

FROM CHALKBOARDS TO SMART SCREENS : BRIDGING THE DIGITAL DIVIDE IN RURAL EDUCATION

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ABSTRACT

In the modern era, the education sector has seen an unprecedented shift in today's age of rapid technological growth with the unveiling of smart classrooms. In contrast to conventional learning settings, smart classrooms use digital tools, AI-powered solutions and interactive technology to improve the teaching-learning procedure. This study explores the profound necessities of smart classroom in reducing the digital divide in rural areas, the impact of the smart classes in improving student engagement as well as learning outcomes in rural schools, identifying the technological requirements and infrastructure required for successful integration of smart classes, investigating the way in which smart classrooms boost teacher-student interaction and identifying the challenges and barriers faced by rural schools in the implementation of smart classroom technologies and analysing the socio-economic benefits of implementing smart classes in rural setting. The study synthesizes existing literature and examines primary and secondary sources using a qualitative research design to clarify the general effect of smart classrooms in rural location. Major findings reveal that numerous initiatives were taken such as The Digital India which had a crucial role in advancing digital literacy and infrastructure, Samagra Shiksha program undertaken by The Ministry of Education to ensure that everyone has access to high-quality education through the use of computers, projectors and smartboards. Students greatly improve their problem-solving, critical thinking and analytical skills through the use of technology tools. It is found that interactive whiteboards, online resources and video slideshows make learning more engaging and dynamic. Smart classrooms also contribute to socio-economic growth by fostering entrepreneurship and digital literacy among rural youth. As there are various challenges faced by rural students as due to limited access to resources and there is lack of cyber security in remote areas, it is recommended to include teacher training programs focusing on digital pedagogy. Central and State Government must allocate more funds to boost additional resources. However, smart classroom acts as a boon in today's society and therefore steps must be taken to implement it judiciously so that students can reap the benefits of smart classes in rural areas.

Keywords: Digital Divide, Smart Classrooms, Technological Requirements, Learning outcomes, Teacher-Student Interaction, Educational Challenges, Socio-economic benefits

1. INTRODUCTION:

1.1. Background of the Study

The phrase "digital divide" is being used more and more to describe the socioeconomic consequences of some segments in the society having unequal access to ICT and the acquisition of the skills they need (Cronin, 2002). The uneven distribution of opportunities as well as resources between rural and urban communities has been a problem in education since many years. India's rural areas are especially disadvantaged due to their large population and unrealized potential. Traditional classrooms in these regions frequently struggle with a lack of resources, poor facilities and a shortage of trained teachers. As a result, children are denied access to high-quality education, which not only limits their chances but also causes hindrance to their overall development. Rural areas frequently suffer from a lack of resources such as adequate infrastructure, qualified teachers and modern teaching

aids, whereas urban areas have embraced educational technology innovations like smart classrooms and digital classrooms with ease. The digital divide has widened resulting in a range of educational alternatives and outcomes.

Alelwi et al. (2014) define a smart classroom as one with access to modern technologies including 3G and 4G connectivity, interactive learning, and online recording and posting capacity for educational events. As technology has evolved and improved throughout time, it has helped to raise the standard of training. Through the use of a computer and projector, we can provide kids creative learning options and transform our rote learning educational system. Students will learn in a variety of ways with the aid of the smart classroom, even if those methods are not interactive, such as by showing images, graphs, maps, videos, and illustrations. (*Takawale and others, 2016*). In the 1990s, numerous nations began implementing technology in the classroom. For example, Malaysia launched its smart school program in 1996 with the goal of creating a smart classroom and fostering creativity in learning via the use of information and communication technology (ICT) frameworks. Students' performance has improved, and the variables of success, interest, training, and curriculum assessment are high, according to statistical evidence. (*Omidinia and others, 2012*). The website created in the United States by the SRI International institution is called School 2.0. The website was later recognized by the US Department of Instruction and used in partnership with districts, schools, and the public to explore how future technology could improve instruction in smart classrooms (Gyeong et al., 2011).

The integration of smart schools appears to be a potential option to close this digital divide and strengthen rural communities. These classrooms can offer cutting-edge learning opportunities, improve teaching strategies, and give access to a wealth of knowledge by utilizing technology. This paper explores the immense potential of smart classrooms to bring a change in education and promote sustainable development while examining the urgent need for them in rural areas. This paper will also identify the problems and challenges of its implementation and provide further recommendations for further enhancement of the system in rural areas.

1.2 Rationale of the study:

Jo et al. (2016) claim that the smart classroom offers a setting that facilitates teacher-student interaction, sharing, and collaboration. According to *Varghes (2017)*, academic achievement is significantly impacted by smart classes. Using technology and engaging in practical exercises helps students learn well. According to *Kumar and Kumar (2017)*, computer-aided teaching has enabled teachers to reimagine instructional design by delivering the educational content in an engaging and multisensory manner rather than the traditional single media approach.

Digital technology is usually more productive when used in addition with conventional teaching methods rather than in place of them, claim *Jha and Shenoy (2016)*. According to *Dhrakshayani (2015)*, smart classes are a complete solution made to help teachers improve students' academic performance through easy, useful, and purposeful technology use. *Menon (2015)* found that when taught in a smart classroom as opposed to a traditional classroom, pupils performed better. According to *Sugant and Anvekar (2014)*, Digital classroom solutions have been used for less than two years by 82% of teachers and less than four years by 96.8% of them. Children's overall learning and information transmission have benefited from these solutions.

The idea behind this study is that implementing smart classrooms in rural areas can be a powerful way to reduce the gap between urban and rural areas. Additionally, this study looks into how smart classrooms may strengthen rural communities. By teaching digital literacy and skills, these classrooms can equip students with the means to succeed in the digital world and lead to improved livelihoods, more job opportunities, and the socio-economic growth of rural communities. In order to help build policies, regulations, and plans to reduce the digital divide and ensure that everyone has equitable access to high-quality education, this study ultimately seeks to give information in support of the implementation of smart classrooms in rural areas.

1.3 Research Objectives:

The research objectives for this study have been formulated as follows:

1. To identify the importance of smart classroom in narrowing the digital divide in rural sector.
2. To explore the impact of smart classes in improving student engagement and learning outcomes in rural schools.

3. To identify the technological requirements and infrastructure needed for efficient integration of smart classes in rural setting.
4. To look into the effectiveness of smart classrooms in enhancing teacher-student interaction in rural areas.
5. To determine the obstacles and difficulties rural schools face while utilizing and sustaining smart classroom technology.
6. To analyse the socio-economic benefits of implementing smart classes in rural setting and the way they contribute to community development.

1.4 Research Questions:

Based on the research objectives, the researchers have prepared the following Research Questions :

1. What is the importance of introducing smart classrooms in rural educational settings in narrowing the digital divide?
2. What is the impact of smart classes in improving student engagement and learning outcomes in rural schools?
3. What are the technological requirements and infrastructure needed for efficient integration of smart classes in rural setting?
4. How effective are smart classrooms in enhancing teacher-student interaction in rural areas?
5. What obstacles and difficulties do rural schools face while utilizing and sustaining smart classroom technology?
6. What are the socio-economic benefits of implementing smart classrooms in rural settings and how do they contribute to community development?

2. REVIEW OF RELATED LITERATURE:

2.1 Importance of smart classroom in narrowing the digital divide in rural sector.

Prensky (2019) asserts that incorporating smart technology into the classroom enables flexible and engaging learning experiences which are essential for students in settings with limited resources. By giving students access to cutting-edge technology and engaging learning materials, smart classrooms are essential in closing the digital gap in rural areas (*Gupta & Sharma, 2021*). By fostering equal educational opportunities and improving digital literacy, these schools help to close the knowledge gap between students in urban and rural areas (*Kumar, 2022*).

2.2 To explore the impact of smart classes in improving student engagement and learning outcomes in rural setting.

According to *Saini and Goel (2019)*, smart classrooms improve teaching and learning effectiveness while equipping students with the skills they need to thrive in an increasingly digital and evolving higher education landscape in India. The efficiency of teaching and learning in India's higher education system has been greatly impacted by smart classrooms. By offering interactive and multimedia-rich content that grabs students' attention and improves comprehension, smart classrooms have been demonstrated to dramatically increase student engagement and learning results in rural settings (*Gupta & Sharma, 2021*).

2.3 Technological Requirements And Infrastructure Needed For Efficient Integration Of Smart Classes In Rural Schools.

Smart classrooms use a range of contemporary technology to give rural kids a better education (*Dai et al., 2023; Yilmaz & Söğüt, 2022*). Digital technologies such as smartphone apps and cloud computing are currently propelling economic growth and citizen empowerment on a global scale (*Tripathi & Dungarwal, 2020*). Learning management systems, classroom response systems, mobile devices, and interactive whiteboards are the four key smart devices for these classrooms (*Kim & Jang, 2020; MacLeod et al., 2018; Yang et al., 2019*). For smart classrooms in rural areas to remain sustainable over the long term, proper maintenance and technical assistance are also essential (*Singh & Yadav, 2019*).

2.4 The Effectiveness Of Smart Classroom In Enhancing Teacher-Student Interaction In Rural Areas.

As smartboards are interactive, teachers can display material in a way that encourages discussion rather than a one-way transfer of knowledge (Gupta & Sharma, 2021). This allows for more frequent and meaningful interactions with students by changing the teacher's role from lecturer to facilitator. Smart classrooms provide a welcoming environment for active engagement in rural schools where conventional classroom arrangements frequently restrict student-teacher contact. The various ways that smart classrooms alter teaching and learning were examined by Saini and Goel (2019). Smart classrooms offer a wealth of resources that make learning engaging and dynamic. Teachers can reach more pupils, including those who live far away, and provide them with greater training with the use of these materials. Nevertheless, the interactive learning and multimedia elements.

2.5 The Obstacles And Difficulties Rural Schools Face While Utilizing And Sustaining Smart Classroom Technology.

According to *Gupta and Sharma (2021)*, lack of infrastructure such as slow internet connectivity and antiquated hardware, continues to be a major problem in rural schools. Due to resource constraints brought on by remote locations, rural children do not have access to high-quality educational resources, which causes them to lag behind urban students in learning outcomes. (*Jang & Kim, 2020*).

By employing smart learning technologies, such as online assessment programs, mobile learning applications, and virtual courses in remote areas, India may be able to overcome its educational obstacles and guarantee that everyone has access to high-quality education. Another barrier is parents' inexperience with technology which can make it more difficult for them to use it to improve their children's education (*Letswalo 2023*).

2.6 The Socio-Economic Benefits Of Implementing Smart Classrooms In Rural Settings And The Way They Contribute To Community Development.

According to *Kumar (2020)*, education plays a significant role in determining socio-economic position and smart classrooms can assist to end the cycle of poverty in rural areas by raising educational standards. Higher investment has frequently been linked to better rural development. It is claimed that if rural areas had more competitive infrastructure that was accessible from many urban sites, they may see rapid socioeconomic growth (*Fox, W. F., & Porca, S.2001*). According to *Miller and Robertson (2010)*, educators in rural schools who receive training in smart technology also act as change agents, promoting digital literacy in their local communities. The level of living and economic climate in rural areas are anticipated to improve with increased education, better water and power, more reasonably priced transportation, better telecommunication are all expected to raise the standard of living and economic climate in rural areas. (*Ahmad et al., 2014 & Yilmaz et al., 2010*).

3. METHODOLOGY

3.1. Research Design

This study's research design is qualitative in nature. The research uses primary and secondary data analysis to examine how smart classrooms can bridge the digital divide in rural education. By synthesizing previous research and reports, this study offers a comprehensive understanding into the effects, difficulties, and socio-economic advantages of smart classrooms in rural areas.

3.2. Data Collection

In order to collect data for this study, a wide variety of sources about the effects of smart classrooms in rural areas are gathered which includes:

➤ Primary Sources

In order to reduce the digital divide, policy documents such as the National Education Policy (NEP) 2020 and Digital India initiatives highlight the use of technology in education, especially in rural areas. Case studies from various organizations, such as the Ministry of Education's "Smart Classrooms in Rural India," demonstrate the effectiveness of smart classrooms in enhancing student engagement and improving educational outcomes.

Statistical data from national surveys like ASER and international reports by UNESCO reveal a persistent gap in educational access and quality between rural and urban areas, with a growing need for digital tools to level the playing field. Testimonials from educators and administrators confirm that smart classrooms are transforming teaching methods and learning experiences, fostering greater community involvement and improving overall educational quality in rural settings.

➤ *Secondary Sources*

Scholarly articles and publications from digital repositories and open-access journals provide significant insights into the implementation and impact of smart classes in rural areas, exploring various dimensions such as student engagement, teacher training, and infrastructure challenges. Books and monographs on educational technologies in rural settings offer in-depth analyses of their socio-economic effects, emphasizing how technology fosters digital literacy, economic growth, and community development. Global reports from international agencies like the World Bank, UNICEF, and UNESCO highlight the necessity of integrating technology to reduce educational disparities and enhance learning outcomes in rural areas, offering global perspectives on the transformative potential of digital education in underserved regions.

3.3. Data Analysis

This study used a multi-method approach, beginning with documentary analysis of various sources such as government reports, policy documents as well as case studies to trace the evolution of digital education in rural areas and examine the role of key policies and technological interventions in bridging the digital divide. A literature review of secondary sources, including peer-reviewed journal articles and reports from international organizations, provided a theoretical framework to contextualize the findings and explore the broader debates on smart classrooms and digital inclusion in rural education. Finally, thematic analysis of both primary and secondary data identified recurring patterns and key themes, such as community involvement, teacher training, and infrastructure, to understand how smart classrooms enhance educational access, improve student outcomes, and contribute to socio-economic development in rural settings.

4. ANALYSIS AND DISCUSSIONS WITH RESPECT TO RESEARCH OBJECTIVES

4.1 Objective 1: *To identify the importance of smart classroom in narrowing the digital divide in rural sector.*

Prime Minister of India Narendra Modi launched the "Digital India" project on July 1, 2015, with the goal of establishing a technologically aware and empowered society where all residents may readily access government services, promoting both economic and digital empowerment. (Thomas, 2019). Considering the adaptability and imaginative spirit of the nation's youth, digital technology has the potential to bring India to the forefront of the world and create a just and equal society. (Gurumurthy et al., 2014; Kumar, 2019).

The Digital India initiative, launched in 2015, played a vital part in developing digital infrastructure and literacy and creating the framework for creative educational environments.

Samagra Shiksha program: The Ministry of Education introduced this program in 2018 as a flagship initiative to ensure that everyone has access to high-quality education. By integrating information and communication technology (ICT) into classroom instruction, this approach seeks to improve learning outcomes.

The initiative was based on following key points:

- To provide schools with digital equipment such as computers, projectors, and smartboards.
- Availability of e-materials in various regional languages.
- Programs launched for educating teachers to use technology in the classroom.
- The state governments share funds to run this program.

Students greatly improve their collaborative skills and problem-solving abilities by reflecting on themselves through the use of technology tools (Di et al., 2019). Students' learning progress and subsequent job development are significantly impacted by these proficiencies (Herro et al., 2021).

4.2 Objective 2: To explore the impact of smart classes in improving student engagement and learning outcomes in rural setting.

Shamim et al. (2022) positioned innovative approaches, particularly "quality education," for "smart classes teaching." They claimed that because of the usage of innovative teaching strategies and state-of-the-art technology, "smart classrooms" are crucial in improving the efficiency of instruction and learning.

Shanwal (2017) examined how "traditional and smart classrooms" differed in their effects on "creativity" and "academic achievement." In contrast to conventional classroom settings, smart classrooms provide students with a wealth of information sources, collaborative learning environments, and interactive resources. These are not in vain; they simultaneously foster creativity and save time. This demonstrates how those teaching styles can be modified and incorporated into the Indian higher education system with the aid of an ideal classroom.

To find out how smart classrooms affect teaching and learning effectiveness in higher education, Madhur, B., et al. (2024) polled 201 participants (teachers and students) from various higher education streams. "Random sampling method" and "Factor Analysis" were used to collect and analyse the data. It was discovered that in smart classes, pupils are more likely to participate. Interactive whiteboards, video slideshows, and online resources make learning more engaging and dynamic. People who participate in this way are better able to retain and comprehend the lessons they are learning. Smart schools make it easier to personalize instruction. Because kids have access to a wealth of digital tools and resources, they may go further into topics that interest them and learn about things at their own pace. Adaptive learning tools can modify the content they provide to meet the requirements of students with different learning styles and abilities. It facilitates learning together, which is an additional advantage.

According to Kaur et al. (2022), smart classrooms could be seen as a crucial instrument for improving the efficacy of teaching and learning, particularly in higher education settings. Learning will concentrate on the various benefits that come from using smart classroom tools, such as increased student engagement, improved academic performance, and individualized instruction, among many others.

4.3 Objective 3: To identify the technological requirements and infrastructure needed for efficient integration of smart classes in rural setting.

Palanivel (2020) makes an effort to talk about the concept of new technologies in smart education, emphasizing how crucial they are in altering conventional classroom operations. Smart classrooms surpass traditional teaching methods with the addition of virtual reality, augmented reality, and engaging video content.

Helton, Stephnie J., (2024) conducted a case study in which Participant 4 stated that technology software, apps, and websites should be "kid-friendly, where it's colorful and catches their attention, but I don't want it to be just playing games either; I want it to be more of an educational reason for it."

Various E-Learning Platforms such as Google Classroom, Google meet must be used. In case of Teacher Training and Support, basic training must be given to the teachers on using smart classrooms, a local team is needed for maintenance and troubleshooting, low - cost devices such as Government-subsidized or refurbished gadgets, NGOs and EdTech companies can help with funding.

4.4 Objective 4: To look into the effectiveness of smart classrooms in enhancing teacher-student interaction in rural areas.

Murugesan and Deepa (2019) investigated the use of smart classroom instruction in high school science classes, and they provided us with helpful details on the several ways that technology could enhance the educational setting. This demonstrated to us the importance of taking a proactive stance and utilizing "smart classroom technologies" to enhance student learning, particularly in STEM fields. Teachers have the ability to construct student-centered learning environments that will increase all students' engagement and foster a deeper understanding of science subjects by utilizing digital content, interactive tools, and real-time feedback systems.

The impact of "learner factors" on higher-order thinking in a "smart classroom environment" was examined by Di et al. (2019). They underlined how crucial it is to consider each student's background and interests in order to

improve the effectiveness of smart classroom activities. By introducing novelty into teaching and learning experiences, educators can help students develop higher-order thinking skills. However, they must modify lessons and technologies according to learner differences, cognitive capacities, and preferred learning styles. In the end, this will improve the effectiveness of classrooms in India's higher education system.

4.5 Objective 5: To determine the obstacles and difficulties rural schools face while utilizing and sustaining smart classroom technology.

One billion children globally are estimated by the *World Bank (2022)* to be living in multifaceted poverty in developing countries. Due to their remote locations, rural students have restricted access to high-quality educational resources, which leads to poor academic performance and inadequate 21st-century skills (*Chen & Lin, 2021*).

The UN fervently urges countries everywhere to use technology strategically to guarantee all underprivileged children equal access to education (*UN General Assembly, 2015*).

Updating smart devices with the most recent security patches may be challenging for rural institutions, increasing their susceptibility to cyberattacks. Lack of cybersecurity may cause teachers to be reluctant to implement smart devices out of concern for the privacy of their students and the security of the network as a whole.

4.6 Objective 6: To Analyse The Socio-Economic Benefits Of Implementing Smart Classes In Rural Setting And The Way They Contribute To Community Development.

The integration of smart classrooms in rural areas offers substantial socio-economic advantages by enhancing educational quality, fostering digital literacy, and contributing to community development. Smart classrooms, equipped with digital tools and internet access, bridge the urban-rural educational divide and improve student engagement and learning outcomes (*Gupta & Sharma, 2022*). One key benefit of smart classrooms is their capacity to develop learning experiences through interactive content, multimedia resources, and real-time assessments, leading to improved academic performance (*Mishra et al., 2021*). These advancements equip students with technological skills that increase their employability in the digital economy, thereby reducing rural unemployment rates (*Patel, 2023*). Additionally, smart classrooms promote teacher training and professional development by providing access to online resources and virtual collaborations, improving instructional quality (*Kumar & Singh, 2020*).

Beyond education, smart classrooms contribute to economic growth by fostering entrepreneurship and digital literacy among rural youth. Access to technology enables individuals to explore online business opportunities, agricultural innovations, and skill-based learning platforms, which can boost local economies (*Sharma & Verma, 2022*). Furthermore, community engagement increases as schools serve as digital hubs, offering adult education programs and facilitating access to government services (*Das, 2021*). Despite challenges such as infrastructure limitations and initial investment costs, the long-term benefits of smart classrooms outweigh these barriers. Policies promoting public-private partnerships and government funding can ensure sustainability (*Rao & Mehta, 2023*). Overall, smart classrooms serve as a catalyst for rural transformation, fostering socio-economic development and bridging the digital divide.

Conclusion

Incorporating smart classrooms into rural education is a potent way to reduce the long-standing digital gap in addition to technological advancement. Smart classrooms equip rural students with previously unattainable information and skills by giving them access to interactive learning materials, real-time updates, and worldwide educational content. They foster digital literacy, improve teacher-student interaction, and get pupils ready for a cutthroat global marketplace. Smart classrooms definitely make the sessions interactive and it has a power to grasp students' attention. In order to overcome these obstacles, it is recommended that legislators, educators, and school stakeholders work together to provide fair access to technology, offer guidance and assistance to parents and teachers, and cultivate alliances with neighbourhood organizations. The development of infrastructure must be given top priority. Particularly in rural and isolated areas, governments should guarantee reliable energy and broadband internet in schools. Collaborations with businesses in the private sector can hasten the rollout of affordable digital equipment like projectors and smartboards. For Smart Classrooms to be used effectively, teacher training is essential. Consequently, it may be said that smart classroom

has a lot of benefits in rural areas and there is an urgent need to remove those obstacles for smooth functioning of the smart schools in rural areas thereby providing a bright future for the students.

References:

- Ahmad, M. S., & Talib, N. B. A. (2014). Empirical investigation of community empowerment and sustainable development: Quantitatively improving qualitative model. *Quality & Quantity*, 49(2), 637–655. <https://doi.org/10.1007/s11135-014-0005-x>
- Alelaiwi, A., Alghamdi, A., Shorfuzzaman, M., Rawashdeh, M., Hossain, M. S., & Muhammad, G. (2014). Enhanced engineering education using smart class environment. *Computers in Human Behavior*, 51, 852–856. <https://doi.org/10.1016/j.chb.2014.11.061>
- Bo-Gyeong, G., Hyeon-Jin, K., Hee-Jeon, S., Jong-Won, J., & Eun-Hwan, L. (2011). Future school 2030 model for the introduction of future school systems. *Korea*.
- Chatterjee, P., Gantait, A., Swamy, G. A., & George, B. (2023). Information and Communication Technologies in Education: A Framework for Transforming the Indian Education System through Smart Learning. In *Digital Technologies for Smart Business, Economics and Education: Towards a Promising Future* (pp. 283-301). Cham: Springer International Publishing.
- Di, W., Danxia, X., & Chun, L. (2019). The effects of learner factors
- Cheng, C.-C., & Yang, Y.-T. C. (2023). Impact of smart classrooms combined with student-centered pedagogies on rural students' learning outcomes: Pedagogy and duration as moderator variables. *Computers & Education*, 207, 104911. <https://doi.org/10.1016/j.compedu.2023.104911>
- Chen, C.-S., & Lin, J.-W. (2021). An action research on the long-term implementation of an engineering-centered PjBL of sustainable energy in a rural middle school. *Sustainability*, 13(19), Article 10626. <https://doi.org/10.3390/su131910626>
- Cronin, B. (2002). The digital divide, *Library Journal* 127 (3) p. 48
- Das, A. (2021). *Digital learning initiatives and rural education*. *Education and Society*, 10(3), 45-62.
- Di, W., Danxia, X., & Chun, L. (2019). The effects of learner factors on higher-order thinking in the smart classroom environment. *Journal of Computers in Education*, 6(4), 483-498.
- Dai, Z., Xiong, J., Zhao, L., & Zhu, X. (2023). Smart classroom learning environment preferences of higher education teachers and students in China: An ecological perspective. *Heliyon*, 9(6).
- Dhrakshayani, M., (2015). Traditional methods vs. Smart classrooms: An integrated approach towards early childhood education. *International Journal of Applied Home Science*, 2(7 & 8): 257-263.
- Fox, W. F., & Porca, S. (2001). Investing in rural infrastructure. *International Regional Science Review*, 24(1), 103–133. <https://doi.org/10.1177/016001701761013007>
- Gupta, R., & Sharma, P. (2022). *Technology-enhanced learning in rural schools: A pathway to equity*. *Journal of Educational Technology*, 15(2), 78-95.
- Gurusurthy, A., Chami, N., Babbar, A., Vasudevan, M. P., & Sudharma, N. (2014). Digital technologies and gender justice in India. *IT for Change*, 202014–202011.
- Helton, Stephnie J., (2024). "Technology Selection in a Rural School District: A Case Study" Digital Commons @ ACU, *Electronic Theses and Dissertations*. Paper 795. <https://digitalcommons.acu.edu/etd/795>
- Hussain, S., Maqbool, R., Hussain, A., & Ashfaq, S. (2022). Assessing the Socio-Economic Impacts of Rural Infrastructure Projects on Community Development. *Buildings*, 12(7), 947. <https://doi.org/10.3390/buildings12070947>
- Jha, N., & Shenoy, V. (2016). Digitization of Indian education process: A hope or hype. *IOSR Journal of Business and Management*, 18(10), 131–139. <https://doi.org/10.9790/487x-181003131139>
- Kambala, Y., & Mathe, R. (2022). Impact of smart classroom: A study. *The Journal of Multidisciplinary Research*, 1(2), Article 280. <https://doi.org/10.37022/tjmdr.v1i2.280> and *Humanities*, 2019, 4
- Kaur, R., & Ahuja, N. (2023). Impediments to Adopt Nep 2020 & Integrate Ict in Indian Educational Ecosystem. *European Economic Letters (EEL)*, 13(5), 768-773.
- Kim, H. J., & Jang, H. Y. (2020). Sustainable technology integration in underserved area schools: The impact of perceived student change on teacher continuance intention. *Sustainability*, 12(12), 4802.
- Kumar, S. (2019). From digital India to skill India or vice versa. *ZENITH International Journal of Multidisciplinary Research*, 9(6), 1–8.

- Kumar, S. and A. Kumar, (2017). A comparative study of computer-aided teaching and traditional teaching in science and Mathematics subjects. *Journal of Teacher Education and Research*, 12(1): 27-34. Available at: <https://doi.org/10.5958/2454-1664.2017.00004.0>
- Kumar, S., & Singh, R. (2020). *Teacher training in digital education: A case for smart classrooms*. *International Journal of Pedagogical Innovations*, 8(1), 32-47.
- MacLeod, J., Yang, H. H., Zhu, S., & Li, Y. (2018). Understanding students' preferences toward the smart classroom learning environment: Development and validation of an instrument. *Computers & Education*, 122, 80-91.
- Madhur, B ., Desale, G.B., Annam,V., Sharma, C.S.(2024). Impact of Smart Classrooms in Teaching Learning Effectiveness in Higher Education: A Quantitative Investigation. *Journal of Informatics Education and Research*. 4. 1526-4726.
- Mishra, P., Sharma, K., & Nair, R. (2021). *Smart classrooms and student engagement: An empirical study in rural India*. *Journal of Digital Education*, 14(4), 101-120.
- (2015). Effectiveness of smart classroom teaching on the achievement in Chemistry of secondary school students. *American International Journal of Research in Humanities, Arts and Social Sciences*, 9(2), 115–120.
- Murugesan, B., & Deepa, H. (2019). Effectiveness Of Smart Classroom Teaching On Achievement In Science Among Secondary School Students. *Think India Journal*, 22(3), 1490-1498.
- Omidinia, S.& Masrom, M.& Selamat, H. (2012). Determinants of smart school system success (case study of Malaysia).
- Palanivel, K. (2020). Emerging technologies to smart education. *Int. J. Comput. Trends Technol*, 68(2), 5- 16.
- Park, J., Ji, H., Yang, Y., & Lim, H. (2015). A study on factor analysis to support knowledge-based decisions for a smart class. *Information Technology and Management*, 17(1), 43–56. <https://doi.org/10.1007/s10799-015-0222-8>
- Patel, M. (2023). *The impact of smart education on rural employment opportunities*. *Rural Development Review*, 12(1), 56-70.
- Prensky, M. (2019). *Digital natives, digital immigrants: Rethinking education for the technology age*. *Journal of Educational Change*, 39(1), 89-104.
- Rao, V., & Mehta, D. (2023). *Public-private partnerships in digital education: Challenges and solutions*. *Policy and Education*, 9(2), 88-110.
- Saini, M. K., & Goel, N. (2019). How smart are smart classrooms? A review of smart classroom technologies. *ACM Computing Surveys (CSUR)*, 52(6), 1-28.
- Sethy, R., & Mohalik, R. (2019). Smart classroom for teaching learning at secondary level in West Bengal: An exploratory study. *American Journal of Social Sciences and Humanities*, 4(1), 129–137. <https://doi.org/10.20448/801.41.129.137>
- Sharma, A., & Verma, T. (2022). *Entrepreneurship education and digital literacy in rural areas*. *Economic Development Journal*, 17(3), 205-223.
- Singh, R., & Yadav, M. (2019). Infrastructure and technological support for smart classrooms in rural India. *Asian Education and Development Studies*, 8(3), 312-326.
- Sugant, R. and S. Anvekar, (2014). E-Learning and digital classroom solutions in CBSE schools: A study of factors that determine the effective knowledge delivery by teachers at secondary level. *IOSR Journal of Research & Method in Education*, 4(4): 27-32. Available at: <https://doi.org/10.9790/7388-04442732>.
- Takawale, N. and Kulkarni, S., (2016). Effectiveness of Smart Classroom over Traditional Classroom in Terms of Academic Achievement of Students Using Statistical Method. *International Journal of Innovative Research in Computer and Communication Engineering*, 4(02).
- Thomas, P. N. (2019). *The politics of digital India: Between local compulsions and transnational pressures*. Oxford University Press.
- UN General Assembly. (2015). *Transforming our world: The 2030 agenda for sustainable development*. A/RES/70/1. <https://www.refworld.org/docid/57b6e3e44.html>
- Varghes, J.F., 2017. The effect of smart class on academic achievement. *International Journal on Recent and Innovation Trends in Computing and Communication*, 5(7): 416-419.
- World Bank. (2022). *The impact of COVID-19 on the welfare of households with children : An overview based on high frequency phone surveys (English)*. In *Equitable growth, finance and institutions notes* Washington, D.C.. World Bank Group. <http://documents.worldbank.org/curated/en/099230003092226699/P1776560f3b3cc0eb0b5b50ce9d88cf44f6>.

- Yılmaz, B., Daşdemir, I., Atmış, E., & Lise, W. (2010). Factors affecting rural development in Turkey: Bartın case study. *Forest Policy and Economics*, 12(3), 239–249. <https://doi.org/10.1016/j.forpol.2009.10.003>
- Yang, J., Yu, H., & Chen, N. S. (2019). Using blended synchronous classroom approach to promote learning performance in rural area. *Computers & Education*, 141, 103619.
- Yılmaz, A., & Söğüt, S. (2022). Language education for social justice: Reproductions or disruptions through technology. *Computers & Education*, 187, 104535.
- Zid, M., Budiaman, Kustandi, C (2023). *Smart Class* as a Culture Learning Resource in the Tourism Village of *Cisaat*, Proceedings of the Unima International Conference on Social Sciences and Humanities (UNICSSH 2022), 2023, p. 878-885, 10.2991/978-2-494069-35-0_106
- <https://www.schoolnetindia.com/blog/revolutionizing-education-bridging-the-digital-divide-between-rural-to-urban-landscapes-with-smart-classroom-technology/>
- <https://educationforallinindia.com/concept-of-smart-classrooms-in-india-its-present-status/tusindiahttps://educationforallinindia.com/concept-of-smart-classrooms-in-india-its-pr>
- <https://www.iotforall.com/5-challenges-of-implementing-iot-in-rural-schools>
- <https://educationforallinindia.com/concept-of-smart-classrooms-in-india-its-present-status/>

