TECHNOLOGY INTEGRATION FOR INCLUSIVE EDUCATION (TIIE)

Program Document

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IT for Change

393, 17th Main Road, 35th Cross,
Jayanagar 4th 'T' Block,
Bengaluru, Karnataka – 560041.

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Executive Summary

The Technology Integration for Inclusive Education (TIIE) project was envisioned recognizing the need for inclusive approaches and strategies to address the learning needs of all students, including those with mild learning difficulties. The project also aimed to explore ways in which technology can be meaningfully integrated into the classroom.

Students in grades 6-9 in government and government-aided schools in Bengaluru, Karnataka, along with teachers, headmistresses, cluster resource persons (CRPs), block resource persons (BRPs), and block inclusive education resource teachers (BIERTs) were engaged in the project from April 2022 until March 2023. Students were engaged through intensive weekly interactions in higher primary schools, and through camps in high schools. Modules for intensive engagement were developed based on a baseline study that highlighted the need to focus on foundational mathematics and language skills. The module for the event-based engagement largely focused on science processing skills.

The Universal Design for Learning (UDL) framework – which offers concrete suggestions to ensure all students are able to meaningfully participate in the learning process – guided the TIIE project design and implementation. Furthermore, digital tools such as a Language Lab (developed as part of the project), PhET, GeoGebra, and TuxMath were also integrated into the project.

An analysis of the baseline and endline findings, as well as the feedback from teachers and students, indicated that the project contributed to significantly improving students' competencies in mathematics and languages, as well as their engagement with learning, and their attitudes towards peers. From our interactions with different stakeholders of the education system, several challenges were identified vis-à-vis making schools inclusive, and the following are some recommendations, based on our learnings, for inclusive approaches:

1. Capacity-building programs should be conducted for all teachers and teacher-educators (BIERTs, BRPs, and CRPs) that focus on the need and importance of inclusive education (IE). These programs must include sensitization to learning disabilities and means of identifying them, and awareness about the UDL framework and how it can be incorporated as part of the teaching-learning process. Differentiated instruction – incorporating multilevel, multilingual, multimodal, and multisensory resources – needs to be the default approach.
2. Given that a large proportion of classrooms, especially in urban areas and in border geographies, are linguistically diverse, capacity building focusing on 'multilingual'

teaching approaches must be a part of teacher professional development (TPD) programs.

3. BRPs, CRPs, and BIERTs should be prepared to offer meaningful academic support to teachers, in addition to administrative support.
4. Coordination between the education and the public health departments should be enhanced to ensure that the facilities and resources available for Children with Special Needs (CWSN) reaches them.
5. Policy-level changes are necessary to ensure that teacher vacancies are filled in all schools and adequate time is provided to teachers for academic planning and activities.
6. All schools have some gaps with respect to the minimum physical and academic infrastructure defined in the Right to Education (RTE) Act. Since the RTE Act recognizes these facilities as a part of the fundamental right of each child, it is essential that all the gaps be filled in a time-bound manner. This will ensure schools can provide IE, as well as encourage parents to move their children from private to government schools.

1. Introduction

Universal quality education is still a far cry in most schools in India. For instance, the Annual Status of Education report suggests that most children are unable to perform basic reading and arithmetic activities that are required for their grades. One cause for this is that teachers mostly use textbooks as their teaching resource, and adopt a one-size-fits-all pedagogy. Differentiated instruction – combining multilevel and diverse resources along with learner-centric pedagogies – is necessary for facilitating the education of students at different levels of engagement and understanding. Exposing teachers to technology for accessing resources, and facilitating their contextualized use is essential for differentiated instruction.

When it comes to inclusive education (IE), there is a general lack of awareness and understanding among teachers, parents, and educational institutions. It is often limited to including Children with Special Needs (CWSN) only. However, children with learning disabilities and difficulties are excluded in classrooms, and teachers are unable to understand or address their challenges. IE shouldn't just be viewed as a way of removing exclusions, it has to be seen as a fundamental part of the learning process itself. IE helps in identifying the strengths of all students in a classroom and allows them to grow to the best of their abilities, rather than restrict growth to a narrow set of principles due to which some children become 'capable', and some become 'disabled'. While there is a lot of information available on IE, there are major problems when it comes to implementation, and to tackle this, the challenges of the teaching faculty need to be addressed.

With the support of the Cognizant Foundation, IT for Change (ITfC) implemented a pilot project titled, 'Technology Integration for Inclusive Education' (TIIE) in government-aided higher primary and high schools in Bengaluru South-3 block from April 2022 to March 2023. This was initiated as part of the Cognizant Foundation's flagship program, 'Teacher Development for an Inclusive School Education System Leveraging Technologies'. The TIIE project was conceived as a three-year project, consisting of a one-year pilot project, followed by two years of scaling up. The pilot was implemented in select schools in Bengaluru South-3 block. The program extends the model of '**teacher professional development'** (TPD), building 'Teachers' Communities of Learning' at multiple levels – within the school, across subject teachers, and across schools in the block.

In addition to demonstrating technology integration for IE at the school level and building communities of practitioners, the TIIE project published teaching-learning materials on the Karnataka Open Educational Resources (KOER) repository, in English and Kannada, for teachers across Karnataka.

This report discusses the work done during the pilot, the project observations, experiences, key insights, and our learnings. It also lists out a few recommendations based on our experience and learnings.

2. Program Objectives

The following were the objectives of the TIIE pilot:

1. Demonstrating integration of digital technologies to make classrooms an effective learning space for all children.
2. Building multilevel learning modules on select subjects for inclusive teaching-learning.
3. Capacity building of teachers and teacher-educators to support inclusive teaching processes.
4. Supporting teachers in creating Open Educational Resources (OER) for their Continuous Professional Development (CPD) and for use in inclusive teaching-learning.
5. Enabling students to access digital technologies for learning.
6. Establishing a teachers' resource center to facilitate creation and sharing of resources for IE.
7. Supporting schools to use digital technologies in administration and management processes.

We worked to achieve these objectives through a combination of specially designed modules, ongoing resource creation, classroom work, teacher training programs, and establishing a resource center. The approach included a combination of intensive and event-based school-level work in select government and government-aided high schools, as well as conducting numerous learning activities at block level.

3. Program Design and Methodology

The program design of the TIIE project was based on the following underlying concepts:

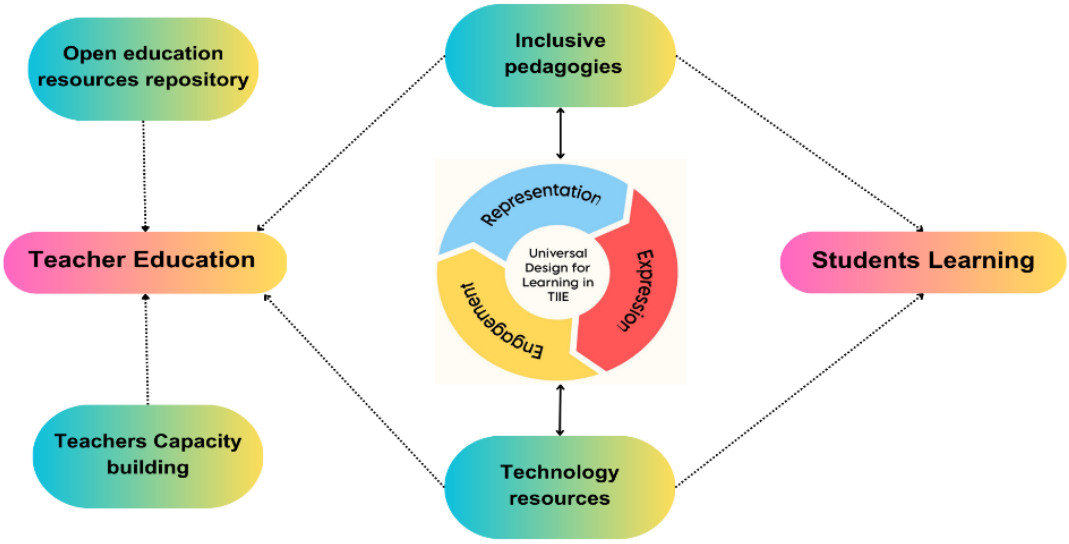
1. Our **inclusive pedagogies** included multisensory, constructivist, and learner-centered approaches to address learning difficulties, and we adopted the following technology-enabled strategies:
    a) Peer learning, experiential learning, and the use of exploratory, co-operative, and collaborative methods in teaching-learning.

b) Adaptation of different technologies to support individual learner needs.

c) Use of games and crafts in teaching-learning to facilitate constructivist opportunities.

2. We adopted **differentiated learning,** including differentiated instruction and assessment, for effective teaching in the identified schools. This involved developing teaching materials and assessment measures so that all students within a classroom can learn effectively, regardless of differences in their interests and abilities.
3. We designed, developed, and transacted technology-integrated modules and demonstrated new IE pedagogies.
4. We focused on integrating Free and Open Source (FOSS) applications and OER in teaching.
5. We set up a digital resource center to encourage teachers to come together to create and share classroom resources, and discuss different possibilities for classroom intervention.
6. Our work included the use and continuous enhancement of KOER in-collaboration with teachers.

Figure 1. Universal Design for Learning in TIIE



Source: IT for Change

The TIIE project included the following key components:

1. Selection of schools
2. Development of modules to support IE
3. School work: Continuous engagement and event based-engagement
4. Capacity building for teachers through workshops and interactions with the teachers and school support systems
5. Setting up of a school lab
6. Setting up of a resource center

4. Implementation

4.1 School selection and students baseline

The selection of schools for the implementation of the project was done in two phases. Firstly, schools in Bengaluru South-3 block were shortlisted based on certain criteria such as school size and composition, availability of relevant infrastructure, and school management type. The team then visited all the shortlisted schools to interact with the teachers and headmistresses, explained the project objectives, and understood their needs while evaluating their interest and likelihood of extending support. Post this, 12 schools that were a mix of government and government-aided higher primary and high schools were chosen for intensive and event-based engagement.

Prior to the implementation of the project, it was important to understand the contexts and learning needs of students in the chosen schools. A baseline module was hence developed, and as part of this, a series of activities was conducted to assess students' abilities in foundational mathematics and languages. The baseline also aimed to understand students' current learning levels and any learning difficulties that they were facing. The team referred to a variety of web resources and consulted with experts while developing tools for the study. Digital tools were used when relevant in the baseline preparation process – both for designing the module and in actual classroom transactions. The observations and findings from the baseline, along with the classroom contexts, formed the basis for the subsequent module development. The baseline report is available here.

Figure 2. Project activities conducted as part of TIIE. Each of these project activities is briefly discussed in the subsequent sections

Source: IT for Change

4.2 Module design and development

Specific modules were designed and developed to help students learn, including those with mild learning difficulties. The Universal Design for Learning (UDL) principles were applied in the design of subject-specific modules. Furthermore, the integration of digital technologies was a key factor during module design that helped create IE resources. Continuous assessments were conducted during the implementation of the project to understand if students' learning needs were being met and to identify areas where additional support was needed.

A. School work – Continuous engagement design

The project aimed to identify innovative, inclusive pedagogical approaches for students in grades 6 and 7. The mathematics and language modules were designed based on IE

principles which encompass strategies to support diverse learners by minimizing barriers to learning and helping each learner achieve their full potential. Owing to the behavioral challenges witnessed in students across schools, content selection and activity design was done in a manner to help improve students' social and emotional learning (SEL) and interpersonal skills, as well as to help them develop a growth mindset. The module intentionally used themes familiar to students. The mathematics module was designed to support the development of students' foundational numerical skills and our aim was to provide students with alternate methods to visualize and understand concepts such as place value, addition, subtraction, and multiplication, both conceptually and operationally.

The English language module aimed to provide a wider exposure to different types of discourses in English to help students become aware of meaningful vocabulary and the correct usage of grammatical structures. The stories that learners read and listened, the topics they discussed, the role plays they enacted, and the activities they engaged in, all had thematic links with issues such as personal and community values, including gender, social justice and democracy, health and nutrition, and the environment. This module also had elements of SEL. Furthermore, the module followed the CASEL framework, where the focus was on self-awareness and self-management. Meanwhile, the Language Lab was also an important component of the language module. It was designed to be learner-centric and used storytelling as a pedagogical tool to develop listening, speaking, and reading skills in English among the learners. It also helped them understand the overall meaning of a story with the help of illustrations.

B. School work – Event-based engagement design

In event-based engagements like camps and science exhibitions, the aim was to expose students to IE approaches and materials. The science module was designed considering students' interests and needs, with the aim of developing science processing skills like observation, classification, inference, experimentation, analysis, etc. Resources and academic inputs were given to students for carrying out experiments and conducting events like exhibitions and camps. While aiming to build scientific temper among students, the activities that were a part of the module were aligned with the Karnataka education syllabus.

Technology integration was considered at two levels, i.e., during planning and transacting the module. Digital methods were used to access various web resources and customize them to the needs of the students. In classroom transactions, technology was used by teachers for demonstrations, while the students used tabs/laptops.

The abovementioned three modules intended to address the following general inclusion barriers:

1. Linguistic barriers (difference in the linguistic levels of the speaker and the listener): Digital resources were created in both Kannada and in English, including supporting text in both languages. Facilitators also provided support in other languages such Tamil and Hindi/Urdu for students who migrated from nearby regions.
2. Use of new vocabulary: The module exercises contained new vocabulary along with a corresponding image. Furthermore, important science vocabularies were introduced using pictures and illustrations wherever necessary.
3. Psychological: The stories were selected based on themes and contexts familiar to the students, and the corresponding activities were designed to keep the students engaged, be it in individual, pair, or group work. Integrating videos and hands-on experiences as part of the science and mathematics modules aimed to sustain the interest and engagement of the children.
4. Physiological: Although no differently-abled student was identified, most activities included images and corresponding texts in both English and Kannada to assist those with partial hearing impairment.
5. The activities included a focus on areas for developing speaking skills using mechanics of speaking (pronunciation), usage (vocabulary and language functions), and cultural and social contexts. Relevant physical resources such as videos and illustrations were used while demonstrating activities to address the needs of diverse learners.
6. Students were provided with multiple learning discourses and encouraged to read out aloud, and were taught how to break down words or sentences for the same if necessary.

4.3 Classroom implementation and technology integration

Government higher primary schools in three clusters in Bengaluru South-3 block were identified as ‘implementation schools’ for intensive school work. In these schools, sessions were conducted for a period of nine months when a team of three-six facilitators visited the schools twice a week to engage students for about 80 minutes each day. Students were divided into two-three groups based on their mathematics and language abilities assessed at the baseline, and on observations made by the facilitators during the course of the year. This enabled each facilitator to interact with seven–10 students. The sessions were organized in such a way that mathematics and language activities were conducted parallelly at different places available in the school like the computer lab, library, or classrooms. The focus of these sessions was on identifying strategies that could be implemented by teachers to address the learning needs of all the students in the classroom, including those with learning difficulties. Specifically designed modules

incorporating multilevel, multilingual, multimodal, and multisensory resources were transacted during the sessions using pedagogies based on UDL principles. After each session, the team held internal discussions, recorded their insights, observations, and challenges, and made the necessary changes to the teaching plans for the following session. Digital technologies were used in classroom processes like lesson planning, classroom transaction, and conducting assessments – both baseline and endline assessments. The resources developed were also published on KOER.

Figure 3. Students taking part in the activities organized as part of the TIIE project

Source: IT for Change

A total of 153 students across four higher primary schools were engaged as part of intensive school work. Although 175 students across five schools were surveyed for the baseline, the sessions could not be continued in one of the schools due to space constraints and lack of adequate support from the administration. In one of the schools, post the midterm holidays, the school could only allocate about 90 minutes per week, and hence the activities conducted were modified and focused more on integrating technology tools for teaching-learning mathematics concepts.

Mathematics sessions focused on understanding the concepts of place value, basic operations such as addition, subtraction, and multiplication, as well as basic shapes, as these were recognized as the need of the hour during the baseline assessment. As UDL suggests, different models and strategies were used to present key concepts in alternative forms of symbolic representation, provide options for organizational methods and approaches, guide exploration and new understanding, and clarify symbols, expressions, and meanings. Flat long unit (FLU) model for place value, addition, and subtraction; area

model for multiplication; games for mental calculation practice; and a skit for learning basic geometric concepts were some of the strategies used.

Table 1. Gender, class, and school-wise distribution of students in the four schools where the project was implemented

School	Grade 6		Grade 7		Total
	Female	Male	Female	Male	
School #1	-	-	22	15	**37**
School #2	5	10	5	9	**29**
School #3	24	22	-	-	**46**
School #4	-	-	23	18	**41**
Total	**29**	**32**	**50**	**42**	**153**

Source: IT for Change

Concrete representational abstract approach was used while teaching concepts where physical and visual aids (such as physical and digital versions of the FLU model, chits, objects, etc.) were initially used to help children understand abstract concepts. Where relevant, different digital tools such as TuxMath, GCompris, and PhET were also used to reinforce concepts learnt, and to provide opportunities for practice. In one school, a skit enactment about properties of shapes was used as a means to explore geometric concepts and learn collaboratively.

At the time of the baseline, a significant number of children in all the schools were struggling with number operations where the understanding of the decade (base-10) structure was a prerequisite, i.e., solving problems involving carry-over and regrouping. Although a majority of the children were aware of what addition and subtraction meant, they could not correlate their understanding with the procedure they were expected to follow with the standard algorithm. Similarly, in the case of multiplication, to begin with, the understanding of the meaning of the x symbol and what the operation meant in context was lacking among children. Their conception was limited to memorizing facts, without really knowing what the operands and the products meant. Secondly, when dealing with bigger numbers, several students faced challenges in remembering the ‘steps’ of the algorithm and weren’t equipped with any tools they could use when their memory failed. The activities in the mathematics sessions hence focused on helping students decode why they were doing what they were doing, and in the process, address misconceptions that they may be holding and teach them ways in which they could approach the solutions to the problems on their own.

Language sessions were aimed at increasing students' exposure to English and improving their listening, reading, and speaking skills. Stories were an integral part of the sessions to ensure that students could learn to read a given text with comprehension, locate details, and identify the theme, sequence of ideas, and events. Laptops, projectors, and speakers were used for these sessions in addition to the existing lab infrastructure in schools. A mix of individual, pair, and group activities (such as role plays, games for revising concepts taught, etc.) were used in the sessions in order to drive more effective collaboration and ensure efficient classroom management. Students were also encouraged to use multiple means of output (speech, writing, making posters, role plays, etc.) as per their comfort level.

Figure 4. Students using the Language Lab set up in their school

Source: IT for Change

The Language Lab was an important component of implementing the language module. The intention of the lab was not merely for students to read stories by themselves and check for reading comprehension, but to enable an immersive language experience. Customized digital resources were developed based on select stories in order to facilitate interaction in English. Stories from Pratham books' 'Storyweaver' were used and some were repurposed to create audio-visual resources in local languages, using FOSS tools to help apply a multilingual approach to teaching. Some of the activities were based on an E-Language Lab software developed by KITE (an initiative by the Kerala Education Department). They included themes such as empathy, teamwork, managing emotions, and other interpersonal skills. The digital audio-visual resources contained level-appropriate

listening and reading components, as well as assessments based on comprehension, vocabulary, and grammar which could be used by learners individually or in groups, so that children can then respond according to their own language proficiency and cognitive ability.

Sessions on SEL were conducted for students in one of the schools where a dire need for this was observed and where disturbances in this domain were acting as a barrier to learning. The CASEL framework was followed, and the focus was on self-awareness and self-management. Session activities included the use of art (drawing and coloring), drama, singing, and clay as means for students to express themselves and experience multisensory engagement.

Figure 5. Core competencies of Social and Emotional Learning

Source: ***CASEL***

As part of the project and based on requests from schools, computer labs were set up and maintained in eight schools. These labs were used by both the teachers and students. Our team also conducted regular classes on ‘digital literacy’ (DL) in three of these schools, and in some others, they provided support to the teachers to conduct the classes. The objective of these classes was to enable children to become comfortable with the use of digital devices and technologies in their learning process. These classes aimed to help students develop computer skills, including typing, text editing, using software applications, and understanding basic computer functions. Additionally, the classes aimed to encourage creativity by providing students with opportunities to explore software applications to create picture stories and understand data collection and analysis. The

classes began with basic computer operations such as switching on and off the computers, and gradually progressed to other skills of accessing tools and creating resources (files).

At the end of the academic year, students created various artefacts like picture stories and data analyses charts to demonstrate their learning. To support students in improving their listening and speaking skills in a second language, the multilingual Language Lab was also used during the DL classes. The session design and plans were adapted from the ‘Students ICT Textbook’ developed by IT for Change, which is based on the National ICT curriculum developed by NCERT. The curriculum for each school was customized based on the number of classes and infrastructure available. Where there were no labs, our project team set up an ICT lab, with computers donated by Cognizant Technology Solutions.

4.4 School camps and science exhibitions

Event-based engagements were conducted in five high schools through camps and exhibitions. To enable the implementation of activities in various settings, a range of schools with different management types (government and government-aided), student populations (boys-only, girls-only, and co-educational), and types (residential and non-residential) were carefully selected.

During the two-day long camps, activities focusing on science and languages were conducted. The objective of the camps was to pique students’ interest and engagement with learning through the creation of opportunities for exploration, inquiry, and creative thinking. "Interacting with flexible content, constructing meaning and generating new understandings, optimizing relevance, value, and authenticity to learners’ interests and goals,” are some of the UDL guidelines that the camps tried to incorporate.

The science-based activities focused on enabling students to get hands-on experience of conducting experiments, and in that pursuit, develop their science processing skills such as observing, classifying, predicting, inferring, and representing data. The activities were all based on themes related to everyday phenomenon and the students’ curriculum. Acid-base testing, web-of-life games, understanding electricity, shadow exploration, and classification of leaves were some of the activities that were conducted. Each station in the camp had a facilitator and students went from one station to the next in small groups. They were given handouts for each activity to record their prior understanding, predictions, observations, and learnings from the activity, and any other notes they wanted to make during the activity. All the activities only used easily found or inexpensive materials. Technology was integrated where relevant for demonstrating concepts, to display audio-visual information, and in some cases, for students to explore simulations. Students were also given feedback sheets at the end to assimilate their thoughts and reflect on all the activities they participated in throughout the day.

Apart from the activity-based camps, science exhibitions were held in two of the high schools. Initially, brainstorming sessions were conducted with the students to identify themes/topics for their projects. Facilitators evaluated the relevance and complexity of the topics and advised students accordingly. Once topics were identified, the facilitators helped find relevant experiments/projects that could be done using inexpensive materials and everyday objects.

Figure 6. Students taking part in one of the science exhibitions that were conducted

Source: IT for Change

Then, the necessary materials and stationery items were distributed and the students spent about five-six days working on their chosen topics for two-three hours per day. Some students worked in groups, while others prepared individually. They were also provided with multiple reference links to help them better understand the concepts and prepare for explanations during presentations by using additional resources such as charts and videos. Students discussed their preparation work with us in person, over the phone, and via WhatsApp groups that were created specifically for this purpose. Students used the group to share their progress levels, needs, and challenges, which helped us in resolving their issues. On the day of the exhibition, the projects were all arranged by theme and nearly 400 students from nearby schools visited the exhibition and learned about the concepts demonstrated through models.

4.5 Student endline

4.5.1 Design and methodology

The objective of the endline study was to understand the impact of the activities on students' learning. The endline assessment assessed students' foundational competencies in mathematics and languages, which the project attempted to develop using inclusive pedagogies. It was conducted through individual interactions with students, over a three-week period in February 2023. Four-five facilitators were involved in the process, wherein two-three of them would be engaged in conducting the one-on-one interactions and the remaining two would engage the rest of the class in the planned activities for that session.

The endline assessment took into account students' learning in the curricular areas that were focused on during the classroom sessions. Students' perspectives on inclusivity in the classroom, teachers' perspectives on students' responses and learnings, and facilitators' reflections from the sessions, camps, and workshops were also captured.

4.5.2 Assessment tools

Mathematics

The baseline assessment tool for addition and subtraction operations included separate sections for operating on single-digit numbers, a single and a double-digit number, and two double-digit numbers (involving carry-over/regrouping). The endline assessment tool was modified from the baseline tool in order to take into account the age-appropriate/grade-level learning competencies and make adjustments for what they might/should have learnt during the year. The endline assessment hence evaluated only the students' ability to solve operations involving double-digit numbers and did not test separately if they were able to solve single-digit addition or subtraction. Similarly, for multiplication, the endline only assessed students' abilities to solve a problem having double-digit operands which involves both recalling the associated multiplication facts and the procedure to solve. Although the assessment activities were not entirely identical in the baseline and endline, the rubrics were standardized accordingly to allow for comparison.

All the students who could not solve the multiplication operation during the baseline (which was over half the students assessed), could either not recognize the sign at all, or not explain what is to be done when the multiplication sign is encountered, indicating that the meaning of multiplication had not been understood by a majority of the students. Since the activities during the TIIE project involved understanding not just the process of multiplication but also the meaning in context, this aspect was included additionally as part of the endline assessment to get a sense of how effective the strategies used were in terms of helping students understand the concept. Since this wasn't captured through a rubric in the baseline, there is no quantitative data available from the baseline, but this issue had been observed by the facilitators when conducting the baseline and during the sessions.

Figure 7. Students taking part in one of the activities organized as part of the TIIE project

Source: IT for Change

Language

The endline assessment tool required students to listen to and comprehend a short passage and answer questions based on it, read words followed by a short story, as well as speak about themselves and write about their favorite animal. Each of these components was assessed on the basis of a rubric that was aligned with the one used during the baseline assessment.

4.5.3 Sample

As evidenced in Table 2, the baseline and endline could not be conducted for all 153 students who were reached as part of the project in the four schools. This does not mean that they were excluded from the regular interactions and activities of the project, but they were not present on either or both of the days when the baseline and endline assessments were carried out.

Students for whom both baseline and endline were not done were those who were enrolled in the school but were absent during the baseline and endline, or attended school for only a few weeks during the year possibly due to health, economic, or other challenges. Students for whom baseline was done but not the endline were those who were absent during the last couple of weeks when the endline assessment activities were

conducted, perhaps because they were travelling to their native places, facing or had other family issues, or had stopped attending school during the year.

Table 2. Number of students surveyed for the baseline and endline studies

School	Baseline and endline not done	Baseline done but not endline	Endline done but not baseline	Both baseline and endline done	Total
School 1	-	3	5	29	**37**
School 2	1	4	8	16	**29**
School 3	3	3	4	36	**46**
School 4	-	7	1	33	**41**
Total	**4**	**17**	**18**	**114**	**153**

Source: IT for Change

Students for whom the endline was done but not the baseline were those who were studying elsewhere or hadn't been attending school for a significant part of the academic year but enrolled towards the end of the year. In order to have a fair comparison between the baseline and endline findings for each competency, only the students for whom both baseline and endline were conducted were considered for comparative analysis.

4.6 Cluster-level workshops with teachers

Cluster-level meetings were held once a month when teachers from schools of two-three clusters came together to learn and share various pedagogical strategies. Following our workshop with cluster resource persons (CRPs), they invited us to cluster meetings to share our work with the teachers. Each cluster had 20-30 teachers and two CRPs. The primary objective of participating in these cluster meetings was to share knowledge about IE, demonstrate inclusive strategies in teaching mathematics, and introduce the Language Lab.

During the meetings, the use of resources was demonstrated using a projector, speaker, tabs, and other peripherals. Teachers were given tabs and laptops to explore resources in various languages. The 'kiwix' application was installed on teachers' phones to enable offline use of the resources and encourage the teachers to use it in their classrooms. The team participated in nine cluster meetings for both primary and higher primary school teachers, reaching out to around 250 teachers.

Figure 8. Teachers participating in the cluster level workshop

Source: IT for Change

4.7 School-level teacher workshops

The efficiency and impact of the project depended significantly on the support and participation of the headmistresses and teachers of the chosen schools, and throughout the project we had regular interactions with them. We conducted school-level workshops to help teachers develop and implement inclusive pedagogies and practices in their classrooms. At these workshops, we discussed school work, our findings from the baseline study, demonstrated resources, and shared our observations and learnings.

The aim was to both encourage teachers to adapt the project material and methods, and collect their feedback on the possibilities as well as challenges of IE. Teachers were encouraged to use, contribute, and share the teaching-learning resources – both at the school level and at the block/cluster level. This was done by setting up a lab in select schools and establishing a resource center at the block level.

School-level teachers' DL workshops were also conducted, on demand, in two schools. Since teachers work on computers to carry out routine administrative and academic work, they felt the need for capacity building on some of the basics of computer-use that would help them save time and work more efficiently. At first, as the teachers were not aware of GNU/Linux FOSS environment, we had to give an introduction to the Ubuntu GNU/Linux interface and applications. Connecting to the web to access OER helped them understand how they should be accessing resources and how they can modify/reuse them to suit their context and students. Teachers learned to work with text editors in English, Kannada, and

Hindi. As per their request, connecting the mobile phone and other peripherals to the system for tethering and transferring files was also taught. Accessing, composing, and sending emails was also part of the workshop.

Figure 9. School-level workshop for teachers

Source: IT for Change

4.8 Workshop with CRPs/BRPs

As part of the project's implementation in the Bengaluru South-3 block, we designed and conducted a DL capacity-building workshop for all CRPs, block resource persons (BRPs), and block inclusive education resource teachers (BIERTs) in the area. The objective of the workshop was to assist these teacher-educators in effectively using FOSS digital tools in their everyday work, such as collecting data from schools, sharing resources with schools, creating resources for teacher development programs, and establishing mobile-based professional learning communities.

The workshop was attended by around 25 CRPs/BRPs/BIERTs. All participants were actively engaged, and explored a variety of digital tools and resources related to IE. In addition to the digital tools explored in the workshop, the CRPs and BRPs were eager to explore and share the multilingual Language Lab resources with teachers in their cluster meetings as well. The multilingual Language Lab resources developed by IT for Change as part of the project, was derived from the English Language Lab created by KITE. The project contextualized it by adding language resources in languages other than English spoken in the project schools, and also made it available on mobiles.

Figure 10. A workshop conducted for CRPs

Source: IT for Change

The workshop provided valuable insights into how digital tools can be used to enhance the effectiveness of CRPs/BRPs/BIERTs and use multilingual resources for classroom teaching. Post this workshop, all the CRPs/BRPs requested more such workshops to help them explore more FOSS digital tools for their routine work and also to exchange teaching/learning resources amongst them.

4.9 Interaction with BIERTs

There are four BIERTs in Bangalore South-3 block, two for primary and two for secondary schools, and they specialize in teaching children with learning disabilities, visual and hearing impairment, and mental retardation. We met these resource persons to discuss our project, understand their work, discuss pedagogical support for teachers, including capacity-building possibilities on IE, and discuss existing government schemes/facilities to support CWSN. We shared the TIIE project's IE resources and also got an understanding on IE resources maintained by them.

4.10 Setting up a resource center for IE

A 'Digital Resource Center for Inclusive Education' was set up at the Vijaya Teachers College, a prominent teacher education institute in Bengaluru. This is a (Bengaluru South-3) block-level resource center. Vijaya Teachers College is also classified as a government-aided College of Teacher Education (CTE), and part of the government of Karnataka's in-service teacher education system for high school teachers.

Figure 11. Block Resource Centre for Inclusive Education set up at Vijaya Teachers College

Source: IT for Change

The primary objective of the resource center is to provide a central location where all teachers in the block can access a wide range of resources, digital tools, and teaching/learning materials to promote IE and address the diverse learning needs of students. The resource center has information, both about IE in general, and about the modules and resources developed as part of this project. The facility is important for accessing and sharing resources that could be useful for student learning in an inclusive setting. In addition to IE resources, teachers can also access other educational materials such as textbooks, teaching guides, lesson plans, and various instructional resources to support their professional development and to enhance their classroom teaching methodology. We are also working with the Block Education Officer (BEO), to set up a resource center at the BRC office where all teachers can access, contribute, reuse, and share materials.

4.11 Meeting with the parents

We organized a meeting with the parents at one of the schools. We created a video of students' participation in many activities. Parents were extremely happy to see the pictures and videos of their child's participation in school activities. One of the class teachers began the meeting by explaining the Covid-19 situation and how it affected students' learning, and subsequently mentioned the teachers' efforts to address this issue. We then had a discussion about their beliefs and practices regarding their child's learning.

The strategies for an inclusive set-up for the meeting included circle-shaped seating, text-audio-visual materials, and a space for parents to express their opinions and for us to share evidence of students' participation with parents.

During our interactions with children in the classroom session, the team noticed three students who seemed to be experiencing some learning difficulties. This was brought to the attention of the school's teachers and the relevant department members. Based on their suggestions, we met the parents of these three children, and we found that all the three children's parents were Illiterate. We explained the difficulties faced by their children in the classroom and the parents were in agreement with us. We then took those three children to the National Institute for Mental Health and Neuro Sciences (NIMHANS) hospital for diagnosis (see next section for details on NIMHANS interactions). The parents of all three children are in contact with us, and we are figuring out the next steps vis-à-vis their education.

4.12 Engaging with the public health system (NIMHANS)

During our school visit, we found that some of the students were facing difficulties in participating in classroom activities. We discussed this with their teachers and began observing and recording their movements in the classroom. We designed a few age-appropriate activities for them and conducted some one-on-one interactions to better understand their difficulties, post which we decided to get a medical diagnosis for a few of them.

We selected three students from one of our intervention schools who were experiencing learning difficulties. We met with their parents and school headmistresses to understand their views. We first went to Sanjay Gandhi Hospital, after which we were directed to NIMHANS and Victoria hospitals in Bengaluru, as only these two institutions care for children with learning disabilities.

Then, along with the parents and teachers, we took the three children to the Department of Child and Adolescent Psychiatry at NIMHANS, where they underwent detailed and comprehensive clinical evaluation and assessment. They diagnosed one child with severe intellectual disability disorder. Owing to the child's difficulties, we registered the child's Unique Disability ID (UDID) as per the 'Rights of person with Disabilities (Amendments) Rules' (2009). Considering the child's learning and parents' financial and logistical difficulties, we plan to work with the parents to admit the child at a special residential school run by Samartham Trust located in HSR layout, Bengaluru (this is in line with the parents' wishes).

The second student was referred to Victoria Hospital for an IQ test and her appointment is due in September 2023, meanwhile the third student was referred to Venkateshwara Hospital in Tirupati since his Aadhaar and ration cards are registered in Andhra Pradesh.

4.13 Team capacity building

For internal capacity building, members of the team attended courses on IE, as well as courses on learning disabilities such as Dyslexia, Dysgraphia, and Dyscalculia offered by Azim Premji University, Anirveda, and the Madras Dyslexia Association (MDA). These courses covered awareness, sensitization, methodology, and preparing suitable timelines and discussions about formulating short-term and long-term interventions. Team members also accessed web resources on UDL and IE.

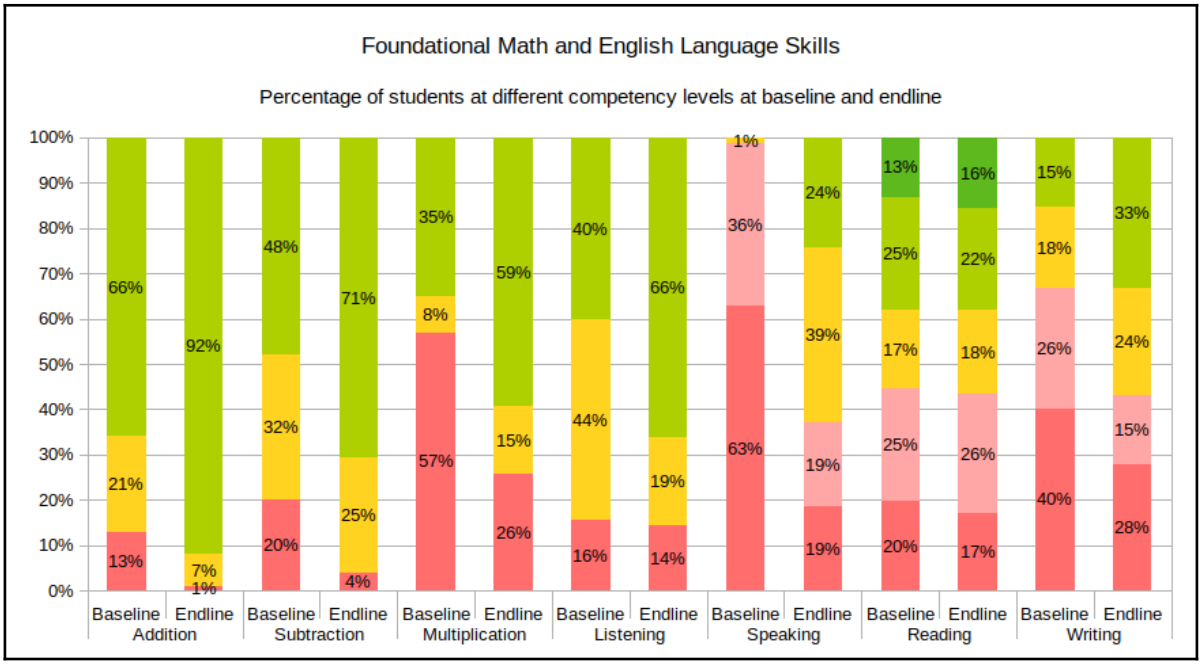
The team also interacted with IE experts, who have a deep understanding of the Karnataka education system, such as Prof. Mythili Ramchand from the Tata Institute of Social Sciences, Dr. Ruma Banerjee and Dr. Manjula Nanjundaiah from Seva-in-Action. In our discussions with these experts, we deepened our understanding of the challenges faced by children with mild learning difficulties, how to recognize these problems, how to support their learning while ensuring their inclusion, and what kinds of learning materials and classroom activities would be helpful to engage such children, especially in mathematics, science, and English.

5. Findings from Student Endline

The chart below shows the change (baseline to endline) in skills and specific mathematics and language competencies across the four schools where there was continuous engagement over the course of the year. The rubrics for assessment varied across competencies. The mathematics competencies for instance, were assessed using a three-level rubric each, while in English language skills, listening was assessed using a three-level rubric, speaking and writing were assessed using a four-level rubric, and reading was assessed using a five-level rubric. The details of each of these rubrics are given in the specific mathematics and language sections below along with their corresponding explanations.

In figure 12, a drop in the percentage of students at levels 1 and 2 from baseline to endline indicates a positive change as it means that those students who were at level 1 or 2 at the time the baseline assessment was carried out have now moved a level or two higher. Similarly, an increase in the percentage of students at levels 3, 4, or 5 indicates a positive change because it means a larger number of students moved to the highest levels.

Figure 12. The percentage of students at different competency levels vis-à-vis math and English skills during baseline and endline findings



Source: IT for Change

5.1 Mathematics

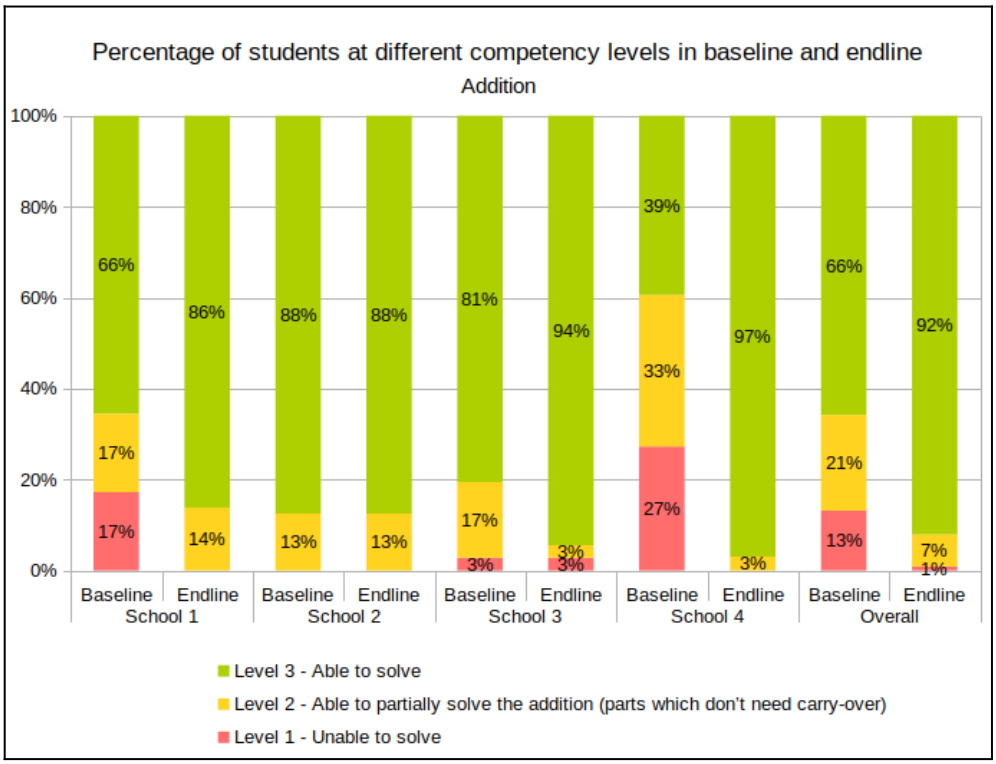
Addition

In figure 13, three of the four schools, an increase in the level 3 percentages and drop in the level 1 and 2 percentages are an indicator of improvements in students' addition skills. Except for School #4, the changes in the level 2 and 3 percentages in the remaining schools have not seen a very large jump. School #2 figures have not seen any change between baseline and endline.

Subtraction

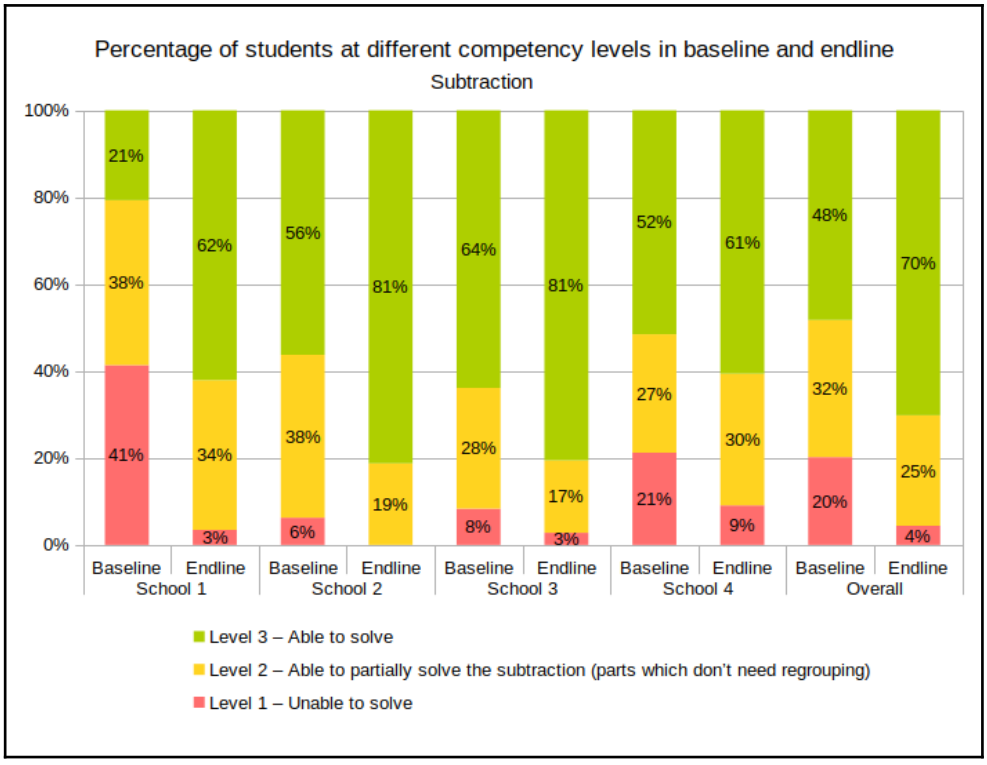
In the baseline, nearly half of all students assessed could not solve subtraction involving regrouping and about 20% of students could not solve subtraction at all. Figure 14 shows that there have been significant improvements in these numbers across schools. A 10-40% increase in the number of students who can solve subtraction with regrouping can be observed in each school, with the average numbers of those who are unable to solve anything reducing significantly from 20% to 4%.

Figure 13. The percentage of students at different competency levels vis-à-vis addition operations during baseline and endline findings



Source: IT for Change

Figure 14. The percentage of students at different competency levels vis-à-vis subtraction operations during baseline and endline findings

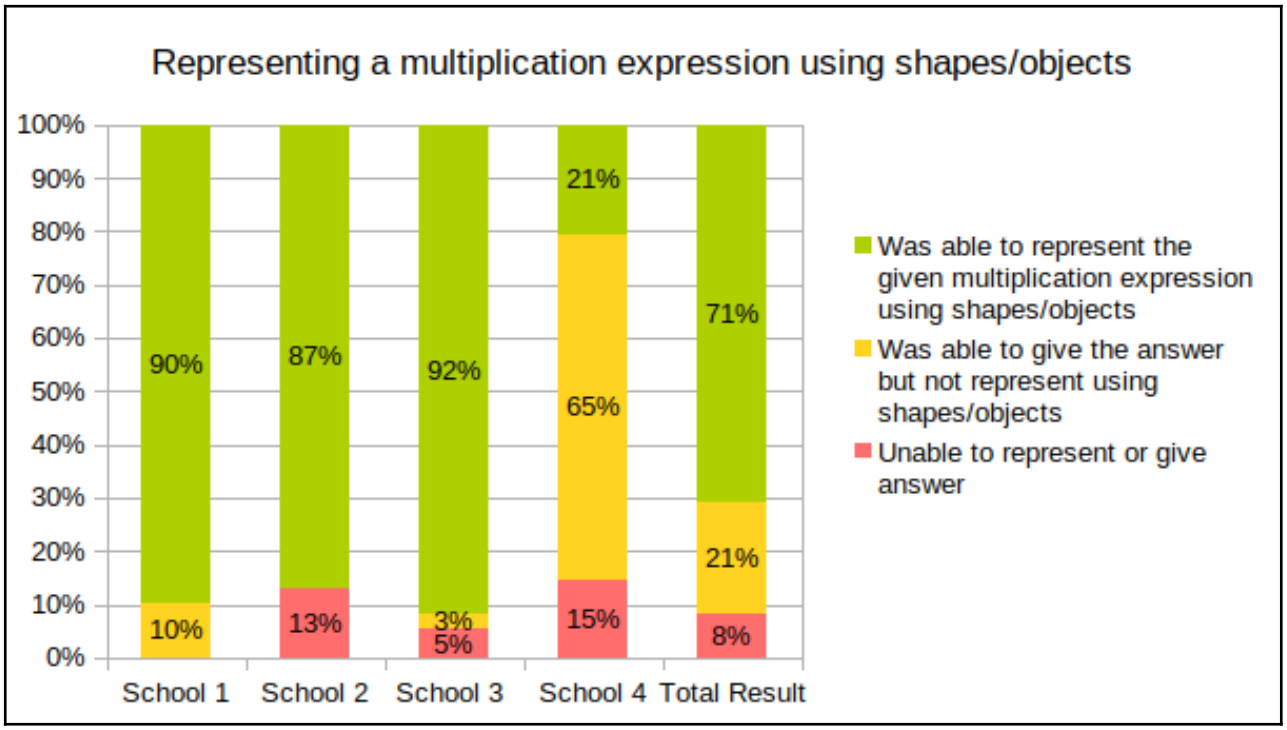


Source: IT for Change

Multiplication

From the data (figure 15), it can be seen that in the three schools where regular engagement was done during the course of the year, about 90% of the students were able to think of a contextual example and represent the given expression using objects or shapes. In School #4, although the percentage of students who were able to answer the given multiplication expression is close to 90%, number of those who were able to depict their understanding through a representational drawing is low. The reason may be because the time spent was lesser (only one session per week) and the way in which the activities were done was different.

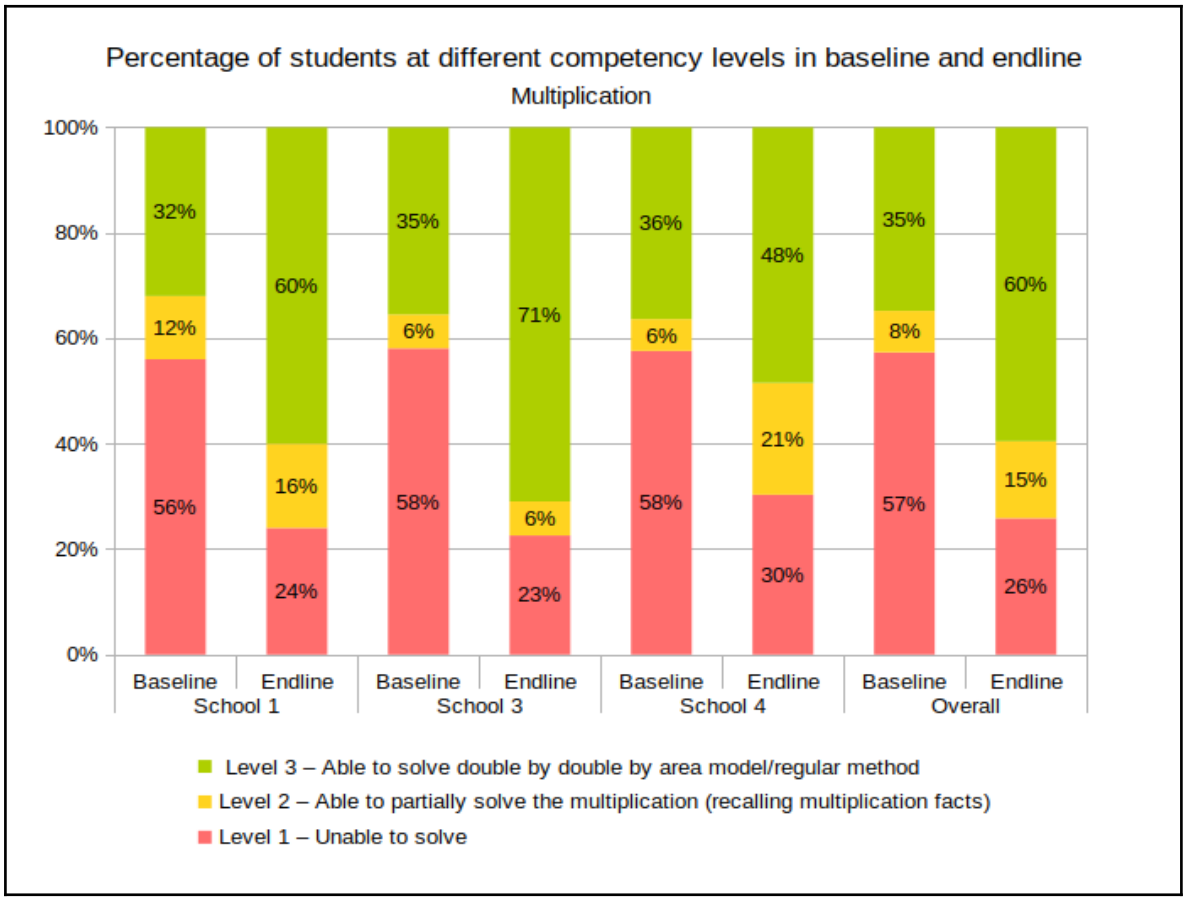
Figure 15. Students' efficiency while carrying out multiplication operations



Source: IT for Change

The percentage of students who could solve a double-digit multiplication problem was only about 35% in the baseline but it saw a positive shift to around 60% in the endline. All the schools assessed have shown an improvement of about 10-30% in level 3. The numbers of students who could not solve anything also significantly decreased in all the schools with an average reduction of about 30%.

Figure 16. The percentage of students at different competency levels vis-à-vis multiplication operations during baseline and endline findings



Source: IT for Change

5.2 Language

Listening

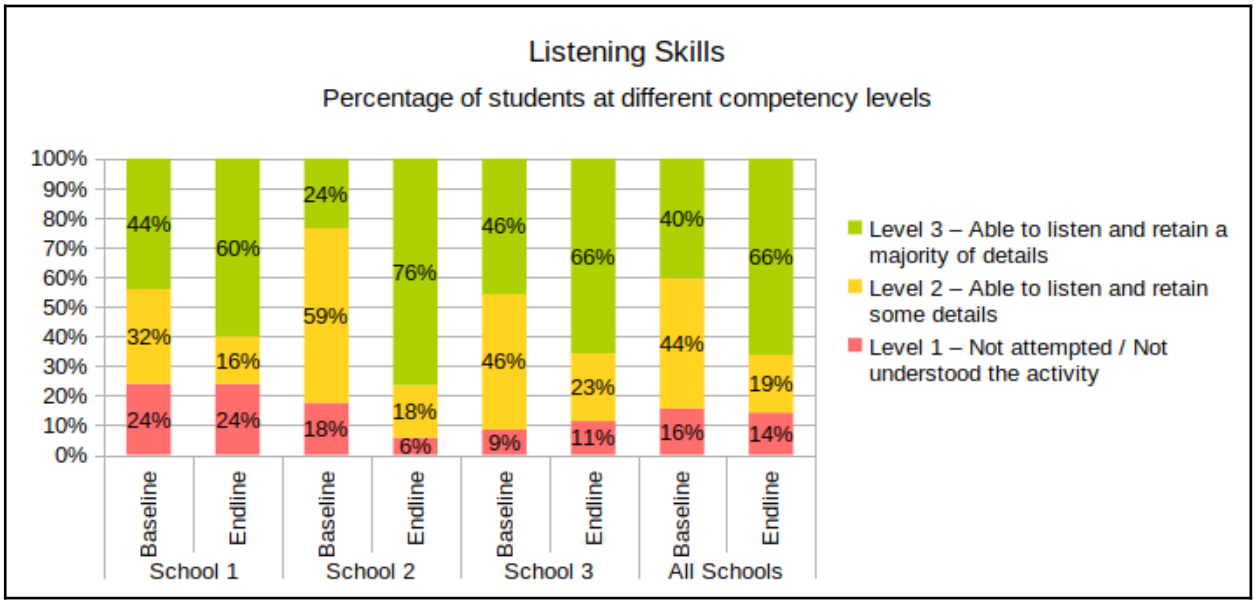
Figure 17 shows the school-wise and overall comparison of the percentage of students at each competency level between baseline and endline. In all three schools, increases in the level 3 percentages are an indicator of improvements in students' listening skills. The most improvement can be seen in School #2.

Speaking

From the below figure, we can see the changes in percentage of students vis-à-vis different competency levels in speaking skills. For this particular skill, School #2 students' assessment data is not included because the school served as a pilot school for testing the baseline assessment tools. The tool and rubrics were then changed for School #1 and School #3, and a similar tool was used during the endline assessment. As seen in the chart, at the baseline, none of the students in these schools could form contextually relevant sentences and speak in English, but this number rose to 24% at the endline and

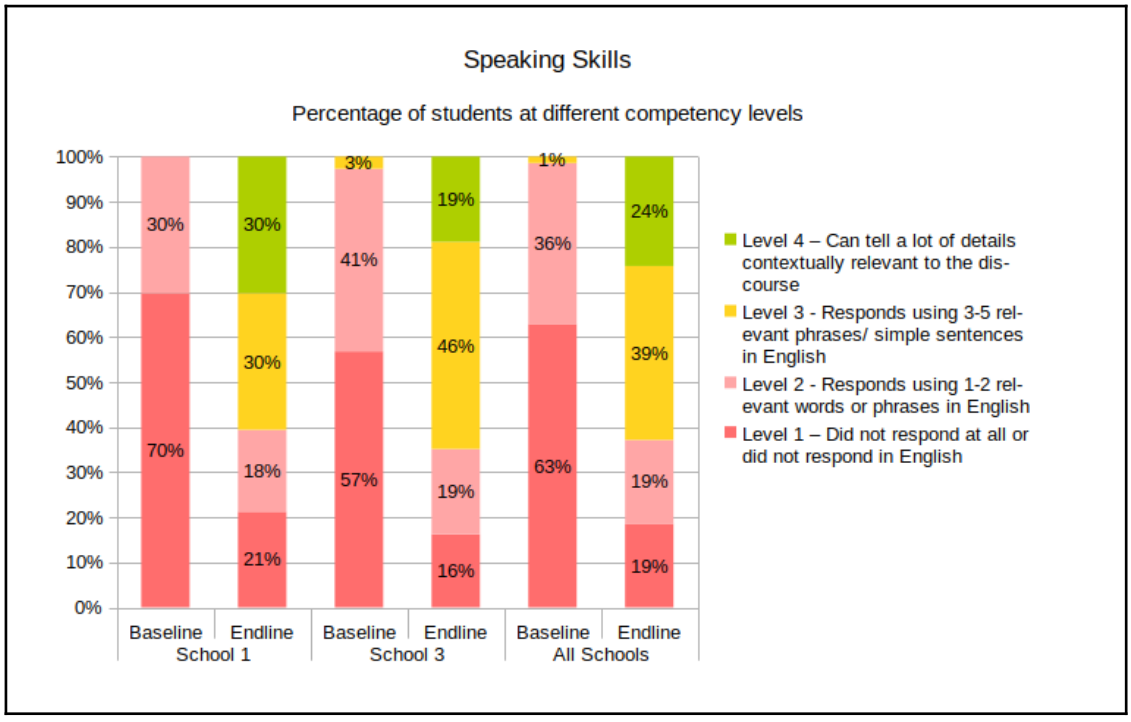
the percentage of students who could respond using phrases/simple sentences in English witnessed a 38% jump.

Figure 17. The percentage of students at different competency levels vis-à-vis listening skills in English during baseline and endline findings



Source: IT for Change

Figure 18. The percentage of students at different competency levels vis-à-vis speaking skills in English during baseline and endline findings

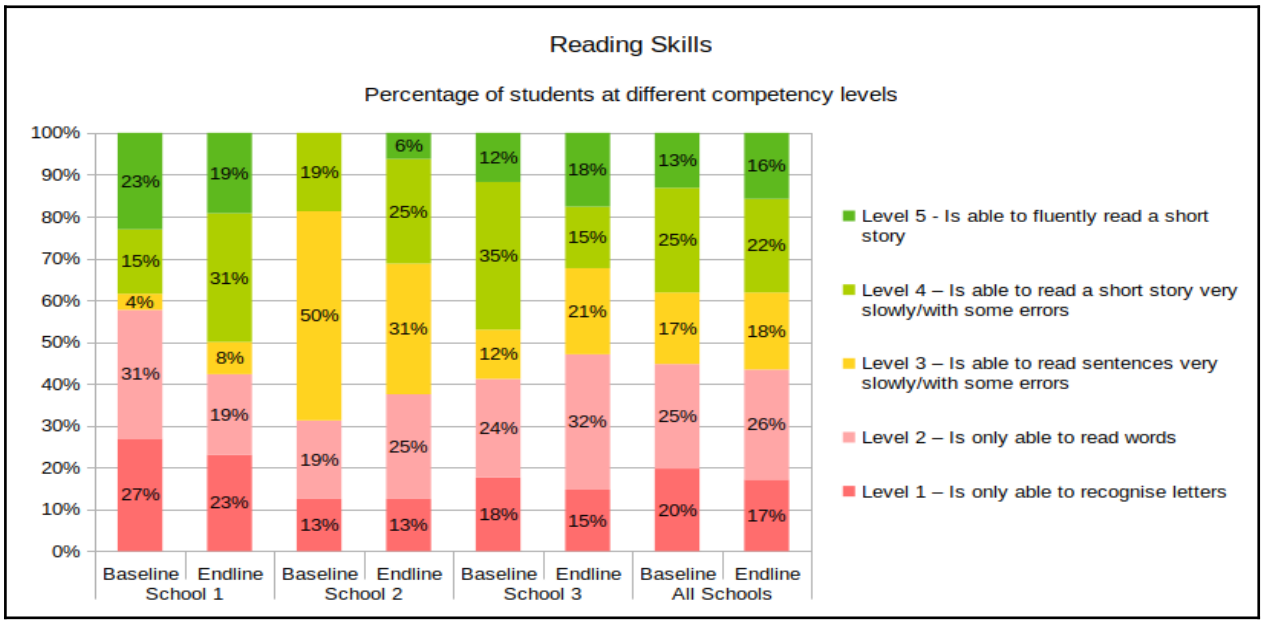


Source: IT for Change

Reading

In the three schools depicted in Figure 19, at the time the baseline study was conducted, 13% of students could read a simple story. This number went up to 16%. The biggest improvement in reading skills was seen in School #1 where the percentage of students at levels 4 and 5 increased from 38% to 50%.

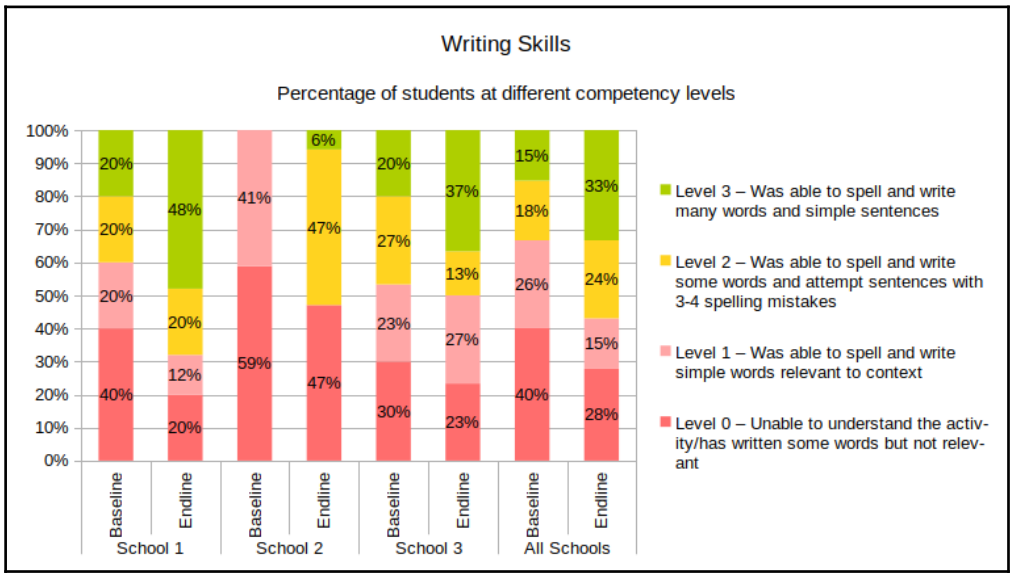
Figure 19. The percentage of students at different competency levels vis-à-vis reading skills in English during baseline and endline findings



Source: IT for Change

Writing

Figure 20. The percentage of students at different competency levels vis-à-vis writing skills in English during baseline and endline findings



Source: IT for Change

In the three schools depicted in Figure 20, at the time the baseline study was conducted, there were 40% students who could not write anything contextually relevant to the activities that were conducted. However, this number declined to 28% and the percentage of students who could write some simple sentences (levels 2 and 3) rose to 57% during the endline study.

6. Stakeholder Reflections and Feedback on the Project

6.1 Students' reflections on the classroom sessions

In this project, analyzing feedback was key to enhancing the teaching-learning experience. Students were requested to share their thoughts on the sessions conducted. Of the 153 students who we engaged with on a regular basis, 62 children shared their views on the sessions. They were given the choice of speaking to the facilitators or sharing feedback in writing. Their responses were then consolidated.

Mathematics

Of all the mathematics sessions, most children (34%) liked the sessions on multiplication and 18% liked the FLU model as they were able to understand 'place value' while solving problems. Students practiced on both paper and computers using TuxMath, GCompris, and PheT simulations. As most of the sessions were conducted in small groups, it helped them participate well in activities and allowed facilitators and teachers to focus on the individual learning of the students.

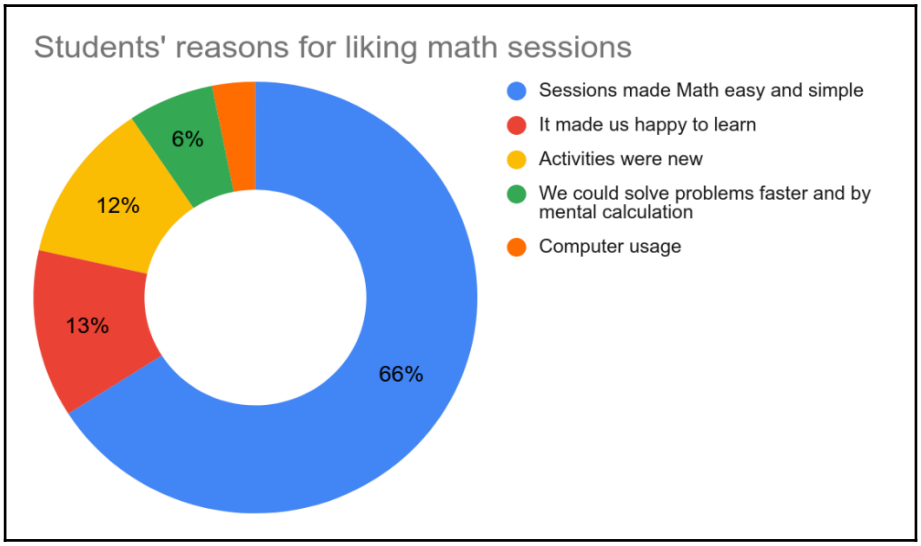
Table 3. Popularity of the various mathematics sessions among the students

Sessions liked by students	Percentage
Multiplication	34%
All sessions	18%
FLU	18%
Using computers to learn mathematics	11%
Math games (complements, book cricket, etc.)	6%
Addition and subtraction	5%
Area model	5%
Skit	3%
Total	**100%**

Source: IT for Change

When asked why they liked the mathematics sessions, about 66% of students said it was because the sessions made mathematics easy and simple. Many students also said that the activities were new, and it made them happy to learn. There were few games related to foundational numeracy which helped students practice quick mental calculations and also enhanced their critical thinking abilities.

Figure 21. Students' reasons for liking mathematics sessions



Source: IT for Change

"*Gunaakaara matte maggi hosa method alli helikottidu tumba use agide*" (It was very useful to learn multiplication and tables in new method), was what many students said because it helped them to comprehend the meaning of multiplication as groups of objects to find the product of any single digit number. Multiplication of two or more digits using the regular method taught to them in school was a challenge for them, but after being introduced to the 'area model' they said they were able to learn in a very simple and interesting way.

"*Modalu namage mathematics astondu barthirlilla, nivu bandmele naanu lekka madodu kalithe*" ("Earlier I didn't know much mathematics, but after your sessions I have learned to solve problems"), many students said adding that they no longer fear the subject.

Language

Almost all the children enjoyed listening to stories and were familiar with narrative conventions as evidenced by the data in the table. Stories provided an ideal introduction to multilingual approaches based on the students' linguistic backgrounds. Most of the students liked the small group activities such as (body parts game, model for sticking body parts, introducing yourself by passing the parcel, skit, poster-making, etc.) This is what some of the students had to say about the activities.

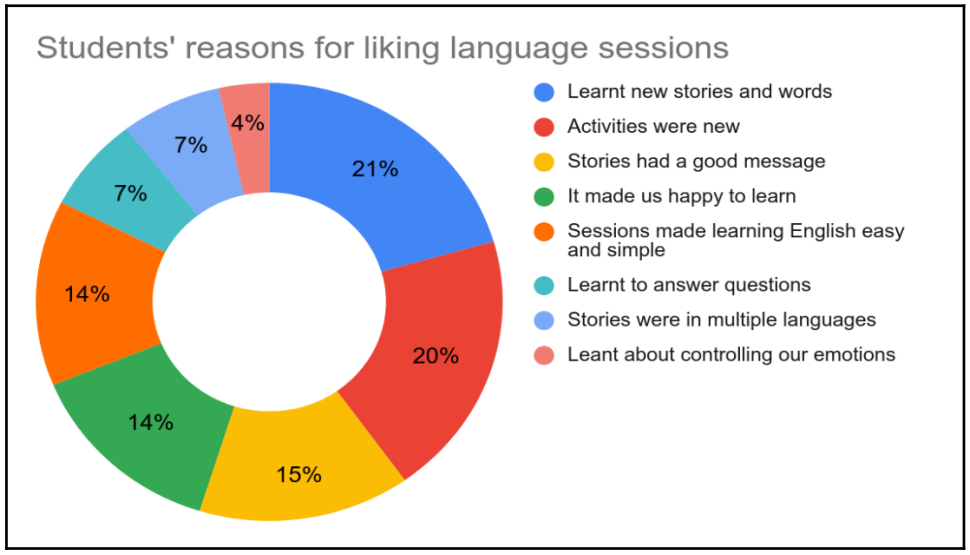
Table 4. Popularity of the various language-related sessions among the students

Sessions liked by students	Percentage
Listening to and reading stories	74%
All language sessions	11%
Session on SEL	4%
Body parts dance and game	2%
Introducing yourself	2%
Session on classroom rules	2%
Skit	2%
Total	**100%**

Source: IT for Change

"*Nanage acting madodu andre tumba ista, nivu classroom alli acting/skit madsiddu nanage tuma khushi aythu*" (I love acting a lot and I was so happy when you acted/conducted a skit in the classroom), one student said adding that it helped them comprehend stories better.

Figure 22. Students' reasons for liking language sessions



Source: IT for Change

Talking about introducing themselves through a game, another student remarked, "*naavu namma bagge share madkobahudu namage yen ista yen ista illa anta helbahudu matte bere avara bagge innu hechu tilkobahudu*" (through such activities, we can share things about ourselves, including our likes and dislikes, while simultaneously learning about others).

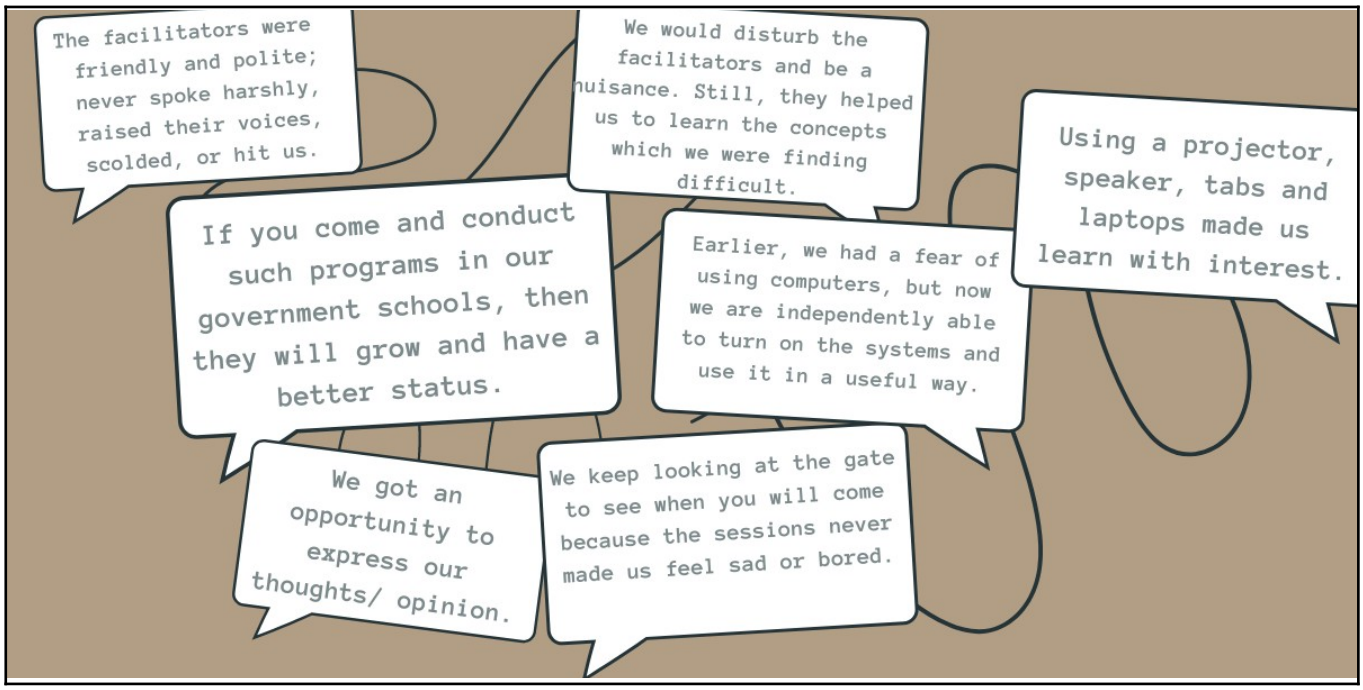
These activities helped students to participate effectively as a group and learn in a collaborative way. It also resulted in greater knowledge acquisition, retention of material, development of problem-solving and reasoning abilities, and communication skills.

Many of the students who migrated from other schools or even other states, had a very low exposure to English. The multilingual approach that was used in the sessions was especially appreciated by these students. They said, "*Yella kathegalannu bere bere bashay yalli torisiddu, mattu kelavomma niva aa katheyannu bera basheyalli heliddu adu tumabane upayogavagidde yekendare navu bera bera basheyalli artha madikondvi, matte bera bashe kaliyalu protsaha needidira*" (All the stories were shown or explained in different languages and this helped us understand better. It was very helpful as it encouraged us to learn another language). Some students even felt comfortable enough to express this to facilitators in their mother tongue (e.g., Hindi, Telugu, Tamil, or Urdu).

In the DL sessions, the Language Lab was implemented in three schools. Students had the opportunity to listen to stories, read them, and then complete related activities on computers in their school computer lab. Students shared that they enjoyed listening to and reading all the stories and answering the questions provided in the different activities.

Overall feedback

Figure 23. Overall feedback from students



Source: IT for Change

Most of the students wanted such activities to continue through the next academic year as they found them to be very useful. Students were also asked about what they did not like about the sessions. A smaller number of students responded to this question as many

perhaps hesitated to give what they thought was ‘negative’ feedback. Of those who responded, some said they did not like doing multiplication in mathematics and others named particular English stories that they did not like, because they had some unfamiliar words.

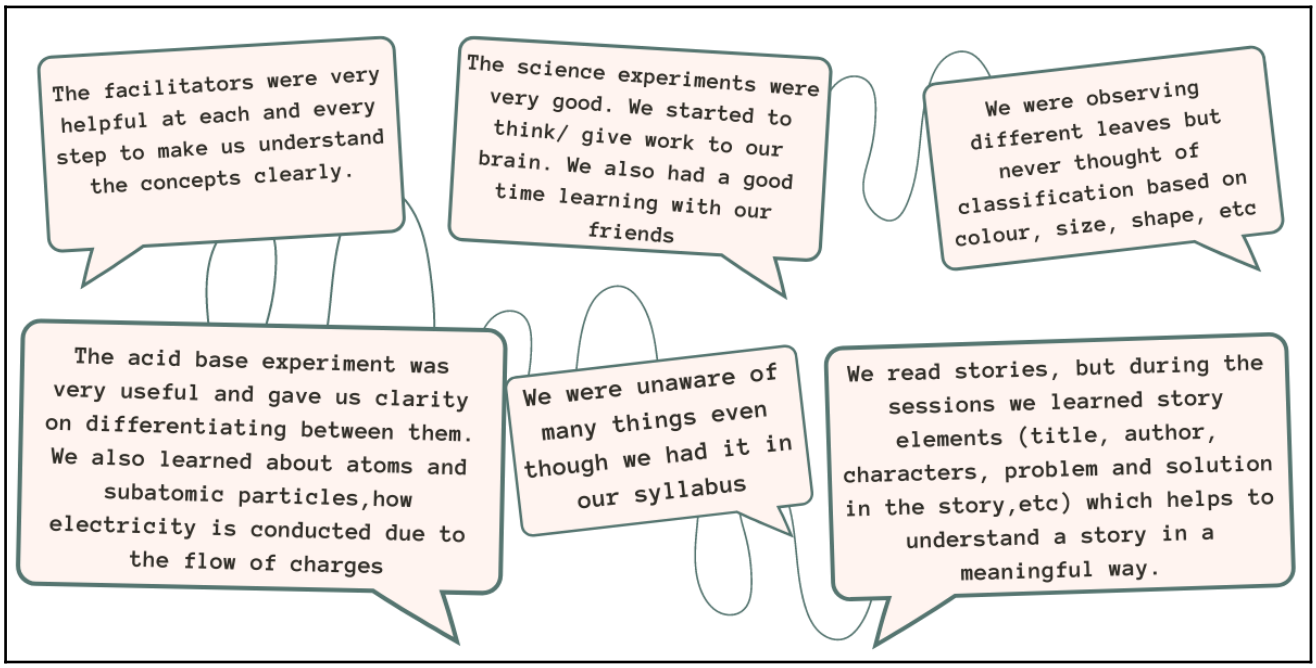
When asked about the new things they had learnt, most students said that they learnt mathematics and English in an easier way and learnt how to use computers. Meanwhile, others highlighted how they learnt to work together and participate in group activities.

6.2 Students’ reflections on event-based engagements

The event-based camp activities were designed in such a way so as to facilitate all students’ learning and help them foster a scientific mindset. Scientific ideas were explicitly taught. Almost all students were given a chance to investigate and learn by taking part in activities (experiential learning). Students enthusiastically participated in every task and shared their thoughts on the camp.

When the camp activities started, most of the students felt that “*yaro bartidare yeno madtare*” (someone's coming to do something) but once the ice breaker activities were initiated, they felt relieved thinking “*evattu namage pata yenu iralla yeno activity games tara madtaray*” (today, we don't have any lessons, we have some activity-based learning). They felt it was a good time for them to enjoy and learn, and it was interesting to get additional information. Their direct quotes can be found in the picture below.

Figure 24. What students had to say regarding the project



Source: IT for Change

6.3 Teachers' feedback

On the whole, teachers faced many challenges during the academic year because children were returning from a two-year break caused due to the pandemic. At the start of the year, teachers noticed that students had forgotten a lot of concepts, including the basics, and many had behavioral issues as they did not speak up in class, could not concentrate, and their attention spans had reduced very significantly. In the aftermath of the pandemic, such signs were widely reported from teachers across the country.

At the end of the year, when we asked teachers about their views on student participation and the changes that they had observed, most of them said that they had seen an improvement in students' confidence, and that they had overcome their hesitation to participate in the classroom. According to the teachers, students' language proficiency also improved and they liked to participate in hands-on activities. The challenges that some teachers had was with regards to difficulty among students to read and write, and students not turning in their assignments.

Table 5. Teachers' feedback about the sessions

What teachers liked about the sessions	Percentage
Approach used for teaching	25%
Improved computer skills of children	25%
Sessions focused on mathematics competencies	17%
Individual attention given to each child	17%
Love and care demonstrated towards children	8%
Digital storytelling	8%

Source: IT for Change

It was challenging to involve the teachers completely during all sessions because of various reasons such as their need to attend to administrative tasks, engage other classes due to shortage of teaching staff, and go on leave. In spite of these difficulties, some teachers who participated in the sessions tried to implement similar strategies and shared positive feedback, as it had a good impact on students' ability to use and work on computers independently. The fact that the sessions benefitted not just the students but teachers as well is important to note. However, the teachers expressed their desire for our continued engagement with the school with the following suggestions/recommendations:

1. Supporting teachers more actively in their classroom sessions and lesson planning
2. Extending the scope of work to lower grades
3. Focusing on other subjects like social studies and Kannada
4. Activities aligned with textbook/syllabus
5. Orientation sessions for teachers on DL

During the DL workshop in two schools, teachers found FOSS tools useful. They showed their excitement about working with multiple languages by typing in text documents, and enjoyed switching between languages with just a few clicks. Given that most teachers rely on the computers provided by schools, they expressed a strong desire to learn basic computer operations such as transferring files from a mobile phone to a computer, connecting peripherals, and surfing the internet. Finally, teachers requested regular workshops to improve their DL, recognizing that continuous engagement would make their learning process more effective, through appropriate technology integration.

Figure 25. Students taking part in one of the science events organized as part of the TIIE project

Source: IT for Change

During cluster meetings, teachers were happy accessing Language Lab resources through the Kiwix application on mobile phones as it obviated the need for a laptop or computer. They shared positive feedback about Language Lab resources as they helped develop foundational literacy and also address multilingual problems. Teachers also appreciated the lab as it provided an opportunity for independent learning, vocabulary development, sentence formation and structure, letter identification, improve speaking and writing skills, expression, etc. The fact that there was no one to judge or correct children, and the

opportunity to attend to the same task multiple times to correct mistakes, helped children develop confidence, teachers said. They also suggested including resources that are applicable for primary-level school children, requested for basic DL training for them, and also wished that the lab included stories connected to *Kalika Chetarike* content.

With respect to the event-based camps conducted in four schools, teachers felt that the activities and experiments helped children to recollect or recapitulate the concepts that they forgot during the pandemic. Helping children understand the ways of conducting experiments using locally available materials was useful in developing their critical thinking skills. Students enjoyed the activities planned for the event, especially the use of technology in some concepts, like the connection of an electric circuit that allowed students to use tabs, and other hands-on activities such as the acid-base test and the functioning of the digestive system. Few students who were absent-minded in class participated actively in camp activities and shared their opinions. Many teachers also requested that the event be extended for another two days.

6.4 Headmistresses' feedback

Interactions with headmistresses of these schools revealed that the sessions had a positive impact on children's behavior as they could see that some of the behavioral challenges which were observed immediately after Covid-19 seemed to have reduced. They were also of the opinion that children need to get inputs on subjects like science, social science, and Kannada to improve their performance. According to them, the DL sessions helped children to use and work on computers confidently. Most of the headmistresses also stressed on the need for building teachers' capacities on DL.

7. Analysis (ITfC's Perspective)

7.1 Classroom and students

Regular classroom interactions with students in all schools revealed that most of them could not concentrate or stay engaged in an activity. Some behavioral issues noticed included fighting, hitting, bullying, and the use of foul language. There were also issues such as inhibition amongst girls and boys to talk or sit with each other, exclusion in the classroom based on language spoken/understood, and persistent bullying or teasing of few children, seen as academically 'weak'. Various strategies, like splitting students into groups to reduce distractions and channelize their energy towards activities, open discussions on the need to devote energies towards studies, respecting others, and treating girls and boys as equals, were integrated with the planned activities in our sessions.

As substantiated in Section 6.1.1., students across grades and schools showed positive improvements in all the three mathematics competencies that were focused on during the intervention. During the baseline, about 70% of the students were already in a position where they could solve addition problems, and while most of them could solve problems with carry-over as well, some of them could only do basic addition with smaller numbers. While very large improvements couldn't be seen in the levels of addition, improvements could be observed in students' understanding of the place value concept during our endline interactions; they could better explain what carry-over meant and how it worked.

Although the data for School #2 shows no change in the figures acquired during the endline, it must be noted that the small sample size (~15) of this school may have influenced the numbers. School #4 showed the maximum change vis-à-vis levels of understanding among students, with significant numbers shifting from levels 1 and 2 to level 3. This was the only school where the sessions in the last two months focused specifically on using digital technology tools for practicing number operations. This, along with the efforts of the teachers in building students' numeracy skills may have contributed to the learning improvements.

Subtraction was one of the skills that students were struggling with the most at the start of the year. Several misconceptions held by the students were observed, with the following being some of the most common ones:

1. Subtracting the smaller digit from the larger one irrespective of the place value or whether the number is part of the minuend or subtrahend.
2. Writing zero as the answer when a smaller digit is encountered in the minuend as compared to the subtrahend in a particular position.
3. Incrementing the digit by one or just appending a zero when 'borrowing' rather than a10.

From the endline findings and the observations made during the sessions, there's been an evident improvement in students' understanding, along with the resolution of these misconceptions. During the sessions, there was more emphasis given on helping students understand 'why' regrouping was necessary. In the FLU model, units, tens and hundreds, can be 'put together' and 'broken apart' similar to how it is done in the case of money. When only numerals are used with the standard algorithm, many could not comprehend that the 'borrowing' actually meant the breaking up of a higher unit into lower units to perform the operation. When students could understand the FLU model and practice with it, many of them were able to apply the logic to the standard algorithm and solve correctly, while some of them also preferred solving with the FLU model as compared to the standard algorithm.

At the start of the continuous engagement with students, class participation was low but over a period of time this increased, and we noticed students reflecting more and working together. Students started participating in activities with a great desire to complete the challenge at hand. The use of a multilingual approach provided the opportunity for students from diverse linguistic backgrounds to participate in sessions. Since the sessions were conducted in different languages and students were encouraged to respond in their native language, they felt that their identity and knowledge was valued. This encouraged them to communicate more. Initially, students had a kind of phobia towards English. To address this, instructions were repeated multiple times slowly, and also in different languages with English words interspersed. Due to this, students were motivated to try and attempt to speak in English. Such continuous interactions helped students learn to speak simple sentences in English.

The Language Lab organized in the school computer lab consisted of stories in different languages along with some activities. Students were very involved as they enjoyed listening to the stories, after which they would try to read it themselves. In one of the schools, apart from learning to speak and read English, there was a focus on SEL as we felt a dire need for it. We found that the students who were struggling with emotional and behavioral issues, found it very difficult to learn a subject or acquire any skills. Some students appeared to be very hyperactive, some extremely shy and timid, and some would be verbally and physically abusive towards their classmates. We tried to address this during the sessions and found that after a few sessions students started to acknowledge their emotions and started to manage them better. They could recognize the impact that their actions had on others and the emotions that are triggered by them. Although we were only able to focus on SEL in one of the schools, we felt the need for socio-emotional support to all students and for work on mental health and wellbeing in all the schools that we engaged with. In our view, giving students a space to share, empowering them, and helping them deal and cope with their emotions is key to them being open to any kind of learning.

Even though the children slowly began to overcome their inhibitions and participate in activities in a mutually respectful manner, sustained improvement requires adequate opportunities for them to perceive inclusion within their school environment. For this to happen, the school should work to implement inclusiveness in its culture and practices.

7.2 Teachers and the school

Periodic observations of the classroom environment and general interaction with teachers suggests that the latter are not meaningfully aware of IE practices. They consider addressing the needs of students with learning difficulties as beyond the limit of their resources and practices.

Equipping the teachers to take an inclusive approach in the classroom with a thorough understanding of UDL principles and collaborating with peers in developing lesson plans, co-teaching, and sharing resources would be extremely useful. For this to be internalized a serious and longer-term TPD program is necessary.

One important issue that surfaced during our discussion with teachers was that they were being pulled into various administrative tasks during teaching hours, due to inadequate administrative staff. Also, in one of the schools there was a shortage of teachers. The recruitment process appears to be slow, and its unpredictability can seriously hinder teaching-learning process.

All five schools had decent infrastructure, except one, where there was no playground. One of the schools operated in a very small and noisy space, due to which we could not continue our engagement. The schools did not have adequate drinking water and toilet facilities. There was an existing computer lab in four of the five schools (IT for Change set up the Language Labs in three schools). The presence of working ICT labs in the schools helped children to use computers effectively and enhance their digital skills.

In two schools, the classroom size was so small that there was no scope for moving around the benches or change the seating arrangement. This hindered diverse types of classroom transactions. Furthermore, specific requirements of inclusiveness such as ramps were not specifically observed.

In general, the availability of resources in schools was inadequate to teach children with learning difficulties. Hence, there is a strong need for bringing about inclusiveness within the school infrastructure which can impact the understanding of inclusion within the school system. School as a system should promote a culture of inclusion both in and out of the classroom. This culture should encourage and persuade teachers to use inclusive strategies. An inclusive school culture requires a shift in the attitudes of all stakeholders, as well as the development of practices that reinforce inclusive behavior.

Some caselets were also developed to illustrate how inclusion can be practiced in the classroom, its impact on students as a diverse group, and individual interventions for students with special educational needs. These also include instances of teacher engagement and agency. The caselets can be found here.

7.3 Community

Measures such as understanding students and their families, communication with the parents about their child, involving parents and families in school activities, and allowing

the families/parents to share their ideas will aid in developing an inclusive environment, though there are associated challenges. According to a few parents, their children enjoy extracurricular activities but are not interested in academic activities. Meanwhile, a few other parents shared instances of how their children enjoy going to school and consider themselves in a social environment, which may not be available at their houses. Some children have single parents who struggle to keep track of their academic progress, in addition to their other responsibilities, including overcoming financial burdens. In such cases, the single parent (almost, always the mother) finds it difficult to provide their children with basic necessities such as clothing, school supplies, and also food in some cases.

It was challenging to get parents to attend regular parent-teacher meetings because most of the parents were daily wage workers and could not afford to miss their work. That it is important to know about their ward’s progress in school was perhaps not internalized among many of them and our reminders on this count did not work because their priority was to earn enough to meet their families’ basic needs. For this reason, a majority of parents stated that meeting times were inconvenient, that they received short notice about the meeting schedule, the meeting purpose was not properly communicated to them, teachers were preoccupied with other administrative tasks or engaged in class and that they did not have enough time to converse with parents. Based on our interactions with the parents we felt that the School Developing and Monitoring Committee is not actively working in schools.

7.4 Interaction with parents of CWSN

Parents (who almost always come from socio-economically marginalized sections of society) may not have adequate understanding about CWSN and how and where to seek help in such instances. Some parents cannot even dedicate a day for their children due to their need to work for their daily wage. Migration from one location to another, the family's economic situation, their beliefs, and their lack of education all play a significant role in parents feeling helpless. This makes it difficult for them to stand up and demand their rights.

Even though parents were initially reluctant to bring their children to the hospital, their perspectives changed slightly after our interactions. Furthermore, after continuous engagement with doctors at NIMHANS, parents became more aware of their child's learning difficulties. They also learnt about government policies and facilities available for children with disabilities. There was a shift in parents’ understanding about their child's future. They gained the confidence to visit hospitals on their own and started informing us of their visits. One of the parents decided to enroll her daughter into a special school when she realized that most ordinary schools won’t be equipped to teach students with learning difficulties. This indicates that if there is a serious effort to engage with parents

of CWSN and raise awareness, such parents would be willing to make efforts to seek medical and other types of assistance for their children.

7.5 Education system

The government education department has made provisions to provide resource support in terms of trained personnel, educational materials, equipment (aids and appliances), and monitoring of learning outcomes of CWSN as is mentioned in state policy. This is done through DIETs at the district level, through BRCs at the block level, through CRCs at the cluster level, and through BIERTs at the school level.

In Bangalore South-3 block, there are only four BIERTs for 145 primary and 46 high schools. They have undergone training regarding learning disabilities, hearing and visual impairments, and mental retardation. During our interactions with them, aspects related to their roles and responsibilities; facilities, aids and schemes available to CWSN; and the efforts undertaken by the department to sensitize teachers, parents, and other stakeholders were discussed.

When asked about the training awareness sessions conducted by the department for teachers, we were informed that the training had been covered for all teachers and that the sessions were held over the course of a month which included different experts being invited to interact with the teachers and brainstorming sessions. However, it was more of a generic sensitization training about the types of disabilities of CWSN, and the need and importance of ensuring that they are not excluded from the education system. It did not include pedagogical design aspects like signs and symptoms that teachers should look out for to identify learning disabilities, strategies that they can use to teach students with learning disabilities. Also, the training sessions were done pre-Covid in 2019 and weren’t conducted after the schools reopened. A refresher session would have been more useful and relevant, given the severe impact that the lockdowns and school closures have had on children.

The Draft Policy on Education of Children with Special Needs by the Department of Education, Karnataka, mentions, “State shall support professional development of teachers and other support staff in pre-service and in-service training programs. It shall be mandatory to incorporate inclusive education both in theory and practice with adequate weightage. Special orientation for resource personnel and managing staff (DIET/BEO/HM /CRC/BRC/ IERTs) shall be organized for capacity building.” However, this does not seem to have been implemented on the ground. From our interactions with the BIERTs, it seemed that they are primarily focused on identifying children with severe physical and cognitive disabilities, and tracking and updating their details on the Student Achievement Tracking System. In obtaining UDIDs as well, the focus seems to be only on these children and not on those who have mild to moderate disabilities. Their understanding and perspectives on the educational needs of CWSN also seemed to be

limited to ensuring that the child knows the basics of self-care like eating, bathing, and brushing, and did not consider academic studies as a necessity for them. There appears to be a general lack of understanding about learning disabilities and the need for IE. The preoccupation with administrative tasks like data collection and maintenance, coordination with public health systems to obtain UDIDs, distribution of physical aids, etc., along with the lack of interest and capability of the BIERTs to delve deeper into the kinds of academic support that can be offered to the teachers and children, seems to be hindering CWSN from getting the education they deserve.

At the CRP/BRPS/BIERTs workshop, all participants engaged actively and mentioned that it was their first technology-related workshop. They requested that similar workshops be organized regularly. During the workshop, the need to focus on IE and observations and findings from the baseline were shared. Participants shared their observations of issues faced by students after the pandemic. Additionally, all participants expressed their desire to explore various methods and tools for data collection, as well as an interest in exploring office-suite tools for data analysis in the upcoming workshops. It was also noted that some of the CRPs were interested in establishing a computer lab at the cluster level. This would allow them to organize similar workshops for teachers in their clusters, providing them with access to technology and opportunities for professional development.

7.6 Public health system

In Bengaluru’s South-3 block, nearly 347 CWSN students were split into three groups: those who were homeschooled, those who were prepared for school, and those who went to school but had certain disabilities that were listed by the department. About 50 students from the block’s higher primary and high schools were experiencing learning difficulties. The government schedules bi-weekly psychotherapy sessions for severely disabled CWSN students (those unable to attend school). For those with UDID, it also offers MR kits and scholarships. Additionally, some public hospitals, including Victoria, Sanjay Gandhi, and NIMHANS diagnose children with learning difficulties.

During the project, few students appeared to be struggling academically in the intervention schools. We took three such children to the Department of Child and Adolescent Psychiatry at NIMHANS, where they underwent thorough clinical evaluations. During counselling, the clinical therapist asked the parents about their child’s developmental milestones, birth details, and other relevant information. However, parents were often unaware of such important information about their child, and were unable to respond to these questions. Second, the majority of therapists speak English, making it challenging for parents to understand. For detailed counselling, each parent was required to spend three-four days for follow-up with a psychiatrist for their child, which was quite difficult for them as most of them were daily-wage workers. If the doctors identify any serious issue with the child, they prescribe medication. However, some systemic

challenges, such as unexpected delays, redundant and repeated processes, and a lack of clarity among doctors and officials on the requirements and defined procedure, are preventing children with learning difficulties from getting the appropriate diagnosis and support. They also do not diagnose children who have migrated from other states as they don’t have an Aadhaar card issued in Karnataka.

Thus, though the schools in the block are fortunate that a national institution like NIMHANS is located there, it is a herculean process to actually get children diagnosed and treated.

8. Recommendations

8.1 Schools and teachers

Teacher Professional Development

A TPD program focusing on building the capacities of teachers to enable IE in schools is an urgent requirement. A similar program for teacher-educators such as DIETs, BRCs, and CRCs to enable them to support, mentor, and guide teachers and schools is equally needed. The program must include:

1. An understanding of the broader philosophy of inclusion – diverse learning needs and possibilities in the classroom – as the basis for pedagogical strategies. Homogenous learning environments do not exist. The shift in thinking and education practices from segregation to integration, and now, inclusion, is essential for teachers to internalize and actualize.
2. Awareness building, sensitizing, and enabling teachers to recognize signs and symptoms of learning difficulties in students. A larger and wider accommodation of learning needs will enrich the learning environment and foster inclusion.
3. Conducting assessments to understand students' learning needs and contextualizing resources, approaches, and strategies that accommodate multilevel and multilingual teaching-learning using the UDL framework.
4. Promoting teacher autonomy to allow for flexibility in determining timetables based on school and classroom contexts.
5. Supporting migrant children's learning, including being familiar with issues, and being sensitive to and accepting of the child's native language.
6. Building professional learning communities of teachers trained for IE. This would ensure peer collaboration on academic issues, reviews of children to support their development, sharing of good practices (resources and activities), and seeking help to address challenges, etc., among teachers in order to connect theory and

practice on an ongoing basis. The ideas and resources shared in these communities can be made available on the state resource repository.

Teacher-parent bonding

Building a relationship with parents is necessary to help student learning. Parent-teacher meetings should be organized regularly, in a decentralized/autonomous manner, and used as an opportunity to discuss each child’s progress, strengths, and areas of concern, as well as get insights about the child’s personal life which may be affecting their learning. The focus must include the child's learning status and trajectory, and not be limited to overall discussions on schools’ infrastructure or the general learning status of children. It is essential that these interactions be based on mutual respect, viewing the parent as a co-owner of the school, rather than as a beneficiary.

8.2 Education department

Academic support

1. Capacity-building programs for all teachers and teacher-educators (BIERTs, BRPs, and CRPs) should include the need and importance of IE as a key component. Training should also include guidelines on how to support children with learning difficulties and help them avail the facilities available.
2. BRPs, CRPs, and BIERTs should be trained to offer more meaningful academic support to teachers in addition to providing administrative support.
3. Resources to support IE should be made available at the cluster level so that teachers can easily access and use them. A small computer lab (with two-five computers with internet connectivity) should be set up in each CRC, so that the teachers in the cluster can use them for academic and administrative purposes. Small teacher training programs could also be organized at the CRC.

Education administration

1. Infrastructure gaps in schools and teacher vacancies need to be urgently resolved by the administration. The Right to Education (RTE) Act mandates the minimum infrastructure requirements of each school and the administration must ensure to fulfil this through a clear and well-publicized road map. The resource support for this must come from the government, though the administration can always try to tap other sources as well.
2. Orientation/sensitization sessions on the need and importance of IE should be conducted for the administration.
3. The Student Achievement Tracking System for CWSN should include data and information on students with learning disabilities, in addition to that of severe cases of CWSN.

4. The use of digital technologies to eliminate any need for teachers or officials to manually collect, enter, and process data is essential to ensure that teachers focus on academic activities. On the other hand, information collected (such as daily attendance through SATS) must be reviewed promptly considering the extraordinary time costs of teachers across the entire system.

8.3 Policy

Teacher recruitment and deployment

The policy on teacher recruitment must be modified to ensure that schools do not have vacancies. Vacancies are usually created with sufficient notice (vacancy due to retirement is known years in advance, and vacancies due to transfers/deputations are created by the department itself). Keeping teaching positions vacant has grave implications for the effective functioning of schools and hence must be taken extremely seriously.

This means that teacher recruitment must be an annual process (currently, it appears to be quite ad-hoc), and based on a thorough assessment of vacancies due to be filled the next academic year. Usually, government recruitment is complex, as well as time- and resource-intensive, i.e., process re-engineering with optimal use of digital technologies (like for instance as is used for counselling in Engineering or Medical admissions) will help reduce costs and delays.

Good hiring practices require the consideration of staff going on leave, including long leave (sick leave, and maternity/paternity leave) and usually, if there are 10 vacancies, 11 people are hired to ensure that long leaves do not impact students.

The training calendar must also allow for the initial induction, so that teachers are able to report to the school before the academic year commences. The rule allowing teachers to retire at the end of the academic year should be extended to headmistresses also, as their absence is equally or more crippling to a school’s effective functioning. Furthermore, all schools must have administrative support staff (clerical) so that teachers can devote their time to academic activities, rather than filling registers and databases.

School-community relationship

The school-community relationship (building on the teacher-parent relationship) requires much higher investment for it to support the development of children. In the government school context, parents usually are poor, daily wagers, and their wherewithal to participate in school events and activities is limited. Hence, it is necessary that the school administration goes out of its way to accommodate parents and facilitate their participation in school activities. In any good school, parental participation is usually visible and supportive. This is sometimes taken to mean that parental participation is

necessary for a good school, and in its absence, the school will find it difficult to enable inclusive learning. This is true. But it could also be possible that the school could take additional efforts to engage parents, convince them of the school's intent (and ability) to meet their children's holistic development needs, and provide the parents space and time to engage, with mutual respect. With such measures, it is likely that some, if not most, parents will begin to reciprocate and start a virtuous cycle of teacher-parent engagement. This also requires that schools and teachers not look at parents as sources for supporting school infrastructure, but engage them as joint custodians of the school's welfare.

Migrant children

Bengaluru and other urban centers usually witness high migration from other parts of Karnataka and India. A large part of these migrants are poor and vulnerable sections looking for employment. Their children are usually admitted to government schools. These children may have inadequate school time (as per their age) before admission and may not be able to learn at the same level as other students in the same class. They may also only be fluent in their native language, which may be different from the medium of instruction in schools and the languages spoken by other students. To tackle this, teachers must be familiar with multilingual approaches to engage such students and enable their participation in class. The parent engagement in such cases can be more difficult and teachers have to pay additional attention to building a bond with them.

Coordination with other departments

As stated in the education policy, a scientific assessment is necessary to determine the medical requirements of CWSN and prevent children from being mislabeled. Therefore, appropriate measures for health check-ups must be developed in collaboration with the health department. Special check-ups and hospital visits for children facing developmental disabilities, malnutrition, etc., will need to be part of the program of action of the education system.

Though many of the recommended processes are already a part of the rule book, they are not implemented many a times. This may be due to resource persons having heavy workloads, and not being fully aware of the concepts, principles, and methodologies of IE. Overall, the lack of adequate resources hinders officials. Hence, equipping the department with human and financial resources is necessary. Furthermore, it is important to facilitate doctors/medical students visits to schools through school health camps every year.

9. Conclusion

Inclusion is about personalizing education to ensure that every child succeeds, regardless of his/her unique needs, and sometimes, implementing an equity-based mind frame is the best way to guarantee this.

The TIIE pilot project revealed that many children with learning disabilities and difficulties are being excluded in classrooms largely because their unique needs and challenges are not being adequately recognized and understood by teachers, parents, and the education system. Teachers feel unprepared to assist such students, require a deeper understanding of IE, and face paucity of time and resources to innovate in their classrooms. Therefore, they are forced to adopt a one-size-fits-all pedagogy that is determined by the limitations of the prescribed textbook, syllabus, and assessments.

The approaches that were adopted as part of the project such as differentiated instruction and learner-centric pedagogies demonstrated the effectiveness of adopting IE and integrating digital technologies meaningfully. This is evidenced by the increased levels of engagement and development of students over the course of the year. Therefore, it is imperative that approaches aligned with UDL principles are adopted to facilitate the education of students at different levels of understanding. Exposing teachers to technology for accessing resources and approaches, and facilitating their contextualized use are also essential. While policies and practices of IE are often well-defined and comprehensive on paper, there is a serious gap in actualizing them and a lot needs to be done on that front.