GYANBODH
An International Multidisciplinary Peer Reviewed Journal

ISSN:3048-9792
Volume: 3
Issue: 4
July - August: 2026

Enhancing Written Expression Among Children with Specific Learning Disability through Assistive Technologies

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Abstract

A perennial challenge in SLD, especially in dysgraphia, is written expression, which comprises handwriting neatness, spelling proficiency, Sentence construction & organization of information on paper. The problem of writing has often been overlooked in existing Indian inclusive classrooms by more focused research & practice of reading. Consequently, there is a thin evidence base about the application of AT- such as speech-to-text, word-prediction, digital graphics organizers, and, more recently, AI-driven generative writing aids- for the enhancement of written expression in Grade V SLD. This paper makes a critical synthesis of both Indian emergent literature & international literature on the use of AT in written expression difficulties, provides a context in relation to Indian inclusive education & proposes a research design for a doctoral study conducted across fifteen inclusive schools of Delhi NCR. Incorporating 50 Grade V children with SLD who would follow a quasi-experimental pre-test post-test research approach & twenty Rehabilitation Council of India trained Special Educators whose approach would be investigated through structured survey, the authors highlighted 5 recurring gaps: Indian studies were too scarce on evidence base regarding AT for writing; there was hardly any comparative study regarding benefits among various writing support tools; generative writing-tech for SLD children were less explored; implementation challenge regarding teaching writing had been underestimated & pre-test-post-test type quantitative studies from India regarding use of AT were missing. The authors emphasize that, to bridge the theory-practice gap, it is very necessary to have AT applications that are linguistically translated, systematic training of teachers & equal access to different schools.

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The paper suggests the possible impact of a designed, replicable AT-based writing intervention module on the process of inclusion, special education pre-service training, & the use of AT for disabled

Keywords: Assistive Technology; Specific Learning Disability; Dysgraphia; Written Expression; Inclusive Education; Special Educators; Delhi NCR.

1. Introduction

Specific Learning Disability (SLD), known internationally under the Individuals with Disabilities Education Act (IDEA, 1990) and under India's Rights of Persons with Disabilities (RPWD) Act, 2016, represents a neurodevelopmental condition characterized by a consistent difficulty processing and using both verbal and non-verbal information – inclusive of dyslexia, dyscalculia, and dysgraphia. In particular, dysgraphia – a condition that impacts the execution and organization of written communication – has received far less empirical attention than literacy challenges, despite the centrality of writing for assessment and progress from the middle grades (i.e., Grade 5 onward), as children transition toward more sustained written output across a variety of curriculum areas. Internationally, Assistive Technology (AT) has emerged as a way to reduce the cognitive-motor demands of handwriting for students with dysgraphia: speech-to-text technologies completely circumvent the physical acts of writing; word-prediction and spell-support tools reduce working memory Load when retrieving words from memory and spelling them out; and digital organizers offer structure to the planning and arrangement of ideas before their transcription.

More recently, generative AI tools have been piloted as novel writing supports that provide students with dynamic and personalized, real-time feedback, which has hitherto been achievable only with individualized instruction (Gharaibeh et al., 2025).

Yet, the uptake of writing-supports technology within Indian schools remains disparate, given infrastructural differences among urban and semi-urban facilities, training limitations in pre-service and in-service training provided to special educators, and the dominant body of research being largely generated from Western and Gulf contexts. Accordingly, there is an acute need for rich, localized evidence concerning writing-focused AT – on par with existing needs – and this paper directly responds to the central tenet of bridging theory and praxis within Indian inclusive

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education by synthesizing currently available evidence for AT that supports children with SLD's writing abilities, and by delineating the framework for an ongoing doctoral study that aims to create local quantitative and qualitative evidence on AT from the Delhi NCR area. The balance of this article continues below; Section 2 critically surveys international and Indian studies conducted on writing AT for children with SLD, Section 3 identifies gaps in this scholarship, Section 4 presents rationale of the proposed study along with its problem statement and research question(s), Section 5 outlines a mixed methods approach to be used, Section 6 discusses the role of AT as a teaching intervention, and in sections 7 and 8, obstacles to implementation and implications of policy as well as practical implementation are addressed respectively. Section 9 concludes.

2. Review of Literature

A body of research has begun to emerge internationally – and, more recently, in India – that is looking at the role of AT in assisting young people with SLD in their written expression, and that documents what's hindering classroom AT utilization.

International Evidence on AT for Written Expression

One quasi-experimental study with eighty Arabic-speaking children with dysgraphia between the ages of eight and ten was implemented by Gharaibeh, Ayasrah and Almulla (2025) in the United Arab Emirates. In this study, 4 weeks and 16 sessions were considered as appropriate lengths of treatment in order to use ChatGPT-based writing support. The improvement of the treatment group with ChatGPT was more significant than the control group; however, this does suggest generative AI is an appropriate supplementary tool not a replacement for direct teaching. A review from Mokmin, Lim and Mohamd (2025) reported on the studies written between 2018-2023 and highlighted the positive effect of speech-to-text software, word prediction software, digital graphic organizers and digital annotation tools on both engagement with and quality of writing for learners with dysgraphia; however, it acknowledged that trained educators and therapists are still needed to make these tools useful.

Han and Wang (2025) analyzed AT research interventions in a ten-year span. Interventions were placed into two groups: technology-supported and combined with a self-regulated learning approach or directly linked to sensorimotor skills. Technology-assisted and combined methods

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proved most effective at boosting students' engagement and accessibility, but scalability and adaptability remain to be determined.

Lindeblad, Nilsson, Gustafson and Svensson (2017) demonstrated the link between reading AT use, in this case the use of smartphone- and tablet-based AT over one year, and reading gains along with an improvement in motivation and independent learning.

It is worth noting that, in a study of these methods with 35 Swedish children with both reading and writing difficulties over a 12-month span, the success of these tools may vary depending on the age of the learner with writing problems. A five-year qualitative follow-up study with students with dyslexia also showed variable results from AT use; it yielded results that indicated that AT tools such as text-to-speech are sometimes of use for certain long-term needs but are very context- and person-specific according to Perelmutter and McGregor (2022). Beyond the specific areas of writing and reading, AT use for students with learning disabilities in higher-education mathematics can significantly alleviate students' cognitive load, as reported by Reddy, Reddy, Chand, Paea, and Prasad (2021), who utilized text-to- speech and screen reader technologies, as well as voice command assistive technology (AT) in their study.

Indian Research on Dysgraphia and Inclusive Practice

Indian literature specifically about dysgraphia, although scarce, is developing. Sasidharan & Kotian (2025), a systematic review that surveyed the neurological, cognitive, motor, and environmental etiology of dysgraphia, proposed that, in the Indian context and South Asia more holistically, neither assessment nor intervention approaches account for culture; additionally, they recommend a move towards combining AI and technology-based technologies with traditional handwriting remediation techniques. Separately, a private school in Hyderabad reported a formal, multisensory writing remediation program delivered to high school pupils having dysgraphia that resulted in significant improvements in readability and writing accuracy after an instructional six-month period; however, no attempt was made in this private school to assess gains from digital Assistive Writing technologies.

Therefore, Indian empirical research for these digital writing-based technologies barely exists at this level. At a systemic level, a pilot study of thirty primary and secondary school teachers in

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India conducted by Kaur (2025) evidenced generally positive beliefs towards special needs education but significant numbers reported inadequate training, support and resources as impediments: a theme recurring widely as research surveys the implementation of Assistive Technologies of any kind with students who have special needs in India.

Overall Conclusion

There are two clear conclusions from this literature. Firstly, AT (notably speech-to-text, word-prediction and, to an increasing degree, generative AI writing assistants) has a role to play in mitigating some of the cognitive and physical load on children with SLD, the writing of those children and should it be, however, paired with appropriate students and appropriately qualified practitioners and Educators. Secondly, there is much less Indian evidence on AT designed for the purposes of writing than there is in relation to reading, where the small number of Indian writing intervention studies conducted (have focused primarily on relatively low technology handwriting interventions rather than digital AT technologies, and consequently remain to answer a number of pertinent questions about how digital writing aids might be employed to support good writing within the context of an inclusive classroom in India.

3. Research Gap

Five gaps have emerged during this review of literature. First, while studies on AT for reading and handwriting remediation exist in India, they seem to lack explicit data on evidence of evaluation of a speech-to-text-based approach, word-prediction software, or digital graphic organizer specifically in writing intervention in an Indian context (with the latter two only being studied individually, rather than in relation to the former). Second, it is hard to find studies, both in India and elsewhere, that evaluate multiple AT tools simultaneously and compare their utility in classrooms, which could aid Special Educators in tool selection.

Third, generative artificial intelligence tools for writing aid are not widely evaluated even in an international context, for children with dysgraphia (Gharaibeh et al. 2025), and have been almost completely understudied for written expression purposes within Indian inclusive classrooms and with regard to the Indian context and languages.

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Fourth, the role and challenges specific to the interventionist – i.e.., Special Educator – in implementation of an AT tool for written expression (and not for other purposes in general classroom) is under-addressed in the Indian context.

Finally, published quantitative evidence on multiple AT tools with pre-test and post-test comparisons in Indian inclusive classrooms among children with SLD for written expression at Grade 5 is scant in the literature. This article and the study it outlines seek to address these five gaps.

4. Rationale, Statement of the Problem, and Research Questions

The rationale for this study rests on three coalescing realities:

This study is justified by the intersection of three factors: Many Indian children with SLD continue to face serious challenges in their writing, and their exposure to the evidence-based AT solutions that target writing skills is meagre. Evidence on writing AT comes primarily from the Western, Gulf, and East Asian worlds and does not map onto the linguistic, structural, and cost conditions found in Indian inclusive classrooms. There is urgent demand for evidence-based, context-specific suggestions to Special Educators, parents and policy-makers about what kind of AT to consider when addressing writing deficits.

The study is conceived in relation to the following problem statement: 'An Impact study of Assistive Technologies in improving Written Expression for children with Specific Learning Disability '. To arrive at this statement, the researcher wants to identify answers to the following questions:

'What Assistive Technologies do Special Educators use to improve written expression of students with SLD?'

'What is the prior Written Expression ability of Grade 5 students with SLD in (Pre-intervention).?'

'To what extent do selected AT interventions enhance writing expression of children with SLD by standard pre-test' and 'post test'.?'

'What are the perceived challenges faced by Special Educators in using AT tools for writing instructional practice within inclusive classroom settings in Delhi NCR region..?'

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'How can a Writing Intervention program based on AT be designed to enhance writing expression of children with SLD..?'

5. Proposed Research Design and Methodology

This study follows a mixed-methods research design that uses a quasi-experimental method for the quantitative comparison of pre- and post-test written-expression abilities, and a survey method to elicit Special Educators' perceptions of the use, barriers, and adoption of ATs. This design makes it possible to quantitatively evaluate the effectiveness of the AT interventions while also encompassing the qualitative nuances of their use in the classroom.

The intended participants will consist of Grade 5 students with SLD and their Special Educators teaching in inclusive schools situated in the NCT of Delhi. Grade 5 was chosen through a purposeful selection process based on: the typical stage of formal identification, a significant increase in demand for written output across subjects, and its suitability as a transition point prior to middle school. Fifteen inclusive schools selected through purposive sampling (stratified across the three management categories, viz., government, private, government-aided, and across the two spatial categories of urban and semi-urban) will participate in the study. This sample will include a total of seventy Grade 5 children with SLD (special attention will be placed on those with dysgraphia and mixed SLD presentations involving difficulty with written output)and their respective Special Educators.

Four instruments will be utilized, all designed and previously validated with Special Educators (Special Education), School Psychologists, and Methodology of Research experts: A structured questionnaire with Special Educators regarding the use, degree of adoption, and perceived utility of AT for written-expression instruction, plus the enabling environments. A standardized pre-test measuring handwriting legibility, spelling, sentence- and paragraph-level organization and cohesiveness (a). A post-test equivalent to the pre-test, once intervention has taken place.

A manual of AT-based instructional intervention for writing based on speech-to-text, word-prediction, and digital tools to organize thoughts.

Quantitative data analyses will involve means and standard deviations; paired T-tests or Wilcoxon Signed-Rank test for pre/post-test scores; independent T-tests or Mann-Whitney U-test for score

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differences between schools based on administration; coefficient correlation by Pearson or Spearman on training acquired and level of efficacy; chi-square test for categorically measured data, and one-way ANOVA according to AT-tool use; conducted with SPSS and Excel. NVivo or manual coding shall be used for analysis by means of themes to identify patterns in open-ended responses addressing hindrances encountered during implementation, thereby generating a more robust interpretative understanding of outcomes. Geographical scope is limited to Delhi NCR; subjects consist of Fifth graders who have previously been formally diagnosed as having SLD, with a deficit in written expression: not spelling nor syntax in any subject matter other than written expression; and the subjects will be Special Educators, instead of General Educators.

6. Role of Assistive Technology in Writing Intervention: Discussion

The cited literature explains how these challenges for written expression can be mediated through the multiple intersecting avenues of AT. The auditory-to-text means of generating writing by children with dysgraphia from a speech-to-text tool overcomes the fine-motor and orthographic challenges associated with handwriting, leaving valuable cognitive resources available for formulation and sequencing ideas. Work-prediction and spelling-support software alleviate the cognitive load on working memory with respect to both spelling and recalling words.

Graphic organizers externalize organization and sequence, a crucial process for those who struggle with holding a sequence of thoughts in mind while also attending to the physical demands of handwriting.

Generative AI writing supports is showing emerging evidence (Gharaibeh et al., 2025) as an additional path: individualized, real-time feedback to a student’s particular error patterns; such responsive scaffolding to a student's ongoing efforts is difficult for teachers to replicate through unassisted classroom delivery, particularly in low-resource contexts, yet such work is almost entirely in non-Indian, non-vernacular languages and it is unclear how, if at all, these effects will translate to Hindi or regional-language writing instruction within inclusive Indian classrooms. To the present research context, the designing of the intervention for Grade 5 students with SLD in Delhi NCR necessarily must also take into consideration the target writing sub-skill (handwriting mechanics, spelling, sentence construction or idea organization), the linguistic mode and the very

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practical and logistical realities that Special Educators negotiate daily. The design of this study's all-of-the-aforementioned tools into a combined instructional module-structured incrementally according to difficulty, flexible with respect to technology access, and approachable for educators with diverse levels of AT experience-endeavors to translate the promise of AT for written expression into scalable outcomes for learners across the Indian inclusive classroom.

7. Challenges and Barriers to Implementation

Even when AT resources are well-designed, however, serious obstacles to classroom adoption in Indian inclusive settings hinder their equitable integration. The pilot study carried out by Kaur (2025) among Indian teachers reveals that even though these educators have mostly supportive attitudes toward inclusion, insufficient specialized training and support services, and limited pedagogical materials were reported as common limitations in implementation, even when inclusive approaches in general were considered by teachers. These factors plausibly influence writing AT even more, which demands more active and consistent educator intervention than low-technology accommodations.

Another constraint is that existing Indian dysgraphia-intervention studies have focused on low-technology multi-sensory handwriting instruction rather than on digital AT, such that Special Educators and Indian schools probably harbor much less familiarity with digital writing support compared to digitally aided reading activities or generic classroom aids- and this exacerbates the lack of trained personnel described already.

Guided by Sasidharan and Kotian's (2025) interest in the need of technology-integrated and culturally specific dysgraphia services, along with Kaur's (2025) conclusions regarding teacher readiness, the current research is purposefully using stratified sampling of students from private, government-aided, and government schools located in both urban and suburban settings to empirically evaluate the extent of these lags, not as inferences. A third hurdle relates to language-most of the extant digital supports that assist writers (or have generative capacity to do so) have their development and efficacy testing focused in English and non-Indian languages. Hence, we have no conclusive proof whether their effectiveness and utility can extend effectively to Hindi or other regional languages as children and young adults draft their academic writing. Our research

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aims to directly assess this research gap through its planned research methods (i.e., stratified sampling; planned instructional module; designed questionnaire) based on input from educators in classroom contexts.

8. Implications for Inclusive Education Policy and Practice

The evidence and gaps above have many policy and teacher-training-related implications in India. To teacher-education providers: training on digital writing-supporting AT, not only reading-supporting AT, in the pre-service special-education and B. Ed-level coursework. To school management: adoption of needs- based distribution of writing-supporting AT infrastructures, and not on the assumption that general AT provides sufficiently supports writing needs.

To policymakers: include concrete, writing-specific usage guidance, and tool specification criteria for special educators when technology is introduced with technology-based education policies. To the research and practice communities: focus research on development and testing of vernacular-accessible tools of digital writing support, building on the case for integration using of technology by Sasidharan & Kotian (2025) and existing knowledge of the use of generative artificialwritingassistancetoolsinternationally(Gharaibeetal.,2025).

This study contributes to bridging the gap by describing the modular AT writing support intervention in a structured, adaptable way. Embedded within the research-practice linkage mediated by a mixed-methods approach, the module serves as the translation from existing international knowledge of AT support for writing expression to a classroom-tested intervention for Indian inclusive classrooms.

9. Conclusion

There is significant potential for AT interventions to impact SLD students' writing-expression proficiency when AT is appropriately selected, linguistically mediated, and implemented context-consciously within the specific institutional milieu of Indian inclusive schools. Although the international literature reviewed in this paper provides ever stronger confirmation of the cognitive and motivational benefits of SPT, prediction and generative AI writing software, evidence for these interventions within Indian classrooms, focusing specifically upon writing (rather than reading) is

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lagging far behind. The doctoral research reported in this paper-an experiment utilizing an embedded mixed-methods design with seventy Grade 5 children with SLD and twenty Special Educators across fifteen inclusive schools in Delhi NCR-aims to provide empirical evidence of the quantitative efficacy and qualitative impact of the use of AT for writing-expression, and to enable the construction of a standardised, reliable and portable intervention module: thus directly contributing to this conference's primary theme of aligning the theory of inclusive education with classroom practice.

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