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A Current Status of Learning Mathematics Using Abacus Among Visually Impaired Students in Special Schools of Delhi NCR

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ABSTRACT

Even though the visually impaired students have the cognitive capacity to excel in mathematics, the absence of materials usually results in the loss of their motivation. The abacus is considered an important tactile aid in the special education system in Delhi NCR, but little is known about its practical application in the contemporary special education system. The purpose of the study was to investigate the status quo of the application of Abacus mathematics, as well as the structural challenges that visually impaired students encounter in special education. A descriptive quantitative method of research was used, and the study polled twenty special schools in the Delhi-NCR region. The method of data collection was through the use of a systematic Observation Checklist. The results indicate a considerable gap between practice and the availability of the necessary resources. While the majority of the institutions are in possession of the necessary tools, the integration of the Abacus in the official schedule of the school is surprisingly absent. In the majority of the institutions, the Abacus is not a priority in the execution of complex mathematical operations, as the results indicate, and students are forced to rely on memorization and

mental calculations. Among the problems are the time-consuming nature of tactile calculations, the trend in the application of other assistive technologies, and the lack of professional knowledge on the part of the teachers. The study has come to the conclusion that the only way to close the "motivation-resource gap" is through the mandatory teaching of the Abacus in the initial period of special education and the standardization of teacher training. For those interested in the field of creating curricula in STEM education for the visually impaired, the results are a treasure.

1. Introduction

It is generally agreed upon that education is an intentional and systematic process that seeks to develop higher-level thinking skills, problem-solving abilities, and numerical literacy skills, which are all necessary for participating in modern society (Kapperman, Sticken, & Heinze, 2018). Assistive technologies that provide easier learning for disabled children, especially visually impaired ones, have gained prominence in special education settings (Kelly & Smith, 2011). The Abacus still remains an important tool for teaching visually impaired students math, despite the availability of other technologies, because of its tactile and conceptual benefits (Kapperman & Sticken, 2003). Visually impaired students have to rely on their tactile and auditory learning skills to receive knowledge about math and develop their concepts since their visual ability provides much environmental information, which is usually used for learning processes (Millar, 1994). Such a dependence on other modalities of perception has led to the creation of a "motivation-resource gap," in which students are dissuaded from pursuing mathematics and other STEM-related courses due to a lack of resources, inaccessibility, and the teachers' lack of knowledge (Siu & Morash, 2014).

Traditionally, there was a common understanding that blind people were not able to comprehend mathematical concepts, with the common understanding that the field of mathematics is a visual one (Kapperman & Sticken, 2003). However, it has been proven that students with visual impairments are able to achieve the same level of understanding of arithmetic concepts as those with normal vision, provided that the right devices and methodologies are employed in the teaching and learning process (Siu & Morash, 2014). Among the devices is the Abacus, which is a tactile device that allows the student to manipulate beads with numerical values to solve arithmetic problems ranging from addition and subtraction to multiplication and division (Kapperman, Heinze, & Sticken, 2000). Structured Abacus

training significantly enhances the tactile memory and mental representation of number systems, resulting in improved accuracy, speed, and understanding of computation for visually challenged learners, as supported by empirical research (Kapperman & Sticken, 2003).

The Abacus is rarely included in the regular mathematics curriculum of many special schools despite the well-proven advantages of the system, based on the current state of education. The system is provided through the institutions, but the regular usage of the system is often limited, especially in areas where teacher preparation programs do not include the provision of instruction in assisted mathematics (Kelly & Smith, 2011). The lack of confidence in their ability to provide instruction in the Abacus system is often cited by the teacher, which may contribute to the limited usage of the system in the classroom (Siu & Morash, 2014). This means that the students will not have the opportunity to learn the tactile skills needed to understand numbers in greater depth.

The perception of the Abacus as a time-consuming tool, as opposed to mental arithmetic or other techniques of calculation using memory, is also a source of difficulty for the students. Memory alone may result in a lack of understanding of the concept of numbers and their relationships, although mental calculation may result in quick answers for basic mathematical calculations (Kapperman & Sticken, 2003). On the other hand, the Abacus offers a concrete and systematic approach for studying numerical numbers as they are expressed physically by the students, as argued by Millar (1994). The students may also miss an opportunity to develop their spatial-numerical cognition, which is essential for solving mathematical problems, if this tool is underutilized.

The reduced level of engagement of visually impaired students in secondary mathematics is another issue that is related. According to studies, the choice of visually impaired students to avoid mathematics-related courses in later grades is normally determined by poor learning experiences, the lack of accessible teaching strategies, and the lack of support from teachers (Siu & Morash, 2014). As mathematical skills are increasingly required in post-secondary education and in STEM-related jobs, these trends are alarming.

The development of inclusive educational policies that require structured Abacus learning and the integration of tactile materials into the curriculum is important to resolve these issues. Tactile materials, Braille mathematical codes, teaching methods, and trained teachers who feel comfortable working with technology are all important for teaching visually impaired students' math. Research has continually proven that by ensuring teachers are aware of learning resources and teaching strategies, student performance improves (Kelly & Smith, 2011). To improve learning outcomes for visually impaired

students, it is important to bridge the gap between current resources and training, which is lacking, and requires systematic development and maintenance of technology. Special schools in the Delhi NCR region can provide visually impaired students with excellent arithmetic skills, helping them participate confidently in academic and professional settings by resolving these systemic issues.

1.1 Research Questions

- What is the current status of learning mathematics using the abacus among Visually Impaired students in Delhi NCR special schools?
- What are the challenges in learning mathematics using the abacus among Visually Impaired students in Delhi NCR special schools?

1.2 Research Objectives

The main objectives of the present study are as follows:

- To study the current status of learning mathematics using the abacus among Visually Impaired students in Delhi NCR special schools.
- To study the challenges in learning mathematics using the abacus among Visually Impaired students in Delhi NCR special schools.

2. Review of Literature

The pedagogical setting of mathematics instruction to visually impaired (VI) students has a constant conflict of the recognized effectiveness of tactile learning aids and the persisting structural barriers to their utilization. Research has demonstrated time and again that tactile aids in mathematics, particularly the Cranmer Abacus, are necessary tools in assisting visually impaired students in performing arithmetic operations effectively and independently (Kapperman, Sticken, & Heinze, 2000). Research has shown that when individuals are provided with instruction on the use of an abacus, they improve their fluency and conceptual understanding better than when they use auditory or memorization techniques (Tuttle et al., 2025).

In spite of this, it is unfortunate that several learning institutions are complaining about the poor arithmetic performance among the visually impaired population, largely attributed to the poor teacher training in the use of tactile mathematics tools (Rosenblum & Smith, 2012). This leads to the use of

memorization techniques, which are not beneficial in the development of mathematical concepts such as algebra or geometry among the visually impaired population (Kapperman & Sticken, 2003).

The implications of the poor use of tactile mathematics tools are wide-reaching in the learning process. Research has shown that the poor use of tactile learning tools in mathematics classes leads to the poor involvement of the visually impaired in the study of complex mathematical concepts (Tuttle et al., 2025). This has a significant impact on their learning process in the future. The use of the abacus has been shown to improve cognitive processes such as working memory, spatial thinking, or even the use of mental computation techniques (Barner, Alvarez, Sullivan, Brooks, & Srinivasan, 2016).

Despite the fact that current assistive technology and digital tools are being applied in special education, researchers indicate that tactile tools are still necessary for mathematical learning for visually impaired students (Gully et al., 2017). A multisensory approach, which incorporates tactile tools, auditory tools, and technological tools, has been identified as the best approach for promoting mathematical literacy and inclusive participation in STEM education for visually impaired students (Tuttle et al., 2025).

3. Method

3.1 Site of Study

The study was conducted in the Delhi National Capital Region, which includes the National Capital Territory of Delhi, the Haryana districts of Faridabad and Gurugram, and the Uttar Pradesh districts of Ghaziabad, Meerut, and Gautam Buddh Nagar. The study was conducted in twenty special schools for the visually impaired to investigate the regional state and problems of the state of teaching mathematics with the help of Abacus.

3.2 Sample of the Research Work

20 special schools for visually impaired will be taken from the Delhi NCR region.

3.3 Sampling Technique

In this study, Purposive Sampling technique is used.

3.4 Description of the Tool

The structured observation checklist was used to collect data. The checklist evaluated the availability of resources (abacus, braille materials, etc.), teacher preparedness (abacus, confidence, etc.), and student involvement, which were either Yes/No or counted.

3.5 Administration of the Tool

The researchers' visits to each school lasted one day. In the context of a standard arithmetic lecture, the abacus use was noted, along with an inventory of the resources.

3.6 Scoring

The responses to the checklist were added for each school. Frequencies and percentages were calculated for all the Yes/No questions.

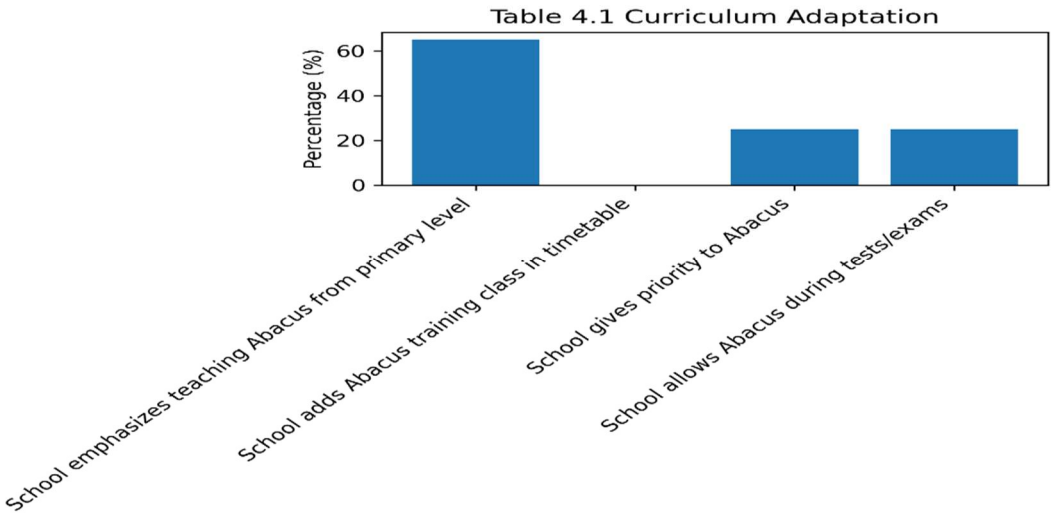
4. Results and Data Analysis

Descriptive statistical techniques, including frequency distribution, percentage distribution, etc., were employed to analyze the collected data. There are four aspects of the use of the abacus in the teaching of mathematics to visually impaired students, namely, curriculum adaptation, accessibility of resources, expertise of teachers, and awareness of students. To make the information easier to understand, tables and graphs are used.

4.1 Curriculum Adaptation for Teaching Mathematics Using Abacus

Table 4.1 demonstrates the extent to which abacus teaching is integrated into the mathematics curriculum in special schools (n = 20).

S.No	Item	Yes	Yes %	No	No %
1	School emphasizes teaching Abacus from primary level	13	65	7	35
2	School adds Abacus training class in timetable	0	0	20	100
3	School gives priority to Abacus for teaching Mathematics	5	25	15	75
4	School allows Abacus during tests/exams	5	25	15	75



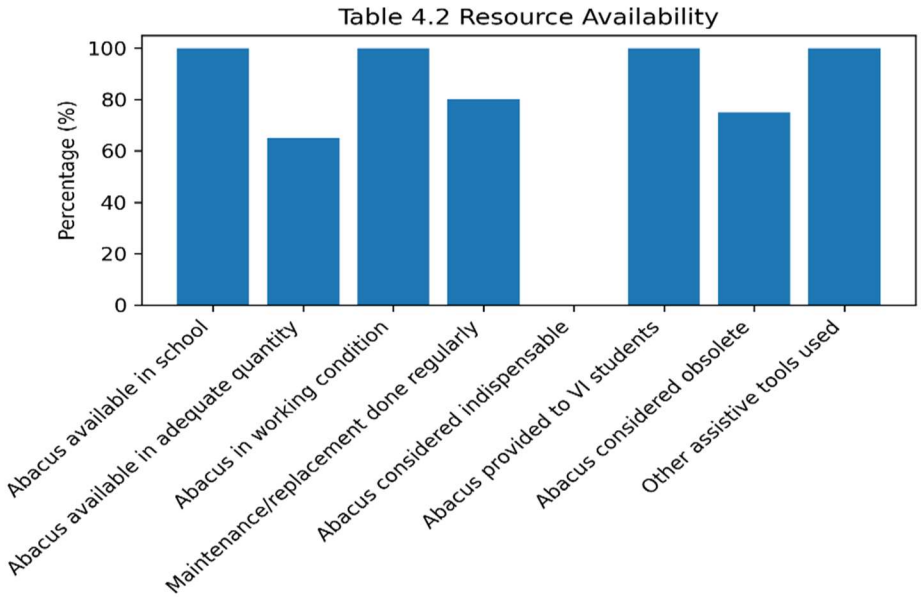
Statistical Interpretation

According to the findings, 65% of the schools prioritize the teaching of abacus from grade one, while 35% do not. None of the schools had a scheduled lesson on teaching the abacus (0%). Only 25% of the schools prioritize the teaching of mathematics using the abacus, and the same percentage allow the use of the abacus in exams. From the findings, it is clear that the teaching of abacus is not fully integrated in the schools.

4.2 Resource Availability for Teaching Mathematics Using Abacus

Table 4.2 demonstrates the availability and maintenance of abacus resources in special schools.

S.No	Item	Yes	Yes %	No	No %
1	Abacus available in school	20	100	0	0
2	Abacus available in adequate quantity	13	65	7	35
3	Abacus in working condition	20	100	0	0
4	Maintenance/replacement done regularly	16	80	4	20
5	Abacus considered indispensable	0	0	20	100
6	Abacus provided to visually impaired students	20	100	0	0
7	Abacus considered obsolete	15	75	5	25
8	Other assistive tools used instead	20	100	0	0



Statistical Interpretation

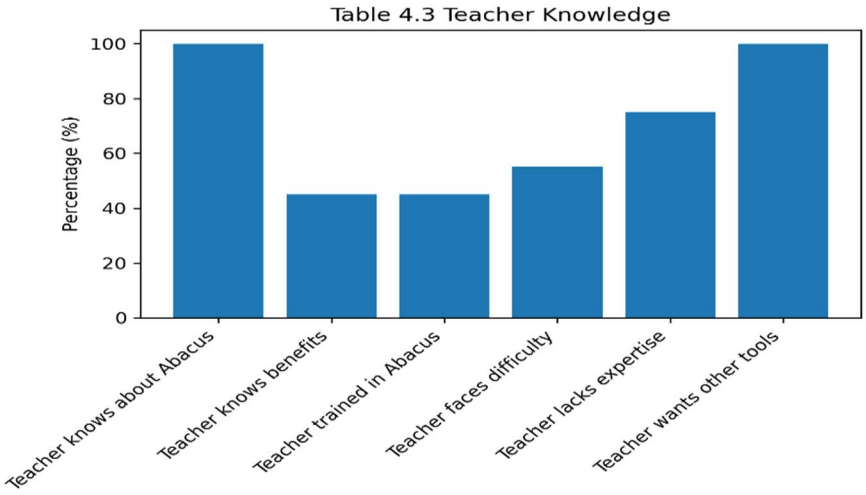
All the schools (100%) were able to provide information on the availability of abacus tools and their distribution to visually impaired students. Further, 65% of the schools reported having sufficient tools, while 35% reported inadequate availability of tools. Also, 80 percent of the institutions reported having regular practices in terms of maintenance and replacements. Despite the availability of the abacus tools, 75 percent of the respondents reported the abacus to be an outdated technology, and all the schools reported using alternative assistive technology.

4.3 Teachers' Knowledge and Awareness about Abacus

Table 4.3 summarizes teachers' knowledge and experience regarding the use of the abacus in mathematics instruction.

S.No	Item	Yes	Yes %	No	No %
1	Teacher knows about Abacus	20	100	0	0
2	Teacher knows benefits	9	45	11	55
3	Teacher trained in Abacus	9	45	11	55
4	Teacher faces difficulty	11	55	9	45

S.No	Item	Yes	Yes %	No	No %
5	Teacher lacks expertise	15	75	5	25
6	Teacher wants other assistive tools	20	100	0	0



Statistical Interpretation

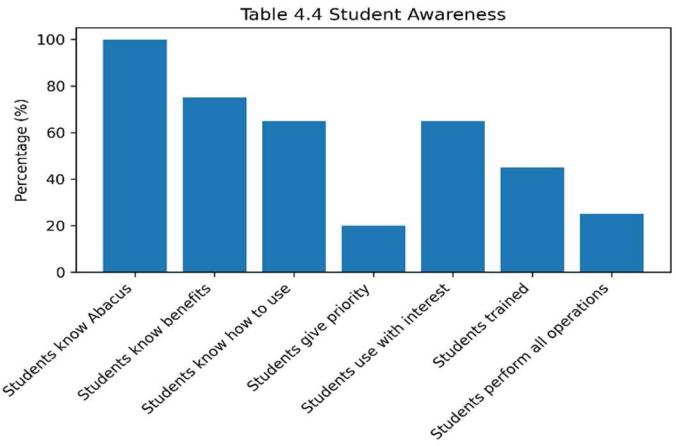
While all teachers (100%) admitted being aware of the abacus as a tool in mathematics, only 45% knew about the educational benefits of the abacus, while the same percentage had some training on the abacus. Most teachers (55%) had difficulty using the abacus while at school, while 75% admitted to poor proficiency in using the abacus. Finally, all teachers (100%) admitted to being interested in using other assistive technology.

4.4 Students' Knowledge and Awareness about Abacus

Table 4.4 presents the level of awareness and usage of the abacus among visually impaired students.

S.No	Item	Yes	Yes %	No	No %
1	Students know Abacus	20	100	0	0
2	Students know benefits	15	75	5	25
3	Students know how to use	13	65	7	35
4	Students give priority	4	20	16	80
5	Students use with interest	13	65	7	35

S.No	Item	Yes	Yes %	No	No %
6	Students trained	9	45	11	55
7	Students perform all operations	5	25	15	75



Statistical Interpretation

All the students (100%) were familiar with the abacus. 75% of the students were aware of the abacus benefits, while 65% had knowledge of the abacus operations. About 65% of the students were interested in using the abacus, but only 45% had been officially taught the abacus. Only 25% of the students could perform all the arithmetic operations using the abacus, but 20% of the students preferred using the abacus for learning.

5. Discussion

The inclusion of abacus learning at the primary level, therefore, reflects a proactive approach to the math intervention of visually impaired kids. This is because, for visually impaired kids, it is essential to introduce math tools at an early age, since they tend to use tactile and auditory learning styles to understand abstract number concepts (Ruth & Naomi, 2025). If abacus learning is not introduced at the basic level, it is likely that visually impaired kids would lack adequate numerical skills, which would impact their ability to develop higher-order math skills (Singh, 2017). The inclusion of abacus learning would, therefore, provide a learning tool for visually impaired kids to develop math concepts, since it would provide them with an opportunity to manipulate numbers using tactile learning, thus enhancing their conceptual learning and independent learning (Singh & Rai, 2014). Moreover, studies on the instruction of mental abacus learning indicate that abacus learning significantly enhances numerical,

working memory, and visuospatial skills, all of which impact math performance (Barner et al., 2016). Without the ability to utilize such touch-based mathematical tools, visually impaired children may experience difficulties in the development of basic problem-solving skills necessary for the learning of mathematics. Therefore, special schools must emphasize the use of inclusive learning techniques, such as abacus learning in the education of mathematics.

For the efficient use of assistive learning tools, many special education learning institutions emphasize the maintenance of abacuses in their classrooms. This implies the learning institution's commitment to the maintenance of learning tools for the visually impaired students, who consider the abacus an integral learning tool in their education. The use of assistive learning tools is vital since the visually impaired use specialized touch tools like abacuses and Taylor frames to participate in learning mathematics (Ruth & Naomi, 2025).

Even though the abacus is an effective method, many Teachers for the Visually Impaired (TVIs) want to use other assistive technology to support the math learning process. Taylor frames, along with other Braille calculation tools, have also been used along with the abacus to cater to the learning needs of visually impaired students, increasing their confidence in math calculations. However, if the abacus is replaced with other tools, the tactile learning experience that the abacus provides may also be compromised. According to studies, tactile interaction with the abacus helps children learn the concept of numerical calculations, keeping the learning process interactive for the children.

The other challenge that has been noted in special education classes is the lack of enthusiasm from the teacher to motivate visually impaired students to learn mathematics. This could lead to a negative attitude towards the mathematical potential of visually impaired students, hence affecting the students' confidence and aspirations (Singh, 2017). The lack of knowledge from the teacher on the use of the abacus could also lead to fragmented learning experiences and low participation from the visually impaired students. According to research, the teacher needs to be trained through various workshops to effectively teach mathematics using tactile assistive devices (Ruth & Naomi, 2025).

There are a number of visually challenged students who are extremely interested in using the abacus to learn arithmetic. The tactile and interesting nature of the abacus has been seen to encourage student involvement in arithmetic learning activities (Singh & Rai, 2014). Nevertheless, it has also been noted that, with time, some of these children might lack the necessary motivation to carry on with their mathematics learning process. This calls for a number of measures to be put in place to ensure that these

challenges are overcome, including the use of inclusive learning practices to encourage the continued involvement of visually impaired children in mathematics learning.

Finally, it is worth noting that learning how to use the abacus might be a time-consuming process, especially for some who might be challenged in this aspect. Students, however, can improve their arithmetic skills through learning and practice (Singh & Rai, 2014). This calls for the provision of adequate learning time to ensure that the visually impaired student benefits fully from learning mathematics using the abacus.

5. Implications for Practitioners

The results of the study have important implications for the construction of the mathematics education of visually impaired students, especially in terms of the integration of tactile learning. There is an immediate need to look beyond the provision of aids for the visually impaired students and instead consider the construction of the curriculum that includes abacus learning from the early grades of primary education. According to studies, the use of tactile mathematics, such as the abacus, helps visually impaired students understand numerical concepts, which enables them to become independent in solving mathematics problems (Singh & Rai, 2014). The early introduction of tactile mathematics helps visually impaired students acquire basic mathematics skills, which helps eliminate learning gaps that often occur due to the introduction of abstract mathematics concepts without adequate tactile support (Sharma, 2022).

Moreover, the results also emphasize the critical importance of teachers' ongoing professional development and the need for specialized teacher training programs. For instance, the "teacher knowledge gap" in the teaching of mathematics to visually impaired students, particularly in mathematics, highlights the fact that teachers must not only be proficient in the use of assistive mathematical devices, but also develop appropriate teaching strategies that promote student engagement. According to Ruth and Naomi (2025), a lack of teacher training and the inability to execute specialized teaching strategies remain major impediments in the teaching of mathematics to visually impaired students. Teachers proficient in the use of tactile aids, such as the abacus and the Taylor frame, are in a position to provide meaningful mathematics learning experiences, promoting student self-confidence in the execution of mathematical calculations.

The results also hold significant implications for policymakers and educators who are responsible for ensuring inclusive STEM education is promoted and supported. For inclusive mathematics training to be delivered, such training needs to incorporate both traditional tactile devices and contemporary assistive

technologies for inclusive learning to take place. Systemic reviews of assistive technologies for mathematics education indicate that visually impaired students heavily depend on tactile and auditory learning modalities to construct their mathematical understanding, and thus the availability of such assistive technologies is essential for inclusive learning (Ali et al., 2023). Providing visually impaired students with a range of accessible materials, such as tactile diagrams, Braille materials, and calculation machines, may help such students to construct a conceptual understanding of mathematical concepts.

Finally, the study points out the significance of community and parental participation in the achievement of mathematics literacy for visually impaired students. Various studies have proven that the learning environment and positive expectations from the community, as well as parents, have a significant impact on the academic achievement of students with disabilities. Such an initiative would help remove barriers for visually impaired students to enroll in colleges for higher studies in the field of mathematics.

6. Conclusions

A thorough analysis of the learning of mathematics through the Abacus for visually impaired kids in special schools in Delhi NCR reveals the following key insights. According to studies, the emphasis on tactile learning at the primary level is an important method for ensuring that the foundational learning of mathematics is solid. However, the absence of formal learning through the Abacus is an important issue that must be addressed, which may have long-term implications for the academic learning of visually impaired kids.

The analysis reveals that, despite the high resource management, the "motivation resource gap" can only be fulfilled through the training of teachers. For ensuring the acquisition of mathematics skills, special schools must focus on tactile learning rather than the acquisition of skills through rote learning. According to the analysis, the incorporation of the Abacus as an assistive device is an important aspect for the acquisition of cognitive skills. For addressing the pedagogical challenges, it is important for policymakers to address the issue for the special context of Delhi NCR.

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