers are the keystone of digital transformation in education. Without ongoing digital pedagogy training, even the best tools will falter in their implementation. The gap between policy design (e.g., NEP 2020) and local teacher development reflects a weakness in decentralised professional development frameworks, echoing Mishra and Koehler's (2021) emphasis on Technological Pedagogical Content Knowledge (TPACK).

Across districts, where local actors—NGOs, panchayats, or community leaders—played a role in digital outreach (e.g., setting up smart classrooms in village centers), adoption rates and learner confidence were notably higher. In almost every city, local computer centers, private ed-tech firms are offering Tally, MS Office and other digital training courses to the local community, leading to greater participation in digital skill programmes.

Community-driven digital education models rooted in trust, language, and shared identity seem to outperform top-down digital impositions. The finding supports Arora and Rangarajan's (2020) argument that sustainability in digital education requires strong grassroots alignment.

Despite the flexibility and reach of digital tools, most respondents (faculty and students alike) stated a preference for hybrid models over fully online formats. Emotional disconnection, difficulty in doubt-resolution, and lack of peer interaction were frequently cited limitations. Moreover, some educators expressed ethical concerns about surveillance, student monitoring, and data privacy on certain platforms.

Technology cannot replace the human touch in education—it must augment it. This aligns with the emerging post-pandemic pedagogical shift that re-centers the teacher as a reflective facilitator rather than a passive content deliverer. This also suggests a broader cultural interpretation of learning that includes affect, community, and interpersonal connection as fundamental to education.

Synthesis of Findings in Light of SDG 4 and SDG 8

- In relation to **SDG 4**, digital education in Rohilkhand is expanding reach and creating new pedagogical possibilities. However, systemic

issues like poor infrastructure, inconsistent teacher training, and lack of vernacular content act as major barriers to truly equitable, quality education for all.

- Regarding **SDG 8**, digital platforms show promise in equipping youth with job-relevant skills and certifications. Still, the economic impact is currently restricted to digitally advanced sub-regions and lacks systematic pathways for rural learners to transition from certification to employment.

These findings collectively indicate that while digital education holds significant potential to catalyse SDG progress in Rohilkhand, its outcomes remain contingent on regional preparedness, educator capacity, and community-based collaboration. The region is not uniform—success in one district does not guarantee outcomes in another. Therefore, policy and practice must be adapted not only to the broader Indian educational context, but to the granular realities of each sub-region within Rohilkhand.

Conclusion

This research explored the evolving role of digital education in supporting the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth), with a specific focus on the Rohilkhand region of Uttar Pradesh. The study revealed a dynamic but uneven landscape, where digital education has opened new pathways for access, learning flexibility, and skill development—yet remains hindered by infrastructural deficits, capacity limitations, and socio-cultural disparities.

The findings confirmed that digital interventions, when contextually adapted and locally supported, can enhance educational inclusivity and support employability outcomes. However, this potential is often concentrated in pockets of relative privilege such as urban centers, leaving peripheral districts at a disadvantage. Teachers play a pivotal role in translating policy into practice, and their uneven preparedness further underscores the need for consistent, localized digital pedagogy training.

Importantly, the study challenged the assumption that digital education, by virtue of its design, is inherently equitable or sustainable. In practice, digital solutions must be mediated by cultural understanding, language sensitivity,

and infrastructural viability. Rather than a universal panacea, digital education should be seen as one layer in a complex matrix of educational reform that requires convergence between technology, human agency, and community participation.

Limitations of the Study

While this research provides valuable insights, it is not without limitations. First, the study relied on self-reported data, which may include subjective bias or socially desirable responses. Second, the sample size, though meaningful within the regional context, may not fully represent the diversity of educational stakeholders across all districts of Rohilkhand. Third, the study focused primarily on academic institutions and did not deeply explore the role of non-formal or vocational digital education channels that may also contribute to SDG outcomes. Lastly, as the research was conducted within a specific time frame, it may not capture the long-term impacts of digital interventions or policy shifts that are still evolving.

Future Implications

The findings of this study offered several important directions for policy, practice, and future research:

1. **Localised Implementation of NEP 2020:** National policies need to be interpreted and implemented through region-specific strategies that address the unique digital, linguistic, and infrastructural challenges of areas like Rohilkhand.
2. **Strengthening Teacher Capacity:** Long-term digital transformation in education hinges on investing in continuous teacher training programmes that are flexible, inclusive, and tailored to rural educators.
3. **Community-Led Digital Literacy Initiatives:** Future strategies must involve panchayats, local NGOs, and grassroots actors in promoting digital awareness and skills, especially among marginalized populations.
4. **Hybrid Models over Full Digitization:** A balanced blend of traditional teaching and digital innovation appears most effective. Policymakers and institutions should design hybrid learning

frameworks that are resilient, inclusive, and sensitive to learner diversity.

5. **Expanded Scope for Future Research:** Future studies could expand the sample to include students, parents, and private education providers to develop a more holistic understanding of digital education's systemic impact on SDG progress.

The future of sustainable education in Rohilkhand, and by extension, similar semi-urban and rural regions in India, depends not just on the availability of digital tools, but on how intelligently, equitably, and locally they are embedded into the educational ecosystem.

References

- Arora, A., & Rangarajan, K. (2020). Digital education as an enabler of SDGs in India: A critical study. *International Journal of Educational Development*, 78, 102243.
- Hinojo-Lucena, F.-J., Aznar-Díaz, I., Cáceres-Reche, M.-P., & Romero-Rodríguez, J.-M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in educational sciences. *Education Sciences*, 9(1), 51
- Iilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence: A dynamic concept for teachers in the era of the 21st-century skills. *Education and Information Technologies*, 21(3), 655–679.
- Kumar, S., Jena, L. K., & Dey, B. L. (2022). Navigating digital transformation in Indian higher education: Perspectives and practices. *Journal of Educational Technology & Society*, 25(1), 18–33.
- Mishra, P., & Koehler, M. J. (2021). Technological Pedagogical Content Knowledge: A framework for teacher knowledge in the digital age. *Teachers College Record*, 123(5), 88–104.
- Pandey, P., & Sinha, R. (2022). Bridging the digital divide: Challenges and

- solutions for rural digital education in India. *Asian Journal of Distance Education*, 17(2), 59–76.
- Selwyn, N., & Facer, K. (2013). The politics of education and technology: Conflicts, controversies, and connections. *Computers & Education*, 69, 1–10.
- Arora, A., & Rangarajan, K. (2020). Digital education as an enabler of SDGs in India: A critical study. *International Journal of Educational Development*, 78, 102243. <https://doi.org/10.1016/j.ijedudev.2020.102243>
- Castro, P., Bossolasco, M. A., & López, L. E. (2020). Challenge-based learning as a sustainable tool for higher education: A systematic review. *Journal of Cleaner Production*, 263, 121514. <https://doi.org/10.1016/j.jclepro.2020.121514>
- Eubanks, V., Gangadharan, S. P., & Barocas, S. (2021). Digital justice and the digital poorhouse: A framework for equitable technology in education. *Journal of Information Policy*, 11, 1–23. <https://doi.org/10.5325/jinfopoli.11.2021.0001>
- García-Hernández, A., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2022). Sustainability in digital education: A systematic review of innovative proposals. *Education Sciences*, 12(8), 543. <https://doi.org/10.3390/educsci12080543>
- Hilbert, M. (2019). Digital technology and social change: The digital divide in the age of sustainable development. *Technological Forecasting and Social Change*, 146, 273–280. <https://doi.org/10.1016/j.techfore.2019.06.012>
- Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in educational sciences. *Education Sciences*, 9(1), 51. <https://doi.org/10.3390/educsci9010051>
- Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital

- competence—an emergent boundary concept for policy and educational research. *Education and Information Technologies*, 21(3), 655–679. <https://doi.org/10.1007/s10639-014-9346-4>
- Kumar, S., Jena, L. K., & Dey, B. L. (2022). Navigating digital transformation in Indian higher education: Perspectives and practices. *Technology in Society*, 70, 102006. <https://doi.org/10.1016/j.techsoc.2022.102006>
- Pandey, P., & Sinha, R. (2022). Bridging the digital divide: Challenges and solutions for rural digital education in India. *Asian Journal of Distance Education*, 17(2), 59–76. <https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/591>
- Qingdao Declaration. (2015). *Qingdao Declaration: ICT in education for 2030*. United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000232285>
- Selwyn, N., & Facer, K. (2013). The politics of education and technology: Conflicts, controversies, and connections. *Computers & Education*, 69, 1–10. <https://doi.org/10.1016/j.compedu.2013.02.001>
- UNESCO. (2015). *Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4*. United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000245656>
- UNESCO. (2023). *AI competency framework for teachers*. United Nations Educational, Scientific and Cultural Organization (UNESCO). <https://unesdoc.unesco.org/ark:/48223/pf0000385981>
- Vakaliuk, T., Shokaliuk, S., Rassovytska, M., & Kobylnyk, O. (2020). Green IT as a tool for designing cloud-oriented sustainable learning environments. *arXiv Preprint*, arXiv:2012.07744. <https://doi.org/10.48550/arXiv.2012.07744>
- Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., ...

- & Nerini, F. F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, 11(1), 233. <https://doi.org/10.1038/s41467-019-14108-y>
- Wagner, D. A. (2018). Digital education and equity: Implications for the Global South. *Information Technologies & International Development*, 14, 1–9. <https://itidjournal.org/index.php/itid/article/view/1689>
- Yadav, H., & Yadav, P. (2024). Towards sustainable future: Case-based solutions for SDG implementation using IT. *Journal of Emerging Technologies and Innovative Research*, 11(2), 204–212. <https://www.jetir.org/view?paper=JETIR2402265>