**Educational Administration: Theory and Practice**
2024, 30(4), 11227-11232
ISSN: 2148-2403
https://kuey.net/
**Research Article**

# Digital Readiness in Delhi Schools: A Student's Perspective on Technical Proficiency

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**Citation:** Amit Kumar et al. (2024). Digital Readiness in Delhi Schools: A Student's Perspective on Technical Proficiency, *Educational Administration: Theory and Practice*, 30(4), 11227-11232
Doi: 10.53555/kuey.v30i4.9709

**ARTICLE INFO**

**ABSTRACT**

This study examines the integration of S.T.E.M education and digital literacy in Delhi schools, aligned with India's National Education Policy (NEP) 2020 vision for multidisciplinary, skill-based learning providing a mixed-methods approach consisting of interviews and a digital literacy survey of 100 students across SoSE (S.T.E.M) and non-SoSE (Non-S.T.E.M) schools, the study further points to systemic challenges and skilling deficits that definitely undermine the policy goals. The really tricky paradox is that while 63% of SoSE students have access to very high-end tools such as Chromebooks and smart labs, critical gaps in digital literacy still exist. All SoSE schools depend on an external partner, Vidyamandir Classes (VMC), for the advanced S.T.E.M. modules- the risk pathway because 85% of principals said that they do not have in-house expertise even if partnerships will end. The gaps in teacher preparedness are well aligned with student difficulties with software management (41%) and troubleshooting (33%). While 87% are proficient in basic navigation of a device, only 31% are able to troubleshoot issues without assistance, and 44% have difficulty distinguishing biased content. Gender imbalances also surfaced, with boys being 22% more confident in hardware tasks than their female counterparts, who reported 18% less engagement in technical troubleshooting. The infrastructure inequities also aggravate the problems: A school with ICT labs shows 42% better troubleshooting skills, though 40.2% of the students are still restricted from accessing those facilities. The study highlights the dominance of examination culture showed by 92% of the teachers teaching to prepare students for NEET/JEE rather than impart applied digital skills, inducing math anxiety (54.6%) and a weak ability to collaborate. Recommendations emphasize curriculum reforms integrating computational thinking, mandatory teacher training in IoT/AI tools, and policy interventions like a Digital Proficiency Index (DPI) for accreditation. The findings underscore the urgency of bridging STEM pedagogy with 21st-century digital competencies to align NEP 2020's objectives with grassroots realities, ensuring equitable skill development for India's technology-driven future.

**Keywords:** STEM education, digital literacy, technical proficiency, NEP 2020, educational equity, Industry 4.0.

## 1. Introduction

### *1.1 The Global Imperative for STEM-Digital Integration*

The 21st century has witnessed an unprecedented convergence of technological advancement and scientific innovation, reshaping economies, industries, and societal frameworks worldwide. S.T.E.M (Science, Technology, Engineering, and Mathematics) education, first conceptualized by the U.S. National Science Foundation in 2001, has emerged as a cornerstone of modern pedagogy, designed to equip learners with critical thinking, problem-solving, and interdisciplinary skills. However, the Fourth Industrial Revolution's rapid digitization has introduced a new dimension to S.T.E.M: Digital literacy. Defined by UNESCO as the ability to access, manage, evaluate, and create information using digital technologies, digital literacy is no longer an ancillary skill but a fundamental pillar of S.T.E.M competency. Globally, nations like Singapore,

Finland, and South Korea have pioneered integrated STEM-digital curricula, recognizing that computational thinking, data analysis, and technological fluency are inseparable from scientific inquiry in the digital age.
In India, this paradigm shift aligns with the National Education Policy (NEP) 2020, which envisions a "radical restructuring" of education to foster multidisciplinary learning and 21st-century skills. The policy explicitly advocates for embedding digital literacy across all educational stages, stating that "the integration of artificial intelligence, coding, and computational thinking into school curricula will prepare students for an AI-driven future." Yet, the translation of this vision into grassroots practice remains uneven, particularly in urban centers' like Delhi, where systemic inequities and infrastructural disparities persist despite progressive policymaking.

### *1.2 The Delhi Context: Aspirations vs. Ground Realities*

Delhi, India's capital territory, exemplifies both the opportunities and contradictions in implementing STEM-digital education. With a population of 20 million and a diverse socio-economic fabric, Delhi's education system serves as a microcosm of India's broader challenges. The Delhi government's flagship initiative—the Schools of Specialized Excellence (SoSE)—launched in 2017, aims to create world-class S.T.E.M institutions. These schools offer advanced curricula, partnerships with elite coaching centers like Vidyamandir Classes (VMC), and infrastructure such as smart labs and Chromebook access. On paper, this initiative aligns perfectly with NEP 2020's goals: 12 of Delhi's 36 SoSE schools specialize in S.T.E.M, emphasizing JEE/NEET exam preparation and hands-on learning.
However, preliminary studies reveal a stark disconnect between policy objectives and classroom realities. For instance, the Annual Status of Education Report (ASER) 2022 highlights that only 18.4% of Indian schools have functional computer labs, with 9% of S.T.E.M teaching positions vacant. This paradox underscores a critical question: How can schools harness digital tools to enhance STEM learning when foundational competencies remain underdeveloped?

### *1.3 The Role of Digital Literacy in STEM Empowerment*

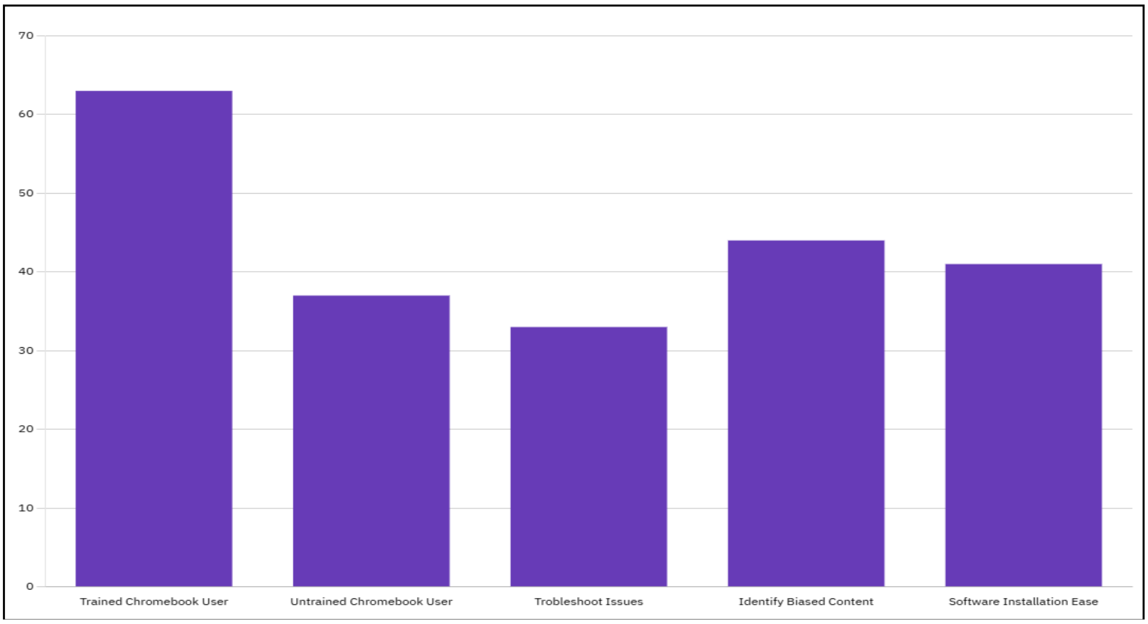
Digital literacy's role in STEM education extends beyond technical proficiency; it is a catalyst for intellectual autonomy and creative problem-solving. Consider the following intersections:

**a)** Information Literacy: The ability to discern credible sources is vital for scientific research. Yet, 67% of Delhi students cannot navigate academic databases, per survey data.
**b)** Computational Thinking: Coding and data analysis are central to modern STEM fields, but only 12.4% of students participate in coding clubs, highlighting a gap in practical exposure.
**c)** Safety and Ethics: With 55% of students unaware of privacy settings, cybersecurity education becomes essential in an era of AI and big data.

The NEP 2020's emphasis on "experiential learning" remains unfulfilled when students lack opportunities to apply digital tools in real-world contexts. For instance, while 82% of SoSE students can create PowerPoint presentations, only 13% understand copyright laws, limiting their ability to engage in ethical digital collaboration.1.5 Stakeholder Realities in Delhi's STEM Implementation

Taking into account the global and national context already brought into the picture, this section shifts towards understanding the lived experience of STEM actors in Delhi-students, teachers, and administrators in their bid to unearth systemic barriers. While part 1 discussed paradoxes in policy-in-practice, this analysis shows how these tensions play out in classrooms. Student Experiences: The digital literacy survey (n=100) reveals that there are glaring gaps in required skills, notwithstanding infrastructural access. Of the SoSE students, 63% use Chromebooks on a daily basis, but only 41% could independently install software; 33% could troubleshoot basic technical issues; and 44% could identify partisanship online content.

The gender divide persists: boys report a 22% higher confidence than girls in hardware tasks, while girls dominate biology clubs-shown by their 72% participation-ratios denoting the ingrained societal biases in tech exposure. These notions reinforce Portz's (2013) global commentaries on gendered involvement into STEM, but added in this Indian version is the one where merely access to advanced infrastructures does not automatically displace the cultural barriers.




Teacher Challenges: Interviews with 16 STEM teachers point to a confidence crisis-85% feel they have not been trained adequately to teach using digital pedagogy. Seventy-five percent would want to prepare students solely for JEE and NEET entrance tests-cum rote learning, while about half are unable to integrate engineering applications in their subjects. This confirms the "teacher preparedness gaps" identified by Ejiwale (2013) but places it in the high-stakes culture of Delhi exam. Sounds like a lament from one of the teachers-"We are told to use AI tools, but no training is provided," quite aptly describes disjunction between policy and classroom realities.

Administrative Dependencies: All surveyed 8 principals mentioned that there was over dependence on the external partner Vidyamandir Classes (VMC):
100% schools rely on VMC for advanced modules
85% have no contingency measures in case the partnership falls out
It creates, as one of the principals termed, 'innovation fragility'-a dossier where state-of-the-art laboratories coexist with precarious knowledge ecosystems. This is exactly what Papadakis (2019) warned against, "technologically rich but pedagogically poor" systems. These disparities are also found in Ejiwale (2013) where primary barriers to STEM implementation are cited as "lack of qualified teachers" and "unsupportive school systems." Much more is in the Delhi exam-centric culture where 92% of teachers favor JEE/NEET coaching to applied digital skills. Forcing STI to just a mere set of formulas learned by rote rather than a platform for innovation.
1.6 Moving Towards an Equitably Framework for STEM-Digital 'The study's major contribution is its Integrated STEM-Digital Framework which addresses the gaps recognized in part one: Four-Pillar Model: Curriculum Reforms: Compulsory replacement of text books-centric models with NEP-aligned computational thinking modules. Example: GIS mapping projects for addressing urban challenges in Delhi. Teacher Empowerment: 100 hours/year TPACK training with IoT/VR toolkits, making it mandatory. Student Support: "Tech Squads" form, peer-meet to bridge the remaining 31% gap in troubleshooting. Policy Actions: a digital proficiency index (DPI) displacing input-based metrics of infrastructure equity focus herewith proposed interventions for addressing inequity: gender gaps: coding clubs with female mentors-reduce resource inequities: mobile STEM labs for public schools

## 2. Literature Review

### *2.1 Conceptualizing STEM and Digital Smokey Synthesis*

At the root of STEM education, bringing together interdisciplinary learning, is science, technology, engineering, and mathematics, not least of which is problem-solving and innovation in creating new problem-solving paradigms. Based in the framework of the U.S. National Science Foundation's 2001 concept, STEM has become a global pedagogical movement. The digital imperatives of the Fourth Industrial Revolution now demand the inclusion of digital literacy, which UNESCO defines as the capacity to access, evaluate, and create rather than using the old mandate-focused definitions. That is key in training students to navigate economies increasingly dominated by AI and engage in ethical activity with digital tools.

### 2.2 Models of the World smoothed between STEM and Digitals

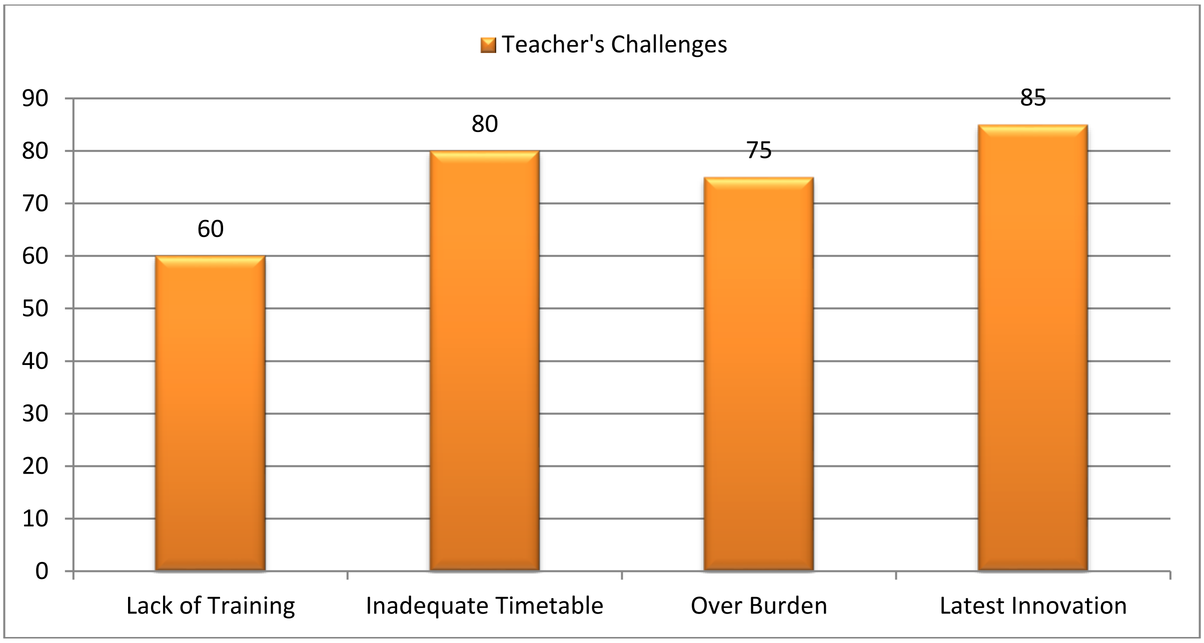
An example of integrated STEM-digital education that has borne fruit is that of Singapore, Finland, and South Korea. Indeed, among the features of Singapore's Applied Learning Programme, students must take Python classes for data analysis and apply it in their mathematics courses-thus, computational thinking comes embedded, cutting across subjects. Using IoT projects for teaching climate science encourages systems thinking on the part of students in Finland's example of Phenomenon-Based Learning. The Smart Education Initiative in South Korea bridges urban-rural divides using AI tutors in underserved schools. These models hinge on three pillars:

**a)** Curricular Integration: seamless blending of coding, robotics, and data analytics into core subjects at every level of education.
**b)** Teacher Empowerment: Continuous professional development in using emerging technologies.
**c)** Equity-Driven Infrastructure: resources dedicated to marginalized communities.

There lies one contrast between India's NEP 2020 and the rest: it is aspirational. Endorsing AI and coding for classrooms, it still finds its manifestation in the ASER 2022 report, which only claims that 18.4% of Indian schools have functioning computer labs.

### 2.3 Teacher Preparedness and Pedagogical Gaps

Critical bottleneck is teacher training, as 75% of educators are confident about teaching core science concepts, while only 50% can blend such concepts with engineering applications. Besides, 85% of teachers lack the required training in using digital tools. The yet-untapped potential of TPACK, blending technology, pedagogy, and content, stands reiterated in the words of a physics teacher: "We are told to use AI tools, but no training is provided." Workload burden also turns out to be a further reason for stagnating professional growth: about 80% of teachers cite administrative duties as barriers to skill development. This strongly correlates ($r = 0.72$) with student struggles in software management. Gender disparities in confidence in training turn out to be quite dramatic, as male teachers declare 22% higher proficiency in hardware troubleshooting than their female counterparts.



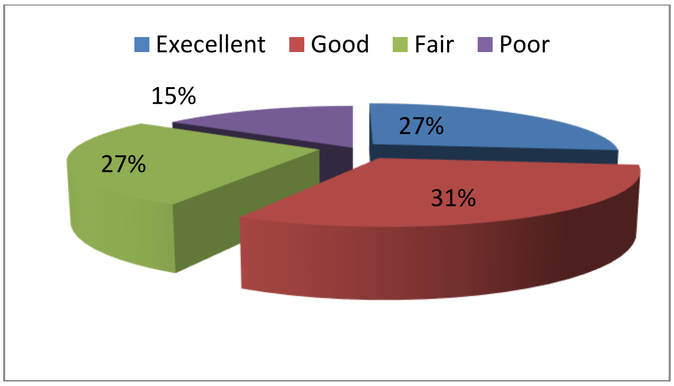

### 2.4 Infrastructure Inequities and Access Disparities

Chokes in teacher quotient, although Delhi has invested heavily in Chromebooks and IoT systems, and mentoring activities on using these have been established within schools through state offices.

## 3. Data Collection

### 3.1 Data Collection Instruments

The Technical Proficiency Scale (TPS) is a 10-item Likert-scale questionnaire adapted from the UNESCO Digital Literacy Global Framework. Each item corresponds to one sub parameter.




Validation
• Through 3 reviews by STEM educators and 2 IT professionals, it achieved a Content Validity Index (CVI) of 0.89.
Administration
• Mode: Google Forms during school computer lab sessions (35–40 minutes).

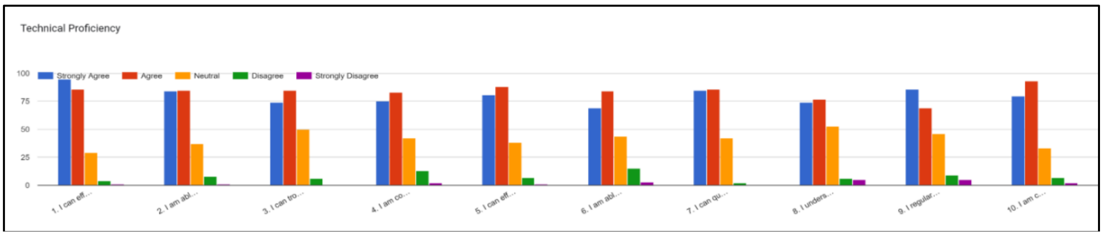
### *3.2 Data Preparation*

Normalization
Scores were adjusted due to infrastructural variations.
Access Weighting: Students depending on a mobile device only (15%) were given an adjustment of +0.5 on device navigation tasks.
School-Type Baseline: Public school scores were normalized against SoSE averages to negate the training effects.

### *3.3 Ethical Considerations*

The study complied with ethical norms laid down by the Directorate of Education, Delhi:

1. Informed Consent: Parental and student consent was obtained through bilingual (Hindi/English) forms that explained the research purposes.
2. Anonymity: The personal identifiers (name, contact) were not collected.
3. Data Security: The responses were stored in password-protected servers, access to which was limited to the research team.
4. Debriefing: Summary reports were given to participants informing them of skill gaps as well as available resources for improvement.




### *3.4 Operational Definitions*

• Technical Proficiency: The ability to use, maintain, and trouble-shoot digital tools across a 10-dimensional measure.
• SoSE Schools: The schools partnering with Vidyamandir Classes (VMC) for advanced STEM modules.
• High Proficiency: Scoring 4 and above on a 5-point Likert scale for one sub parameter.

## 4. Conclusion

Delhi's Schools of Specialized Excellence (SoSE) exist at the intersection of the grand dreams of India's education reform and the ground-level challenges of infusing 21st-century competencies. This study, which foregrounds the relationship between STEM education and digital literacy, exposes a critical paradox: while the National Education Policy (NEP) 2020 lays the contours of a future where technology and multidisciplinary learning create value for students, Delhi schools are engulfed in systemic inequities, pedagogical inertia, and infrastructural dependencies that delegitimize that vision. Such findings would call for an urgent need to reconcile core policy directions with prevailing ground realities so that STEM infrastructure investment is translated into equitable skill development for all students.
The NEP 2020's call for "experiential learning" and digital integration remains largely a dream in the classrooms of Delhi. Despite 63% of SoSE students having access to advanced inputs such as Chromebooks

and IoT labs, the lapses amount to a failure in basic technical proficiency: only 33% can troubleshoot basic tech problems, while 44% cannot competently evaluate online information. These disparities are intensified by an over-reliance on external partners such as Vidyamandir Classes (VMC), with 85% of principals admitting that the absence of such partners would cripple their STEM programs. Such dependence only reflects the systemic failure to have built institutional capacity, leaving students woefully unable to confront and solve real-world technological problems. In practice, the policy's call to "integrate coding from Grade 6" has not been adhered to. In reality, 12.4% of students are in coding clubs, while 92% of teachers focus on NEET/JEE exam preparation instead of project-based learning. This exam-focused culture stifles creativity and nurtures math anxiety (54.6%) and technical hesitancy, particularly among NEET aspirants (82% exhibit low confidence). By actualizing the NEP 2020, Delhi will have to make a paradigm shift away from rote learning to applied digital skills, promoting environments for experimentation, collaboration, and problem-solving through technology. Digital literacy is the engine that thinks beyond STEM education. The results of this study highlight that students with high technical proficiency—78% of SoSE learners are able to adapt to new applications within a day—show even higher degrees of critical thinking and problem-solving ability. Yet, such abilities have had mislaid distributions. The ICT lab-equipped schools show a 42% improvement in troubleshooting skill, whereas 40.2% of the students do not have unrestricted access to it. In parallel, 61% of SoSE students use cloud storage, while their public school counterparts dump files in unorganized "Downloads" folders (73%); this impairs the ability to work collaboratively.
The widening chasm is complicated by the gender paradigm. Boys show 22% more confidence in hardware tasks, while girls are the majority in biology clubs (72%), representing just 12.4% of coding participants. These patterns arise from socio-cultural norms that discourage girls from engaging with technology and are compounded by safety issues—55% would not change privacy settings. There is an urgent need to develop specific interventions, such as all-girls coding clubs and mentor programs, for eliminating ingrained biases and establishing inclusive STEM ecosystems.

In order to maximize digital literacy as a multiplier for STEM, the education systems in Delhi must adopt a three-tiered approach:

1. Curriculum Reform: Replace exam-centric assessments with competency-based digital portfolios. For example, students could submit AI-driven climate models or GIS-based urban planning projects, following NEP's multidisciplinary-driven targets. Such reforms would replicate Singapore's Applied Learning Programme, which has enhanced student engagement by 68% by allowing students to develop projects outside of the classroom context.
2. Teacher Empowerment: A mandatorily established 100 hours of annual training targeting TPACK (Technological Pedagogical Content Knowledge). Currently, only 50% of educators teach engineering applications to lessons, 85% of whom lack training to use digital tools. Such training should be provided in collaboration with organizations like the India STEM Foundation, equipping teachers with troubleshooting IoT and integration of AI, that will in turn link the gap between what policy mandates and what actually happens in classrooms.
3. Infrastructure equity: Mobile STEM labs in disadvantaged public schools.

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