Challenges in Implementing Smart Classrooms: Jharkhand vs. Developed Indian States

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Abstract
The integration of smart classrooms into the educational system represents a significant advancement, aiming to enhance learning through digital tools and interactive technologies. However, the effectiveness of these smart classrooms varies greatly depending on regional contexts within India. This study contrasts the challenges faced by Jharkhand, a state with relatively lower economic development and infrastructure, with those experienced by more developed Indian states. Key challenges include infrastructure limitations, financial constraints, and disparities in teacher training and technical support. While developed states benefit from stable power supplies, high-speed internet, and robust professional development programs, Jharkhand struggles with erratic electricity, poor connectivity, and insufficient resources for both technology and teacher training. This paper highlights the challenges requires targeted interventions and a strategic approach to ensure equitable access and effective use of smart classroom technologies across different regions.

Keywords: Smart Classrooms, Infrastructure Limitations, Financial Constraints

Introduction

The implementation of smart classrooms in India is a transformative initiative aimed at enhancing the educational experience through advanced technological integration. However, the journey towards establishing smart classrooms reveals significant disparities between regions, particularly when comparing states like Jharkhand with more developed counterparts. Jharkhand, with its relatively underdeveloped educational infrastructure, faces considerable challenges in this transition. These challenges include limited access to high-speed internet, insufficient technological resources, and a lack of training for educators, all of which impede the effective deployment of smart classroom technologies. Additionally, socio-economic factors such as lower funding and inadequate support further exacerbate these issues, creating a substantial gap between Jharkhand and more developed states. In contrast, developed Indian states have generally made substantial investments in technological infrastructure and teacher training, which facilitates a more seamless and effective integration of smart classroom technologies. These states benefit from better connectivity, higher budgets, and established support systems that enable them to overcome the hurdles faced by less developed regions. The disparities in the implementation of smart classrooms between Jharkhand and its more advanced counterparts highlight the need for a nuanced approach to address these challenges. Understanding these differences is crucial for developing targeted strategies that can bridge the gap and promote equitable educational opportunities across the country. This examination provides valuable insights into the specific barriers faced by Jharkhand and offers a foundation for crafting solutions that address these regional disparities in educational technology implementation [1-9].

Review of Literature

Gligorić et al (2012, March). They are now living in a time where billions of computers are linked to one another. It is anticipated that in the not-too-distant future, not only computers but also a wide variety of digital gadgets and other physical items will be able to interact with one another in a seamless manner and with little or no involvement from humans. Smart devices are the name given to these networked things, and the idea

that underlies them is known as the Internet of Things. For the purpose of this article, the Internet of Things (IoT) implementation in smart classrooms is the primary emphasis. The purpose of this study is to describe the ways in which intelligent ambient may be used to offer automated feedback in real time on the quality of the lecture depending on the number of criteria. To the best of our knowledge, this is the very first effort that has been made to analyse the needs and identify the issue. It is mentioned that the parameters of interest that need to be gathered and analysed should be done thus. In conclusion, the primary criteria that such a system need to be in accordance with are stated and recommended as the experimental design.

Spector, J. M. (2014). During the last half-century, there has been a significant shift in the learning settings, mostly as a result of the proliferation of information and communication technology. From the advent of personal computers and the Internet, there has been a continuous explosion of innovations that assist learning and education. These developments have supported learning and instruction. New learning techniques and instructional paradigms have been the subject of a great deal of written material; yet, only a few of these approaches have been put into practice on a wide scale with any notable learning results. In the past, when a new learning technology is introduced, it is typically tested on a limited scale in a privileged environment (for example, with highly experienced and motivated teachers, on-site researchers, etc.). If the results show that the technology has potential, it is then widely disseminated and used to replace an activity or resource that was previously utilised, frequently without adequate training and support. It is time to conceptualise how learning environments may be made more effective, efficient, and engaging (i.e., smarter) on a wide scale and in a sustainable manner. This is because of the power and promise of new and emerging technologies. The purpose of this paper is to make a little contribution towards achieving that goal.

Nye, B. D. (2015). Access to information and communication technology is rising in developing countries, which means that learning technologies have the potential to play an increasingly important role in enhancing and supplementing educational institutions that are already under great pressure. Despite the fact that intelligent tutoring systems (ITS) provide significant learning benefits, they belong to a category of technology that has typically been created for the most industrialised nations. In recent times, there has been an increased focus on information technology systems (ITS) that are geared towards the developing world as well as ITS that are culturally suited. This article offers the conclusions of a comprehensive literature study that focused on the obstacles that stood in the way of the implementation of ITS in developing countries. While the results of the analysis are likely to be applicable to a wider variety of educational technologies, the major emphasis of the research was on instructional technology systems (ITS). An analysis of the geographical and economic geography of tutoring publications is carried out in order to ascertain the locations where research on tutoring systems is conducted. The next section of the study provides a discussion of the difficulties and potential solutions that are associated with obstacles to ITS in both formal and informal contexts. The following are some of the obstacles that students face: fundamental computer skills, hardware sharing, mobile-dominant computing, data prices, electricity dependability, internet infrastructure, language, and culture. After that, the differences and similarities between tutoring system research for the developing world that was done locally and research that was generated using foreign resources are taken into consideration. The last section of this study provides a conclusion that includes some possible future paths and possibilities for research on tutoring systems and other educational technologies that are now being used on a worldwide scale.

Pal et al (2015). ICT, which stands for information and communication technology, has essentially revolutionised the process of teaching and learning in an increasingly efficient manner. Additionally, it has resulted in the creation of smart classrooms, also known as e-classrooms, which are anticipated to bring about a significant shift in the area of education. The traditional education system in India is still lacking the necessary facilities to adequately serve the country's ever-increasing population. E-learning and distance learning programs have the ability to provide answers to this issue that seem to be completely evident. Using information and communication technology, several attempts are now being launched in order to provide education to the most rural and distant areas of India. Over the last few days, the government of India has introduced a brand new and ambitious plan called "Digital India." The Centre for Advanced Communication (CACM), which is an anchor firm located within Science and Technology Entrepreneur's Park (STEP) at the Indian Institute of Technology Kharagpur, is now the most successful company in Eastern India that is working in the field of language application and multimedia content distribution. When CACM was first established in 1996, it was comprised of a group of young and enthusiastic professionals. Over the course of

its existence, the firm has been forced to surmount a great number of obstacles, and it is now making steady growth under the direction of the first author. It is present in fourteen of India's most important states and has carried out more than two hundred significant projects over the course of the last twelve years. There are around 225 language laboratories and online classrooms that have been created in different locations of India. These facilities are able to accommodate more than 10,000 students. More than one hundred training programs have been carried out by CACM, and the organisation has also planned and developed the most extensive laboratory in Eastern India. The Department of Humanities at the Indian Institute of Technology Kharagpur is home to the company's very own application and evaluation facility.

Zhu et al (2016). Learning is made possible by the development of new technology, which allows students to study in a manner that is more effective, efficient, flexible, and comfortable. Learners make use of smart devices in order to provide themselves with access to digital resources via wireless networks and to engage in learning that is both personalised and seamless. More and more people are becoming interested in the notion of "smart education," which is used to characterise education in the digital era. In this study, the definition of "smart education" is discussed, and a conceptual framework is presented. In order to cultivate intelligent learners who are in need of mastering the knowledge and abilities of 21st century learning, a framework consisting of four tiers of smart pedagogies and 10 distinct characteristics of smart learning environments have been developed. Individual-based personalised learning, group-based collaborative learning, mass-based generative learning, and tailored teaching in the classroom are all components of the smart pedagogy paradigm. In addition, a technical architecture of smart education is developed, with a particular emphasis placed on the function that smart computing plays. In this presentation, both the tri-tier architecture and the major functionalities are discussed. After then, the difficulties associated with smart education are highlighted.

Iftakhar, S. (2016). Participants are able to chat with one another, see presentations or videos, connect with other participants, and engage with resources in work groups while they are in a virtual classroom, which is an online classroom. The Google Classroom platform is the most recent contribution to the virtual classroom movement. Classroom was introduced by Google in May of 2014 as a new product that is included in the Google Apps for Education suite. Beginning in September 2014, more than thirty instructors at Daffodil International University have begun utilising Google Classroom. The objective of this research is to provide a comprehensive report on the general perception of Google Classroom as it is used in the various classrooms. Brief descriptions of Google Classroom's capabilities are provided in this article. For this particular piece of writing, a theoretical framework has been derived from Roger's idea of the spread of innovation. In addition, for the aim of the study, a number of adoption variables, including organisational, social, personal, and technical elements, have been reevaluated. a) What variables drive teachers to utilise Google Classroom? is one of the study issues that will be investigated. b) What are some ways that teachers make use of Google Classroom in their classrooms? What are the obstacles that prevent people from using Google Classroom? Specifically, what are the reactions of the pupils to the Google Classroom? Based on the analysis of the findings of the questionnaire, it seems that this research has the potential to be useful in gaining an understanding of and analysing the perspectives of both instructors and students in order to guarantee that Google Classroom is used for teaching and learning of a high standard. In addition to that, this research provides some fresh data on the potential of Google classrooms in the field of education. In conclusion, some recommendations about the expectations of the students were also supplied for the instructors of the various fields of study who are interested in using Google Classroom.

Hoelscher, K. (2016). With the election of Prime Minister Narendra Modi in 2014, urban-led economic growth in India was firmly framed around a vision of "smart cities." Smart cities is an ambiguous concept that promotes the integration of information and communication technologies in cities to improve economic growth, quality of life, governance, mobility, and sustainability. Smart cities are a concept that has been gaining traction in recent years. In light of the fact that it is now of significant relevance to policymakers, this essay investigates the origins of the smart city’s agenda in India, as well as its scope and the potential it has for bringing about revolutionary urban transformation. The purpose of this article is to trace the emergence of the smart cities discourse in India. It does so by reviewing policy documents and statements and conducting interviews with selected key stakeholders. The article suggests that the vision and concept of the smart city has shifted over time and has been evoked in different ways to serve different purposes. In general, it seems that the smart city’s goal in India is characterised by a failure to conceptualise and establish an integrated set

of policies. Despite the fact that a clearer idea is forming, which is still being challenged, the chances for success remain questionable.

Dhingra, M., & Chattopadhyay, S. (2016). The purpose of this project is to evaluate the application of the idea of Smart Sustainable Cities in communities that have been traditionally designed and evolved organically. An ambitious initiative, the Smart Cities Mission is being undertaken by the Government of India with the goal of enhancing the quality of life in one hundred cities throughout the country. On the other hand, because to the expansive and ambiguous nature of the concept, there is no definition of smart cities that is widely acknowledged. When faced with such a circumstance, it is of utmost importance to have an understanding of the current state of our older cities in terms of inclusion and intelligent sustainability. The analytical approach takes a case-based approach, analysing historic Indian towns and Arab cities in terms of the environmental, economic, and social planning paradigms that they use. Land use mix, compact development, housing density, internal and external connections, open spaces, walkable neighbourhoods, availability to social services, collective cohesion, local area governance, crime and safety, economic diversification, and socio-cultural variety are some of the factors that are included in this category. The research identifies smart urban features in our existing ancient cities. These elements are obtained from a comprehensive literature analysis of cities in the Middle East as well as primary surveys of around 160 samples in a medium-sized old Indian city located in Rajasthan. In this research, the baseline state of culturally rich and diverse ancient cities is evaluated. These cities are required to develop from their inherent smartness by using new and interactive information and communication technology (ICT) and methods of urban engineering.

Hayat, P. (2016). In light of the significant paradigm change that has been brought about by globalisation and industrialisation, the influence of these two processes has been the focus of study all around the world. These kinds of occurrences are also a matter for worry since cities are responsible for the generation of three-quarters of the world's pollution and waste, and they use close to three-quarters of the world's natural resources. In order to handle the issues of large-scale urbanisation and discover new methods to create cities that are livable, competitive, and self-sufficient, it is necessary for cities to become more intelligent via the implementation of creative solutions.When seen from this perspective, the introduction of smart cities has the potential to be a far broader wave of revolution that is poised to take the whole globe by storm. Geographical conditions, ecosystems, resource availability, and the most significant difficulties that are being confronted all have a role in determining the exact type, content, and characteristics of smart cities. These characteristics differ from nation to country. Pilot projects have been initiated in almost every region of the globe in an effort to model a city after the one in question. There are a number of nations that have presented ambitious plans for the creation of smart cities, including both greenfield and brownfield models. As a result of concerns over cyberattacks, risks to privacy, and other related issues, there have been a number of protests against the widespread use of information technology in societies. On the other hand, civilisations have made the decision to go forward because of the larger benefits as well as the requirement of more intelligent systems in order to provide a quality of life for their population. As a consequence, the revolution of approaching smart cities would be one of the most comprehensive revolutions. It would need widespread involvement from practically all aspects of society, which would ultimately result in a development that is genuinely significant. As a result of the increased reliance on data sensors, automation technologies, information and communication technologies, software analytical applications, and so on, any interruption or tragedy has the potential to disintegrate the whole chain of services and put the ecosystem of smart cities in jeopardy. Furthermore, because of the great concentration of both economic operations and people, smart cities are susceptible to suffering significant harm, both in terms of the loss of human lives and the collapse of their financial systems. Therefore, it is necessary to take precautions against a variety of natural and man-made catastrophes in order to ensure resilience. The majority of metropolitan places on the planet are located along rivers or coastlines, which puts them at risk of flooding and storm surges caused by rising sea levels and rivers. Impacts of climate change, such as cyclones, floods, and droughts, have a significant influence on the economy, causing significant disruptions to corporate operations and the financial resources of cities. This implies that concurrent activities be taken from the beginning of the creation of smart cities in order to make them robust to disasters as well when they are not yet fully developed.

Fragkaki, M. (2017). This article examines the difficulties that higher education institutions (HEIs) in the West (Europe and the United Kingdom) and the East (Palestine, India, and Turkey) are encountering when it

comes to the adoption of new technologies and educational transformation, and it offers some suggestions on how these difficulties might be overcome. Within the economic, social, and cultural contexts that these nations operate within, one of the two primary goals of the study is to highlight the constraints that higher education institutions (HEIs) in these countries are confronted with. The second purpose of this is to discover enablers that might address these issues, break down the current barriers, and establish activities for an educational transition by making use of the advancements that new technologies are giving. In the west, educational stakeholders and policy makers are attempting to tackle a number of challenges, the most significant of which seems to be the development of employability skills and digital competences among graduates in order to satisfy the requirements of the market. On the other hand, in many regions of the globe, particularly in the eastern region, despite the fact that the issues with education might be attributed to the same elements, they are mostly experiencing difficulties in other areas, particularly in the areas of practicality and culture. Both in terms of practical issues, such as a lack of infrastructure and connectivity, and in terms of theoretical issues, such as a lack of a liberated culture, an empowering philosophy, and up-to-date knowledge on emerging pedagogies, methodologies, digital technologies, and experiences, the academic institutions in the East appear to be facing fundamental limitations. Both the national synergies that exist between universities in the east and the international synergies that exist between nations in the east and west need to be strengthened. In addition, the requirements of the labour market are requesting that they be fulfilled, although this does not seem to be the primary obstacle that stands in the way of the so-called "modernisation." For the most part, modern education has not been successful in either the West or the East in terms of deliberating the educational systems or encouraging the societies that are looking for a healthy, happy, and sustainable future. The only exception to this is the handful of new projects that have been implemented. It is not possible for academics and graduates to possess the power and the depth of knowledge necessary to be active and critical-reflective educators, learners, and citizens given that they are confronted with "new" faces and old positions. It is possible that technology-enhanced learning (TEL) in education might be intelligent enough to enable higher education institutions (HEIs) professors and students to use pedagogically for the purpose of critical-reflective and creative learning. University students and academics will be provided with the opportunity to flourish and meet the challenges of the post-digital era through the implementation of Technology Enhanced Smart Learning (TEsL) curricula that incorporate global cultural values and an empowering culture, Deep Learning Theories, Critical Pedagogies, on the edge eLearning and blended technological environments, and Open Educational Resources (OER). This will result in the creation of a future that is equitable, deliberated, and sustainable for all.

Alaa et al (2017). Smart home applications, which will be referred to as apps from this point forward, are a relatively new and disruptive technology that is based on the Internet of Things (IoT). It is necessary for us to have an understanding of the available possibilities and the gaps in this area of study in order to give researchers with relevant insights into technological settings and to help researchers. Therefore, in this work, a review is carried out in order to map the research landscape into a taxonomy that is consistently consistent. The frameworks that are proposed for use in the development and operation of applications are included in the third class. Studies that include genuine efforts to construct Internet of Things applications for smart homes are included in the final class.

Suprayogi et al (2017). The increasing variety of students in today's classrooms necessitates the use of suitable educational practices. Despite the fact that it seems to be difficult, differentiated instruction (DI) is being proposed as a major answer. The actual application of DI by instructors is connected to a complicated collection of factors in this research. These variables include teachers' self-efficacy about DI, teaching beliefs, teaching experience, professional development, teacher certification, and classroom size. According to the data, the implementation of DI seems to be high, but it is still much lower than a crucial benchmark. The findings of the regression analysis reveal that 39% of the variance in DI implementation may be substantially associated to greater constructivist beliefs, bigger classroom sizes, and higher levels of self-efficacy in relation to DI. Several consequences of the research are highlighted.

I. Comparative Key Challenges

Challenges	Jharkhand	Developed Indian States

Infrastructure	Inadequate infrastructure, lack of proper classrooms (Patel, 2017)	Well-established infrastructure, advanced classroom setups (Singh, 2016)
Electricity and Connectivity	Frequent power cuts, limited internet access (Mishra, 2015)	Reliable power supply, high-speed internet availability (Nayak, 2017)
Funding	Insufficient funding and budget constraints (Kumar, 2016)	Adequate funding, budget allocations for digital education (Roy, 2015)
Teacher Training	Lack of trained teachers in using digital tools (Das, 2014)	Regular training programs for teachers (Sharma, 2016)
Technological Access	Limited access to advanced digital devices (Verma, 2015)	Easy access to the latest digital technologies (Patil, 2016)
Maintenance and Support	Poor maintenance and technical support (Sinha, 2017)	Efficient maintenance systems, quick technical support (Mehta, 2015)
Student Accessibility	Low accessibility for students in remote areas (Rai, 2014)	High accessibility, even in rural areas (Bhatia, 2015)
Curriculum Integration	Slow integration of digital tools in the curriculum (Pandey, 2016)	Seamless integration of digital resources in the curriculum (Joshi, 2017)
Policy Implementation	Delayed implementation of educational policies (Tiwari, 2015)	Prompt implementation of progressive policies (Reddy, 2016)
Community Awareness	Low awareness and acceptance among the community (Jha, 2015)	High community awareness and acceptance of digital education (Anand, 2017)

Infrastructure Limitations

Infrastructure limitations refer to constraints in a region's physical and organizational structures that impact its ability to support various functions and services. These limitations can affect multiple areas, including transportation, utilities, and technology. Inadequate infrastructure often leads to inefficiencies, higher costs, and reduced quality of life. For example, poor transportation infrastructure can hinder access to education, healthcare, and employment opportunities, while insufficient utilities like electricity and water can disrupt daily activities and economic productivity. In technology, lack of robust internet connectivity can impede access to information, online services, and e-commerce. These limitations can be particularly severe in developing regions, where resources for building and maintaining infrastructure are often limited. Addressing these issues typically requires substantial investment, strategic planning, and effective management to improve infrastructure and support economic growth, enhance quality of life, and ensure equitable access to essential services [10-15].

Financial Constraints

Financial constraints refer to limitations imposed by inadequate financial resources, affecting an individual's, organization's, or government's ability to fund necessary projects and operations. These constraints can lead to reduced capacity for investment in essential areas such as infrastructure, healthcare, and education. For businesses, financial constraints may hinder expansion and innovation, while for governments, they can restrict the implementation of social programs and public services. In both cases, limited funding often necessitates prioritization and difficult trade-offs, impacting long-term growth and development prospects. Addressing financial constraints typically involves careful budgeting, seeking alternative funding sources, and strategic financial planning [16-21].

Teacher Training and Development

Teacher training and development are crucial for enhancing educational quality and improving student outcomes. Training typically involves initial education programs that equip teachers with fundamental skills and knowledge, such as pedagogical techniques, classroom management, and subject matter expertise. Development, on the other hand, focuses on ongoing professional growth, including workshops, seminars, and advanced degrees, aimed at keeping educators updated with the latest teaching strategies, technological advancements, and educational research. Effective teacher training and development help educators adapt to

diverse classroom environments, integrate new teaching methods, and address varying student needs. It also fosters a culture of continuous improvement and reflection, encouraging teachers to refine their practices and adopt innovative approaches. Investing in teacher development leads to higher job satisfaction, improved student engagement, and better academic performance [22-25].

Technical Support and Maintenance

- **Ensuring Operational Continuity:** Technical support and maintenance are vital for ensuring that systems and equipment operate smoothly and efficiently. This involves conducting routine check-ups to identify and address potential issues before they escalate, troubleshooting problems as they arise, and applying updates or patches to keep software and hardware up to date. Regular maintenance helps prevent downtime, enhances system performance, and extends the lifespan of technology. By proactively managing these aspects, organizations can maintain operational continuity, reduce the risk of major failures, and ensure that their technological infrastructure supports their goals effectively.
- **Enhancing System Longevity and Performance:** Regular maintenance and technical support play a crucial role in extending the lifespan of hardware and software. By addressing potential issues early, these practices help prevent major failures and minimize downtime. Routine check-ups, performance optimization, and timely upgrades ensure that systems run smoothly and efficiently. This proactive approach not only reduces the risk of significant disruptions but also enhances overall system reliability and performance. Ultimately, investing in regular maintenance and technical support contributes to better operational continuity and a longer, more effective lifespan for technology assets.

6.2 Community and Stakeholder Engagement

- **Building Trust and Collaboration**: Engaging with communities and stakeholders fosters trust and collaboration by involving them in decision-making processes. This participatory approach ensures that diverse perspectives are considered, leading to more inclusive and effective solutions while strengthening relationships and mutual understanding.
- **Enhancing Project Success and Sustainability:** Active engagement with stakeholders and community members helps identify their needs and expectations, leading to better-aligned projects and initiatives. This involvement increases the likelihood of project success and sustainability by ensuring that outcomes are relevant, supported, and more likely to be maintained over time [27-29].

Adaptation to Technological Change

Adaptation to technological change is crucial for individuals and organizations to stay competitive and efficient in a rapidly evolving digital landscape. It involves embracing new technologies, modifying existing practices, and continuously learning to leverage innovative tools and solutions effectively. For organizations, adaptation requires assessing and integrating emerging technologies that can enhance productivity, streamline operations, and improve customer experiences. This may include investing in training programs to upskill employees, updating systems and infrastructure, and fostering a culture of innovation and flexibility. Individuals must also adapt by acquiring new digital skills and staying informed about technological advancements relevant to their fields. This might involve pursuing additional education or certification, participating in workshops, and actively seeking opportunities to apply new technologies in their work or daily lives. Embracing technological change not only improves operational efficiency but also helps in navigating challenges and seizing new opportunities. With proactively adapting to technological shifts, both individuals and organizations can maintain relevance, drive growth, and achieve long-term success in an increasingly digital world .

Conclusion

The implementation of smart classrooms represents a transformative shift in education, promising to enhance learning experiences and outcomes through advanced digital tools and interactive technologies. However, the disparity between Jharkhand and more developed Indian states highlights significant challenges in realizing these benefits. In Jharkhand, infrastructural limitations such as unreliable electricity supply and poor internet connectivity impede the effectiveness of smart technologies. Frequent power outages and slow internet speeds

disrupt the functioning of digital tools, undermining their potential benefits for students and educators. Furthermore, financial constraints in Jharkhand, characterized by insufficient budgetary allocations for technology and maintenance, exacerbate these issues. The lack of resources extends to the professional development of educators, leaving them ill-equipped to effectively use and integrate smart classroom technologies. In contrast, developed states benefit from a more conducive environment for smart classroom integration. These states have stable power supplies, high-speed internet, and greater financial resources, facilitating both the acquisition and upkeep of advanced technologies. Teachers in these regions also have access to extensive professional development opportunities, enhancing their ability to incorporate digital tools into their teaching practices. Moreover, robust technical support systems in developed states ensure regular maintenance and prompt assistance, contributing to the optimal functioning of smart classroom technologies. Despite these advantages, challenges persist even in more developed states, such as the rapid pace of technological change and the need for continuous teacher training. However, the foundational challenges faced by Jharkhand, including infrastructure deficiencies, financial limitations, and inadequate community engagement, represent more significant barriers that require focused interventions. Bridging the gap between regions necessitates strategic efforts to improve infrastructure, increase financial support, and enhance stakeholder engagement. With addressing these challenges, it is possible to ensure equitable access to smart classroom technologies and foster a more inclusive and effective educational environment across India.

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