



Accessible Digital Textbooks

Creating digital tools to enable universal design
for learning and inclusive education

Paraguay

August 2022

UNICEF OFFICE OF RESEARCH – INNOCENTI

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Requests to utilize larger portions or the full publication should be addressed to the Communications Unit at: researchpublications@unicef.org.

Correspondence should be addressed to:

UNICEF Office of Research – Innocenti

Via degli Alfani, 58

50121 Florence, Italy

Tel: (+39) 055 20 330

Fax: (+39) 055 2033 220

researchpublications@unicef.org

www.unicef-irc.org

@UNICEFInnocenti on Twitter, LinkedIn, Facebook, Instagram and YouTube

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Abbreviations

ADT	Accessible Digital Textbooks for All
ICT	Information and communications technology
MEC	Ministry of Education and Science (Ministerio de Educación y Ciencias)
SENADIS	National Secretariat for the Human Rights of Persons with Disabilities
UDL	Universal design for learning
UNICEF	United Nations Children's Fund

Executive summary

In the Latin America and Caribbean region, more than 19 million children have a disability (UNICEF, 2021). Although school attendance and completion rates have increased steadily over the last 20 years in the region, especially at the primary level, barriers to access quality education are still too high for children and adolescents with disabilities (UNESCO, 2020). In Paraguay, disability is a major factor associated with school-based participation, learning achievement, completion and transitioning to next level. According to the *National Development Plan: Paraguay 2030*, just 57 per cent of the population with disabilities is literate, while the overall literacy rate in Paraguay is 95 per cent. According to the *2018-2023 Education Action Plan*, the Paraguayan education system comprises general, special and other forms of education. Formal education is structured into three levels: early childhood education, primary school education and secondary education. In 2014, there were about 70 special schools and educational centres for people with disabilities in Paraguay. The eradication of special schools in favour of inclusive schools¹ is one of the main objectives of the General Directorate of Inclusive Education that is supporting a transition process from special schools to inclusive services, with the possibility of using past special schools as resource services.

To address the challenge of achieving inclusive education, it is crucial to invest in accessible infrastructure, learning materials in accessible formats, assistive technology, teacher training and data on children with disabilities. The [Accessible Digital Textbooks \(ADT\)](#) initiative aims to enable educators to use the [Universal Design for Learning \(UDL\)](#), an educational framework that recognizes that children learn differently, that they benefit from differentiated learning techniques in the classroom, and that lessons should plan for different learning styles and capabilities in order to include all learners. The objective of the ADT is to integrate accessible textbook content and technology, following the principles of UDL, to ensure that textbooks are accessible to all learners, including those with disabilities and different learning styles so that all learners can access the same content in the same classroom. The technological component enables the textbooks to be made accessible for students who are blind or have low vision, to those who are deaf or hard of hearing, and to those who have intellectual, developmental or learning disabilities, among others.

This report presents the results of testing the ADT prototype in Paraguay. The goal of this research is to test the usability of the ADT prototype and inform the production, distribution, infrastructure, and implementation phases.² The ADT prototype produced in Paraguay was tested in 10 educational centres with a total of 133 students with and without disabilities.³ During the pilot, the ADT prototype was used as a teaching tool by 10 primary school teachers who guided their students through its use in the classroom. Each teacher, together with the students, engaged with the ADT prototype for two sessions over the course of one month.

This research presents the results of the ADT prototype testing in Paraguay in three areas:

- First, it analyses the familiarity and ability of teachers and students to interact with technology, either as an instrument to support inclusive education or to learn.
- Second, it investigates the pedagogical practices used for inclusive education and to integrate the prototype as a tool in the classroom by teachers to support inclusion.
- Third, it presents recommendations for improving the content and interface of the prototype.

This study is part of a longer-term research examining the implementation of the ADT in multiple countries. Future research will explore the impact of the use of the ADT on student learning at larger scale.

1 An education system that includes all students, and welcomes and supports them to learn, whoever they are and whatever their abilities or requirements. This means making sure that teaching and the curriculum, school buildings, classrooms, play areas, transport and toilets are appropriate for all children at all levels. Inclusive education means all children learn together in the same schools (UNICEF, 2017).

2 More details on the ADT phases can be found on the [UNICEF ADT Portal](#).

3 Details on selected schools can be found in Annex 1.

Results

Results from the pilot in Paraguay indicate that the ADT prototype has the potential to improve student motivation, classroom dynamics and the ability of students to interact with each other, appreciating and recognizing the different learning styles. Research results based on classroom observations suggest that the accessibility features incorporated in the prototype are key for the interaction and inclusion of all students in activities, whether or not they have a disability.

After testing in classes, teachers found that the ADT would be very useful in their daily teaching practice. Especially in its ability to make reading more interesting for students, and because of features such as images, the glossary and sign language videos that make teaching engaging for students.

Students were engaged and curious about the ADT and demonstrated spontaneous peer support between children with and without disabilities in using the platform. Students interacted and supported each other to use the ADT in the classroom.

Students with disabilities were observed being active participants in the classroom when using the ADT, raising their hands and commenting. Students responded to questions in different ways, using sign language, orally or by pointing to the prototype images.

The pilot also highlighted the need for a systemic approach so that all factors necessary for successful implementation coexist simultaneously. It is important to note that more research is required to better understand the possible impact on learning and what is required for a full-scale up phase.

Recommendations

Investments need to be made in teacher professional development on key concepts of inclusive education and pedagogy that includes all learning styles. Inclusive education and teacher training on the subject should be seen as an ongoing process that needs to go hand in hand with all dimensions of the education system, from strategy and planning, curriculum, leadership and structure, to learning and assessment processes for children with and without disabilities. Training content needs to be developed and delivered based on local contextual factors and needs.

Teacher training on basic computer topics needs to be accompanied with training on how to incorporate technology in the classroom. Teacher training should also be complemented by support to caregivers and children to acquire basic digital skills before introducing the ADT in classrooms.

To ensure that students and teachers can use the ADT for inclusive education, the government needs to prioritize investments in more curriculum-aligned accessible content, ICT equipment, safe storage of devices and infrastructure according to specific school needs. With regard to content, it is important to include representations of both genders for different roles and a positive image of people with and without disabilities. Schools, for their part, need to take care of monitoring the status of existing equipment and maintain a plan for storing and recharging equipment to ensure it is ready for use at the time of planned activities by children with and without disabilities.

Monitoring and researching the use and usefulness of the content developed and accessibility features of the ADT is important to continue improving the interface and content as the programme scales. Continuing to add inclusive curriculum-aligned content will make the tool more useful for teachers as well as more engaging for students.

1. Introduction

In the Latin America and Caribbean region, more than 19 million children have a disability⁴ (UNICEF, 2021). This number represents 10 per cent of children between the ages of 0 and 17 living in the region. Although school attendance and completion rates have increased steadily over the last 20 years in the region, especially at the primary level, barriers to access quality education are still too high for people with disabilities (UNESCO, 2020).

In Paraguay, disability is a major factor of exclusion from the education system. According to the *National Development Plan: Paraguay 2030*, the illiteracy rate among the population with disabilities is 43 per cent while it is only 5 per cent in the overall population. Many children with disabilities do not attend school. It is estimated that only 36 per cent of children with disabilities between 6 and 18 years of age attend school, and 83 per cent of the population has not completed 6 years of primary education (only 2 per cent have access to higher education).

According to the 2018-2023 Education Action Plan, the Paraguayan education system comprises general, special and other forms of education. The action plan proposed the creation of inclusion support centres through the gradual renovation of special schools. In 2014, there were about 70 special schools and educational centres for students with disabilities in Paraguay. The eradication of special schools in favour of inclusive schools is one of the main objectives of the Directorate of Inclusive Education. On 6 August 2018, the Ministry of Education and Science (MEC) specified that all textbooks that will be purchased must be accessible (UNICEF, 2019b). This decision is in line with the [Marrakesh Treaty](#) commitments (BACCN, 2016), to facilitate access to published works for people who are blind, visually impaired or otherwise print disabled.

Even before COVID-19, Paraguay was already working on a plan to incorporate digital technology as part of the educational system through the Plan Nacional de Educación 2024 and the 2018-2023 Education Action Plan. As in all countries, the pandemic led the education system to reorganize and advanced new policies to support education for all children through remote learning and digital devices. As part of the national strategy (FEEI, 2018), digital devices were distributed to more than 870 educational centres in the country (IP, 2021), schools were connected to the Internet and teacher training programmes were developed to support teachers and school administrators with the use of technology. However, data from the national household survey in Paraguay 2019 ([Encuesta Permanente de Hogar](#)) show that 81 per cent of school-age children and adolescents (from 5 to 17 years of age) did not have an Internet connection at home. Of students enrolled in public school, 92 per cent do not have Internet access at home.

Inclusive education requires that all schools are prepared to welcome children with disabilities and guarantee appropriate inclusive learning opportunities and participation. Schools need to be prepared in terms of infrastructure, accessible learning materials, assistive devices (WHO and UNICEF, 2022), as well as teacher training and support, the curriculum, assessment systems, and supporting and preparing families (IIEP-UNESCO et al., 2021). In Paraguay, a focus of UNICEF is to address the situation of children and adolescents with disabilities by supporting the implementation of the inclusive education model with an emphasis on Universal Design for Learning (UDL) to produce accessible digital textbooks (ADT) and learning materials. Within this focus, the goal of the ADT is to allow children with different learning styles to access the same content, participate in the same textbook-based activities inside and outside the classroom, and have equal opportunities to achieve positive learning outcomes. The technological component enables the textbooks to be made accessible for students who are blind or have low vision, to those who are deaf or hard of hearing, and to those who have intellectual, developmental or learning disabilities, among others.

⁴ Disability is defined as “long-term impairments that affect the functioning of a person and which in interaction with attitudinal and environmental barriers hinder the person’s full and effective participation in society on an equal basis with others” (UNICEF, 2006).

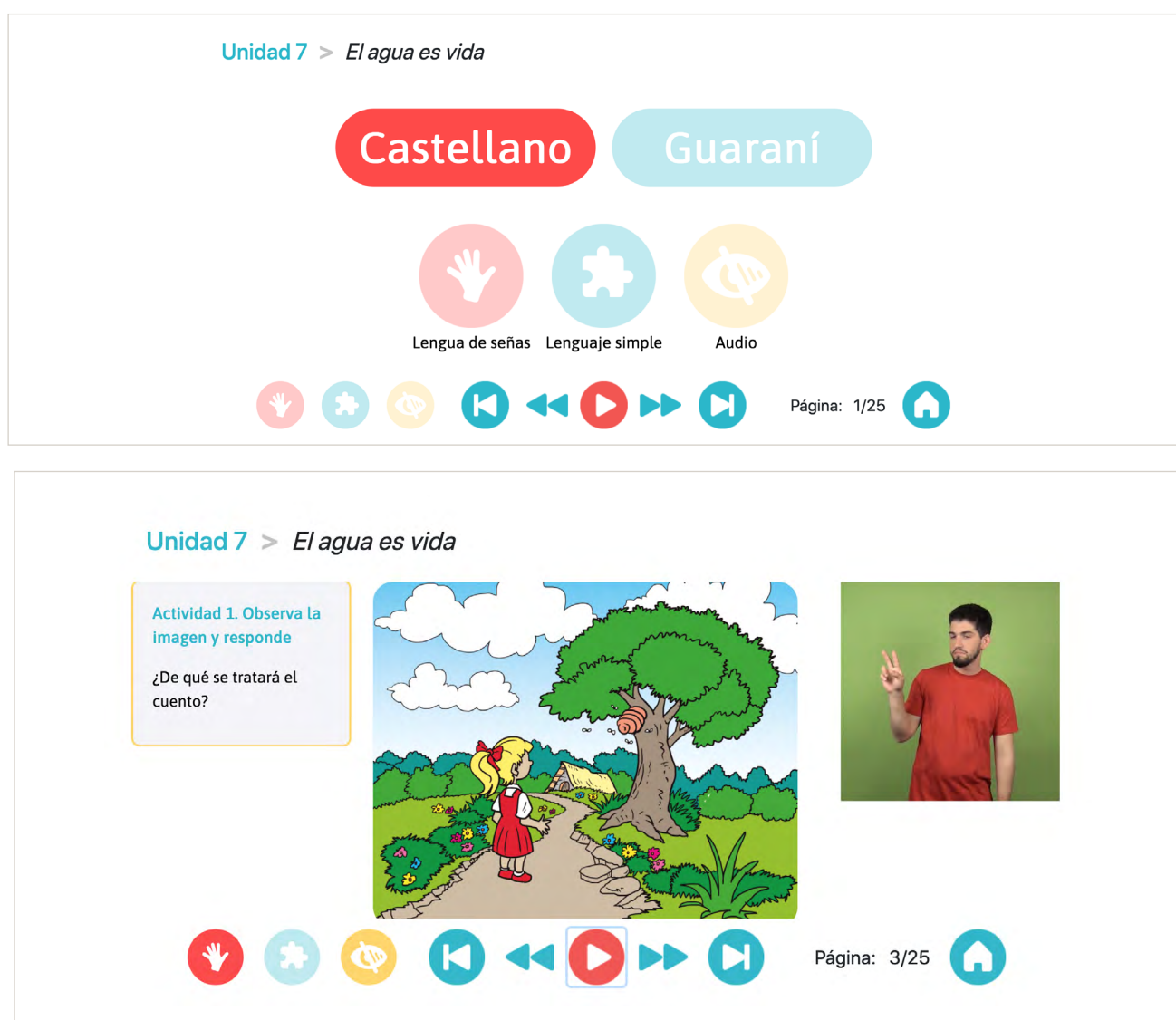
Box 1. What is an accessible digital textbook?

An accessible digital textbook is a tool that follows the UDL principles to allow all students, with and without disabilities, to access information in alternative formats. Accessible digital formats are versatile and allow each user to customize them and combine various functions – be they universal or specific – including narration; interactivity, audio description of images, simplified texts, and other more specific ones such as sign language and other functions that adapt to different preferences, learning styles or access needs.

The ADT project is a culmination of several steps that support an inclusive digital transformation of education and seeks to reach all children with and without disabilities in Paraguay, so that they can learn at the same time as their peers in the format that best suits their needs.

Accessible digital textbooks enable teachers, schools, and other educators to harness the potential of inclusive digital education so that Paraguay can achieve improved learning outcomes and skill development for all, regardless of their learning status or learning style.

Figure 1: Screenshot of the ADT prototype



This report explores the piloting of the ADT project in Paraguay through mixed methods (quantitative and qualitative) research to help inform the MEC through the ongoing development of the ADT programme in Paraguay. Research and documentation to be undertaken during additional stages of the implementation will provide additional evidence for the MEC to use for inclusive education policy development and implementation. In addition, results of this effort in Paraguay are part of a global ADT multi-country initiative in eight countries (Colombia, Dominican Republic, Jamaica, Kenya, Paraguay, Nicaragua, Rwanda and Uruguay).

The main report includes: a brief review of the context and background of the ADT in Paraguay, including the focus, objectives and methodology of this research component; description and results of the multiple components of this pilot; and highlights of the challenges and main lessons learned.

1.1 Context of the pilot

The ADT initiative began in 2014 after several consultations and workshops led by UNICEF with representatives from various countries such as Argentina, Brazil, Paraguay, the United States, India and Kenya. As a result of the consultations, guidelines (UNICEF, 2019a) were developed to support ministries of education, publishers, technology and content developers, teachers and implementers, on how to digitally adapt textbooks based on the principles of UDL. The goal of the guidelines is to identify the intersection between (accessible) technology and content adaptation to support ministries of education, publishers and other stakeholders to pilot and implement the ADT initiative and improve learning outcomes for students regardless of their learning style.

Representatives from the Paraguay National Secretariat for the Human Rights of Persons with Disabilities (SENADIS) and MEC, who participated in these workshops, brought the project proposal to Paraguay. In 2018 and 2019, the MEC together with UNICEF started the process of producing ADT by adapting the content of the first-grade textbook *Leo, Pienso y Aprendo* (Read, Think and Learn). The textbook adaptation was accompanied by training for several actors in the education system on UDL and the production of ADT. Some initial field testing of this first textbook adaptation was conducted in 2019 in three schools (UNICEF, 2029b).

Following the experience of developing the first prototype, the MEC created more titles with accessible features. This resulted in a pilot of the ADT prototype in November and December 2021 in 10 schools to conduct usability testing and collect lessons in order to inform the following implementing phase.



2. Methodology and research objectives

Research methods were co-created by UNICEF and the MEC with the objective of verifying the usability of the ADT in classrooms with primary school teachers to promote more effective inclusion practices for students with and without disabilities.

To understand the use and fit of the ADT prototype, a total of 10 schools located in the Central and Capital departments were selected for the pilot (more information on selected schools can be found in Annex 1). The implementation of the prototype was carried out in 10 groups of first and second grade students. Students group size ranged from 6 to 9, with an average of 7.5 students per teacher. In total 38 girls and 37 boys aged 7 to 9 years participated in the pilot with the facilitation of 10 female teachers (see Annex 2 for more details on the sample of students). Each group of teachers and students used the ADT prototype for two sessions over two to three weeks. The ADT prototype was accessed through computers available at the school facilities.

This research effort explores this testing of the ADT prototype in Paraguay to answer the following questions:

1. How do students and teachers interact with the ADT prototype?
2. How can pedagogical practices with the ADT be improved and teachers supported?
3. What are the key considerations needed to embed the use of the ADT within the Paraguay education system?

To answer these questions, the pilot research process relied on a combination of qualitative and quantitative methods to collect information on the use of the ADT prototype by teachers and students. All instruments were developed, adapted and validated by the technical board of the MEC, UNICEF Paraguay, and the UNICEF Office of Research – Innocenti. The research protocol and all instruments received ethical approval from the Health Media Lab ethics review board (see more information in Annex 3).

The following is a brief description of the techniques and instruments used in this research:

- **A pre- and post-teacher training survey** was conducted to learn about teachers' familiarity with technology, experience with inclusive education, and perception of technology-enhanced education, and to gather their feedback on the training.
- **Focus group discussions** were conducted before and after the ADT pilot with students of similar age and grade, in each of the 10 schools that took part in the pilot. In the pre-implementation focus groups, familiarity with and use of electronic devices in learning was the main focus. In the focus groups after the pilot, feedback was gathered on the use of the ADT prototype in the classroom, challenges and opportunities.
- **Direct classroom observations** were conducted to gain insight into classroom dynamics and implementation during the use of the ADT prototype. Observations covered the interactions between students and teachers, students' verbal and non-verbal expressions, the time teachers devoted to learning with the use of the prototype, and the quality of teaching practices to develop students' skills in an inclusive manner.
- **Semi-structured interviews** with teachers were conducted at the end of the pilot to learn about teachers' familiarity with the digital equipment and access to technology. They also enabled the researchers to gain feedback and comments on teacher training, use of the prototype in the classroom, useful aspects of the prototype content, possible improvements to the prototype, and perceived impact on learning with the use of the prototype, as well as the prospect of sustainability and scaling up.

Figure 2: Information by type of instrument

SURVEYS

25 pre- and post-training surveys



FOCUS GROUPS

19 focus groups in **10** schools



CLASSROOM OBSERVATIONS

14 classes observed



SEMI-STRUCTURED INTERVIEWS

10 teacher interviews



Focus groups and observations were conducted and transcribed by UNICEF Paraguay consultants between November and December 2021. Surveys and interviews were conducted in digital format, using KoboToolBox, a digital platform for data collection. Qualitative and quantitative data were triangulated from the various sources to validate findings and ensure that lessons learned included different dimensions. To code, organize and analyse the data collected, a thematic content analysis was performed (see Annex 4 for detail on ethical procedures).

3. Preparation for the ADT prototype testing

The transition from a system of special education where specialized teachers provide support to students with disabilities in segregated schools or classes to an inclusive education system where students with disabilities are included with their peers requires a shift in the practice of all teachers and other school staff (including directors and support personnel).

The UDL framework recognizes that all children learn differently and benefit from differentiated learning techniques in the classroom. The ADT initiative, using technology to present content in various accessible formats, can be a powerful tool for applying UDL principles in a classroom as it allows students to learn through content presented in different ways. Teachers are the centre of students' learning. They must consider how and in what formats classroom content is presented, how to keep students motivated and assess the most appropriate way for them to demonstrate their learning. Paramount to this shift is that teachers have the tools to carry out inclusive education and to support children with diverse types of learning styles and needs.

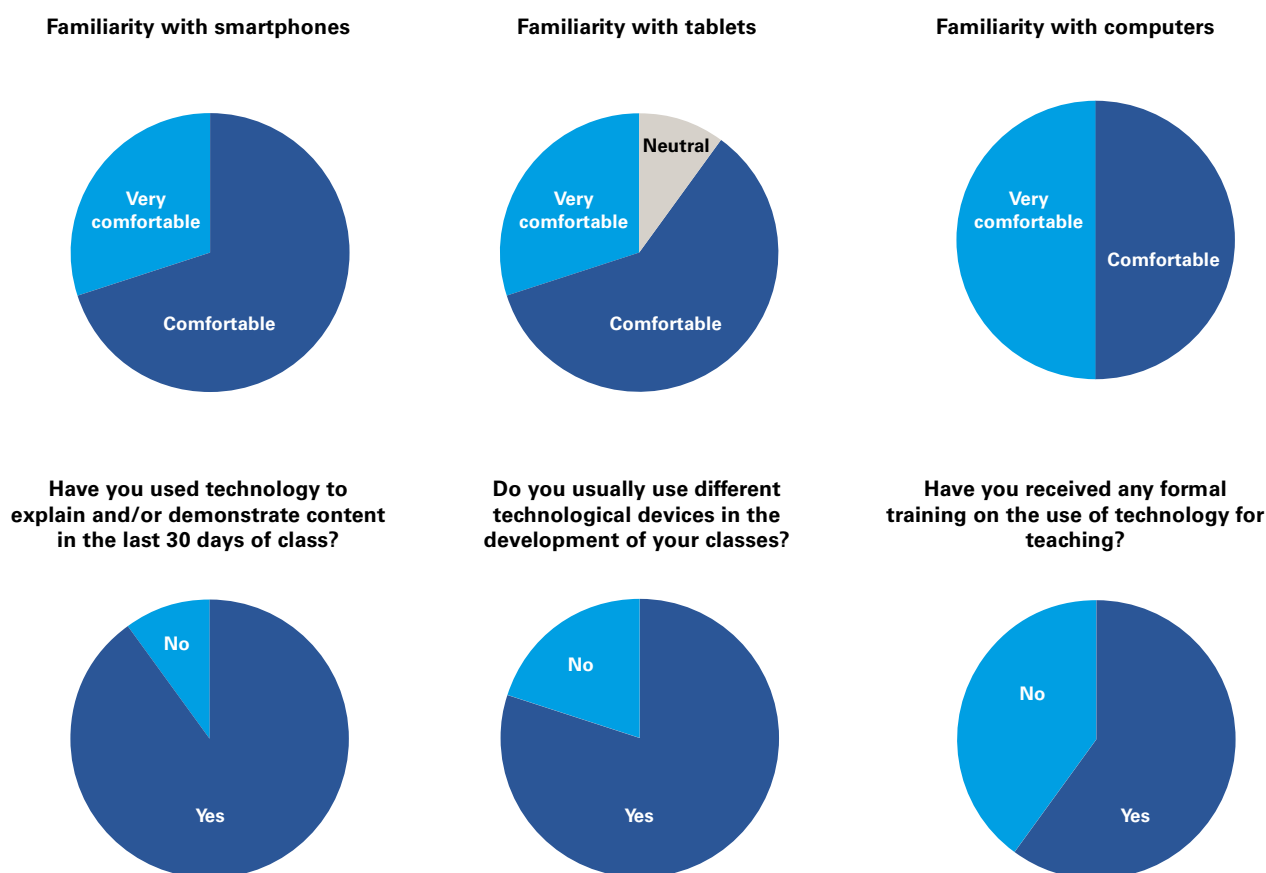
To build these capacities, the MEC, in collaboration with UNICEF, provided training on the UDL framework and on the development and use of the ADT prototype for teachers and technical staff participating in the ADT pilot. The training objective was to help teachers use inclusive pedagogies, to understand how the ADT prototype functions and can be used, and to build confidence in using its basic features with children with and without disabilities. At this stage, the training was not prescriptive for the specific use of the ADT in classes, providing opportunities for teachers to use it as part of their lessons at their discretion. Prior to the training, information was collected on teachers' digital competencies, and inclusive teaching practices and experience. At the end of the training, information was collected through a brief survey on the teachers' first impressions on the use of the ADT prototype and the training received on its use.

3.1 Teacher experience in inclusive education and the use of technology

Even though 9 of the 10 participating schools were recognized as inclusive schools, the pre-training survey found that **prior to the teacher training, just 2 out of 10 teachers had received any formal training on inclusive education**. This highlighted the need for additional pre- and in-service training on inclusive education. The pre-training survey also found that less than half of the teachers reported having any teaching experience with students with disabilities. This could indicate that while schools may recognize themselves as inclusive on paper, they might not be ready yet to identify, address and respond to the diverse needs of all students in each classroom.

All participating teachers reported feeling comfortable using electronic devices such as computers, tablets or phones prior to the training. Most teachers reported using electronic devices in the month prior to the training and during school closure to prepare their classes and explain or demonstrate content. Specifically, 6 out of 10 teachers reported having received prior training on the use of technology for teaching.

Figure 3: Pre-training teacher survey results (n=10)



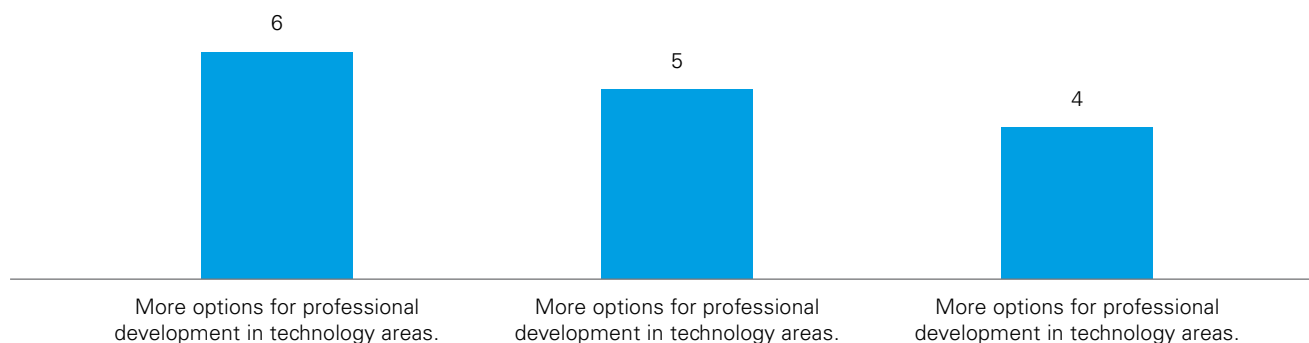
Nine out of 10 teachers reported feeling comfortable navigating the ADT prototype upon completion of the pre-implementation training. This ability to use it during training did not, however, necessarily translate to ease in using the prototype in classes with students. In the final interview after using the ADT in the classroom, the opinion of some teachers changed.

At the end of the prototype testing in classrooms, only half of the teachers confirmed that they felt ready to use the digital textbook in the classroom, citing the need for more practice. In the final interview, 8 out of 10 teachers reported that additional training would be critical to use the prototype for teaching and to be able to integrate it into their classroom activities with students. When it came to solving student questions and basic technology problems in the classroom during the prototype testing, some teachers delegated the task directly to the technical team supporting the pilot. Teachers also indicated that they needed more assistance and time to practise using the ADT prototype to integrate it into their teaching. Providing adequate time and freedom to teachers to practise and integrate technology-enabled learning tools into lesson planning, has been shown as a key enabler of success in digital learning programmes (Karamperidou et al., 2020).

Teachers also expressed the need for more consistent training on inclusive education and UDL. Teachers highlighted the need to have more options for professional development regarding inclusive education, accessibility and disability.

These results reflect the need to provide additional support such as training, capacity-building and follow-up activities for teachers for the development of technical capabilities, including basic digital skills, so that teachers can incorporate digital textbooks into the classroom.

Figure 4: In what area would you need more support to use the ADT prototype in the classroom?
(Source: teacher interviews)



Lessons learned and recommendations for teacher training

Evidence from the information collected through teacher interviews and classroom observations reflects the need to **provide more structured training and technical support for the use of the prototype** on the following topics:

1. Lesson planning with UDL principles and using the ADT as a tool

"It would be useful to create a lesson plan with suggested activities for teachers and recommendations on how to guide a class in a flexible way where each student can learn at their own pace, according to their learning style and interacting with their peers."

—Teacher

2. Basic technical computer skills, e.g., how to use the basic functions of a computer, the importance of loading the computers ahead of time, how to adjust the audio, how to install the prototype on the computers, and how to support students in using the computers.

"I downloaded the prototype on the computer to look at the content and prepare my class, but I couldn't because it didn't work."

—Teacher

3. More time to practise, including the possibility for each teacher to practise at home with additional 'take-home equipment' and self-instruction guides, in his or her own time, before class.

3.2 Student experience with technology

Ensuring that students have the skills to navigate and use the ADT is key to enabling them to benefit from the content on the ADT and use it to enrich their learning experience. To understand students learning experience and previous use and familiarity with technology, pre-implementation focus group discussions were carried out with students from each of the 10 participating schools.

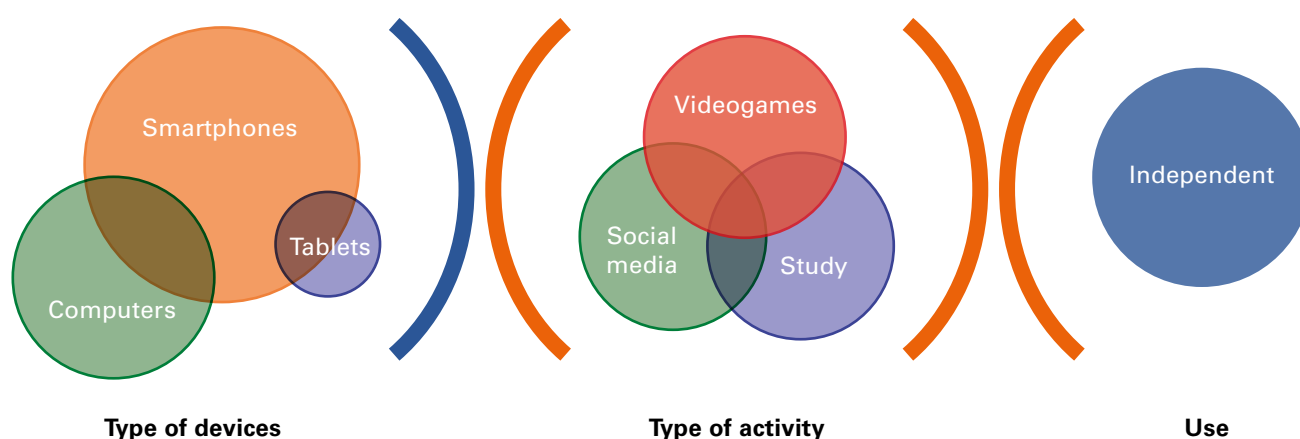
The majority of students reported using digital devices in their daily lives. Most students reported using a family member's mobile phone to play games, use WhatsApp and watch videos on YouTube. More than half of students reported that they used digital devices without adult supervision for recreational use and that they had used digital devices to study, especially during school closures due to the COVID-19 pandemic. This was consistent for students with and without disabilities. Students with disabilities were more likely to report using mobile phones and computers with the support of a family member. Just one student of the 62 who took part in focus groups reported that he did not use phones or computers.

"I use the cell phone to do homework, play games, look up pizza recipes, TikTok, YouTube, use WhatsApp to talk to my cousins, aunts, uncles, etc."
—Student

While the majority of students reported using mobile phones on a regular basis, a limited number of students had access to computers at home. Of those who reported having a computer at home, several noted that they had connectivity problems that have caused inconveniences in accessing virtual classes on Zoom during school closures. This is consistent with data at country level where, while a large proportion of the population (74 per cent) uses the Internet, less than 8 per cent have a fixed broadband subscription that is most commonly used to connect computers at home. As the ADT continues to be developed, exploring its use on mobile phones should be a priority given its big potential, with 110 mobile subscriptions for every 100 people (ITU, 2020).

During the class, it was possible to observe the difference between the students who said they had access to a computer and those that did not. At the end of the class, it was observed that they gained confidence and the ability to handle the cursor with greater ease and enjoyment of the activity.
—Direct classroom observation data

Figure 5: Types of devices used and for which activities



3.3 Having the technology ready for the classroom

Access to functioning equipment⁵ is a key initial step in realizing the potential of ADT. Schools selected for the prototype testing had some basic computer equipment. Of the 10 schools selected for the pilot, 7 had previously received 'mobile carts' that include PCs, notebooks and projectors, as part of another MEC programme. However, in most of those schools, prior to the implementation of the ADT, the computers were not in use, and those that were, were not updated, had viruses or were out of battery. A careful diagnostic of the ICT infrastructure in schools and their use would be critical to understand how schools and teachers are using technology, and what support they need.

The technology conditions in the schools highlighted the importance of having IT implementation and monitoring plans with well-defined roles. A plan for the use, storage and monitoring of IT equipment is necessary to ensure that the equipment is functional. This plan should include clear roles and responsibilities of both teachers and students to securely store and recharge the equipment and ensure that it is ready to be used during planned activities. This process should be included in the overall training package for the ADT. Creating a clear plan for the management and storage of technology in the classroom or community setting is critical to the success of technology-enabled learning programmes but is often overlooked (Dreesen et al., 2021). Budgeting at the school level also needs to account for one-time and recurring costs for IT equipment.

In addition to the computers, it is important to have accessories to be able to use the prototype and the different learning options it offers. Fundamental accessories are:

- **Headphones** for each student computer so that students are free to use the audio function. If they are not available, the audio (sound) of each device can generate confusion in the classroom, causing constraints and distractions for both teacher and students.
- **One mouse** for each computer so that students can navigate the prototype with ease, as most of the students were unfamiliar with the *touchpad* integrated into the computers, which was difficult for many to use. A controlled study comparing mouse with touchscreen performance indicates that, while touchscreen is faster than the mouse overall, only those without motor impairments benefit from a lower error rate on touchscreen. In the case of tablets, it is recommended to use a touchscreen with a target size of at least 18 mm (Findlater et al., 2017) with a large enough button size (Chen et al., 2013) to limit accidental touches for users with motor impediments.



5 Including computer, laptops and tablets.

4. In-classroom implementation

After the initial teacher training, the ADT prototype was tested in classrooms in each of the 10 schools. Research was conducted on (i) how students interact with the prototype; (ii) how teachers integrate prototype use as part of the classroom learning; and (iii) how the use of the ADT influences the pedagogy and dynamics within the classroom. The prototype pilot was conducted throughout two sessions per school, addressing the unit of the ADT prototype entitled “water is life”

4.1 Dynamics between teachers and students

After participating in the training, teachers had the opportunity to develop the lesson and the activity based on what they had learned.

The teachers had different ways of approaching the activity. Of the trained teachers, half led the activity and integrated the prototype in their lessons in a blended approach. They were able to integrate the ADT digital materials and opportunities for interaction offered by the digital content with more traditional classroom methods. Some teachers were able to connect the use of the prototype with the students’ previous knowledge, asking questions and encouraging participation by relating the contents to real-life aspects of the students’ context.

“Do you use water in your house? What for?” “Look for what letter is the same as this letter, the letter G.”
—Teacher

Introduction of the prototype and its functionalities was critical at the beginning of class. In the cases where the teachers did not start the class by mentioning the objectives of the lesson and the functionalities of the prototype, the students had more difficulties in following the activities.

First, the teacher starts the class by showing the prototype on a screen and explains the functions of the icons. The teacher continues providing information to her students and showing the icons to move forward, backward, activate and deactivate audios. She shows how they have to move the cursor. She invites her students to experiment and then asks: “How do we move the little arrow?” And then she waits a moment so they can do it. Then she asks what image they see and a student answers “It is a drop”. After listening she continues and explains that: “Today we are going to study the ‘letter G’” with the objectives that are exposed in the prototype.
— Classroom observation data

Some teachers prepared very structured lessons, using support equipment such as projectors, external audio, and notebooks. In these cases, the students were more attentive and followed the activities. Observations showed, however, that due to the highly structured class, students had less opportunity to explore the learning functionalities of the ADT prototype at their own pace.

In other cases, teachers had difficulty conducting the class independently with the ADT and asked for ongoing support from the MEC and UNICEF technical team on the use of technology, the platform and integration with their lesson.

4.2 Using the ADT as an inclusive education tool for children with and without disabilities

In the 10 pilot groups, 3 groups had students with and without disabilities. In 2 groups, it was possible to observe pedagogical practices by teachers that considered the characteristics of the students in the classroom. In one of the three groups, the teacher attended to the learning diversities of the students in an inclusive manner, following the principles of UDL. Among the good practices of teachers, the following were observed:

- The teacher explains in different ways, receives answers in different ways, and addresses each student according to their motivation and learning style (oral, sign language, signalling, short questions – diversified ways to reach everyone in line with the principles of UDL).
- The teacher maintains active interest by using concrete and real-life examples close to all students (e.g., showing the activity by bringing a glass of water).
- The teacher enables interaction between teacher, student and the prototype by adapting the questions for the students, expressing them in different ways.
—Direct classroom observation data

In other groups, less desirable practices for inclusive education were observed. For example, there were cases where the teacher intervened before the student could respond through pictograms or in a low voice, or another case where the teacher gave a very strict schedule that did not respect the needs of the students.

Teachers reported being excited and satisfied with the activity of using the ADT prototype in their lessons, although they mentioned feeling anxious and challenged at the beginning of the implementation. Teachers need time to test and plan lessons using technology in order to incorporate it into their practice. However, all teachers ended the activity with a positive opinion about the use of the ADT prototype for students with and without disabilities.

“It was something unknown to me. I also had my doubts, I didn’t know how they were going to receive it and I was a little afraid. I felt comfortable working with them. I liked the content and the topics.”
—Teacher

4.3 How children with and without disabilities use the ADT

Most students were energetic, curious, attentive and enthusiastic about using the prototype. No significant differences were found in the use of the prototype between genders and between students with and without disabilities. Some students were initially apprehensive about interacting with the technology, especially those students who reported not having a computer at home. However, once the initial hesitation was overcome, students were curious and began to test and explore the functionalities of the prototype. In all classes observed students were actively asking questions about the use of the prototype to understand how it worked and to better follow the activities led by the teacher, demonstrating their interest. In general, most students were attentive during all the various activities, looking at the screen and trying to use the prototype. At the time of interacting with the prototype, there were also students who did not yet know how to read and write and still managed to follow the activities with interest.

Several students with disabilities were active participants when using the ADT, raising their hands and commenting on familiar topics. Students were observed responding to questions in different modalities; with sign language, orally or by pointing to the prototype images.



At the same time, the girls without disability read the story. Children with hearing disability watch the story in Paraguayan sign language. Children with intellectual disabilities listen to the story.

— Classroom observation data

Spontaneous peer support between students with and without disabilities to support each other in the use of the prototype was observed, even when not guided by the teachers. This positive result occurred even though the students waited for the teacher's instructions, according to the standard classroom dynamics.

“Look at the screen of your classmate on the side; when you see they need support, show them how to do the exercise.” At the time of performing the exercises, they stand up and show the others how to complete the task.”

— Teacher

A child with a hearing impairment communicated, showed and talked about the activity to another child (without a visible disability) during the experience.

— Classroom observation data



Lessons learned and recommendations for the integration of the prototype in the classroom

Qualitative evidence based on data collected through student focus groups, classroom observations and teacher interviews identified the need for:

- **explaining the objective of the class** and incorporating in the development of the class a creation of context; for example, through the use of a short story, dialogue, riddle, short dynamic activity to introduce the topic of the class before incorporating the use of the prototype
- **introducing the prototype**, spending some time to explain all its functionalities and its use in an inclusive way
- **allowing time for students to interact**, familiarizing themselves with the prototype and selecting their preferred way of learning
- **actively checking whether students are understanding the activities**, or if they need guidance or help
- **promoting collaboration among students and allow them to work individually as well**
- **as much as possible, relating class content to real-life situations**

The **arrangement of the tables** is an important factor in maintaining the attention of the group. The arrangement of the tables (U-shaped) helps the teacher to see all the students and, for example, to give the class in two languages (Spanish and Paraguayan sign language), improving the attention of the students.

5. The ADT prototype

5.1 Prototype content and interface

Overall, teachers and students were satisfied with the ADT prototype and its content. The teachers indicated that the experience was excellent (5 teachers) or good (5 teachers) and it is very likely or likely that they will continue to use the prototype in the future. A total of 8 out of 10 teachers considered that the content of the ADT prototype would be very useful for daily teaching activities. One teacher remarked how the interface of the ADT prototype and its way of presenting the content could make some activities such as reading more interesting for some students. In addition, all teachers positively rated the glossary feature that defines key words, including images and symbols. One teacher highlighted the importance of the **glossary**, noting that it was particularly useful to teach and understand sign language. Teachers and students found that the **images** were very useful in that they can facilitate the learning process for students both with and without disabilities. The students who used the **sign language videos** and their teachers were happily surprised to see the content presented in this way.

“The prototype is great, I thought that this content would be difficult for a first grader, but with this we see that it is not. I have a student with many difficulties, but I saw that she became more interested in reading through this experience.”
—Teacher

All the teachers agreed that the students understood the different instructions of the proposed activities, although there were cases where they had to explain several times or provide support. It was found that 9 out of 10 affirmed that the ADT prototype and its content would be very useful for students with disabilities. One of the teachers was positively surprised by the case of a girl with learning disabilities who was able to solve the syllables part completely and independently.

Recommendations for improving the content of the prototype

Overall, the feedback on the content of the prototype was very positive from students and teachers. Below are some key points to keep in mind about the design of the content based on the results.

- **Align content to the school curriculum** so that it can be integrated into classroom activities and be in line with teachers’ activities and students’ needs.
- **Review prototype content through an additional quality control process** to ensure that all materials are accessible and flawless, particularly sign language content.
- **Include representations of both genders for different roles and positive image of people with and without disabilities.**
- **Keep texts short,** attractive and add more images to make students more interested and motivated.

6. Conclusions

The ADT initiative aims to build inclusive digital tools that enable children with and without disabilities to learn in the same classroom and engage with the same content as their peers. By providing digital learning content with features that allow every student to engage with it, including those with different types of disabilities, the ADT has the potential to be a key tool for teachers to employ UDL principles in their lessons. This report presents the findings from an initial pilot testing of the ADT prototype and process in 10 schools in Paraguay, which is part of a larger journey to improve and expand inclusive education in Paraguay through an evidence-based approach. In Paraguay, results from the prototype testing show that the ADT has the potential to improve student motivation and enable positive and inclusive teaching in the classroom.

After testing the tool, teachers found that the ADT would be very useful in their daily teaching practice. Especially in its ability to make reading more interesting for students, and features such as images, the glossary, and sign language videos that make teaching engaging for students.

Students were engaged and curious about the ADT and demonstrated spontaneous peer support between children with and without disabilities in using the platform. Students interacted and supported each other to use the ADT technology.

Students with disabilities were observed to be active participants in the classroom when using the ADT, raising their hands and commenting. Students responded to questions in different ways, with sign language, orally or by pointing to the prototype images.

While the pilot demonstrated the potential of the ADT initiative, it also highlighted the need for a systemic approach to support schools, students and teachers so that all factors for successful inclusive education supported by technology coexist simultaneously.

Teachers need to have access to professional development opportunities on key concepts of inclusive education and pedagogy that includes all learning styles. Inclusive education and teacher training on the subject should be seen as an ongoing process that needs to go hand in hand with all dimensions of the education system, from strategy and planning, curriculum, leadership and structure, to learning and assessment processes for children with and without disabilities. Training content has to be developed and delivered based on local contextual factors and needs.

To ensure that students and teachers can use the ADT for inclusive education, the government needs to prioritize investments in ICT equipment, safe storage of devices and infrastructure according to specific school needs. Schools, for their part, need to take care of monitoring the status of existing equipment and maintain a plan for storing and recharging equipment to ensure that it is ready for use at the time of planned activities by children with and without disabilities.

Teacher training on basic computer topics needs to be accompanied with training on how to incorporate technology in the classroom. This process involves facilitating teachers' access to resources on the use of technology, training on innovation and learning strategies with the use of technology and providing a support system through pedagogical coaching that accompanies teachers in the different stages. Teacher training should also be accompanied by support to caregivers and children to acquire basic digital skills before introducing the ADT in classrooms.

Monitoring and researching the use and usefulness of the content developed and accessibility features of the ADT is important to continue improving the interface and content as the programme scales. Continuing to add inclusive curriculum-aligned content will make the tool more useful for teachers as well as more engaging for students.

As the programme scales, subsequent research will be conducted on the impact of the ADT on learning for children with and without disabilities. A built-in monitoring system, if made available, could facilitate the monitoring of key information such as usage, engagement and students' learning progress. Quality data, treated respecting data protection and security, is essential for decision-making and to further inform future public policies and their implementation in the Paraguayan context.

Annex 1

Schools were selected according to the following criteria:

- schools that returned to face-to-face classes or that could attend the implementation days in November and December 2021
- educational centres with computer equipment
- classrooms with students between 7 and 9 years old (age appropriate to the content of the prototype) who were in the first cycle of basic education
- classrooms with students with educational support needs due to an established disability (intellectual, motor, visual, hearing, ASD, psychosocial)

Participating Educational Centres

Participating educational centre	Type of environment	Type of school
1 Special school	Segregated	Subsidized - urban
2 Escuela básica	Inclusive	Public - urban
3 Escuela básica	Inclusive	Subsidized - urban
4 Escuela básica	Inclusive	Public - urban
5 Escuela básica	Inclusive	Public - urban
6 Escuela básica	Inclusive	Public - urban
7 Escuela básica	Inclusive	Public - urban
8 Escuela básica	Inclusive	Public - urban
9 Escuela básica	Inclusive	Public - urban
10 Escuela básica	Inclusive	Public - urban

Annex 2

Table 1: Characterization of students⁶

	Girl	Boy
No disability	30	28
Hearing impairment	5	6
Intellectual disability	1	2
Learning disorder	1 (Presumptive Dx) ⁷	1
Psychosocial disability	1 (Presumptive Dx) ⁸	
Total	38	37

6 Resolución Ministerial N° 17.267. "Lineamientos para un Sistema Educativo Inclusivo en Paraguay" Ministry of Education and Science (May 2018). Paraguay. https://www.mec.gov.py/cms_v2/adjuntos/15039?1531495353

7 Presumptive diagnosis referred by the teacher and based on academic requirements. Inclusive education guidelines, 2018.

8 Presumptive diagnosis referred by the teacher.

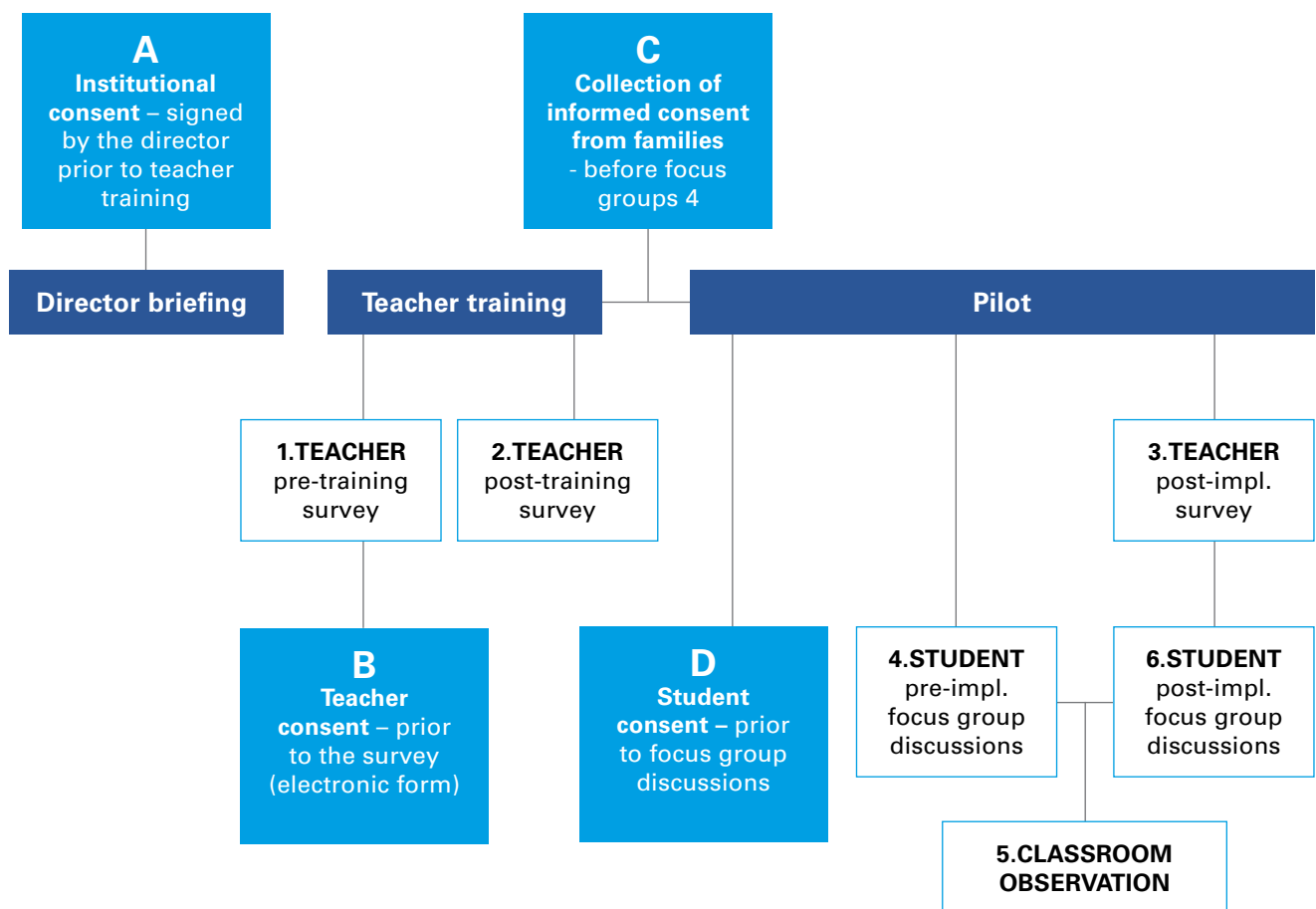
Annex 3

Data collection, storage and management followed the *UNICEF* Procedure on Ethical Standards in Research, Evaluation and Data Collection and Analysis. The research instruments and fieldwork protocols were reviewed and approved by the Health Media Lab and the Institutional Review Board of the Office for Human Research Protections in the US Department of Health and Human Services Research.

Annex 4

The chart below presents the data-collection procedure with the instruments used with emphasis on informed consent.

Figure A4: Data collection map and consent forms



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UNICEF Office of Research – Innocenti

Via degli Alfani, 58 – 50121

Florence, Italy

Tel: (+39) 055 20 330

Fax: (+39) 055 2033 220

researchpublications@unicef.org

www.unicef-irc.org

twitter: @UNICEFIInnocenti

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