

education

Report No.2

**Roadmaps
for the incorporation
of technology
in education systems**

Social and Human Development | Education Working Paper

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Content

4 — **Introduction**

7 — **Use of the tool and development of the roadmap**

14 — **Roadmaps to prioritize and cross-cut interventions**

19 — **Considerations for roadmap costing**

19 — Costing assumptions

20 — Consideration of costs by components

20 — Governance of public policies and/or national programs for the inclusion of technology in education systems

24 — Pedagogical model

28 — Connectivity, access to devices and cloud content

31 — Professional development for teachers and administrators

33 — Data protection and security

34 — Information systems and education management

36 — **Final recommendations**

36 — Public policies and/or national programs for the inclusion of technologies in the education systems

37 — Connectivity, devices and cloud content

37 — Professional development for teachers and administrators

38 — Data protection

38 — Interoperable information systems

39 — **Bibliography**

47 — **Annex 1.**

Documentary sources supporting the development of the roadmaps

56 — **Annex 2.**

Roadmaps by level of advancement for each dimension

Introduction

The new scenario imposed by the COVID-19 pandemic generated situations of unprecedented complexity for Latin American education systems, such as the discontinuity of school attendance, asymmetries in terms of access to platforms, devices and virtual resources, disparities in the capacity of teachers and students to deal with virtuality, among others. This highlighted the unavoidable need for countries to promote and deepen the processes of incorporating technologies in this area. Within this framework, and with inadequate school formats to face this situation, governments have taken the most pressing measures in education. They also identified relevant data that show the deep existing gaps as well as the pending challenges in digital and pedagogical matters.

With this report, CAF proposes the development of a roadmap for the adoption of technology in education, outlining two major objectives:

- Development of a diagnostic tool to identify a country's level of progress in each of the dimensions that make up the comprehensive approach to the adoption of technology in an education system.
- Design of three roadmaps for different levels of progress toward the efficient incorporation of technology in education systems to serve as input for the development and/or revision of a program/policy for the adoption of technology in learning processes.

The project work generated five deliverables:

- Diagnostic tool to assess the state of technology adoption in education systems;
- Report containing the roadmap for designing a program for the effective adoption of technologies in learning, considering three scenarios based on the level of development of digital inclusion in a country's education system;
- Report on the pilot case of the use of the tools in a selected country, to be defined by CAF;

- Workshop with various areas of CAF to validate the roadmaps and explore areas of greatest opportunity for intervention from CAF in the technological field;
- Final report with adjustments and recommendations on critical concerns raised in the workshop.

It is hoped that the instruments to be developed will be useful for the countries of the region to undertake or strengthen the incorporation of technology in all areas of education systems, from the perspective that these processes require a comprehensive approach to primary and secondary education. The comprehensive approach includes the design and implementation of interventions in five dimensions:

- (i) National programs or public policies for the inclusion of technologies in education systems with a focus on pedagogical models; (ii) connectivity, devices, and cloud content; (iii) professional development for teachers and administrators; (iv) child data protection and security; and (v) interoperable information systems.

This document is the third deliverable of the project, which completes objective No.2 (see figure 1).

It includes the design of roadmaps for different levels of progress in the adoption of technology in education. These represent inputs for the elaboration and/or revision of a program/policy for the adoption of technology in the learning processes of compulsory education.

Figure 1
Project objectives

OG Develop three tools for the adoption of technology in education with a learning-centered approach based on the degree of advancement.

OE1

Develop a diagnostic tool to identify the level of progress in each of the dimensions that make up the comprehensive approach to the adoption of technology in the education system.

#1
Connectivity, devices,
and cloud content

#2
Child data protection
and security

#3
Technology inclusion,
competency development,
metrics and content programs

#4
Teacher training and support

#5
Interoperable information
systems

OE2

Design at least three roadmaps for different levels of progress toward the efficient incorporation of technology in education systems.



First Steps: Incipient
development scenario



Consolidation of progress:
Scenario of in-process cases



Reaching system maturity:
Advanced cases in the efficient
incorporation of technology

OE3

Apply the diagnostic tool and the corresponding roadmap to a pilot case in a country to be selected in partnership with the CAF team.

The strengthening of ICT policies in all areas of education systems, under a learning-centered model, implies designing, implementing and evaluating processes and results from a comprehensive and multidimensional perspective. The roadmaps developed are a key input to accompany countries in the process of developing and reviewing programs and policies in each of the dimensions. Like the Diagnostic Tool, this type of model is relevant in that it provides a comparative perspective between entities, in this case countries, in relation to a process, in this case the availability of enabling infrastructure, public policy frameworks and governance that allows the use of digital technologies in education, based on best practices or advanced stages of development. Its value lies in the generation of an analytical framework and common language, shared by organizations (governments and multilateral organizations) for the understanding and socialization of the levels of progress.

The roadmaps are a key input to assist countries in the process of developing and reviewing programs and policies in each dimension

A diagnostic tool for evaluating technology adoption in education systems, which is the first product produced, provides key background for the development of the roadmaps. It is an exhaustive analysis of the degree of incorporation of technologies in five dimensions: (i) national programs or public policies for the inclusion of technologies in education systems with a focus on pedagogical models; (ii) connectivity, access to cloud content and devices; (iii) professional development of teachers and administrators; (iv) protection of children's data and security; and (v) interoperable information systems.

Once the diagnostic tool has been applied, the roadmaps are used to initiate planning processes within the countries. In order to achieve greater specificity in the roadmaps, the first dimension of analysis has been divided into (a) governance of national public programs or policies for the inclusion of technologies in education systems and (b) pedagogical model. The first refers to the six key elements that make it possible to account for the complex process of planning, implementing and evaluating an ICT policy at the strategic and operational levels: governance and the actors involved in policy planning, legislation and regulations, the vision behind the policy, design components, strategies associated with financing and evaluation mechanisms. The Pedagogical Model dimension

brings together aspects related to regulations, curriculum and institutional management.

A diagnostic tool for evaluating technology adoption in education systems, which is the first product produced, provides key background for the development of the roadmaps.

Before getting into the specifications about how these roadmaps work, it is necessary to explain the strategic equity-driven principles on which the objectives, actions and intervention paths proposed in each one of them are based:

- Build a strategic vision of ICT policy and ensure its sustainability to reduce digital and educational gaps;
- Ensure access to connectivity, devices and digital educational resources;
- Renew school formats and update curricular designs by integrating ICT and Computer Science or computational thinking contents;
- Improve the capabilities of teachers and school administrators to implement ICT projects and foster improved learning opportunities for students;
- Protect children and youth in the digital world;
- Guarantee financing of the ICT policy in compulsory education; and
- Enhance the digital transformation of education systems to favor the socio-productive development of the territories and mitigate the effects of the pandemic crisis.

Use of the tool and development of the roadmap

The diagnostic tool and the roadmaps are conceived as two associated instruments. In this regard, the estimate of the level of progress of the country (or subnational level) in each dimension provided by the diagnostic tool determines the starting point of the roadmap.

The diagnostic tool measures the level of technology use in education based on quantitative and qualitative indicators. The analytical framework is based on a diagnostic model that estimates the level of development and maturity in a given process, according to consistently evaluated levels. The tool makes it possible to evaluate the level of development and maturity of a country according to a continuous gradation based on three levels:

- Level 1-First Steps-Incipient development scenario
- Level 2-Consolidation of Progress-Scenario of in-process cases
- Level 3-Reaching system maturity-Advanced cases in the efficient incorporation of technology

The use of these models makes it possible to assess the maturity level of a process based on multiple components or indicators. Likewise, this type of models provides a comparative perspective between entities, at national or subnational level, in relation to a process, in this case the use of digital technology in education, in relation to best practices or advanced stages of development. Its value lies in the generation of an analytical framework and common language, shared by organizations (national and sub-national governments and multilateral organizations) for the socialization of assessments. More importantly, the tool allows the development of a roadmap focused on a vision for the future and on medium and long-term

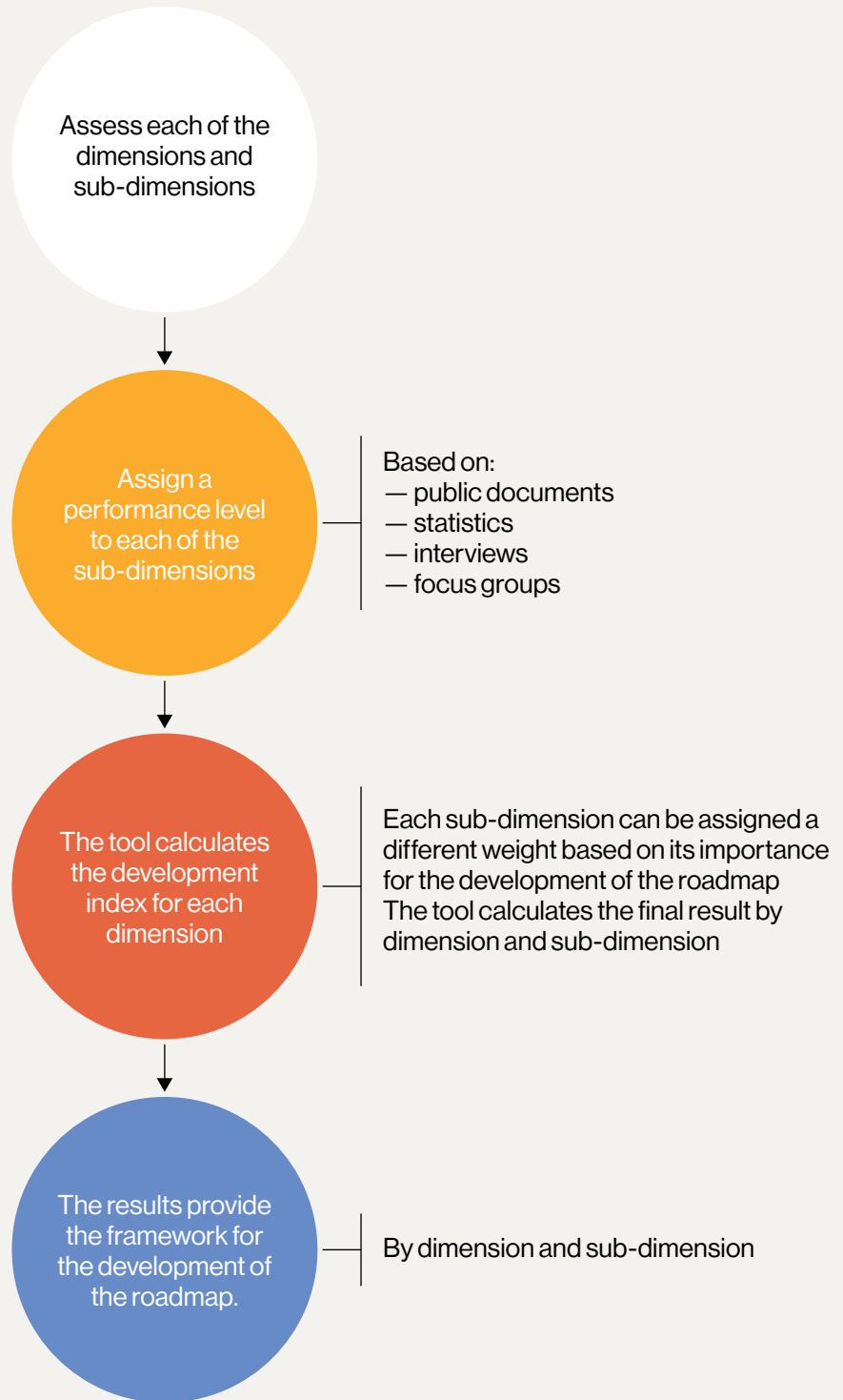
performance improvement. The tool also allows formalizing goals and metrics/indicators to monitor progress on the roadmap.

The application of the tool requires positioning the country under consideration in each of the subdimensions, so that the combined level of development can be estimated (see Figure 2).

The tool is composed of five dimensions, each of which is based on multiple sub-dimensions, which positions the country being assessed at a specific level of development in the corresponding area.

The use of technology in education is the result of the combination of numerous metrics and evaluations in different dimensions and sub-dimensions. Therefore, the tool is composed of five dimensions, each of which is based on multiple sub-dimensions, which positions the country being assessed at a specific level of development in the corresponding area.

Figure 2
Application of the diagnostic tool



By combining the evaluation levels in each subdimension a development index per dimension of analysis is generated, in addition to an index composed of the four dimensions. The index positions the country in each subdimension on a scale ranging from a limited to an advanced level of development,

reflecting best practices. The subdimensions can be based on quantitative metrics (e.g., Internet adoption) or qualitative metrics (e.g., use of digital technologies in the preparation of lesson plans) (see Figure 3).

Figure 3
Example of calculation using the diagnostic tool

	First steps: Incipient development scenario	Consolidation of progress: Scenario of in-process cases	Reaching system maturity: Advanced cases in the incorporation of technology		
Connectivity (I)	National and regional scope/development of connectivity	Fixed broadband coverage (percentage of population): < 80% 4G coverage (percentage of population): < 80% Rural broadband coverage: < 20%	Fixed broadband coverage (percentage of population): 80% - 90% 4G coverage (percentage of population): 80% - 90% Rural broadband coverage: 20% - 60%	Fixed broadband coverage (percentage of population): > 90% 4G coverage (percentage of population): > 90% Rural broadband coverage: > 60%	<div style="display: flex; flex-direction: column; align-items: center; gap: 10px;"> 1 2 1 1 <hr style="width: 20px; margin: 0 auto;"/> 1.25 </div>
	Institutional and legal framework for network development	National Telecommunications Plan: No update in the last four years Responsibility for public policy for telecommunications development: Secretariat of State under the Ministry of Transport and Communications	National Telecommunications Plan: drafted in the last four years without deployment goals Responsibility for public policy for telecommunications development: Autonomous State Secretariat	National Telecommunications Plan: drafted in the last two years with deployment goals Responsibility for public policy for telecommunications development: Cabinet-level ICT Ministry	
	Quality of broadband service (capacity, speed, latency)	Average fixed broadband download speed: < 30 Mbps Average mobile broadband download speed: < 18 Mbps International bandwidth per user: < 25 Mbps	Average fixed broadband download speed: 30-70 Mbps Average mobile broadband download speed: 18 - 25 Mbps International bandwidth per user: 25 - 60 Mbps	Average fixed broadband download speed: > 70 Mbps Average mobile broadband download speed: > 25 Mbps International bandwidth per user: > 60 Mbps	
	Broadband and Internet access	Fixed broadband adoption (by household): < 40% Mobile broadband adoption (by individuals): < 60% Internet adoption (by individuals): < 60%	Fixed broadband adoption (by household): 40% - 70% Mobile broadband adoption (by individuals): 60% - 80% Internet adoption (by individuals): 60% - 80%	Fixed broadband adoption (by household): > 70% Mobile broadband adoption (by individuals): > 80% Internet adoption (by individuals): > 80%	

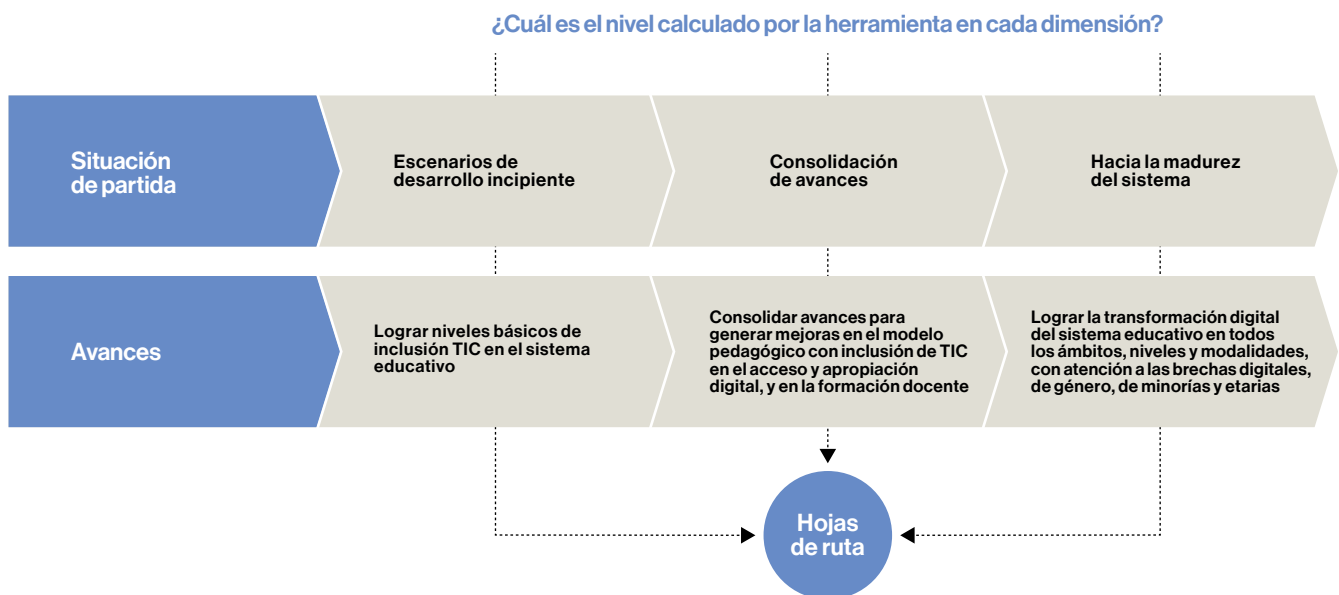
Each dimension includes a series of questions that guide the application of the tool (see Figure 4). For more details on the tool, its dimensions and application, see Diagnostic tool for evaluating technology adoption in education systems and implementation manual.

By estimating the level of development, the tool stipulates the country's situation, defines the strategic objective, and provides the framework for the development of the roadmap (see figure 5).

Figure 4
Example of guiding questions

Professional development for teachers and administrators	Sub-dimension: Initial teacher education	Variable: Institutional Structures	First steps: Incipient development scenario	Consolidation of progress: Scenario of in-process cases	Reaching system maturity: Advanced cases in the incorporation of technology	Questions	
			Absence or weakness of agencies in charge of ICT-inclusive teaching policies	Existence of agencies in charge of ICT-inclusive teaching policies	Existence and type of governing body for teacher policies with political decision and normative instrumentation for ICT inclusion with the participation of the authorities in charge of ICT policy		<p>Is there a governing body that coordinates initial teacher training actions at the national level, including planning, accreditation, implementation, and monitoring of the program?</p> <p>Is there a National Plan that takes into account the comprehensiveness of the levels of the mandatory education system and is updated based on the evaluation of results?</p> <p>Are authorities linked to ICT policy involved in these actions?</p>
			Absence or weakness of articulation of actions	Existence of articulation and coordination initiatives between educational policy bodies for ICT in Education in the last four years of actions	Existence of programs implemented in the last two years of educational policies for ICT in Education with the participation of the authorities in charge of ICT policy		
			No national teacher training plan with ICT inclusion (or not updated)	National teacher training plan with ICT inclusion at some level and/or modality of the educational system	National teacher training plan with ICT inclusion that addresses all levels and modalities of the formal and updated system based on the evaluation of the results of the policy		
			Absence, weakness of coordination and/or overlap between institution(s) responsible for the planning of the program, accreditation, and monitoring of the training program	Existence of coordinated actions between institution(s) responsible for the planning of the program, accreditation, and monitoring of the training program	Existence of a governing body for the planning of the program, accreditation, and monitoring of the training program (and/or coordinated actions with periodic updates between the responsible institution(s))		

Figure 5
Use of roadmaps



The proposed roadmaps involve two key moments:

- The application of the diagnostic tool that places the states (national or subnational) at a level of progress with respect to each of the dimensions.
- The use of the corresponding roadmap for each dimension according to the level of progress determined by the diagnostic tool. The roadmaps are presented together with a general roadmap that includes priority interventions by dimension according to the level of progress and incorporates cross-cutting interventions that integrate two or more dimensions.

It is important to note that a country, province, state or city may present different levels of development for each dimension. In other words, it is possible that the level of progress in connectivity is high (“Reaching Maturity”) but in terms of teacher training it may be low (“Incipient Development”). Therefore, the development of the roadmap must be based on actions that vary according to the dimension. This entails the development of 18 roadmaps, i.e., one for each of the three levels of progress for the six dimensions.

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The application of the diagnostic tool that places the states (national or subnational) at a level of progress with respect to each of the dimensions.

The use of the corresponding roadmap for each dimension according to the level of progress determined by the diagnostic tool. The roadmaps are presented together with a general roadmap that includes priority interventions by dimension according to the level of progress and incorporates cross-cutting interventions that integrate two or more dimensions.

Figure 6
Number of roadmaps

		Performance levels					
		Performance levels		Consolidation of progress		Reaching system maturity	
Dimensions	Public policies	1	→	2	→	3	
	Pedagogical model	4	→	5	→	6	
	Teacher training	7	→	8	→	9	
	Data protection	10	→	11	→	12	
	Information systems	13	→	14	→	15	
	Connectivity	16	→	17	→	18	

Using this approach, once the diagnostic has been completed and the questions have been answered, the corresponding roadmaps are identified (see figure 7).

Figure 7
Combining roadmaps by dimension: a country-level example



Each roadmap is structured around eight components:

1. Description of the situation at the starting point
2. Analysis of strengths and opportunities
3. Guiding questions to analyze the situation
4. Outline of critical nodes to be addressed in the implementation of the roadmap to advance to the next level of performance.
5. Objectives to be achieved in the implementation of the roadmap
6. Lines of action: lines of intervention
7. Stakeholders responsible for the implementation of the roadmap
8. Constraints and risks that may arise during implementation

The implementation of the roadmaps to the reality of a country should not be done in a mechanical way. Given the vast range of specific situations in each country, the roadmaps should be viewed as general guidelines for plan development, which should be adjusted to the specific country context.

The roadmap outlines how a country can move from the level estimated by the tool to the next level. What happens if a country is at the highest level? The roadmap indicates the pending actions to be taken at this level.

To make better use of the roadmaps so that they lead to suitable implementation plans with an effective and efficient impact, there are some requirements and focus points that must be kept in mind:

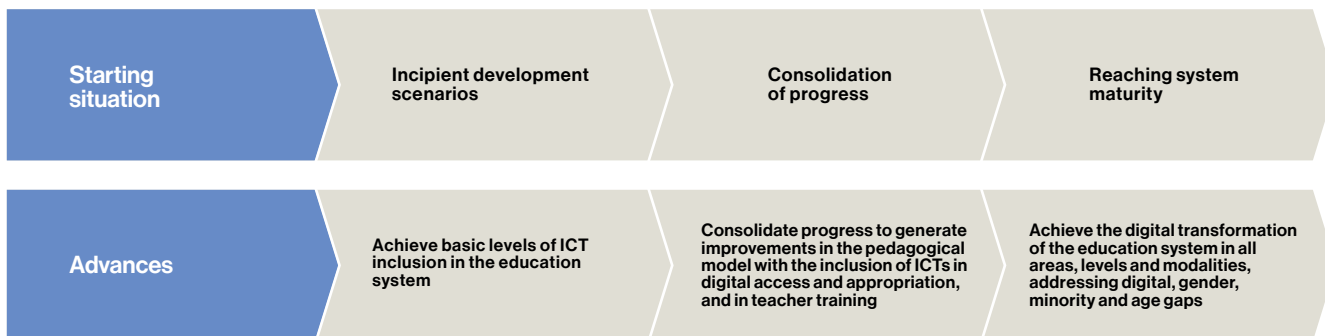
- Multiplicity of starting points. The complexity of each country's education system determines the need to "customize" the roadmap according to the context, the starting point, the opportunities and resources available and those that need to be lined up, and the progress of digital technologies.
- Comprehensiveness of the intervention. Although the roadmaps are structured by dimension, countries need to make progress in all six dimensions simultaneously, building synergies and intersectoral linkages. Each of the proposed objectives is a necessary but not sufficient condition for achieving change.
- Interconnection of actions. The lines of action proposed for the fulfillment of each intradimensional objective must be connected in order to achieve the objectives toward greater maturity of the system.
- Governance of actions. Once the process has begun, political-strategic and technical-pedagogical directionality must be ensured.
- Policy feasibilities. To achieve policy sustainability, it is necessary to build and address technical, political and organizational feasibilities. All of them require attention.

- Coexistence of different models of ICT integration in education systems. The roadmaps support the deployment of these different models based on the principles of integration of the different dimensions of analysis: governance, pedagogical model, cloud and device connectivity, access, teacher and management professional development, interoperable information systems, and child data protection and security.

The application of roadmaps to the reality of a country should not be done in a mechanical way. Since it is impossible to consider the range of specific situations in each country, the roadmaps should be considered as guidelines for the elaboration of a plan, which should be adjusted to the specific country context.

Roadmaps to prioritize and cross-cut interventions

As described in section 3, in addition to the roadmaps developed for each dimension (see Annex 2), a general roadmap is presented with prioritized objectives by dimension and cross-cutting objectives that integrate more than one dimension.



Cross-cutting interventions

Strengthening governance	<ul style="list-style-type: none"> – Strengthen the mechanisms and capacities of central and decentralized governments. – Strengthen the governance of the teacher training system 	<ul style="list-style-type: none"> – Create an innovation agency/agency with high autonomy and created by law. – Form an Advisory Council in the Agency with representatives from industry, trade associations, academia, civil society organizations (CSOs), supranational organizations, etc. – Strengthen the quality of pedagogical support by empowering inspectors through increased training, improved management tools, and a better regulatory framework, while also creating a team of tutors and mentors to provide additional support 	<ul style="list-style-type: none"> – Consolidate ICT policy as a state policy – Guarantee advanced levels of digital transformation in the education system to achieve impact on the socio-productive development of the territories
Establish multisectoral alliances for ICT development	<ul style="list-style-type: none"> – Establish alliances with different sectors to strengthen ICT policy. – Form permanent multisectoral roundtables with the industry, the scientific-technological system, and other relevant stakeholders of the digital ecosystem and education for the development of standards and profiles 	<ul style="list-style-type: none"> – Guarantee multisectoral action commitments that can be monitored for the improvement of the strategic lines of the National Plan for digital inclusion in the education system – Design and implement multisectoral projects and programs in partnership with the private sector, CSOs, academia and international organizations to improve ICT policy actions 	<ul style="list-style-type: none"> – Strengthen articulation with the digital ecosystem through the integration of different sectors and stakeholders. – Generate a basis for multisectoral agreements, embodied in documents, regulations and the National Plan for digital inclusion in the education system.
Ensure access to connectivity and infrastructure	<ul style="list-style-type: none"> – Contribute to the expansion of access and pedagogical appropriation of technology infrastructure in the education systems 	<ul style="list-style-type: none"> – Emphasis on connectivity in rural and isolated populations 	<ul style="list-style-type: none"> – Complete deployment of connectivity to all educational establishments – Massive deployment of advanced connectivity technologies (fiber optic access, free public Wi-Fi in cultural and educational institutions)
Review and update the proposals and formats for teaching and learning in compulsory education	<ul style="list-style-type: none"> – Review and update the curricula of compulsory education in at least one of the educational levels (with priority given to the secondary level). 	<ul style="list-style-type: none"> – Scaling innovative formats for educational programs – Design innovative proposals for the teaching and learning of digital knowledge that articulate the needs and expectations of Industry 4.0. 	<ul style="list-style-type: none"> – Include knowledge from the disciplinary fields of computational thinking and computer science in the curricula of all levels and modalities
Develop teaching and management skills	<ul style="list-style-type: none"> – Improve the technical skills of future teachers, in-service teachers and school administrators through innovative training programs with updated content on digital knowledge 	<ul style="list-style-type: none"> – Enhance networks and communities of practice to encourage innovative leadership in management teams when implementing hybrid-format ICT projects 	<ul style="list-style-type: none"> – Create and execute a top-tier academic program to train teachers in computer science and computational thinking, with collaboration from national and international academic centers, industry chambers, and knowledge networks
Securing financing	<ul style="list-style-type: none"> – Improve the budget allocation to at least 4% of expenditure per student – Establish mechanisms for seeking extra-budgetary funds to ensure the deployment of the policy – Implement a transparent and standardized system for the acquisition of infrastructure and technological services that contemplates the criteria for the protection of private data. 	<ul style="list-style-type: none"> – Improve the budget allocation to 6% of cost per student – Implement standardized and transparent online systems for the purchase and procurement of infrastructure and technology services, with an audit trail 	<ul style="list-style-type: none"> – Improve budget allocation to more than 6% of cost per student – Leverage synergies between international agencies and the private sector to finance policy costs

Continued →

Implement monitoring and evaluation systems with a focus on accountability	<ul style="list-style-type: none"> – Lay the foundations for a monitoring and evaluation system for ICT, teacher training and teaching policies – Provide information on policy results, such as distribution, use and application of resources to ensure policy transparency. 	<ul style="list-style-type: none"> – Include items on digital literacy, computational thinking or computer science in standardized learning tests. 	<ul style="list-style-type: none"> – Improve the ICT policy evaluation system in all its dimensions, with special emphasis on the measurement of learning and accountability.
Implement management and information systems for decision making	<ul style="list-style-type: none"> – Strengthen the technology units at the central and decentralized levels in terms of technological labs, computer equipment and technical-professional competences. 	<ul style="list-style-type: none"> – Implement a strategic systems development plan for the main processes of the education system with special emphasis on the technological infrastructure. – Develop an updated monitoring and control system that consolidates management indicators on supply, education (trajectory), positions, absenteeism, expenditures, school buildings and equipment, investments, with cross-referencing of variables, standardized test results, academic results, school environment. 	<ul style="list-style-type: none"> – Develop a strategic plan for the digital transformation of the education system, with secured funding for continuous improvement and sustainability.

Priority interventions by area

Scope of ICT policy governance	<ul style="list-style-type: none"> – Develop a comprehensive multisectoral and cross-sectoral vision of the policy. – Update relevant and pertinent regulatory and action frameworks and mechanisms to implement an ICT policy (including guidelines, initiatives, and recommendations). – Design a National ICT Plan for the education system with emphasis on digital inclusion and learning opportunities. – Lay the foundation for an ICT policy monitoring and evaluation system, with emphasis on learning opportunities. 	<ul style="list-style-type: none"> – Update regulatory frameworks in light of supranational and regional agreements, including cross-cutting issues such as privacy, data protection, innovation policies, coordination with the productive ecosystem, etc. – Develop a communication plan for the ICT policy, including a permanent survey of perceptions and expectations of society and the educational community, the consolidation of the Brand and contributing to the transparency of government actions. – Consolidate the ICT policy monitoring and evaluation system with emphasis on pedagogical appropriation and learning opportunities. 	<ul style="list-style-type: none"> – Promote greater administrative, pedagogical and financial autonomy of schools. – Generate a system of incentives for innovation. – Establish a specific fund for the promotion of experimental initiatives aimed at the innovative inclusion of technologies to improve learning opportunities, with special emphasis on the development of hybrid formats. – Consolidate the intermediate level of permanent support between the educational units and the central agencies in charge of the ICT Policy.
Scope of the pedagogical model with emphasis on digital knowledge learning	<ul style="list-style-type: none"> – Update curricula at some educational levels, prioritizing secondary education, with content in computer science and related disciplines, ICT content that cuts across the different disciplines, and socioemotional competencies. – Develop regulations and implement experimental hybrid initiatives, especially in secondary education. – Develop and promote the production of open educational resources (OER). – Accompany schools in the process of digital inclusion, with the assignment of qualified technical personnel for technological support and assistance to teachers. 	<ul style="list-style-type: none"> – Update the curricula for all levels and modalities of the education systems, with content in computer science, ICT content that cuts across the different disciplines, and socioemotional competencies. – Develop a learning management platform and Ed Tech solutions with interoperability with other platforms and management systems. – Strengthen the tasks of accompanying schools with technical teams of high technical and pedagogical expertise and with stable appointments and territorial scope. – Implement institutional evaluation and self-evaluation model and mechanisms for technology projects in the school. 	<ul style="list-style-type: none"> – Implement a system of permanent curricular updating of contents related to Computer Science or Informatics, ICT content that cuts across the different disciplines, and socioemotional competencies. – Consolidate a comprehensive transformation of hybrid school formats with ICT inclusion for the entire education system. – Consolidate an intermediate level of management and support (technical teams, inspectors, etc.) with expertise and autonomy for the work and experimentation in schools.

Continued →

Connectivity, technological infrastructure and access to devices

- | | | |
|--|--|--|
| <ul style="list-style-type: none">- Ensure 4G coverage of at least 80% of the population.- Ensure fixed broadband coverage of at least 20% of rural households.- Universal service plans not specific to schools, although the Digital Agenda has a chapter for the education sector.- Access to basic broadband service at a price below 6% of GDP per capita.- At least 30% of schools with Internet access, 50% of secondary schools with a digital lab | <ul style="list-style-type: none">- Ensure 4G coverage of 80% to 90% of the population.- Ensure fixed broadband coverage of 20% to 60% of rural homes- Universal service plans with deployment targets in rural areas- Access to basic broadband service at a price between 3% and 6% of GDP per capita- Promote alternative connectivity models- Strengthen alliances with regulators and the private sector for the provision of services.- Ensure access to devices in the school environment exclusively or with delivery to students- Assign delivery of devices to teachers- Appoint persons responsible for the maintenance of the technological infrastructure in educational institutions.- 50% of all primary and secondary schools with access to digital labs | <ul style="list-style-type: none">- Ensure 4G coverage of 90% of the population.- Ensure fixed broadband coverage of up to 60% of rural households- Have an updated National Telecommunications Plan, with adoption goals.- Achieve average fixed broadband speeds of up to 70 Mbps and mobile broadband speeds of up to 25 Mbps.- Universal service plans with goals in primary and secondary schools, and specific plans in rural areas.- Access to basic broadband service at a price below 3% of GDP per capita.- Achieve full connectivity in primary and secondary schools, complemented by digital laboratories.- Use connectivity models based on Wi-Fi technologies for schools and students.- Ensure that every student and teacher have access to a PC with broadband access (fixed or mobile).- Budget and administrative processes for the maintenance of technological infrastructure in educational institutions have already been formulated. |
|--|--|--|

Teacher and administrator training

- | | | |
|--|---|--|
| <ul style="list-style-type: none">- Develop a jurisdictional plan for teacher training with ICTs.- Review background information and develop curricular standards for initial teacher training and/or performance (see: frameworks of reference) for the inclusion of ICT and computer science content or Computational thinking and digital citizenship- To lay the foundations and carry out an initial development of a system for monitoring and evaluating ICT policy, teacher training and teaching.- Guarantee budget for teacher training | <ul style="list-style-type: none">- Create an area of the educational administration in charge of coordinating initiatives for ICT teacher training.- To develop a plan of jurisdictional scope for initial and continuous teacher training with the inclusion of ICT knowledge for all educational levels and modalities. It is regulated by law.- To reach a consensus and update the rules and regulations of the professional teaching career with regard to training, mobility and incentives addressing the inclusion of ICT in the education system. | <ul style="list-style-type: none">- Strengthen an area of the educational administration in charge of coordinating initiatives for teacher training with ICTs and evaluating and sustaining a broad territorial plan for initial and continuous teacher training with the inclusion of ICT knowledge, regulated by law.- Strengthen the mechanisms for accreditation, follow-up and evaluation of the offer |
|--|---|--|

Protection of minors in the digital environment

- | | | |
|---|---|--|
| <ul style="list-style-type: none">- Developing regulatory frameworks for the protection of minors in the digital world- Strengthen institutions and mechanisms for the treatment of rights and crimes against children and youth in the digital world.- Develop specific rules and regulations on digital rights in the education system.- Developing an awareness and training plan- Strengthening technical teams | <ul style="list-style-type: none">- Establish or update the strategy for the protection of children and youth in the digital world, considering the different stakeholders involved.- Establish a comprehensive regulatory framework for the recognition of the rights and protection of children and youth in the digital world, including preventive, punitive and remedial measures.- Strengthen the judicial system with technical capabilities, budgets and knowledge to address crimes in the digital world.- Strengthen technical and professional teams to act with solvency in prevention, assistance and repair. | <ul style="list-style-type: none">- Establish permanent mechanisms for updating the national strategy for the protection of children and youth in the digital world, including the different sectors of society and the scientific community, with emphasis on the development of codes of good practices and appropriate responses to technological changes.- Ensure the implementation of online security policies in the digital ecosystem.- Ensure partnerships with CSOs working to protect children online, including mechanisms for the private sector to identify, block and eliminate online child abuse. |
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Continued →

Management and information systems area

- Have a strategic plan for the development of an educational management information system (EMIS) with general guidelines and a vision of data comprehensiveness.
 - Implement a nominal student system
 - Digitization of priority educational management processes
 - Strengthen the technology units at the central and decentralized levels in terms of technological floors, computer equipment and technical-professional skills.
 - Complete the digitalization of critical educational management and system administration processes: school, personnel, resource, infrastructure and equipment management systems.
 - Develop an updated monitoring and control system that consolidates management indicators on: supply, education (trajectory), positions, absenteeism, expenditures, school buildings and equipment, investments, with cross-referencing of variables, standardized test results, academic results, school environment.
 - Expand the functionalities of the student system.
 - Consolidate the digital transformation of the education system, focusing on the management of institutions to provide information to all levels of government and the improvement of the education system.
 - Add functionalities, with early warning systems for risk and data analysis, based on management indicators, prospective analysis of school supply and demand, and information for service programming.
-

Considerations for roadmap costing

As explained above, the roadmaps are the result of the application of the diagnostic tool and the actual starting conditions in relation to the different dimensions defined in each territory. Therefore, as a basis for the development of global costing parameters, a set of components are defined

for estimating the investment of the action plan, as well as some assumptions that must be considered when defining the costing of the roadmap. Under this consideration, the proposed model defines costing criteria per component.

Costing assumptions

The calculation of the cost of each roadmap will vary according to the enrollment data, the number of educational centers per level, the number of teachers per function at each level, the initial technological layout, as well as the pedagogical model adopted, among other elements to be considered at the initial stage. This implies that, in order to estimate the cost of implementing the roadmap, a set of physical indicators should be developed and projected over the estimated policy implementation period (considering a time horizon of 2030).

In addition, it is recognized that each government agency already has administrative and operational structures in place to provide education services. Within the framework of the implementation plan, many of the defined activities should be part of the regular activities of the project management,

and therefore are not considered as additional expenses to be applied as a cost of this policy (sunk-cost consideration). Therefore, the pre-existing budget allocation prior to the implementation of the roadmaps should be considered to be part of the financing needs of the project. In those cases where new activities are proposed, the inclusion of technical personnel should be considered and included in the cost as an operating expense.

For costs related to teaching tasks, the average values of personnel, according to category or level, are considered. For the calculation of infrastructure, connectivity, equipment and specific technical work costs, international consulting values in U.S. dollars (USD) are considered.

Consideration of costs by components

The costing variables considered are presented by performance dimension based on the evolution by levels: in other words, what a country must invest (at the national or

subnational level) to move from one level to the next in each of the dimensions.

Governance of public policies and/or national programs for the inclusion of technology in education systems

Level I: first steps toward Level II: consolidation of progress

To move from Level I to Level II in ICT policy governance, an area must be created with technical teams of specialists in the following areas: operations/technical (technical service, information technology services, telecommunications, data processing and protection), education/learning (training, professional development, disciplinary specialists, educational

technologies), support (communication, quality, evaluation and monitoring, administration, logistics, legal). Once the technical teams are formed, they will receive regular training in technological advances and professional development opportunities.

Concept	Criteria	Financial indicator
Creation of an area with technical teams	20 core specialists (at a national level, 12 specialists at subnational levels), plus 2 per educational level included in the ICT policy	Average high-level professional salary (depending on country and exchange rate)
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50

Once formed, the technical teams should focus on developing the ICT policy, for which it will be necessary to make a diagnosis of the ICT inclusion/improvement situation by educational center (schools, among others).

Concept	Criteria	Financial indicator
Assessment of the situation of ICT inclusion/one survey per educational center.	Consider the number of educational centers at the level(s) contemplated under the policy.	USD 18 average survey value per educational center (calculation based on the number of centers surveyed per day) One-time cost

In order to build the program's image and raise public awareness of the inclusion of ICTs in the education system, a communication plan for the ICT policy in education is planned, with a variable cost.

Concept	Criteria	Financial indicator
ICT policy communication plan	2 specialists (social communicators) or agency	Average high-level professional salary (depending on country and exchange rate)
	Production of dissemination materials	Variable according to the dimension of the communication plan
	Media buying	Recurring cost

Additionally, this dimension includes the development and implementation of follow-up, monitoring and evaluation systems for digital policy, pedagogical models and teacher training.

These developments should take into account existing systems and the consideration of the country's development standards as aspects of interoperability.

Concept	Criteria	Financial indicator
Follow-up, monitoring and evaluation system for digital policy and pedagogical models. Implementation of ICT policy evaluations	The cost of the evaluation is calculated as a percentage of the cost of the program.	Consider program evaluations as 20% of direct ICT policy spending. Carried out over three-year periods
Adjustments to teacher training evaluation systems	600 hours programming x module	USD 50 x hour programming + 50% coordination + expenses One-time cost

Level II: consolidation of progress toward Level III: toward maturity

In order to move from the initial state Level II to Level III, the national or subnational government must strengthen the technical teams, mentioned above, in terms of quantity

and quality. Likewise, the teams must be improved in their technical competencies to carry out the ICT policy. To this end, consideration should be given to:

Concept	Criteria	Financial indicator
Strengthen the area with technical teams	Complement teams by development areas (approx. 40-80 additional [hours? People? Resources?] depending on the situation) core specialists, plus 2 per educational level included in the ICT policy.	Average high-level professional salary (depending on country and exchange rate)
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50

Like in Level I, it is necessary to assess the situation of ICT inclusion/relevance of each educational center.

Concept	Criteria	Financial indicator
Assessment of the situation of ICT inclusion/one survey per educational center.	Consider the number of educational centers at the level(s) contemplated under the policy.	USD 18 average survey value per educational center (calculation based on the number of centers surveyed per day) One-time cost

In order to continue building the program's image and raise public awareness about the inclusion of ICTs in the education system, a communication plan for the ICT policy will be expanded.

Concept	Criteria	Financial indicator
ICT policy communication plan	4 specialists (social communicators) or agency	Average high-level professional salary (depending on country and exchange rate)
	Production of dissemination materials	
	Media buying	Variable according to the dimension of the communication plan Recurring cost

If not previously developed, this dimension includes the development and implementation of follow-up, monitoring and evaluation systems for digital policy, pedagogical models and teacher training.

These developments should take into account existing systems and include development standards as aspects of interoperability.

Concept	Criteria	Financial indicator
Follow-up, monitoring and evaluation system for digital policy and pedagogical models. Implementation of ICT policy evaluations	The cost of the evaluation is calculated as a percentage of the cost of the program.	Consider program evaluations as 20% of direct ICT policy spending. Every three years
Completion of teacher training evaluation systems.	400 hours of programming x module	USD 50 x hour programming + 50% coordination + expenses One-time cost

Level III: From maturity onwards

At this time, the country (national or subnational jurisdiction) is at a level of maturity of ICT policy. Therefore, the creation of an Innovation Agency is proposed, which requires the consolidation of a basic organic plant to assume the functions of the ICT policy and the coordination of actions

with other actors. Additionally, profiles may be required for the implementation of incentive programs for innovations. To this end, management groups should be formed for these programs. It is also recommended that the technical staff of the central team be trained on an ongoing basis.

Concept	Criteria	Indicador financiero
Conformation of the Innovation Agency plant	To complement technical and administrative teams. It is estimated that a nationwide program of approximately 400 technical and administrative profiles (source: Plan Ceibal-Uruguay, Educ.ar-Argentina, and Enlaces-Chile).	Average higher technical salary (depending on country and exchange rate) Administrative salary (depending on country and exchange rate)
For each program to be developed: ICT innovation promotion program. Creation of an innovation fund Incentive program for teachers and schools Development of a research and innovation fund with other stakeholders	For each program: 1 specialist + 2 technicians	Average high-level professional salary (depending on country and exchange rate) Average higher technical salary (depending on country and exchange rate)
Strengthening and training of technical teams	10 hours training x year x profile	International training hour: USD 50

Diagnostic activities do not require a survey, and therefore should be carried out with available resources.

In order to continue building the program's image and raise public awareness about the inclusion of ICTs in the education system, a communication plan for the ICT policy is planned.

Concept	Criteria	Financial indicator
ICT policy communication plan	4 specialists (social communicators) or agency	Average high-level professional salary (depending on country and exchange rate)
	Production of dissemination materials	Variable according to the dimension of the communication plan
	Media buying	Recurring expense

The follow-up, monitoring and evaluation systems are operational and do not require additional budget.

At this level, innovation is an aspect that requires special development. To that end, the development of three programs is proposed:

Concept	Criteria	Financial indicator
ICT innovation promotion program Creation of an innovation fund	Project funding per school according to presentations. Average 15% of educational centers per year	Average allocable fund of USD 3,000 per project. Recurring expense
Incentive program for teachers and schools for the development of innovative projects in the area of ICTs.	Teachers and schools with innovative projects	2% of each teacher's salary Assignment of 4 teaching hours for project development. Recurring expense
Development of a research and innovation fund with stakeholders from other levels of government or from the private or community sector.	Establishment of a research and innovation fund	1% of the total budget allocated to ICT policy (source: experience in Argentina). Recurring expense

Pedagogical model

Level I: first steps toward Level II: consolidation of progress

To move from Level I to Level II, the national or subnational government must strengthen the technical teams at the central level to update the pedagogical model. At the first level, technical teams should be hired to carry out a curricular

change that includes ICT content, the development of curricular documents and the analysis and proposal of initiatives with hybrid formats:

Concept	Criteria	Financial indicator
Creation of an area with curricular technical teams	5 core specialists, plus 2 per educational level included in the ICT policy	Average high-level professional salary (depending on country and exchange rate)
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50

At this level, the development of experimental initiatives of hybrid formats is expected. For that purpose, the creation of a variable fund per school is proposed. Likewise, it is

promotes a fund for the production of content OER (open educational resources) . These funds will be allocated through public competition.

Concept	Criteria	Financial indicator
ICT innovation promotion program Creation of an innovation fund	Allocation of 1 for every 50 establishments for the development of hybrid format experiences per year.	Average allocable fund of USD 5,000 per project. Includes HD camera, sound equipment, electronic whiteboard and development materials. Recurring expense
Competitive grant for Open Educational Resources development	Competitive grant to recruit 3 specialists for coordination and follow-up of proposals.	Competitive grant for USD 50,000 per year for OER production Technical team salaries Recurring expense

In order to develop an ICT policy for all levels with an adequate implementation, it is necessary to strengthen the technical teams at the decentralized level (local or regional). At the

first level, the presence of one technical profile for every 10 educational centers is recommended.

Concept	Criteria	Financial indicator
Technical support teams for the implementation of the ICT policy	1 technician every 10 schools	Average high-ranking technical salary (depending on country and exchange rate)

Level II: consolidation of progress toward Level III: toward maturity

As noted for the governance model, in order to move from Level II to Level III, the national or subnational government must strengthen the technical teams and improve their technical

competencies to implement the ICT policy. To ensure this, the following disbursements should be considered:

Concept	Criteria	Financial indicator
Strengthening of an area with curricular technical teams	Reach 7 core specialists, plus 2 per educational level included in the ICT policy.	Average high-level professional salary (depending on country and exchange rate)
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50

En este nivel se espera un aumento en los fondos destinados a la evaluación y mayor desarrollo de iniciativas de formatos híbridos. Para ello, se propone una evaluación de las iniciativas experimentales y el fortalecimiento de un fondo variable por

escuela para promover las iniciativas. Asimismo, se aumenta el fondo asignado por concurso para la producción de REA (recursos educativos abiertos).

Concept	Criteria	Financial indicator
Evaluation of hybrid format initiatives	Percentage of cost of allocation of experimental initiatives	20% of the cost of the experiences One-time cost
ICT innovation promotion program. Increase of the innovation fund	Allocation of 1 for every 10 establishments (preferably secondary level) for the development of hybrid format experiences each year.	Average allocable grant of USD 5,000 per project. Includes HD camera, sound equipment, electronic whiteboard and material development. Recurring expense
Open educational resources Competitive grant	Competitive grant 3 specialists for coordination and follow-up of proposals	Competitive grant for USD 100,000 per year for OER production Technical team salaries Recurring expense.

In order to strengthen the intermediate level of support to schools for all levels with adequate implementation (e.g., inspectors, supervisors, regional teams), it is necessary to

strengthen the technical teams at the decentralized level (local or regional). At the second level, the presence of one technical profile for every five schools is recommended.

Concept	Criteria	Financial indicator
Technical support teams for the implementation of the ICT policy	1 technician every 5 schools	Average high-ranking technical salary (depending on country and exchange rate)

Level III: from maturity onward

At Level III, the national or subnational government's performance is high. To this end, the digital transformation of the education system is promoted. To this end, the components

of strengthening the technical teams at the central level, the evaluation of hybrid format initiatives, and the consolidation of decentralized teams are proposed, as in level II.

Concept	Criteria	Indicador financiero
Strengthening of an area with curricular technical teams	Reach 7 core specialists, plus 2 per educational level included in the ICT policy.	Average high-level professional salary (depending on country and exchange rate)
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50
Evaluation of hybrid format initiatives	Percentage of allocation cost of experimental initiatives	20% of the cost of the experiences One-time cost
Grant fund/Funding grant Open educational resources	Grant fund/Funding grant 3 specialists for coordination and follow-up of proposals	Competitive grant for USD 150,000 per year for OER production Technical team salaries Recurring expense
Technical support teams for the implementation of the ICT policy	1 technician every 5 schools	Average high-ranking technical salary

At this level, a program is proposed to scale the implementation of hybrid/innovative formats to the entire education system, based on the evaluation of the experience.

Concept	Criteria	Financial indicator
New model implementation program/scale-up models	All the establishments that have not participated in previous projects	Average allocable fund of USD 5,000 per project. Includes HD camera, sound equipment, electronic whiteboard and material development. Recurring expense

To monitor activities at the local level, it is suggested that computerized management support modules be implemented at the decentralized levels.

Concept	Criteria	Financial indicator
IT development to support and back-up of the accompaniment tasks	1,200 hours programming x module	USD 50 per hour programming plus 50% coordination plus expenses One-time cost

At this level, it is expected that the digital transformation of the education system will reach a national level and bring together different social actors. Two types of tasks are proposed to be developed in this exchange:

Concept	Criteria	Financial indicator
Consolidate production of technological solutions with industry / support start-ups and incubators	Percentage of program cost	1% of the total amount of the cost of the policy Recurring expense
Implement a model of technological surveillance, research and dissemination of experiences.	Percentage of program cost	1% of the total amount of the cost of the policy Recurring expense

Connectivity, access to devices and cloud content

In this dimension, costs do not differ by performance level, except for the deployment of advanced technology laboratories, which occurs at level 3 and above.

Level I: first steps toward Level II: consolidation of progress

Broadband deployment scheme per household:

The cost of deploying fiber optic broadband is a function of the construction of the access network and the home connection.

Concept	Criteria	Financial indicator
Deployment cost depends on building density	Urban center	Cost per household: USD 700
	One thousand homes per square mile	Cost per household: USD 800
	One hundred homes per square mile	Cost per household: USD 2,000
	Ten homes per square mile	Cost per household: USD 3,500
Connection cost	Cost per household	USD 500

Alternatively, the cost of the basic digital basket per household includes monthly connectivity plans, a laptop, a smartphone and a tablet. This results in:

- Access for unconnected households. On average, the countries of the region should make an investment of around 1% of GDP, although with large differences among them.
- Cost of the basket in relation to average monthly income: Chile: 3.6; Ecuador: 8.8; Colombia: 7.5; Argentina: 4.4.

Broadband deployment plan per school:

The cost of school broadband deployment is a function of the technology to be used, which in turn depends on its location.

Concept	Criteria	Financial indicator
Connection cost (rural school)	Optical fiber	Connection cost: USD 6,000 + operating (Source: interviews) (one-time cost)
	Satellite	USD 300 (annual cost) (Source: Conectar Igualdad)

Device access plan per school:

At level I, all schools at one level (primarily secondary level) must have access to devices and connectivity. To move on to levels II and III, access to devices is universalized, ensuring that every student has access to a device and appropriate levels of connectivity throughout the territory.

At the school level, a technological floor and basic equipment for school management (administrative function) should be completed, with the following criteria:

Concept	Criteria	Indicador financiero
Technology floor per school, including 2 rackable servers (content and communications); electrical, voltage stabilizer and security systems; school-wide Wi-Fi wiring/wireless router	Ensure technological floor for each school of the level of advancement of the ICT policy	Average server cost: USD 2,350 Average router cost: USD 260 Voltage stabilizer: USD 70
Implement a model of technological surveillance, research and dissemination of experiences. 3PC Projector Laser printer	For each educational center	Average cost PC: USD 1,000 Base software: USD 55 Projector: USD 500 Multifunction printer: USD 300

Consideration should be given to replacing or updating this equipment every five years (20% of facilities per year).

management system is also considered (the cost depends on the extension of the platform, between USD 700,000 in Argentina and USD 300 million in Panama).

The need to implement a platform to integrate contents and applications within an integrated learning

Level III requires the incorporation of AI labs:

Concept	Criteria	Financial indicator
Artificial Intelligence Laboratory (AI lab)	1 per educational center	Cost USD 1,200

Distribution plan of devices for teachers:

Prior delivery of equipment must be considered. One device per teacher must be delivered, considering an update every five years (20% of equipment/teacher).

Concept	Criteria	Financial indicator
Equipment for teachers	One device per teacher (do not include teachers who already have a device, unless it was delivered more than 5 years ago).	Average cost Equipment: USD 1,000 Software: USD 56

**Distribution plan of devices for students by educational level
(Source: Educ.ar):**

Concept	Criteria	Financial indicator
Initial level classrooms- 4- and 5-year-olds	Tablet cabinets (to store and recharge 5 to 10 tablets). 1 cart for every 3 sections	Average cost Storage carts: USD 700 Upgraded PC (teaching) USD 1,000 Tablet x unit USD 70 Communications software Maintenance/spare parts 10
Primary level-1st and 2nd grade: MDCs with tablets	Mobile digital classrooms (MDCs) with tablets (wheeled carts to store and recharge 20 to 30 tablets, which can be moved from classroom to classroom) 1 cart every 3 sections	Average cost Storage carts: USD 700 Upgraded PC (teaching) USD 1,000 Tablet x unit USD 70 Communications software Maintenance/spare parts 10
Primary level - 3rd and 4th grade: MDCs with netbooks	Mobile digital classrooms (MDCs) with netbooks (wheeled carts to store and recharge 20 to 30 netbooks, which can be taken from one classroom to another) 1 cart for every 3 divisions	Average cost Storage carts: USD 700 Upgraded PC (teaching) USD 1,000 Netbook x unit USD 250 Communications software Maintenance/spare parts 10
Primary and secondary level - 5th grade and upwards: 1:1 Netbooks programs. The student receives a netbook on loan that can be used at home or at school.	1 netbook per student 5th grade delivery and 9th grade upgrade At least one device replacement is proposed to ensure coverage of the entire mandatory cycle. 1:1 Netbook programs (the student receives a netbook on loan that can be used at home or at school).	Netbook: USD 250 Maintenance/spare parts 10

Professional development for teachers and administrators

Level I: first steps toward Level II: consolidation of progress

To move from Level I to Level II, the national or subnational government must strengthen the technical teams at the central level in the area of teacher and management training to ensure

the development of teaching competencies linked to ICT policy. At the first level, technical teams must be contracted in order to implement an adequate training plan.

Concept	Criteria	Financial indicator
Strengthening of an area with curricular technical teams	5 core specialists, plus 2 per educational level included in the ICT policy	Average salary for senior professionals
Strengthening and training of technical teams	20 hours training x year x profile	International training hour: USD 50

In order to develop a training plan and improve the supply of training, two surveys are required: a needs assessment and diagnosis of teacher training, and a survey of training institutions and evaluation of their capabilities.

Concept	Criteria	Financial indicator
Census and survey of training needs	Cost per teacher	Cost of teacher census One-time cost
Cost of survey of training institutions and diagnostics	Cost per institution	Cost of census of training institution One-time cost

At all levels, the training of teachers and administrators is a central policy axis. Graduation refers to the level of ICT policy progress according to levels and types of training formats and modalities. In all cases, the design and implementation of a system for monitoring and evaluating ICT policies in the training system, academic programs and teacher evaluation should be foreseen.

Concept	Criteria	Financial indicator
Virtual training program Includes: a) training materials; systematization, curatorship and/or production; b) maintenance of virtual platform; c) teachers and tutors/coordinators; d) training materials; systematization, curatorship and/or production; e) maintenance of virtual platform.	Overall cost: production of materials and platform maintenance Conduct of training courses 50% of teachers	Cost of production of materials: USD 100,000 per year Platform maintenance USD 15,000/per condition Cost per teacher: US\$4 (Source: Browne, M., Alvarez, M. and Gardyn, N (2020) El Derecho a la educación en números: ¿cuál es la inversión necesaria para cumplirlo en los próximos 10 años? SES Foundation and UNICEF)
In-service training Includes amount for transfers, materials for teachers, etc.	100% of urban area establishments; 3 training sessions every 6 sections, 4 teaching hours per meeting; 3 sessions x 4 teaching hours x number of sections / 6	Cost of production of materials: US\$ 100,000 per year Cost per teacher: USD 20 (Source: Browne, M., Alvarez, M. and Gardyn, N (2020) El Derecho a la educación en números: ¿cuál es la inversión necesaria para cumplirlo en los próximos 10 años? SES Foundation and UNICEF)
Design and implementation of an ICT policy monitoring and evaluation system in the training system.	1,200 hours programming x module	USD 50 x hour programming + 50% coordination + expenses One-time cost
IT development for monitoring academic programs	600 hours programming x module	USD 50 x hour programming + 50% coordination + expenses One-time cost
Design and implementation of a teacher monitoring and evaluation system. System development	1,200 programming hours x module	USD 50 x hour programming + 50% coordination + expenses 20% of spending on teacher training One-time cost

All teachers and teacher training students will be provided with computer equipment:

Concept	Criteria	Financial indicator
Teacher trainers	Per teacher	Upgraded PC: USD 1,000
Students	Per student	Notebook: USD 250

Level II: consolidation of progress toward Level III: toward maturity

The cost of the teacher training policy is similar to that of level I. The difference refers to the scope of the training policy: in the first case, its scope is limited to one level, while in levels II and III, the scope is universal.

On the other hand, although the costing of the policy follows the same method, the contents of the training are different as a deepening of the ICT policy.

Level III: from maturity onwards

In order to deepen and sustain the training system for the development of ICT skills in teaching, this level proposes, in addition to what is considered in the previous levels, the

inclusion of hybrid formats for teacher training and professional internships.

Concept	Criteria	Financial indicator
Transformation of training into hybrid formats	By institution/classroom	Installation of hybrid classrooms plus pedagogical project; USD 5,000. One-time cost

Data protection and security

Level I: first steps toward Level II: consolidation of progress

To move from Level I to Level II, the national or subnational government must install a program for the development of regulatory and procedural frameworks for the protection of

minors in the digital world, with the definition of criteria for the development of standards for the use of the Internet and protocols for action.

Concept	Criteria	Financial indicator
Program for the development of regulatory and procedural frameworks	National study and proposal	Study of regulations and regulatory and process proposals Preparation of proposals Development of dissemination and training plan USD 250,000 One-time cost
Development of an outreach and public awareness program.	Development of documentary pieces and dissemination plan	Materials development: USD 50,000 Dissemination program (varies according to use of media) Recurring expense
Training program for teachers and staff working with children and young people	By faculty and staff	Unit cost: USD 10 per capita Recurring expense
Strengthening of technical teams for prevention and action (incorporation of profiles and training).	2 specialists per group of 10 schools	Average salary for senior professionals Recurring expense

Level II: consolidation of progress toward Level III: toward maturity

The cost of the data protection and security policy is similar, although with greater scope.

Level III: from maturity onwards

With the aim of deepening the security policy, specific programs are proposed that refer to the surveillance of digital policies and a research program.

Concept	Criteria	Financial indicator
Digital policy monitoring system	At the central level	Technology watch project USD 30,000 Recurring expense
Child protection research program online	At the central level	Technology watch project USD 30,000 Recurring expense

Information systems and education management

For the costing of the development of management systems, a set of factors must be considered, such as:

- The systems in use in the country: a) if they are proprietary developments; b) third-party developments; or c) free software;
- Survey available domestic and international systems and analyze reusable aspects;
- Interoperability aspects of the systems;
- The country's system development and licensing standards;
- The inclusion of data development and analysis tools (Business Intelligence type, or equivalent).

Other priority aspects to be taken into account at all levels of ICT policy development:

- Consolidation of professional technical teams to carry out a strategic plan for the development of the EMIS;
- Training in systems/computer areas;

- Strengthening of the technology units to sustain the changes (technological resources - technological floor, connectivity and equipment -, software and cloud support technology to face the change;
- Definition, development and implementation of a strategic information dashboard for management and decision making;
- Development and implementation of security modules for the protection of personal data and security of access and safeguarding of information;
- Development of standards, protocols and procedures to ensure system interoperability;
- Assembly of integration layer of available information.

The priorities identified are, first, to implement the nominal student system (or its completion), and then to move forward with the digitalization of educational management processes (development plan) and the implementation of a monitoring and control system for all components of the education system.

The systems development plan should aim at consolidating the digital transformation of the education system, focusing on schools. Some references of ICT policy implementation costs:

- Cost per student for ICT policy implementation in Uruguay: USD 100.
- Cost of developing administrative management systems for the education system according to IDB evaluation of country requirements, including connectivity costs:¹
- Secretariat of Education of Bogota USD 77 million;
- Ministry of Education of the province of Córdoba in Argentina: USD 5 million;
- Ministry of Public Education (MEP) of Costa Rica: USD 29 million; USD 48 training in computer areas USD 10,700 per school;
- Ministry of Education (MINED) of El Salvador USD 50 million;
- State Secretariat of Education of Espírito Santo, Brazil: R\$ 965,384;
- Municipal Department of Education of the Municipality of Florianópolis (SME) R\$ 1,380,000;
- Ministry of Education (SEDUC) of Honduras: USD 42 million;
- Ministry of Education, Youth and Information of Jamaica: USD 6,621,400 (initial) and USD 3,170,000 (recurrent);
- Ministry of Education (MEDUCA) of Panama: USD 24.5 million (does not include connectivity of the centers);
- Ministry of Education and Science (MEC) of Paraguay: USD 43 million;
- Ministry of Education (MINEDU) of Peru: USD 69 million;

- Ministry of Education of the Dominican Republic (MINERD): technological floor projected by República Digital: USD 30 million in five years, with a total investment per school of USD 4,200; Training in systems/computer areas: USD 37 million; Investment per school: USD 5,000; investment in Internet connectivity of educational centers: USD 56 million.
- Suriname Education Management Information System (EMIS) (Develop and implement system components (single registry, school, student and human resources management systems, financial management systems, digital content) and consolidate the Executive Management Information System; connectivity gaps in schools and training plan): USD 3,733,000 (initial) and USD 525,700 (recurrent).²

The priorities identified are, first off, to implement—or complete—the nominal student system to next move forward with the digitalization of educational management processes (development plan) and the implementation of a monitoring and control system for all the components of the education system.

The systems development plan should consolidate the digital transformation of the education system, focusing on schools.

¹ Arias Ortiz, E. et al. (2021) *Los Sistemas de Información y Gestión Educativa (SIGED) de América Latina y el Caribe: la ruta hacia la transformación digital de la gestión educativa*. [The Educational Management Information Systems (EMIS) of Latin America and the Caribbean: the social and digital transformation of educational management.] Education Division. Inter-American Development Bank. IDB Monograph, 933.

² The budget for the expansion of the student data enrollment system in Argentina (UNICEF-Generación Única: Project to support the establishment of the student enrollment module in SINIDE) has a budget of USD 338,830, which includes: system development costs (USD 59,467), strengthening of technical teams (USD 94,560), strengthening of technological architecture (USD 78,000) and development of strategies for schools without connectivity (USD 106,803).

Final recommendations

It is the central responsibility of countries to ensure access to and appropriation of digital technologies as a condition for consolidating democratic projects of inclusion and social justice for all citizens. Under this initial condition, it is key to deepen the incorporation of technologies from their pedagogical dimension to review and update educational practices and strengthen the learning processes of students of digital and socioemotional knowledge. In the context of the Pandemic, the inclusion of technologies is also an opportunity to mitigate the

effects of the crisis on the disengagement of students from the education system.

The following are some recommendations for the design and implementation of ICT policies in compulsory education in light of the commitments set out in the Sustainable Development Goals and in consideration of the challenges posed by the outbreak of the Pandemic by COVID-19. The following recommendations are presented disaggregated by the dimensions of analysis worked on:

Public policies and/or national programs for the inclusion of technologies in the education systems

- Design and implement ICT policies in compulsory education considering education as a right and digital technologies as public goods.
- Strengthen the governance of the agencies responsible for digital policies in education. It is necessary to ensure the political-strategic and technical-pedagogical directionality for the necessary interventions and improvements.
- Building sustainable ICT public policies with a high impact over time, beyond contingencies. Digital policy plans should specify objectives for the short, medium and long term, be based on the identification of strategic problems and be directed jointly with the educational priorities of the countries.
- Securing funding lines for the implementation of all strategic policy lines. This involves reviewing the funds needed for the policies as a whole and identifying additional sources of funding as required.
- Strengthen multi-sectoriality and the participation of various public and private actors, with special emphasis on the socio-productive sector and the country's scientific and technological system in the face of the human and institutional capacity requirements of Industry 4.0 and of the Ed Tech sector in particular.
- Promote differential policies aimed at guaranteeing digital inclusion through strategies tailored to each country and actions that take into account socioeconomic, territorial, age and gender criteria.
- Strengthen the training of technical-political actors involved in digital policies. Such training should recognize the strategic importance of digital policies, as they offer a specific potential to address the growing inequalities in the processes and learning outcomes of girls, boys and young people, with a regional perspective that recognizes the complexities and tensions that constitute the field of digital education.

- Develop hybrid models and innovative formats in schools in a permanent articulation with their needs and that can be adapted to suit the territories, levels and modalities and the needs of the communities.
- Update curricula for the integration of digital knowledge and socioemotional competencies. Emphasize the need to include content from the specific field of Computer Science and Informatics. This requires the creation of specific training instances for teachers so that they can teach these new contents in specific curricular spaces.

Connectivity, devices and cloud content

- Develop public policies for the distribution of digital devices based on a device ecology and promote initiatives to ensure universal access to quality Internet in schools. The technology distribution format and the device to be used will respond to the educational level and teaching modality.
- Periodically mapping the situation of the educational community in order to know the needs of technological infrastructure and connectivity both in schools and homes. This information should be the basis for digital policy initiatives at the national level that, on the one hand, expand coverage and improve the quality of the connection according to the possibilities of the different contexts based on public-private articulation schemes.
- Promote the inclusion of technological solutions that are articulated with the prescribed curriculum and with the topics prioritized in the educational agenda. It is key to identify that platforms, especially interoperable and state-of-the-art ones, play a central role in hybrid models and their selection is a fundamental aspect as they respond to various functionalities: learning management and monitoring, teaching of a particular area, synchronous communication and assessment. Similarly, strengthening the development of open educational resources.

Professional development for teachers and administrators

- Strengthen teacher training policies in the pedagogical use of digital technologies and in the appropriation of new digital knowledge. Strategies for teacher training and careers in the use of digital technologies should include training strategies located in schools, communities of practice and attention to the new hybrid formats required.
- Prioritize pedagogical approaches in teacher training based on technological tools that allow the deployment of innovative educational practices, going beyond the mere instrumental use of digital tools.
- Promote management, leadership, innovation and project management skills in school management teams through specific training. In this scenario, it is strategic to strengthen the role of management teams, assuming that strategic planning must be built on the basis of problems that arise in a situational manner and that the creation of hybrid models requires transformations both in institutional conditions and in the position assumed by its actors.
- Train and strengthen intermediate levels (technical teams, ICT referents and facilitators and inspectors) in order to build the installed capacity of teaching teams and train management teams and supervisors to provide adequate institutional spaces for digital inclusion proposals.

Data protection

- Develop a national strategy for the protection of children and youth online and mobilize the collective action of all stakeholders to minimize risks and threats and to take advantage of the opportunity provided by technological deployment for their development, while respecting the right of children and youth to be free from all forms of violence, abuse and exploitation.
- Ensure regulatory and procedural means to prevent, detect, respond, act and redress any type of online abuse, including clear, communicable and appropriate procedures for the reporting of children and youth.

Interoperable information systems

- Strengthen and prioritize the development of student management systems that include the monitoring of school trajectories, strategies to promote online learning and early warning systems for dropouts.
- To start the path toward the digital transformation of the education system, focusing on the management and evaluation of educational centers, teaching teams, students with their needs and expectations.

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United Nations (S/f) Digital Human Rightx. Ensuring the protection on human rights.

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Annex 1. Documentary sources supporting the development of the roadmaps

The roadmaps were designed based on the survey, review and analysis of regional and international experiences, interviews with reference persons and documentary sources for each of the dimensions (see tables 1 to 7).

Table 1
Experiences surveyed in the planning subdimension

Country/institution	Experience	Source
South Korea (Korea Education and Research Information Service - KERIS)	South Korea has been developing 5-year master plans for the implementation of ICT in education since 1996; the current sixth plan covers the period 2019-2023. The main agency responsible for carrying out these plans is the Korea Education and Research Information Service (KERIS) under the Ministry of Education. KERIS develops and advises on current and future government policies and initiatives related to education, provides educational information and research services, and fosters global cooperation to share knowledge and experiences of ICT in education.	Korea Education and Research Information Service: https://www.keris.or.kr/eng/cm/cntnts/cntntsView.do?mi=1172&cntntsId=1321 Gruffat et al. (2020) Towards a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America. CAF/ C4IR/INTEL. Retrieved from: t.ly/xBcO
Portugal (Council for Information and Communication Technologies in Public Administration - CTIC)	The need to define a common strategy driven from the center of government for the operation of the digital transformation strategy determined the creation of the Council for Information and Communication Technologies in Public Administration (CTIC). The CTIC is composed of a Technical Committee (TC) and an Advisory Committee. The TC includes representatives from: the Administrative Modernization Agency (AMA), who presides it as an independent public body, with administrative and economic autonomy; the Government's Computer Network Management Center (CEGER); the Public Administration Shared Services Entity (ESPAP); and one representative from each Ministry responsible for ICT. The CTIC Advisory Committee is made up of five independent and recognized experts in the area of administrative modernization and ICT, appointed by the Prime Minister or the government official in charge.	CAF (2021) Portugal: The leap to digital transformation. Retrieved from t.ly/1qxW
Uruguay (Ceibal Plan)	The Ceibal Center for the Support of Education for Children and Adolescents, known as Plan Ceibal, is a public agency in Uruguay aimed at generating inclusion and equal opportunities with the support of technology and constituted as a center for educational innovation with digital technologies. Plan Ceibal provides children and adolescents who enter the public education system with a computer for their personal use with free Internet connection from the educational center and provides the education system with a set of programs, educational resources and teacher training to transform the ways of teaching and learning. The Ceibal Foundation is an autonomous organization oriented to problematize and contribute ideas and solutions to the challenges related to learning and the mediation of technologies with innovative methodologies within the framework of the implementation of the Ceibal Plan and other national and international educational contexts.	Plan Ceibal - Institutional. https://www.ceibal.edu.uy/es/institucional Fundación Ceibal - Institutional. https://fundacionceibal.edu.uy/acerca-de/
Colombia (Ministry of Information Technology and Communications, Ministry of National Education and the National Learning Service)	Computadores para Educar (CPE) is a program of the Colombian National Government, constituted as a second-order public entity, legally autonomous, with independent assets and its own management and control bodies. Its board of directors is made up of the Ministries of Information and Communication Technologies, National Education and SENA. Currently, the development of the Technologies to Educate plan aims to expand the focus of the CPE program to promote innovation in educational practices based on digital technologies.	National Council for Economic and Social Policy (2020) Technologies for learning: national policy to boost innovation in educational practices through digital technologies. Retrieved from https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/3988.pdf
Argentina (COFEFUP)	The Federal Council of the Public Function (COFEFUP) is the meeting place that the Argentine provinces and the Autonomous City of Buenos Aires have chosen to reflect on and discuss the main topics related to the modernization and innovation of public management in each jurisdiction. The presidency of the organization is held by the National Secretariat of Public Management and Employment, while the first and second vice presidencies are held by the provinces for a one-year term.	argentina.gob.ar/jefatura/gestion-y-employment-public-employment/cofefup

Table 2
Experiences surveyed in the Curriculum dimension
Institutional management (curricular regulations - curricular development - roles and organization)

Country/institution	Experience	Source
Argentina (Sadosky Foundation- Ministry of Science and Technology)	Program.AR. This initiative seeks to ensure the teaching of programming in secondary education by renewing the curricula of Information Technology or Technology Education courses. Among other activities, the Foundation conducts studies, generates teaching resources and supports provinces that are integrating programming into their curricula (for example, they carry out the Hora del Código program in Argentina). The Foundation also carries out training activities for teachers and students through partnerships with universities throughout the country. Development of its own curricula and its own platform to learn programming with a didactic sequence and formative comments designed for students.	https://pilasbloques.program.ar/
Uruguay (Ceibal Plan)	<p>These initiatives aim for all teachers to include activities that promote computational thinking in their classes, through projects that address problems related to the curriculum, where technological solutions involving programming resources, robotics or Makers can be developed. It is expected, therefore, that students will be motivated to work actively in collaboration; acquire a greater understanding of the digital world and develop logical reasoning, critical thinking and communication skills; build their own knowledge, learn by doing and, above all, develop problem solving skills, in particular, those that use computational thinking strategies (decomposition of a problem into sub-problems, pattern recognition, abstraction, algorithm design, etc.).</p> <p>The initiative Pensamiento Computacional en Primaria [Computational Thinking in Elementary School] proposes that 5th and 6th graders have two teaching hours per week on a project: one hour with a remote teacher specialized in robotics and programming via videoconference; and another with the class teacher. Both teachers meet weekly virtually to prepare activities and improve the course of the students' projects.</p> <p>The schools receive robotics kits, different types of cards, physicochemical sensors and waste material to build prototypes and models. The schools use videoconferencing equipment, as well as student and teacher laptop computers that received as part of the Ceibal Plan. Ceibal has requested the support of Fundación Telefónica to have professionals play the role of facilitators who teach one of the two weekly computational thinking sessions remotely via videoconferencing, which allows them to assist many more schools. Didactic guides have been prepared to support the teaching of computational thinking in primary schools. Ceibal commissioned teachers with knowledge of the local context to draft the guides.</p> <p>The proposal for secondary schools is the installation of a new space, called Ceibal, with its own technological resources where all teachers will find the means and the support of a facilitator for the development of their projects. The Ceibal will have a wheeled cart with 15 laptops and 15 tablets with pre-installed programs; and a mobile trunk/trolley/cabinet with robotics kits, sensors (temperature, humidity, luminosity, etc.) and other control devices as well as various materials such as fabric, cardboard, sticks, glue, recycling, etc. The secondary school facilitators are ICT teachers or teachers of other subjects with interest and availability to support their colleagues within the institution.</p>	Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH .

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Country/institution	Experience	Source
Costa Rica (Omar Dengo Foundation-FOD)	<p>The FOD program begins in preschool with robots and then with block programming (Scratch), in second grade with storytelling, in third grade with geometry, music and nature. In the second cycle—fourth, fifth, and sixth grade—more cards and external elements are used (Makey Makey, Picoboard, Adafruit Circuit Playground). In sixth grade, they start with scripting, using Arduino. In seventh grade, they are introduced to Alice, oriented toward 3D objects. Eighth graders use engineering design, with some robots, Legos and Arduino. In ninth grade, students explore the Internet of Things, machine-to-machine communication, Big Data, networking, etc. This process starts from a very concrete level, moving forward with the same conceptual foundation with an iterative process for a deeper understanding of the concepts.</p> <p>The teachers of the Informatics in Education courses are graduates and have a university degree specifically for teaching this subject, with a disciplinary base in computer science and pedagogy. The FOD has developed curricula, resources and teaching guides, as well as a training and support structure for teachers throughout the country.</p>	<p>Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH.</p>
Colombia (Ministry of Labor - National Learning Service - SENA)	<p>Fortalecimiento de la enseñanza de la programación en las especialidades tecnológicas de la educación vocacional [Strengthening the teaching of programming in technological specialties in vocational education].</p>	
Colombia (Ministry of Education-ICT Ministry)	<p>Currículo Exploratorio con Énfasis en la Programación [Exploratory Curriculum with a Focus on Programming].</p> <p>Both initiatives focus on secondary technical education in the tenth and eleventh grades and aim to strengthen the pedagogical work of educational institutions that offer specializations in technological fields with new curricula and training strategies; renew the teaching of some institutions that have a course offering that is not attractive or relevant; and change some institutions with academic specializations into technical campuses or centers, thus generating a greater opportunity for technical training in technology.</p> <p>The teachers of the educational institutions participating in these initiatives receive training and support, as well as didactic material. In the case of the SENA-supported program, a knowledgeable professional assumes the role of instructor and works within the institution and in the classrooms, directly with the students. This instructor must coordinate their work with the classroom teacher in order to jointly cover the total number of modules and hours of the curriculum of the specialty. Similarly, in order to improve teachers' skills, both initiatives have promoted the formation of "teaching work communities," some virtual and others face-to-face, to promote learning through collaborative work, the exchange of significant experiences, the availability of digital resources, the recognition of good practices and success stories, as well as the organization of events such as fairs and competitions, among others.</p>	
Chile (Chilean Ministry of Education)	<p>Plan Nacional de Lenguajes Digitales [National Digital Languages Plan]. A set of initiatives aimed at promoting the teaching of programming and computational thinking in the school system. The first strategy would be implemented by the KODEA Foundation, which has been promoting programming among young people through the "Hour of Code" and other initiatives. Technology Education teachers will be trained and will receive material and guides; and will use the CODE STUDIO curriculum and platform, developed by the North American organization CODE.ORG (the same organization that organizes the "Hour of Code" worldwide). Teacher training begins with a two-day classroom session and is complemented by a 25-hour online training based on the CODE.ORG model. For the nationwide expansion of this strategy, the Ministry will contract civil society organizations in several cities across the country that will complement KODEA's work. The second strategy will be led by the TELEFONICA Foundation, which has a long track record in school projects and, in recent years, in teaching SCRATCH programming through the problem-based learning methodology. This part of the plan will train school leaders and teachers at all levels and subjects to help them incorporate the project-based methodology.</p>	<p>Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH</p>

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Country/institution	Experience	Source
Chile (Chilean Ministry of Education)	Plan Nacional de Lenguajes Digitales [National Digital Languages Plan]. A set of initiatives aimed at promoting the teaching of programming and computational thinking in the school system. The first strategy would be implemented by the KODEA Foundation, which has been promoting programming among young people through the "Hour of Code" and other initiatives. Technology Education teachers will be trained and will receive material and guides; and will use the CODE STUDIO curriculum and platform, developed by the North American organization CODE.ORG (the same organization that organizes the "Hour of Code" worldwide). Teacher training begins with a two-day classroom session and is complemented by a 25-hour online training based on the CODE.ORG model. For the nationwide expansion of this strategy, the Ministry will contract civil society organizations in several cities across the country that will complement KODEA's work. The second strategy will be led by the TELEFONICA Foundation, which has a long track record in school projects and, in recent years, in teaching SCRATCH programming through the problem-based learning methodology. This part of the plan will train school leaders and teachers at all levels and subjects to help them incorporate the project-based methodology.	Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH
Argentina (Ministry of Education)	Núcleos de Aprendizaje Prioritarios Educación Digital, Programación y Robótica [Priority Learning Cores Digital Education, Programming and Robotics] (primary and secondary level). Developed through a process that included technical work, regional consultations, discussions and federal agreements, as of this resolution, digital education, programming and robotics are mandatory in all establishments in the country (2018).	https://www.educ.ar/recursos/150123/nap-de-educacion-digital-programacion-y-robotica
Uruguay (Ceibal Plan)	The traveling suitcase seeks to bring technological tools to Uruguayan public educational institutions and thus facilitate access to Plan Ceibal devices, favoring in a timely manner to those students who face motor, visual and/or cognitive barriers. The main objective of the traveling suitcases is for the teacher to know and offer a wide range of resources (either software or hardware) in order to determine the one that best suits the specific need(s) of a given student.	https://blogs.ceibal.edu.uy/formacion/certi/#lines
Uruguay (Ceibal Plan)	The Diseño Universal de Aprendizaje (DUA) [Universal Design for Learning] corresponds to a model for the development of multiple planning strategies, which is based on the idea that diversity is the norm, not the exception, and aims to correct the main barrier to learning and participation faced by many students, such as curricula designed and implemented in a uniform manner, without considering differences.	https://blogs.ceibal.edu.uy/formacion/certi/#lines

Table 3
Experiences surveyed in the initial teacher training subdimension

Country/institution	Experience	Source
Costa Rica	(1990s) University degree in pedagogy in educational informatics including computer science and education fundamentals, specially designed for teaching such courses in schools.	Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH
Uruguay (Ceibal Plan)	Course "Tecnologías en clave de Inclusión" [Technologies key to inclusion] taught by CeRTI Ceibal and designed by the Creática team, the purpose of which is to provide tools and methodologies that enable accessibility and inclusion in educational contexts. As for the contents offered, it presents a diversity of topics, all of them transversal to the educational curriculum and within the framework of the Universal Design for Learning. The proposed methodology is theoretical-practical. It offers practical applications and examples related to inclusive education through the use of technology. Aimed at teachers from all subsystems and teacher training students from all over the country.	At https://blogs.ceibal.edu.uy/formacion/certi/#lines

Table 4
Experiences surveyed in the continuing teacher training (CTT) subdimension

Country/institution	Experience	Source
Argentina (Sadosky Foundation-ProgramAr)	Network of computer science (CS) departments in universities throughout the country, which serve as a base for CS promotion, training and research activities	http://www.fundacionsadosky.org.ar/programs/program/
Argentina (Ministry of Education-Aprender Conectados Program)	Classroom accompaniment for mathematics teachers for a period lasting one to two semesters, after which they are expected to be able to continue to work independently	Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH
Chile	Teaching project-based learning and computational thinking concepts through online courses to thousands of teachers across the country.	t.ly/jaNH
Uruguay (Ceibal Plan)	Course "Tecnologías en clave de Inclusión" [Technologies key for Inclusion] taught by CeRTI Ceibal and designed by the Creática team, whose purpose is to introduce tools and methodologies that enable accessibility and inclusion in educational contexts. As for the contents offered, it presents a diversity of topics, all of them transversal to the educational curriculum and within the framework of the Universal Design for Learning. The proposed methodology is theoretical-practical. It offers practical applications and examples related to inclusive education through the use of technology. It is hosted on the CREA platform and its modality is virtual. It has a duration of 18 hours, with an asynchronous format. It is aimed at teachers from all subsystems and teacher training students from all over the country.	https://blogs.ceibal.edu.uy/formacion/certi/#lines .

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Country/institution	Experience	Source
Uruguay (Ceibal Plan)	Postgraduate degree "Innovation in practices with the use of open educational resources", which aims to certify knowledge and emerging practices in the creation and use of Open Educational Resources (OER) and is intended for in-service teachers, graduates of ANEP.	https://blogs.ceibal.edu.uy/formacion/formacion-educativa/
	Micro-workshops: short online courses, educational practices that support the production, use and reuse of Open Educational Resources. From the course, knowledge is generated collectively and in close relation to the practice itself. Intended for teachers.	https://blogs.ceibal.edu.uy/formacion/formacion-educativa/
Uruguay (Ceibal Plan)	The CeRTI Ceibal group exists on the CREA platform, which aims to promote a space for the exchange of resources, materials, strategies and experiences that allow to know what actions are being carried out in public education in Uruguay related to technology and inclusion. It seeks to generate networks and links based on what has been published that will make it possible to implement new actions. The purpose of this group is also for its participants to share innovations, projects and any other information they consider relevant to the topic. It is hosted on the CREA platform and its modality is virtual. It has a duration of 18 hours, with an asynchronous format.	https://blogs.ceibal.edu.uy/formacion/formacion-educativa/
	Aimed at teachers and teacher training students interested in exchanging experiences related to the use of technology as a capacity enhancer in the work of students with disabilities or learning barriers.	
Colombia	"Teaching Practice Communities" (virtual and face-to-face), which promote collaborative work, the exchange of experiences, resources, best practices and the organization of events, together with fairs and competitions, among other strategies.	Jara, I.; Hepp, P.; Claro, M. and Rodríguez, J. (2019). "Políticas y prácticas para la enseñanza de las Ciencias de la Computación en América Latina." [Policies and practices for Computer Science education in Latin America] Microsoft Latin America. At t.ly/jaNH
	Universities support policies to strengthen vocational education in CS.	
	Insertion of an external specialist directly in the schools, who assumes the role of a classroom teacher working directly with students on various CS topics (SENA).	
South Korea	The Korea Education and Research Information Service (KERIS) created the Edunet T-Clear platform as part of its master plan for ICT implementation. It offers online courses, lesson plans and teaching materials. The platform reached some 360,000 registered teachers in 2018; that is, more than 60% of the total teaching force.	Gruffat et al. (2020) Hacia una agenda integral de la adopción de tecnologías para el aprendizaje 4.0 en América Latina [Working toward a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America]. CAF/C4IR/INTEL. Retrieved from: t.ly/Dkac

Table 5
Experiences surveyed in the connectivity dimension, access to devices and content in the cloud

Country/institution	Experience	Source
Uruguay	The country is the most advanced in Latin America in terms of fixed broadband deployment, particularly in terms of fiber to the home. Connectivity to schools, teachers and students has been addressed in an integrated manner with the ICT policy within the framework of the Ceibal Plan.	https://blogs.ceibal.edu.uy/formacion/certi/#lines
Colombia	The Vive Digital Plan in its two iterations has boosted the development of connectivity in rural and isolated regions of the country.	CINTEL. Measuring the Impact of Vive Digital
Chile	The advancement of connectivity in the Chilean context has been the result of a state policy consistently applied by governments of different political parties.	Chile Digital
United States (Federal Communications Commission-Department of Education)	The Federal Communications Commission has implemented several programs aimed at broadband deployment in schools, libraries, and universities.	US Department of Education, National Center for Education Statistics (2018). The condition of education 2018. NCES 2018-144. Bulman, G. and Fairlie, R. (2016). Technology and Education: Computers, Software, and the Internet. National Bureau of Economic Research Working Paper 22237, Cambridge, Massachusetts, retrieved from: http://www.nber.org/papers/w22237 .

Table 6
Experiences surveyed in the dimension of child data protection and security

Country/institution	Experience	Source
Estonia	The information in Estonia is secured by a technology called Keyless Signature Infrastructure (KSI), which makes it impossible to change the data entered, and makes it possible to prove the authenticity of the stored electronic data.	Gruffat et al. (2020) Hacia una agenda integral de la adopción de tecnologías para el aprendizaje 4.0 en América Latina [Working toward a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America]. CAF/C4IR/INTEL. Retrieved from: t.ly/Dkac
South Korea	South Korea's Act on Protection of Children and Juveniles from Sexual Abuse establishes various penalties related to child pornography and its distribution, procedures for the care of victimized children and juveniles.	
Portugal	The SeguraNet Awareness Center has been promoting Digital Citizenship in educational communities since 2004, developing various initiatives, educational resources, campaigns and awareness and teacher training sessions.	
Singapore	Cyber Wellness (CW) in Singapore refers to the positive well-being of Internet users. The Ministry of Education uses the CW framework to work with, protect and empower children to take responsibility for their own well-being in cyberspace. CW education comprises: CW lessons in the formal curriculum and as school-wide programs.	
Research ICT Africa	The Global Responsible AI Index measures progress toward the responsible use and development of artificial intelligence in more than 100 countries around the world from a human rights perspective. The Global Index equips governments, civil society, researchers and other stakeholders with the key evidence needed to uphold responsible use principles in the development and deployment of AI systems, meet development and human rights obligations, build capacity for responsible AI worldwide, and deepen international cooperation.	https://researchictafrica.net/2021/11/30/research-ict-africa-to-lead-a-100-country-global-index-on-responsible-ai-assessment/

Table 7
Interoperable information systems

Country/institution	Experience	Source
Mexico	Mexico has a Registry Information System (RIS or SIR, for its acronym in Spanish) which, although it requires login credentials for certain data, it contains information on schools, their location and indicators; teachers and their trajectory; and student performance.	Gruffat et al. (2020) Hacia una agenda integral de la adopción de tecnologías para el aprendizaje 4.0 en América Latina [Working toward a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America]. CAF/C4IR/INTEL. Retrieved from: t.ly/Dkac
Costa Rica	Costa Rica has a Geographic Information System (GIS), which manages and visualizes, through maps and online services, the geographic data of the country's education system, hosted on public servers of the Digital Governance Directorate of the Ministry of Science, Technology and Telecommunications (MICITT).	Gruffat et al. (2020) Hacia una agenda integral de la adopción de tecnologías para el aprendizaje 4.0 en América Latina [Working toward a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America]. CAF/C4IR/INTEL. Retrieved from: t.ly/Dkac
Uruguay	Uruguay's EMIS provides different services (information management, resource management, budget management, etc.) and learning platforms, online assessments and analytics based on the use of learning management platforms and systems.	Gruffat et al. (2020) Hacia una agenda integral de la adopción de tecnologías para el aprendizaje 4.0 en América Latina [Working toward a comprehensive agenda for the adoption of technologies for learning 4.0 in Latin America]. CAF/C4IR/INTEL. Retrieved from: t.ly/Dkac. Arias Ortiz et al. (2019) From paper to the cloud: how to guide the digital transformation of Educational Management Information Systems (EMIS). IDB. Retrieved from t.ly/fNM8.
Estonia	Estonia has a school management platform called eKool, which is a 100% Internet-based system offered as software as a service (SaaS). It works through a web browser and can be accessed from mobile devices. Resources like e-learning platforms, e-bookstores, exam results and student queries, nationwide citizen registration, among others, are some of the products and services the platform offers.	Arias Ortiz et al. (2019) From paper to the cloud: how to guide the digital transformation of Educational Management Information Systems (EMIS). IDB. Retrieved from t.ly/fNM8.

Annex 2. Roadmaps by level of advancement for each dimension

Level 1 Roadmap
First steps - Governance of public policies and/or national programs for the inclusion of technology in education systems

Starting situation	Strengths	Opportunities	Preguntas orientadoras	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
ICT inclusion policies or programs in compulsory education are sectoral. There is little or no coordination with other areas of government or other sectors aimed at the socio-productive development of the country. It has a weak management, with no normative guidelines to guide actions. There are scattered initiatives that are not articulated in a national plan. There is no consolidated medium and long-term vision on ICT inclusion. There are specific public funds, but they represent less than 2% of the cost per student and private funds are discontinuous and do not correspond to pedagogical priorities. Monitoring and evaluation actions are incipient and there are no specific funding lines for this purpose.	Pandemic expansion of the Edtech ecosystem for the development of technological solutions available for teaching and learning. Demands from families, students and teachers to ensure access to ICTs.	Relevance of ICT inclusion for sustaining educational continuity in pandemics. The consensus of international organizations to recommend and finance ICT inclusion policies based on the pandemic and within the framework of the SDGs. Need for accurate information to support students' educational trajectories and to ensure re-engagement. Consensus on building an inclusive digital society, promoting measures to support connectivity and devices in lower-income households.	Is there an organization that conducts ICT policy actions in education? What is its responsibility? Are your actions articulated with other areas of government linked to ICT policies, development and innovation? What is the vision of ICT policy in education? Is there a National ICT Plan for the education system? What frameworks regulate ICT policies? Are there specific budget lines for ICT policy? What is the scope of the ICT Policy? What levels and modalities of the system does it cover? Are ICT policy actions evaluated? If so, what criteria and strategies are used to carry out the evaluation? Are the results of the policy known to all?	Weak governance of ICT policy Insufficient capacity of technical-political teams Lack of a comprehensive and cross-sectoral vision Lack of regulatory frameworks for ICT policy Lack of a National ICT Plan in education. Weak formulation and implementation of policies that take into account socioeconomic, age, territorial, gender and disability diversity. Inequalities linked to the digital divide have not been overcome, with special emphasis on the gender gap. Insufficient funding to ensure the sustainability of an ICT policy. The results of the ICT policy are not shared with the education system or communicated publicly. Policy evaluation mechanisms do not aim to monitor or measure the results of ICT inclusion in the education system.	1. Strengthen mechanisms and capacities to ensure robust governance of a sustainable and sustainable ICT policy. 2. Develop a comprehensive multisectoral and intersectoral vision of the policy. 3. Update relevant and pertinent regulatory and action frameworks and mechanisms to implement an ICT policy (including guidelines, initiatives and recommendations). 4. Design a National ICT Plan in the education system with emphasis on digital inclusion and learning opportunities. 5. Develop an ICT Policy action plan that is inclusive and takes into account diversities. 6. Secure funding for ICT policy development. 7. Consolidate a communications team that supports the initiatives and actions of the Policy. 8. Lay the foundation for an ICT policy monitoring and evaluation system, with emphasis on learning opportunities.	1.1. Create an organization or area for the conduction of ICT policy 1.2. Develop a recruitment and training plan for the agency's technical teams. 2.1. Develop maps of relevant stakeholders for ICT policy implementation. 2.2. Identify networks of relevant actors for the implementation of experimental initiatives for digital inclusion. 2.3. Establish a multisectoral commission to ensure the development of an integrated policy 2.4. Develop a policy document including a strategic vision 3.1. Gather international and national policy background and best practices. 3.2. Develop guidelines and documentation for the implementation of ICTs in compulsory education. 4.1. Assess needs and prepare a participatory diagnosis and best practices. 4.2. Gather normative precedents 4.3. Develop political consensus to regulate the Policy. 4.4. Elaborate a development plan that includes the comprehensiveness and temporality of the interventions. 4.5. Develop the ICT policy monitoring and evaluation system. 5.1. Assess needs and prepare a diagnosis 5.2. Implement a plural call for proposals (civil society organizations, government, educational community, unions, academia, private sector) to define the action plan. 5.3. Development plan that includes the integrality and temporality of interventions. 5.4. Develop a system for monitoring and evaluating the Action Plan. 6.1. Formulate a costing of ICT policy expansion, based on data on infrastructure, equipment, resources and professional development. 6.2. Identify sources of financing complementary to the national budget, as well as increase the financing allocated to ICT policy. 6.3. Develop mechanisms for budget reallocation 7.1. Identify required profiles 7.2. Securing funds 7.3. Hiring expert personnel 7.4. Elaborate proposals for communication actions 7.5. Validating actions 8.1. Define purposes and objects of evaluation 8.2. Define costs, procedures and timelines 8.3. Define ethical procedures and channels of communication Define and design the dimensions, instruments and indicators. 8.5. Implementation of evaluations	Presidency; Ministry of Education; Ministry of ICT Presidency; Agency for ICT Policy in Education; Ministry of Education ICT in Education Policy Agency; Ministries of Education; ICT Ministry Presidency; ICT Policy Agency; Ministries of Education and ICT; Ministry of Education and ICT ICT Policy Agency; Planning Area; Ministry of Social Policy ICT Policy Agency; Ministry of Finance ICT Policy Agency; Agency's Communication Team ICT Policy Agency; Evaluation Area of the agency; Ministry of Education	That ICT policies do not form part of the priority lines on the educational agenda. Difficulty in reaching a global consensus on the inclusion of ICTs in the education system Discontinuity of ICT policies Guaranteed budget line including technological infrastructure and human resources recruitment Communication deficiencies

Level 2 Roadmap
Consolidation of progress – Governance of public policies and/or national programs for the inclusion of technologies

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks					
<p>The ICT policy in education is led by an organization that presents some weaknesses related to its capacity for strategic political leadership. The national plan for ICT policy in education requires improvement and sustainability over time, avoiding discontinuities and ruptures in the strategic lines and results in the face of changes in government. The policy has weaknesses in the articulation with other areas of government or sectors linked to the country's socio-productive development and the scientific and technological system. There are some national programs that promote ICT inclusion in the education system with a medium- and long-term horizon only for some of the levels and modalities. The guidelines on the inclusion of ICTs in education are not prescriptive nor do they articulate with other cross-cutting areas of education. There are specific public funds that represent less than 5% of the cost per student and are mainly destined to infrastructure and equipment. There are scattered actions or strategies for the evaluation and monitoring of ICT policies in education with budgetary funds, but there is no governing body to guide them.</p>	<p>Existence of an agency dedicated to ICT policies in education that coordinates actions</p> <p>Existence of channels of dialogue with other sectors such as the national science and technology sector Experience in the design and implementation of national programs that promote the inclusion of ICTs in the</p> <p>Existence of knowledge exchange or cooperation actions on ICT and education with national, subnational, international and multilateral agencies and civil society organizations.</p> <p>Existence of guidelines and documentation supporting the inclusion of ICT in education as a key factor for educational improvement.</p>	<p>The consensus of international organizations to recommend and finance ICT inclusion policies based on the pandemic and within the framework of the SDGs.</p> <p>Consensus on building an inclusive digital society promotes measures to support connectivity and devices in lower-income households</p> <p>The development of Industry 4.0 drives new alliances and promotes interest in digital knowledge training in the education system.</p> <p>The expansion of the Edtech ecosystem based on the need to guarantee pedagogical continuity in Pandemic.</p>	<p>How can ICT policy be strengthened? What is the degree of articulation of ICT policies in education with other sectors? What are the strategic actions to achieve the articulation of ICT Policy priorities?</p>	<p>An ICT Policy that does not sustain its objectives and actions over time and is interrupted by changes in political management.</p> <p>An ICT policy that does not support a comprehensive and intersectoral medium- and long-term vision. Some of the dimensions are regularly addressed, such as technological infrastructure and connectivity, teacher training and teaching practices. Non-prescriptive guidelines or regulations that are not in line with supranational or regional guidelines. Insufficient funding for the deployment and universalization of ICT policy.</p>	1. Form an autonomous innovation agency.	<p>1.1. Enact by law the creation of an innovation agency, granting it autonomy.</p> <p>1.2. Regulate the composition of the agency's board of directors in order to access competitive positions.</p> <p>1.3. Regulate the creation of an advisory council with the participation of representatives from government areas, educational communities, industry, the scientific system and the territories.</p> <p>1.4. Allocate a budget line for the operation of the Agency.</p>	<p>Presidency; Ministry of ICT; Ministry of Education; Ministry of Productive Development; Ministry of Science and Technology; Ministry of Education; Ministry of Science and Technology</p>	<p>Achieve high-level political agreements for the implementation of the policy.</p> <p>Adequate financing. Positive look toward the evaluative culture of technology. Accountability. Overcoming the economic and social crisis caused by the Pandemic.</p>					
					2. Strengthen the policy by integrating all its dimensions with a medium and long-term vision and with a perspective of inclusion and equity.	<p>2.1. Develop maps of relevant stakeholders for the implementation of the National ICT Policy Plan.</p> <p>2.2. Identify networks of relevant stakeholders for the implementation of the National ICT Policy Plan.</p> <p>2.3. Establish a multisectoral commission to ensure the development of an integrated policy</p> <p>2.4. Prepare a policy document that includes the medium and long-term strategic vision and contemplates the articulation of connectivity and infrastructure, professional development, pedagogical model, data protection, and information systems) and with a perspective of inclusion and equity.</p> <p>2.5. Regulate by law the National ICT plan</p>			<p>Innovation Agency; Ministry of Education; ICT Ministry</p>				
					3. Update regulatory frameworks in light of supranational and regional agreements, including cross-cutting issues such as privacy, data protection, innovation policies, coordination with the productive ecosystem, etc.	<p>3.1. Identify and analyze international ICT policy regulations.</p> <p>3.2. Define guidelines to regulate the ICT Policy.</p> <p>3.3. Develop supporting documentation linked to all the axes of the policy (connectivity, devices, curriculum, professional development) that contemplates the articulation and coherence between the different existing regulatory frameworks.</p>				<p>Innovation agency; Legal area.</p>			
					4. Secure funding for ICT policy development.	<p>4.1. Cost the expansion of ICT policy, based on data on infrastructure, equipment, resources and professional development</p> <p>4.2. Increase funding for ICT policy to 4% of the cost per student</p> <p>4.3. Identify sources of financing complementary to the national budget.</p> <p>4.4. Develop monitoring and auditing systems</p> <p>4.5. Develop budget reallocation mechanisms.</p>					<p>Innovation Agency; Ministry of Finance</p>		
					5. Strengthen the mechanisms for consultation and updating of the strategic lines of the National ICT Plan in the education system.	<p>5.1. Establish permanent working groups with representatives of industry, the scientific sector, the educational community</p>						<p>Innovation Agency; Ministry of Science and Technology; Ministry of Productive Development or similar; Chambers of Commerce.</p>	
					6. Develop a communication plan for the ICT policy, including a permanent survey of perceptions and expectations of society and the educational community, the consolidation of the Brand and contributing to the transparency of government actions.	<p>6.1. Survey the needs and expectations of society</p> <p>6.2. Elaborate criteria and innovative strategies for communication with emphasis on the installation of the Brand.</p> <p>6.3. Strengthen the technical team in charge of communication, both in terms of training and financially.</p> <p>6.4. Develop and monitor the communication plan</p>							<p>Innovation Agency Communication Team.</p>
					7. Consolidate the monitoring and evaluation system of the ICT policy with emphasis on pedagogical appropriation and learning opportunities.	<p>7.1. Include items on digital literacy, social-emotional competencies, computational thinking, or computer science in the standardized learning tests.</p> <p>7.2. Consultation to validate items</p> <p>7.3. Implementing standardized tests with ICT items</p> <p>7.4. Communicate the detailed results of the evaluation to the educational units for their improvement and to the society the global results for transparency.</p> <p>7.5. Promote the use of evaluation results for improvement.</p>							

Level 3 Roadmap
Reaching system maturity - Governance of public policies and/or national programs for the inclusion of technologies

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There is an innovation and development agency dedicated to ICT policy in education. A council made up of representatives from different sectors is consolidated. Presence of an innovative ecosystem including the scientific-technological, socio-productive and education systems. Financing of at least 5% of the cost per student is guaranteed. The scope of the policy has an impact on all educational levels and modalities, but with a diversity of results. There are opportunities to improve the ICT Policy through greater autonomy for educational centers to contextualize interventions in the communities and propose pedagogical innovations with ICT. Favorable conditions have been identified for promoting incremental systemic improvements throughout the education system that will have an impact on the socio-productive development of the countries.</p>	<p>The ICT policy is consolidated, through an innovation agency, and with adequate regulations. The ICT policy reaches all educational levels and modalities. The evaluation and monitoring system is consolidated and the information it produces is used for decision making. There are adequately trained technical teams that support policy development at both the central and decentralized levels. Medium- and long-term financing is guaranteed through state funds and extra-budgetary funds from the private sector and international lending agencies.</p>	<p>Social and trade union consensus is being consolidated, as well as the support of international organizations for ICT policy. The multisectoral public-private alliance is strengthened. There is consensus and guidelines for the inclusion of emerging technologies in education. There is an innovative ecosystem that includes the national science and technology system, the socio-productive sector and the education sector. There are formal consolidated networks with national, subnational, international and multilateral academic institutions and centers and with civil society organizations for research, dissemination and cooperation on ICTs and education, prioritizing the inclusion of emerging technologies. Lowering the cost of technologies and permanent innovation in the ICT sector.</p>	<p>How to consolidate ICT policy as a state policy? How to strengthen the articulation of the digital ecosystem through the integration of different sectors and stakeholders? How to generate a vicious circle between research, innovation and dissemination of good practices in ICT inclusion?</p>	<p>ICT policy is not consolidated as a state policy Limitations on administrative, financial and pedagogical autonomy for the management and innovation of educational units. Weakness of incentive systems for the promotion of innovative schools and teachers. Low participation of teachers and students in the formulation and implementation of the policy.</p>	1. Consolidate ICT policy as a state policy	<p>1.1. Developing strategies for consensus building</p> <p>1.2. Implement a system of competitive examinations for all positions in the innovation agency.</p> <p>1.3. Permanently review the policy through the establishment of an information and evaluation system linked to the ICT policy.</p> <p>1.4. Review and update on an ongoing basis the norms and regulations that accompany the participation and decentralization of functions to the educational institutions.</p> <p>1.5. Disseminate the results of the ICT policy on a permanent basis.</p>	Presidency; Innovation Agency; Ministry of Education; Ministry of ICTs	<p>Economic crisis and political discontinuity Inability to sustain funding for innovations and digital transformation of the education system. Lack of consensus with the trade union sector Low productivity of the industry Low investment in emerging technologies Social impacts and prolonged economic reactivity of the region after the pandemic Economic crises resulting from the Pandemic The post-pandemic situation of educational crisis linked to interrupted student trajectories.</p>
					2. Promote greater administrative, pedagogical and financial autonomy of schools.	<p>2.1. Identify and analyze capabilities at the level of the schools</p> <p>2.2. Define priority guidelines to promote greater school autonomy.</p> <p>2.3. Guarantee resources and strengthen capacities at the level of educational centers.</p> <p>2.4. Develop a program for the promotion of innovation with ICT in educational centers.</p>	Ministry of Education; Ministry of Finance	
					3. Generate a system of incentives for innovation.	<p>3.1. Design a system of incentives for the promotion of innovation and improvement with ICTs for schools and teachers.</p> <p>3.2. Implement the incentive system.</p>	Ministry of Education; Ministry of Finance	
					4. Establish permanent participation mechanisms for teachers and students.	<p>4.1. Establish a Student Council with democratic participation of student representatives.</p> <p>4.2. Form participatory working groups with teachers and administrators for the development of policy priorities.</p> <p>4.3. Identify issues or concerns of educational communities and territories in order to seek innovative solutions.</p> <p>4.4. Elaborate a portfolio of innovative solutions to disseminate.</p>	Innovation Agency; Ministry of Education	
					5. Strengthen the communication plan that includes a survey of perceptions and expectations of the policy that provides information about the policy's transparency and the educational community's participation.	<p>5.1. Generate a system for the ongoing assessment of the needs and expectations of society</p> <p>5.2. Develop innovative communication criteria and strategies to reinforce the presence of the Brand.</p> <p>5.3. Agreeing on ethical principles for communication</p> <p>Strengthen the technical team in charge of communication.</p> <p>5.5. Monitoring and validating communication actions.</p>	Communication team of the Innovation Agency.	
					6. Set up a specific fund for the promotion of experimental initiatives aimed at the innovative inclusion of technologies to improve learning opportunities, with special emphasis on the development of hybrid formats.	<p>6.1. Costing innovations to assess their scalability.</p> <p>6.2. Cost a digital observatory for the identification and dissemination of innovative ICT practices that contribute to the promotion of learning opportunities.</p>	Innovation agency; Ministry of Education; Finance	
					7. Generate a virtuous circle of research, innovation and dissemination of good practices of ICT inclusion in compulsory education.	<p>7.1. Map relevant actors in science, technology, academia, industry and other sectors that contribute to development and innovation.</p> <p>7.2. Identify strategic lines for the country's development and innovation.</p>	Innovation Agency; Ministry of Science	
					8. Consolidate an intermediate level of permanent support between the educational units and the central agencies for the administration of the ICT Policy.	<p>8.1. Define the framework of action of the intermediate levels (inspectors, technical teams, support teams).</p> <p>8.2. Estimate the cost of strengthening the intermediate levels.</p> <p>8.3. Define profiles</p> <p>8.4. Hiring intermediate technical teams through competitive bidding processes.</p> <p>8.5. Define performance evaluation mechanisms.</p>	Ministry of Education; Innovation Agency	

Level 1 Roadmap
First steps - Pedagogical model

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>The curricula of compulsory basic schooling do not include updated contents in the field of Computer Science, computational thinking or Computer Science as a specific curricular space. The learning of socioemotional competencies is not promoted. There is no presence of updated ICT contents integrated to the teaching of the different disciplines, that these contents are not evaluated nor are planned mechanisms for the production and distribution of open educational resources and technological solutions for education developed.</p> <p>There are initial guidelines for the development of ICT projects in schools, but there are no guidelines for management teams in relation to leadership and the promotion of ICT integration or ICT referents that meet the needs of schools. There is a low supply of formats that include virtuality.</p>	<p>Teachers have implemented educational practices with ICT to support the pedagogical continuity of students in Pandemic.</p> <p>The need to guarantee, on the part of educational administrations, ICT education strategies to support the pedagogical continuity of students in pandemic situations</p> <p>Teacher collaboration networks</p> <p>Expanded use of digital educational resources in Pandemic</p> <p>Reevaluation of the role of schools and teachers in Pandemics</p>	<p>The existence of consensus documents and recommendations from international and regional organizations on the need for digital inclusion in compulsory education to mitigate the impact of COVID.</p> <p>The Expansion of the Ed Tech Ecosystem in Pandemic</p>	<p>Are there ICT contents integrated into the teaching of the different disciplines or curricular areas? And of Computer Science or Computer Science as a specific curricular area?</p> <p>Are there any actions for the evaluation of these contents in the national tests?</p> <p>Is a central learning management platform available?</p> <p>Is there a planned policy for the development and acquisition of Ed Tech solutions and are Open Educational Resources promoted?</p> <p>Are guidelines defined for the development and evaluation of ICT projects in schools?</p> <p>Are modalities or formats established that include virtuality in the different levels and orientations of the system? Are there specific figures for the integration of ICTs with territorial support?</p>	<p>Outdated curricula that do not include ICT contents transversal to the disciplines. The contents of Computer Science, computational thinking or informatics are not present in a specific curricular space. Socioemotional competencies are not included among the knowledge to be learned.</p> <p>Low existence of support documents for the implementation of ICT projects in schools.</p> <p>Low presence of hybrid school formats</p> <p>Profusion of Ed Tech Solutions that do not respond to the educational needs of teachers or students.</p>	<p>1. Update curricula at some educational levels, prioritizing secondary education, with content from the disciplinary field of Computer Science or related fields. ICT content that cuts across the different disciplines and socioemotional competencies.</p> <p>2. Produce complementary documents to the new curricula that contain guidelines for teachers and school administrators.</p> <p>3. Develop regulations and implement experimental initiatives of hybrid formats, primarily at the secondary level.</p> <p>4. Promote articulation strategies with the Ed Tech industry to promote the development of technological solutions for education.</p> <p>5. Develop and promote the production of open educational resources.</p> <p>6. Accompany schools in the process of digital inclusion, with the assignment of qualified technical personnel for technological support and assistance to teachers.</p> <p>7. Promote experimentation and self-evaluation of innovative practices with ICT in schools.</p>	<p>1.1. Identify areas of vacancy and outdated in relation to ICT contents integrated to the different disciplines, of the Computer Science disciplinary field or to socioemotional learning purposes and competences.</p> <p>1.2. Review international curriculum regulations.</p> <p>1.3. Promote intersectoral working groups to update the curriculum.</p> <p>1.4. Produce updated curricula for some of the educational levels.</p> <p>1.5. Validate and regulate the new curriculum(s).</p> <p>2.1. Develop guidelines for the selection and organization of ICT curricular contents in schools.</p> <p>2.2. Develop guidelines and orientations for the leadership of ICT projects by the management teams.</p> <p>3.1. Gather and systematize international and regional experiences in the successful implementation of hybrid formats.</p> <p>3.2. Establish multisectoral working groups to promote the development of innovative formats using ICTs.</p> <p>3.3. Develop appropriate proposals based on the characteristics of local contexts, modalities and budgetary requirements necessary for expansion.</p> <p>3.4. Develop an implementation plan for the new formats that takes into account the needs of the contexts, pedagogical priorities, the required teaching and management skills, the expectations of the educational communities and technological availability.</p> <p>3.5. Implement experimental initiatives of the designed formats at some of the educational levels with priority to the secondary level.</p> <p>4.1. Establish permanent working groups with the Ed Tech industry to promote the development of technological solutions.</p> <p>4.2. To develop criteria for the design and acquisition of technological solutions geared toward the educational needs of the country and schools.</p> <p>5.1. Training teachers in OER production</p> <p>5.2. Disseminate OER Production Networks</p> <p>5.3. Create contract tenders for the production of OER.</p> <p>5.4. Generate criteria for OER validation</p> <p>5.5. Publish OER on central educational platform</p> <p>6.1. Identify profiles required for accompaniment.</p> <p>6.2. Reassign tasks to existing personnel.</p> <p>6.3. Designate a central team and decentralized teams.</p> <p>6.4. Train personnel.</p> <p>6.5. Monitor the performance of the teams.</p> <p>6.6. Promote self-evaluation</p> <p>7.1. Form school learning networks.</p> <p>7.1. Disseminate innovative practices with ICTs.</p> <p>7.3. Encourage experimentation in Makerspaces or tech-labs.</p>	<p>Educational administrations; Curriculum and planning areas; Legal area</p> <p>Educational administrations; Curriculum and planning areas.</p> <p>Ministry of Education; Planning Area.</p> <p>ICT Policy Agency</p> <p>ICT Policy Agency</p> <p>Ministry of Education; ICT Policy Agency</p> <p>Ministry of Education; ICT Policy Agency</p>	<p>Learning basic mathematics and reading and writing contents.</p> <p>Connectivity and access to devices for students and teachers</p> <p>Budget constraints</p>

Level 2 Roadmap
Consolidation of progress - Pedagogical model

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>The curricula of compulsory basic schooling include updated contents related to the field of Computational Thinking, Robotics, Programming and Algorithms as a specific curricular space for some of the levels and modalities of the education system. The curricula include updated ICT curricular contents integrated to the teaching of the different disciplines. There is a policy of didactic resources for education for all levels and modalities of the education system that is not periodically updated and validated. The central platform of digital educational resources is organized. The content repository format is combined with communication and interaction spaces for teachers, students and families. There are ICT referents who attend to the technical-operational dimension in schools and technical teams at the central level promote actions for the integration of the teaching of contents of the disciplinary field of Computer Science or Informatics. There are isolated and/or discontinued actions for the development and/or acquisition of technological solutions for education framed in the curricular guidelines that are not periodically reviewed.</p>	<p>There is content in the field of science and technology or computer science as a specific curricular area. Experiences developed in the curricular updating of specific contents of the disciplinary field for some level of the education system Use of digital educational resources by teachers based on the COVID pandemic. There is a planned offer of formats that include virtuality at some educational level of the system.</p>	<p>There is a well-developed Ed Tech ecosystem that includes emerging technologies The existence of consensus documents and recommendations from international and regional organizations on the need for digital inclusion in post-pandemic compulsory education. Productive development linked to the digital transformation of industry 4.0 calls for new digital and socioemotional skills for the entry of young people into the job market Post-pandemic economic recovery drives digital transformation</p>	<p>Are there ICT and socioemotional contents integrated into the teaching of the different disciplines or curricular areas in the curricular prescription? And of Computer Science or Informatics as a specific curricular space? Are there any actions for the evaluation of these contents in the national tests? Is there a central learning management platform and is there a planned policy for the development and acquisition of Ed Tech solutions? Are guidelines defined for the development and evaluation of ICT projects in schools? Are modalities or formats established that include virtuality in the different levels and orientations of the system? Are there specific figures for the integration of ICTs with territorial support?</p>	<p>Curricula that do not include for all ICT contents transversal to the disciplines, Computer Science contents, computational thinking and the learning of socioemotional competences. Need to scale hybrid and innovative school formats that include virtuality for all levels. An Ed tech ecosystem that does not widely respond to pedagogical needs and technological innovation. Learning platform data and management systems are not interoperable with educational information and management systems. The territorial deployment capacity of intermediate levels to support and accompany schools in the digital inclusion process is limited.</p>	1. Update the curricula for all levels and modalities of the education systems, including content from the disciplinary field of Computer Science, ICT content transversal to the different disciplines and social-emotional competencies.	1.1. Promote inter-sectoral working groups for the development and updating of ICT content across disciplines, in the field of Computer Science, and socioemotional competencies for all levels and modalities of the education system. 1.2. Develop frameworks for the pedagogical use of ICTs 1.3. Develop curricula with ICT content that cuts across the disciplines and with computer science content as a specific disciplinary field for all levels and modalities of the system. 1.4. Prepare complementary documents to the curriculum design containing guidelines for the selection and organization of new curriculum content and for the use of ICTs for learning. 1.5. Validate and regulate the curricula for each level and modality. 1.6. Design and implement a training plan that includes training in digital knowledge in line with the new curricula.	Innovation Agency; Ministry of Education; Curriculum Area; Planning; Competitions and Appointments Area.	<p>Basic mathematics and reading and writing skills Connectivity and access to devices for students and teachers Budget restriction. Social consensus and consensus with the educational community.</p>
					2. Develop new proposals for the implementation of hybrid or blended formats with the inclusion of ICT for all levels and modalities of the education system.	2.1. Evaluate results of experimental initiatives. 2.2. Implement experimental initiatives of the designed formats at all educational levels. 2.3. Implement consolidated hybrid formats throughout the secondary level according to territorial particularities.	Innovation Agency; Ministry of Education; Ministry of Education; Curriculum Area; Planning	
					3. Develop a learning management platform and Ed Tech solutions with interoperability with other platforms and management systems.	3.1. Define guidelines for the development of a scalable learning management platform with interoperability with other platforms and management systems.	Innovation Agency; Chambers of the 4.0 sector.	
					4. Consolidate the production of innovative technological solutions.	4.1. Establish criteria and definitions to guide the design processes of technological solutions in line with educational priorities, which are adaptable to the diversity of users, including special education, rural education and intercultural bilingual education. 4.2. Promote coordination strategies with the Ed Tech industry to promote the development of innovative technological solutions that include emerging technologies. 4.3. Establish mechanisms for the procurement process of technological solutions. 4.3. Define criteria and mechanisms for the evaluation of the technological solutions in use.	Innovation agency; Development companies	
					5. Strengthen the tasks of accompanying schools with technical teams of high technical and pedagogical expertise and with stable appointments and territorial scope.	5.1. Mapping the status of personnel assigned to support tasks in the territory. 5.2. Define required profiles and define the responsibilities of the different positions. 5.3. Define optimal plant to cover the needs in the territory. 5.4. Competition for positions 5.5. Develop computer modules to support the development of the accompaniment tasks.	Innovation Agency; Ministry of Education; Ministry of Education; Curriculum Area; Planning	
					6. Implement institutional evaluation and self-evaluation model and mechanisms for technology projects in the school.	6.1. Design an institutional evaluation model for technology projects in schools. 6.2. Implementing the evaluation 6.3. Disseminate evaluation results, promoting the use of the results for improvement.	Innovation agency; Ministry of Education; Planning	

Level 3 Roadmap
Reaching system maturity - Pedagogical model

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>The curricula of compulsory basic schooling include updated contents in the field of Computer Science or Informatics as a specific curricular space in all levels and modalities of the education system. The curricula include ICT curricular contents integrated to the teaching of the different disciplines. There is a sustainable policy for the development of digital teaching resources for education. There is a central learning management platform that is interoperable, universally accessible, organized by levels and with guidelines that are periodically updated with content spaces, pedagogical tools and guidelines and interaction with families, teachers and students. It offers individualized learning metrics to guide pedagogical decision-making. There are stable ICT referents that attend both the technical-operational and the didactic-pedagogical dimensions in schools and technical teams with territorial structure for the integration of the teaching of contents of the Computer Science disciplinary field. The offer includes hybrid, dual and bimodal formats at different levels and orientations.</p>	<p>Updated curricular designs in the field of Computer Science or Informatics in a specific curricular space for all or some of the levels and modalities of the education system. Inclusion in the academic offer of socioemotional competencies for all levels and modalities of compulsory education. Existence of digital educational resources</p> <p>There is a permanent evaluation system that includes assessment of digital knowledge.</p> <p>There is a layer of technical support teams at the intermediate level that provides support to the educational units.</p>	<p>Broad development of Industry 4.0 and technological innovation Expanded connectivity and access to devices for students and teachers.</p> <p>Existence of consolidated developments in the Ed Tech ecosystem</p> <p>Industry 4.0 requires workers with training in social-emotional and digital skills</p>	<p>Are there ICT and socioemotional contents integrated into the teaching of the different disciplines or curricular areas in the curricular prescription? And of Computer Science or Computer Science as a specific curricular space?</p> <p>Are actions carried out to evaluate the learning of these contents in the national tests?</p> <p>Is a central learning management platform available?</p> <p>Is there a planned policy for the development and acquisition of Ed Tech solutions?</p> <p>Are guidelines defined for the development and evaluation of ICT projects in schools?</p> <p>Are modalities or formats that include virtuality (hybrid formats) established at the different levels and orientations of the system?</p> <p>Are there specific personnel for ICT integration for territorial support?</p>	<p>The compulsory education curriculum includes a specific disciplinary field related to computer science or informatics that requires constant updating.</p> <p>Outdating of contents related to socioemotional competencies.</p> <p>Lack of evidence-based modeling of hybrid or technology-inclusive school formats.</p> <p>An Ed Tech ecosystem that does not fully respond to current pedagogical needs and technological innovation.</p> <p>Learning platform data and management systems are not interoperable with educational information and management systems.</p> <p>The support provided by the intermediate levels of management is not enough to cover all schools</p>	<p>1. Implement a system of permanent curricular updating of contents in the specific field of Computer Science or Informatics, of ICT contents transversal to the disciplines and socioemotional knowledge.</p>	<p>1.1. Conduct surveillance of new emerging technologies and requirements for new knowledge and socioemotional skills.</p> <p>1.2. Promote intersectoral and permanent working groups to update the curricula with new knowledge.</p> <p>1.3. Periodically update the curricula of all levels or modalities of the system.</p> <p>1.5. Periodically update complementary documents to the curricula that contain guidelines for their implementation.</p> <p>1.7. Periodically implement training plans on the new knowledge incorporated into the curricula.</p> <p>1.8. To install a permanent evaluation system to guarantee curricular relevance.</p>	<p>Innovation Agency; Ministry of Education; Curriculum Area; Planning;</p>	<p>Budget constraint</p> <p>Basic literacy and numeracy skills in students.</p>
					<p>2. Consolidate a comprehensive transformation of hybrid school formats with ICT inclusion for the entire education system.</p>	<p>2.1. Identify and analyze international experiences.</p> <p>2.2. Mapping and evaluating experiences developed in the territories</p> <p>2.3. Develop a map of relevant stakeholders for the implementation of the models.</p> <p>2.4. Develop alternative models of evidence-based hybrid formats.</p> <p>2.5. Define guidelines for the implementation of the new models based on the collection and appropriate to the educational levels.</p> <p>2.6. Scaling the models</p> <p>2.7. Evaluate and make a portfolio of strategies</p> <p>2.8. Disseminate the results of the experiences</p> <p>2.9. Establish peer-to-peer cooperation networks as a driver of innovation and continuous improvement.</p>		
					<p>3. Upgrade and enhance the state-of-the-art learning management platform.</p>	<p>3.1. Establish mechanisms for ongoing consultation and updating with Industry 4.0 for technological innovation of the learning management platform.</p> <p>3.2. Transferring acquired knowledge to national and international research centers.</p>	<p>Innovation Agency; Ministry of Education; Ministry of Education; Curriculum Area; Planning</p>	
					<p>4. Improve the development of scalable and sustainable Ed Tech solutions.</p>	<p>4.1. Update criteria to guide the design and/or acquisition processes of innovative technological solutions that include learning assessment metrics.</p> <p>4.2. Support the development of start-ups and incubators to promote the development of innovative technological solutions.</p> <p>4.3. Update mechanisms for the evaluation of the technological solutions in use.</p>	<p>Innovation agency; Chambers of the 4.0 sector.</p>	
					<p>5. Consolidate an intermediate level of management and support (technical teams, inspectors, etc.) with expertise and autonomy for work and experimentation in schools.</p>	<p>5.1. Develop permanent updating plans for the intermediate level.</p> <p>5.2. Develop learning circles with the permanent development of research as a practice to become innovation leaders</p> <p>5.3. Support the development of innovative projects at the school level with the allocation of specific funding.</p> <p>5.4. Implement a system for monitoring and evaluating practices in the territorial areas.</p>	<p>Innovation agency; Chambers of the 4.0 sector.</p>	

Level 1 Roadmap
Getting started - Connectivity, device access and access to cloud content

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
4G coverage less than 80% of the population. Significant digital divide in the rural context. Lack of a budget and administrative processes for the maintenance of technological infrastructure in educational institutions.		Low institutional visibility for connectivity policies Limited broadband coverage in schools and other educational institutions Limited Quality of Service (e.g. speed and latency)	What is the degree of national and regional development of connectivity? Are there institutional and legal frameworks for network development? What is the quality of broadband service? Are there alternative models for different geographic and territorial contexts? What about ongoing and/or planned service extension projects? What are the costs of access and opportunity? Which is/are the organization(s) leading the actions aimed at guaranteeing access and connectivity to the population? What is the degree of access to the Internet in schools? And to digital devices? What is the degree of access to the Internet at home and to digital devices of students at home?	ICT policy development is not being valued in terms of its importance as an infrastructure for development. Institutional responsibility lies with a secondary level entity (undersecretary or secretary of state). Broadband service universalization policies are not translated into targets to be monitored. A large digital divide, especially in the rural context, limits the capacity to impact on social inclusion and the educational field. Serious gaps in broadband service coverage and educational technology in schools The low quality of broadband service affects the possibility of leveraging it in the educational field The lack of operating budget for digital infrastructure in schools with technology results in operational gaps Likewise, the possibility of applying technology in the educational field is not sufficiently recognized institutionally or in development plans.	1. Ensure 4G coverage of at least 80% of the population. 2. Ensure fixed broadband coverage of at least 20% of rural households. 3. Have a National Telecommunications Plan 4. Achieve average fixed broadband speeds of up to 30 Mbps and mobile broadband of up to 18 Mbps. 5. Universal service plans not specific to schools, although the Digital Agenda has a chapter for the education sector. 6. Access to basic broadband services at a price below 6% of GDP per capita 7. Ensure that a minimum of 30% of schools have Internet access and that 50% of secondary schools are equipped with digital labs.	1.1. Inclusion of mobile broadband coverage targets in the Universal Service Plan 2.1. Inclusion of fixed broadband coverage targets in the Universal Service Broadband Plan 3.1. Promote changes in the institutional framework by assigning a higher level of responsibility and visibility to the entity responsible for public policies. 4.1. Establishment of quality-of-service targets in the Telecommunications Plan 5.1. The National Telecommunications Plan should include goals for the deployment of technological infrastructure in schools, with explicit coverage targets. 6.1. Develop subsidized bandwidth offers to provide access to vulnerable social sectors. 7.1. The Ministry of Education should execute a budget for the deployment of technological infrastructure in schools, with explicit coverage goals.	Ministry of Communications Ministry of Communications, Telecommunications Regulatory Agency Ministry of Communications Ministry of Communications Ministry of Education Ministry of Communications Ministry of Education	

Level 2 Roadmap
Consolidation of advances - Connectivity, access to devices and content in the cloud

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>Serious coverage gaps in primary schools</p> <p>Gaps persist in vulnerable social sectors</p> <p>Lack of maintenance plan for technological infrastructure in schools</p>	<p>Beginning of importance of connectivity in the education system</p>	<p>Limited progress in broadband service quality level</p>	<p>What is the degree of national and regional development of connectivity? Are there institutional and legal frameworks for network development? What is the quality of broadband service? Are there alternative models for different geographical and territorial contexts? What about ongoing and/or planned service extension projects? What are the access and opportunity costs? Which is/are the organization(s) leading the actions aimed at guaranteeing access and connectivity to the population? What is the degree of access to the Internet in schools and to digital devices? What is the degree of access to the Internet at home and to digital devices of students at home?</p>	<p>Although the economic and social importance of the digital infrastructure is recognized, it has not yet translated into a significant reduction of the digital divide. However, the importance of broadband in education is beginning to be seen in universal service plans. ICT policy development is subordinated to other infrastructure priorities. Broadband service quality demonstrates progress but is not up to the level required for leading-edge applications. In addition, there are still barriers in terms of affordability for the most vulnerable social sectors. Although progress is being made in broadband service coverage in secondary schools, serious gaps still persist in primary schools. There is still no infrastructure maintenance plan for schools and no plan for recycling technological waste.</p>	1. Ensure 4G coverage of 80% to 90% of the population.	1.1. Include mobile broadband coverage goals in the National Telecommunications Plan. 1.2. Build incentives for the deployment of mobile broadband infrastructure in spectrum allocation auctions.	Ministry of ICT	
					2. Ensure fixed broadband coverage of 20% and 60% of rural households.	2.1. Include mobile broadband coverage goals in the National Telecommunications Plan.	Ministry of ICT	
					3. Have an updated National Telecommunications Plan.	3.1. Undertake the updating of the National Telecommunications Plan.	Ministry of ICT	
					4. Achieve average fixed broadband speeds of between 30 Mbps and 70 Mbps and mobile broadband speeds of between 18 Mbps and 25 Mbps.	4.1. ICT policymakers should define targets to achieve service levels for schools comparable to those observed in advanced economies.	Ministry of ICT, Ministry of Education	
					5. Universal service plans with deployment targets in rural areas.	5.1. Define rural coverage goals included in the National Telecommunications Plan.	Ministry of ICT	
					6. Access to basic broadband service at a price between 3% and 6% of GDP per capita.	6.1. Ensure that private operators offer basic broadband service plans with low tariffs.	Ministry of ICT, Telecommunications Regulatory Agency	
					7. Promote alternative connectivity models	7.1. Development of a plan for the recycling of technological waste from schools	Ministry of Education	
					8. Strengthen alliances with regulators and the private sector for the provision of services.	8.1. Establish working tables of coordination between the private sector (e.g., chambers of commerce) and government sectors oriented to the incorporation of technology in education.	in coordination with entities responsible for ICT policies Ministry of ICT, Ministry of Science and Technology, Ministry of Production, etc.	
					9. Ensure access to devices in the school environment exclusively or with delivery to students.	9.1. Ensure that the educational technology plan includes precise targets for deployment in primary schools.	Ministry of Education	
					10. Assign delivery of devices to teachers	10.1. Computer allocation program for all teaching personnel	Ministry of Education	
					11. Persons responsible for the maintenance of the technological infrastructure in educational institutions have been appointed.	11.1. Development of a plan to ensure the maintenance and operations of technological infrastructure in schools.	Ministry of Education	

Level 3 Roadmap
System maturity - Connectivity, device access and access to cloud content

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
Digital divides still or present in the rural context Barriers to broadband affordability in the most vulnerable sectors of society Limited broadband uptake in certain sectors due to lack of digital literacy Formal coordination between ICT authorities and the Ministry of Education is limited.	At an aggregate level, fixed broadband coverage has reached high levels High visibility in the elaboration and implementation of ICT policies The Universal Service Fund includes a chapter dedicated to educational institutions.	High number of students lack broadband coverage at home	What is the degree of national and regional development of connectivity? Are there institutional and legal frameworks for network development? What is the quality of broadband service? Are there alternative models for different geographical and territorial contexts? What about ongoing and/or planned service extension projects? What are the access and opportunity costs? Which is/are the organization(s) leading the actions aimed at guaranteeing access and connectivity to the population? What is the degree of access to the Internet in schools and to digital devices? What is the degree of access to the Internet at home and to digital devices of students at home?	Broadband network coverage has reached an advanced level, although there are still some gaps in rural areas. The demand gap (i.e. the population that can access technology but does not) indicates that there are still barriers in terms of affordability and digital literacy. ICT policy making already receives an adequate level of institutional importance but there are still some barriers in inter-institutional coordination with authorities in the educational field (formal collaboration does not exist at working group level). Accordingly, the universal service plan includes a chapter to cover educational institutions. Although coverage in schools has already reached advanced levels, the affordability gap poses a lack of service for students from vulnerable social sectors.	1. Ensure 4G coverage of 90% of the population. 2. Ensure fixed broadband coverage of up to 60% of rural households. 3. Have an updated National Telecommunications Plan, with adoption goals 4. Achieve average fixed broadband speeds of up to 70 Mbps and mobile broadband speeds of up to 25 Mbps. 5. Universal service plans with goals in primary and secondary schools, and specific targets in rural areas. 6. Access to basic broadband service at a price below 3% of GDP per capita. 7. Achieve total connectivity in primary and secondary schools, complemented with digital labs. 8. Use connectivity models based on Wi-Fi technologies for schools and students. 9. Ensure that every student and teacher have access to a PC and broadband access (fixed or mobile). 10. Budget and administrative processes for the maintenance of the technological infrastructure in educational institutions have already been formulated.	1.1. Implement spectrum allocation programs with mobile broadband coverage obligations. 2.1. The Universal Service Plan has the required funding and allocation processes to ensure broadband deployment in the rural context. 3.1. Update the National Telecommunications Plan with coverage and adoption highlights for fixed and mobile broadband for the population. 4.1. Develop incentives to accelerate investment in advanced technologies (4G and FTTx) by the private sector. 4.2. Implement tax exemption program for equipment imports and broadband deployment in isolated areas. 5.1. Ensure that the Universal Service Plan includes a specific chapter for elementary and secondary schools. 5.2. Creation of working groups between representatives of educational and technology entities to ensure the continuous development and monitoring of specific connectivity policies for the educational sector. 6.1. Ensure that private operators offer basic broadband service plans with low tariffs. 7.1. Implement a 100% connectivity program for primary and secondary schools, based on the National Telecommunications Plan and supported by the Universal Service Fund. 8.1. Allocate sufficient unlicensed spectrum to ensure efficient deployment of Wi-Fi in schools, libraries and cultural centers. 9.1. Implement a subsidy and financial support plan for the acquisition of broadband service for households in vulnerable social classes. 9.2. Development of a digital literacy program focused on vulnerable social sectors, rural population, unemployed people with children, and mothers.	Telecommunications regulatory agency Ministry of ICT Ministry of ICT Ministry of ICT, Telecommunications Regulatory Agency, Ministry of Finance Ministry of ICT, Ministry of Education Ministry of ICT, Telecommunications Regulatory Agency Ministry of ICT, Ministry of Education Ministry of ICT, Telecommunications Regulatory Agency Ministry of Education	

Level 1 Roadmap
First Steps - Professional development for teachers and administrators

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
A training system with weak governance and an outdated and irrelevant academic offer. to ensure digital inclusion in teacher training.	Experiences or initiatives of teaching work with ICTs based on the pandemic Self-managed peer-to-peer work and support networks Systematized best practices in ICT teacher training, both international and regional Wide range of training courses for teachers related to ICT knowledge (programming, robotics, computational thinking) offered by educational administrations and the corporate sector.	Wide availability of Ed Tech solutions for teacher training Demand for ICT training by teachers Strengthening social recognition of teachers' work during the pandemic and their key role in the development of the educational task	Is there a governing body that coordinates in-service teacher training actions at the national level, including planning, accreditation, implementation and monitoring of the offer? Is the participation of the authorities linked to ICT policy included in these actions? Are the needs and demands of the teaching population surveyed? and articulated in an updated National Plan based on the evaluation of results?	Weak institutional framework for the conduction of ICT policies in the training system Fragmentation of the supply of the training system Absence of competency frameworks and teaching standards. Outdated and irrelevant academic programs Follow-up and monitoring system weak or does not provide information for decision making Disarticulation of training with teaching career development Need for new administration leadership	1. Strengthen the governance of the teacher training system.	1.1. Create or strengthen an area of the administration responsible for coordinating initiatives for teacher training with ICTs. 1.2. Strengthen the technical capabilities of the area. 1.3. Develop the national ICT teacher training plan or guidelines for the implementation of a national ICT teacher training plan for any level and/or modality of the education system. 1.4. Update reference frameworks (guidelines, or standards) for competent use of ICTs. 1.5. Update or develop guidelines or orientations for the inclusion of ICT contents in the curricular design of initial teacher training and in teachers' professionalizing practices (internships). 1.6. Develop guidelines and orientations for continuing teacher training.	Central government; Educational administration; Teacher training area.	Consider teacher training as a key factor for improving the inclusion of ICTs in education systems Consensus vision of ICT inclusion in the education system, known by all. Guaranteed budget line that includes the required technological infrastructure Negotiation with teachers' unions for teaching careers and work frameworks
					2. Develop a national plan for teacher training with ICT.	2.1. Assess needs and prepare a teacher training diagnosis 2.2. Implement a plural call to define the teacher training action plan. 2.3. Prepare a development plan that includes the comprehensiveness and timing of interventions. 2.4. Develop the monitoring and evaluation system for the teacher training policy. 2.5. Communicate the results.	Area of the administration responsible for coordinating initiatives for teacher training with ICT.	
					3. Review background information and develop curricular standards for initial teacher training and/or performance (see: frameworks of reference) for the inclusion of ICT and Computer Science content or Computational thinking and digital citizenship.	3.1. Background review of good teacher training (TT) practices and development of curricular standards for initial teacher training (ITT) and performance for the inclusion of digital knowledge. 3.2. Survey, systematize and diagnose the initial training and continuing education programs in light of the new requirements of ICT inclusion. 3.3. Develop a plan to improve the initial and continuing education offerings, including curricular reform and the revision of institutional formats and teaching models using technologies 3.4.	Teacher Training Area; Planning	
					4. Update the mechanisms for accreditation, evaluation and follow-up of the existing academic programs for initial and continuing teacher training for the inclusion of ICT content, digital educational resources and teaching practices in virtual or hybrid formats.	4.1. Gather background information on accreditation, evaluation and follow-up of the offer	Teacher Training Area; Training Institutions.	
					5. Develop technical capacities of teachers and school administrators through group training, situated training and communities of practice.	5.1. Conduct a diagnosis of key teaching competencies for ICT inclusion in TT. 5.2. Quantify the required training demand 5.3. Conduct a survey of existing training institutions and evaluation of capacities 5.4. Design training mechanisms, with special attention to the development of networks and communities of practice. 5.5. Design training evaluation mechanisms 5.6. Budget the implementation of the plan 5.7. Implement training plan 5.8. Evaluating training	Teacher training area; Planning; Administration and budgets	
					6. Lay the foundations and carry out an initial development of a monitoring and evaluation system for ICT policy, teacher training and teaching.	6.1. Design and implement the ICT policy monitoring and evaluation system in the training system. 6.2. Design and implement the system for monitoring and evaluating the TT's academic programs. 6.3. Design and implement the teacher evaluation system	Areas responsible for evaluation, competitive examinations and teaching careers	
					7. Develop a consultation to update and adapt the framework of teaching conditions for digital inclusion.	7.1. Establish a dialogue with the teachers' unions and those responsible for labor and education policy to analyze the new working conditions for teachers 7.2. Regulate the conditions of teleworking for teachers	Teacher training area; labor unions; labor regulatory agency.	
					8. Generate incentives based on the articulation of training with the teaching career.	8.1. Update the training, experience and function requirements for each available position and promotion with a focus on digital competencies.	Competitive examinations and teaching careers	
					9. Guarantee budget for teacher training	9.1. Short-, medium- and long-term costs of the teacher capacity building policy 9.2. Negotiate with the authorities the necessary budget for the implementation of the plan.	Teacher Training Area; Planning	

Level 2 Roadmap
Consolidation of progress - Professional development of teachers and administrators

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>A training system whose governance and institutionalization of teacher training policies with ICT inclusion is distributed among different agencies that in the last four years have articulated and coordinated some initiatives. Some actions were established for the planning, accreditation, follow-up and evaluation of the teacher training program with updated contents linked to ICT for some levels and modalities of the system.</p>	<p>Existence of an area in charge of coordinating ICT teacher training projects or initiatives. Existence of guidelines and work guides for teacher training with ICTs Initiatives for pedagogical and curricular renewal of initial teacher training geared to ICT inclusion Wide range of continuing teacher training programs for ICT inclusion Intensive development of platforms, social networks and digital educational resources since the pandemic. Expansion of support strategies for teaching teams</p>	<p>Industry 4.0 demands to expand teacher training and the training of students with digital knowledge Favorable scenarios for the articulation of ICT policies with industry 4.0 Identification of priority areas for teacher training based on the pandemic. Demands from teachers' collectives and unions to review issues related to teacher training International and regional consensus to enhance teacher training with ICTs</p>	<p>Is there a governing body that coordinates continuing teacher training actions at the national level? Are the needs and demands of the teaching population surveyed and are they articulated in an updated National Plan based on the evaluation of results? Are the participation of specialized profiles and actors relevant to the inclusion and use of ICTs in different areas of social life included in these actions? Do these actions include attention to the characteristics of the training system, its institutions and stakeholders? Is the participation of authorities linked to ICT policy included in these actions? Are teaching working conditions and professional trajectories throughout the professional career surveyed? What are the necessary and possible modifications for its adequacy for ICT inclusion?</p>	<p>Existence of different areas in charge of initial teacher training policies for ICT inclusion. Insufficient availability of systematized information on the supply of initial training and continuing education. Limited scope of regulatory frameworks, guidelines and orientations at some levels and modalities of the system. Weak scope of supply control and regulation. Academic programs with a high level of dispersion, inequality and quality. Updated and innovative academic programs only in some levels and/or modalities of the education system. Existence of weak or conflictive mechanisms for consensus building. Economic and budgetary constraints.</p>	1. Create an area of the educational administration in charge of coordinating initiatives for teacher training with ICT.	1.1. Create a governing body for ICT teacher training with the participation of the authorities responsible for ICT policy and multisectoral cooperation. 1.2. Implement the normative provisions for its operation and regulation. 1.3. Implement competitive examinations for the appointment of officials and technical teams. 1.4. Guarantee a budget for the operation of the governing body.	Ministry of Education.	<p>Guarantee consensus with the teachers' unions Guarantee budget for the creation of the TT area with ICT. Ensure connectivity for training institutions and devices for teachers.</p>
					2. Develop a national plan for initial and continuous teacher training with the inclusion of ICT knowledge for all educational levels and modalities. It is regulated by law.	2.1. Survey, systematize and diagnose the initial training and continuing education programs in light of the new requirements of ICT inclusion. 2.2. Gather normative antecedents 2.3. Develop political consensus for the enactment of the Law. 2.4. Prepare a development plan that includes the comprehensiveness and temporality of the interventions. 2.5. Develop the TT policy monitoring and evaluation system. 2.6. Communicate the results.	Governing body of TT with ICTs	
					3. Strengthen teacher training for the development of ICT skills in teaching.	3.1. Develop reference frameworks (guidelines or standards) for the competent pedagogical use of ICTs articulated with the reference frameworks of the teaching profession and with the curricular guidelines of the levels of the mandatory education system. 3.2. To develop guidelines for the inclusion of ICT contents in the ITT curriculum related to Computational Thinking, Robotics, Programming and/or Algorithms as a specific curricular space and with digital citizenship (including professional internships for teachers and/or internships) that gradually reach all levels and modalities of the education system. 3.3. Develop guidelines for the curricular inclusion of ICTs in the CTT and their development in a diversity of models and formats.	Curriculum Area; Governing Body of TT with ICT.	
					4. Strengthen the mechanisms for accreditation, evaluation and follow-up of the academic programs of initial and continuing teacher training, including pedagogies and emerging technologies.	4.1. Develop and/or update guidelines, orientations and regulations for the accreditation, follow-up and evaluation of the TT offer at all levels and modalities of the system. 4.2. Design a plan to improve the supply of initial and continuing education and training. 4.3. Advance in the implementation of the TT improvement plan with a focus on reaching all levels and modalities of the education system. 4.4. Develop a planned program of ITT degrees linked to the disciplinary field of Computer Science and Informatics. 4.5. Adapt the supply of teacher training according to the different stages of the professional trajectory. 4.6. Strengthen the capabilities of ITT entrants with recruitment and leveling programs based on technological knowledge and certification requirements. 4.7. Develop processes of situated training and strengthen networks and communities of practice to promote renewed leadership in management teams for the implementation of ICT projects. 4.8. Design and implement an academic offer of excellence for teacher training with emphasis on ICT inclusion, including the articulation with knowledge networks and national and foreign academic centers. 4.9. Develop guidelines for the construction of a system for the evaluation of teaching skills and performance.	Governing Body of the TT; Curriculum and Planning Areas of the Ministry of Education	
					5. Reach a consensus and update the norms and regulations of the professional teaching career in terms of training, mobility and incentives addressing the inclusion of ICT in education.	5.1. Update the requirements for training, career and functions and their articulation with mobility and incentives. 5.2. Articulate the professional teaching career with the inclusion of ICT in the different stages of professional careers. 5.3. Design and implement a new labor regime linked to the new conditions that contemplates work in hybrid and distance modalities. 5.4. Review and improve the working conditions of teachers based on the construction of agreements.	Governing body of TT with ICT; Teaching competition and career area; labor unions; labor regulatory agency.	

Level 2 Roadmap
Consolidation of progress - Professional development of teachers and administrators

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
Teacher training policies are conducted by a governing body with political decision for the implementation of ICT inclusion. It is coordinated with authorities responsible for ICT policy and multisectoral cooperation. There is an updated National ICT knowledge inclusion plan for all levels and modalities of the education system and reference frameworks for competent pedagogical uses of ICT. There is a governing body for the planning, accreditation and monitoring of teacher training. There are Computer Science and ICT contents integrated to the teaching of the different curricular disciplines prescribed for all or some of the levels or modalities of the education system. The teacher training program includes articulation with the professional degree program and hybrid formats.	There is political leadership for decision making Initial teacher training updated toward ICT inclusion Variety of formats and modalities in continuing teacher training programs Increased participation of teachers' collectives in the implementation of teacher training policies	Recognition of the importance of teacher training to improve educational policies, at the international level. Consensus on content and powerful modalities for the pedagogical and curricular inclusion of ICTs New regulatory frameworks for teleworking	Is there a governing body that coordinates continuing teacher training actions at the national level? Are the needs and demands of the teaching population surveyed and are they articulated in an updated National Plan based on the evaluation of results? Are the participation of specialized profiles and actors relevant to the inclusion and use of ICTs in different areas of social life included in these actions? Do these actions include attention to the characteristics of the training system, its institutions and stakeholders? Do these actions include the participation of the authorities linked to ICT policy? Are teachers' working conditions and professional trajectories throughout their careers being surveyed? What are the necessary and possible modifications to be made to adapt them to ICT inclusion?	Discontinuity in coordination policies and/or strategies Lack of or weak curricular evaluation mechanisms Lack or weakness of mechanisms for supply monitoring and evaluation	1. Strengthen the area of educational administration in charge of coordinating initiatives for teacher training with ICTs and evaluating and sustaining a national plan for initial and continuous teacher training with the inclusion of ICT knowledge, regulated by law. 2. Deepen and sustain the training system for the development of ICT skills in teaching. 3. Strengthen the mechanisms for accreditation, follow-up and evaluation of the offer 4. Update the norms and regulations of the professional teaching career with regard to training, mobility and incentives addressing ICT inclusion in education.	1.1. Sustain continuity and develop strategies to renew and broaden the participation of stakeholders and inter-institutional alliances based on the needs of the training system for ICT inclusion. 1.2. Establish and carry out mechanisms for the evaluation and revision of the national plan for initial and continuous teacher training with the inclusion of ICT knowledge for all levels and/or modalities of the education system, as regulated by law. 2.1. Collect, systematize and evaluate curricular updating experiences at the institutional level 2.2. Design and develop IT T graduate evaluation mechanisms based on the reference frameworks and curricular guidelines. 2.3. Design and implement an academic offer for teacher training in Computer Science and Computational Thinking. 2.4. Periodically update the guidelines or orientations for the inclusion of ICT contents in the ITT curriculum related to Computational Thinking, Robotics, Programming and/or Algorithms as a specific curricular space and to digital citizenship (including teachers' professional internships and/or internships) for all levels and modalities of the education system. 2.5. Design curricular development actions for the implementation of production strategies and use of pedagogies based on the use of digital resources and Ed Tech solutions. 2.6. Strengthen networks and communities of practice and promote renewed leadership in administration teams for the implementation of ICT projects with articulation in situated training processes. 2.7. Strengthen continuing teacher training (CTT) strategies aimed at developing the technical skills of teachers, teacher trainers and directors through in-service training and various mechanisms adapted to the needs and institutional contexts. 2.8. Offer hybrid formats for teacher training including professionalizing internships in the Industry 4.0 sector. 2.9. Strengthen the articulation with knowledge networks and national and foreign academic centers for teacher training in computer science and computational thinking. 3.1. To establish mechanisms for periodically updating the guidelines, orientations and regulations for accreditation, follow-up and evaluation of the TT offer at all levels and modalities of the system. 3.2. Review and adjust the guidelines for the construction of a system for the evaluation of teaching skills and performance. 4.1. Updating of training, career and function requirements and their articulation with mobility and incentives. 4.2. Include in the professional career aspects related to training, mobility and career incentives linked to the development of collaborative practices among peers and administration teams at the institutional level. 4.3. Review of the labor regime linked to the new conditions that contemplate work in hybrid and distance modalities. 4.4. Review and improvement of teachers' working conditions. 4.5. Guarantee institutional and working conditions to strengthen collaborative learning practices among teaching peers and their rotation of assignments in different educational institutions.	Ministry of Education; TT Policy Body/ICT Area Ministry of Education; Agency in charge of TT Governing Body of the TT; Curriculum and Planning Areas of the Ministry of Education Ministry of Education	Ensuring consensus to regulate the teaching profession Guarantee budgets for incentives linked to ICT inclusion in the training system.

Level 1 Roadmap Getting Started - Protecting Children's Data

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There are no specific and updated normative, regulatory or administrative frameworks on personal data protection in the digital world, nor is there a clear political priority to include it in the agenda. Although it adheres to international conventions on rights and the fight against crimes, they do not consider the specificity for children and adolescents, nor do they consider support devices for the prevention of online violence or other addictions such as programs or technical teams for assistance.</p> <p>In the educational sphere, there are no regulations governing the recognition of children and youths' rights on the Internet or digital violence at school. There are no specific reporting mechanisms or prevention or assistance actions, nor school climate or cyberbullying records. There are no data integrity regulations or access to codes.</p>	<p>There are general frameworks for data protection and habeas data recognition.</p>	<p>The pandemic led to the intensive development of social platforms and networks and brought the issue of security in the virtual world to the forefront.</p> <p>There is a great deal of scope for action. Interventions in this field can be relatively inexpensive.</p> <p>Civil society is mobilized around these issues and it is possible to generate links and agreements for joint action.</p> <p>There is an international movement, both from supranational and civil society organizations, to put data protection issues on the agenda.</p>	<p>What is the policy for the protection of minors in the digital world?</p> <p>What is the scope of the country's regulations and regulatory framework in relation to personal data and cybersecurity? Are there authorities to enforce these regulations? Is there specific legislation recognizing digital human rights?</p> <p>Are crimes against children and youth adequately criminalized in the digital world?</p> <p>Are there programs or projects for technical assistance or assistance to children and youth in situations of digital violence?</p>	<p>Regulatory and normative frameworks on the protection of minors in the digital world obsolete or inadequate</p> <p>Insufficient development of specific bodies, mechanisms and devices to address the rights of children and youth or crimes against children and youth in the digital world</p> <p>Insufficient development of specific regulations on digital rights in the education system</p> <p>Limited scope of awareness-raising, sensitization and prevention activities</p> <p>Weakness of the technical teams working in both prevention and remediation</p> <p>Weak cybersecurity systems for public data protection</p>	<p>1. Develop regulatory frameworks on the protection of minors in the digital world.</p> <p>2. Strengthen institutions and mechanisms for the treatment of rights and crimes against children and youth in the digital world.</p> <p>3. Develop specific rules and regulations on digital rights in the education system.</p> <p>4. Develop an awareness and training plan.</p> <p>5. Strengthen technical teams</p> <p>6. Establish cybersecurity systems for data protection.</p>	<p>1.1. Develop guidelines and supporting documentation for the protection of minors in the digital world.</p> <p>2.1. Building a base with the review of international antecedents</p> <p>2.2. Strengthen links with international organizations (supranational or civil society organizations).</p> <p>2.3. Survey and diagnose local organizations, mechanisms and devices for the treatment of rights and crimes against children and youth in the digital world.</p> <p>2.4. Define a management framework for treatment, based on the existing mechanisms.</p> <p>3.1. Develop guidelines, documentation and specific regulations on digital rights and protection in the digital world in the education system.</p> <p>3.2. Disseminate and train on new norms and regulations.</p> <p>4.1. To develop a public awareness and sensitization program.</p> <p>4.2. To develop a teacher training program.</p> <p>4.3. Implement projects in schools</p> <p>4.4. Establish collaborative action agreements with CSOs.</p> <p>5.1. Evaluate available capacities</p> <p>5.2. Define competency profiles by technical team</p> <p>5.3. Develop a development/training plan for the technical teams and hire specific profiles.</p> <p>5.4. Develop agreements with other entities for the strengthening of teams.</p> <p>6.1. Define guidelines for the protection of children and youth data in agreement with system development.</p> <p>6.2. Develop and implement modules for data access and usage</p>	<p>Ministry of Justice and Human Rights; Ministry of Education; Ministry of Education</p> <p>Ministry of Justice and Human Rights; Ministry of Education;</p> <p>Ministry of Justice and Human Rights; Ministry of Education;</p> <p>Ministry of Education</p> <p>Ministry of Justice and Human Rights; Ministry of Education;</p> <p>Ministry of Justice and Human Rights; Ministry of Education; ICT Innovation Agency.</p>	<p>Integral participation is fundamental to achieve good results.</p> <p>External consultations with individuals who could potentially be affected by the interventions, with experts from the private sector and possibly with the data protection supervisory authority.</p>

Level 2 Roadmap Consolidation of Progress - Child Data Protection

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There are regulatory frameworks for the protection of personal data in the digital world and initiatives for coordination with different sectors and institutions without forming consolidated networks.</p> <p>The common justice system handles criminal cases.</p> <p>Human rights in the digital era and regulatory frameworks for defining online crimes are recognized but limited in scope and without consolidated and adequate procedures for children and youth.</p> <p>Support mechanisms include civil society observatories, some discontinued communication actions and professional teams that provide ad hoc technical assistance. There are violence prevention programs that are limited in scope or sporadic, assistance teams for specific events and a follow-up and monitoring system for these actions.</p> <p>In education, there are weak regulations on digital violence at school without clear event management procedures and specific but not appropriate or used reporting mechanisms.</p>	<p>Agenda item installed in society</p>	<p>The pandemic led to the intensive development of social platforms and networks and brought the issue of security in the virtual world to the forefront.</p> <p>There is a great deal of scope for action. Interventions in this field can be relatively inexpensive.</p> <p>Civil society is mobilized around these issues and it is possible to generate links and agreements for joint action.</p> <p>There is an international movement, both from supranational and civil society organizations, to put data protection issues on the agenda.</p>	<p>How are the issues of digital citizenship, cybersecurity and cybercrime addressed at school? When faced with an event, are the steps for filing a complaint known and how do the different bodies intervene? Are there protocols for action? Are there sanctions? Is there case law? Is there a body of specialists to advise institutions? How are they formed, what are their characteristics and competencies? Are there programs or projects for technical assistance or assistance to children and youth in situations of digital violence? Are there monitoring and evaluation mechanisms? Which ones? Are the results of the evaluations known to all and are they used to redefine actions?</p>	<p>Lack of a national strategy or vision on data protection and digital security of children and youth.</p> <p>Limited regulatory frameworks for the recognition of rights and offenses in the digital world</p> <p>There are no standards or agreements with digital service providers to incorporate data protection perspective</p> <p>The judicial system does not have the competences to address the digital issues related to children and youths</p> <p>Education authorities are not sufficiently advised to adequately analyze and evaluate digital safety and security policies</p> <p>Technical teams do not have adequate skills to deal with the digital issue</p>	<ol style="list-style-type: none"> 1. Establish or update the national strategy for the protection of children and youth in the digital world, considering the different actors involved. 2. Establish a comprehensive regulatory framework for the recognition of the rights and protection of children and youth in the digital world, including preventive, punitive and remedial measures. 3. Establish agreements with the private sector to incorporate the security approach. 	<ol style="list-style-type: none"> 1.1. Review and analyze international experience in online safety and security for children and youth. 1.2. Prepare a document and set up high-level working groups to define the strategy. 2.1. Based on the agreements set forth in the national strategy for data protection and security of children and youth in the digital world, develop proposals for the normative and regulatory framework. 2.2. to develop legislative agreements for the sanctioning 3.1. Establish working groups with the private sector to incorporate the online security approach in the services provided. 3.2. Develop frameworks and protocols for improving the online experiences of young people. 3.3. Implement systems for reporting inappropriate content for children and youths online. 	<p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice;</p> <p>Ministry of Justice; Ministry of Education; CSOs</p> <p>Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p>	<p>Train technical teams and officials in data protection and make them aware of the risks involved in processing operations. Social consensus for the promotion of data protection.</p> <p>Establish a budget national level that contemplates the revision and development of regulatory frameworks.</p> <p>Higher associated costs for the private sector to incorporate data protection issues into the system.</p>
					<ol style="list-style-type: none"> 4. Strengthen the judicial system with technical capabilities, budgets and knowledge to address crimes in the digital world. 5. Promote the participation of CSOs in the protection of children and youth online. 6. Strengthen awareness campaigns and training actions for teachers and all professionals who work with children and youth. 7. Strengthen technical and professional teams to act with solvency in prevention, assistance and repair. 8. Strengthen online security systems 	<ol style="list-style-type: none"> 4.1. Develop a program to raise awareness of and adapt the treatment of online crime. 4.2. Promote the incorporation of technical profiles with specific competence in the treatment of digital crimes. 5.1. Establish collaborative action agreements with CSOs. 6.1. Develop a public awareness program on digital rights and online protection of children and youth. 6.2. Develop a teacher training program. 6.3. Implement projects in schools 7.1. Evaluate available capacities 7.2. Define competency profiles for each technical team. 7.3. Develop a development/training plan for the technical teams and recruit specific profiles. 7.4. Develop agreements with other entities for the strengthening of teams. 8.1. Establish regulations for the systematization and management of child and youth data in the platforms. 8.2. Implement modules for the security and management of child and youth data. 	<p>Ministry of Justice;</p> <p>Ministry of Justice; Ministry of Education; CSOs</p> <p>Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p>	

Level 3 Roadmap
Reaching system maturity - Child data protection

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There is a regulatory framework for the protection of the rights of children and youth and for the protection of the on-line experience, with a national enforcement authority for the protection and supervision of specific data for the treatment of children and youth offenses.</p> <p>There is broad recognition of the right to data protection of minors on the Internet, the right to digital education, the right to privacy of children and youth on the Internet, age-appropriate content, the right to be forgotten, among others.</p> <p>There is a comprehensive regulatory framework with a broad classification of offenses.</p> <p>There are developed programs for the prevention of online violence, harassment, digital addictions and other aspects that threaten a safe Internet, with a wide scope and regular frequency.</p> <p>There are specific technical assistance or institutional advisory bodies</p> <p>There is a community that supports online child protection actions.</p>	<p>Data protection and online safety of children and youth is a government agenda item</p> <p>There is a regulatory and procedural development of personal data protection and security of minors and in the educational environment</p> <p>The systems keep cybersecurity guidelines, particularly with respect to the data of minors There are wide-ranging training and awareness programs on the responsible use of data, digital citizenship and safe Internet.</p>	<p>The pandemic led to the intensive development of social platforms and networks and brought the issue of security in the virtual world to the forefront.</p> <p>There is a great deal of scope for action. Interventions in this field can be relatively inexpensive.</p> <p>Civil society is mobilized around these issues and it is possible to generate links and agreements for joint action.</p> <p>There is an international movement, both from supranational and civil society organizations, to put data protection issues on the agenda.</p>	<p>How are the issues of digital citizenship, cybersecurity and cybercrime addressed at school? When faced with an event, are the steps for filing a complaint known and how do the different bodies intervene? Are there protocols for action? Are there sanctions? Is there case law? Is there a body of specialists to advise institutions? How are they formed, what are their characteristics and competencies? Are there programs or projects for technical assistance or assistance to children and youth in situations of digital violence? Are there monitoring and evaluation mechanisms? Which ones? Are the results of the evaluations known to all and are they used to redefine actions?</p>	<p>Ongoing adaptation to new forms of online crime and recognition of online rights</p> <p>Alignment among different stakeholders to achieve synergies in data protection issues</p> <p>Lack of definition of requirements for all professionals working with children and youth.</p> <p>Permanent information on actions and practices in the network</p>	<p>1. Establish permanent mechanisms for updating the national strategy for the protection of children and youth in the digital world, including the different sectors of society and the scientific community, with emphasis on the development of codes of good practice and appropriate responses to technological changes.</p> <p>2. Ensure the implementation of online security policies in the digital ecosystem.</p> <p>3. Ensure partnerships with CSOs for online child protection, including mechanisms for the private sector to identify, block, and eliminate online child abuse.</p> <p>4. Establish certification of competencies for all professionals working with children and youth.</p> <p>5. Strengthen the assistance system with permanent evaluation of actions.</p> <p>6. Produce relevant knowledge to identify and disseminate experiences and opportunities for online child protection.</p>	<p>1.1. Establish a committee that includes different sectors of society and the scientific community, to members of the educational community and youth representatives to update them on the principles of the national strategy for the protection of children and youth in the digital world.</p> <p>1.2. Implement a technological surveillance system on digital rights and crimes and review of new online practices.</p> <p>1.3. Implement agreements for the development of codes of good practices for the different sectors, based on emerging technologies.</p> <p>2.1. Establish a permanent monitoring system for security policies in the digital ecosystem and review compliance with such policies.</p> <p>2.2. Establish mechanisms for observation/attention to non-compliance.</p> <p>3.1. Establish a permanent working group with CSOs to coordinate actions for the protection of children and youth online.</p> <p>3.2. Identify areas for cooperation between organizations</p> <p>3.3. Promote actions to ensure that different stakeholders take measures against the dissemination of CSAM-type content and online child abuse.</p> <p>4.1. Agree on basic competencies that professionals working with children and youth should have in relation to the promotion of rights, attention to vulnerabilities, prevention, action and reparation in the face of crimes.</p> <p>4.2. Define mechanisms for competency certification and implementation of the certification system.</p> <p>4.3. Establish these competencies as desirable requirements for access to public office.</p> <p>5.1. Develop metrics for the student care and assistance system.</p> <p>5.2. Establish a mechanism to follow up on actions and attention.</p> <p>5.3. Develop strategies for violence prevention</p> <p>5.4. Develop conflict mediation mechanisms in the school.</p> <p>5.5. Strengthen awareness and action measures in the educational community.</p> <p>5.6. Develop a system for analyzing risk factors.</p> <p>6.1. Establish gaps in knowledge regarding the protection of children and youth online.</p> <p>6.2. Establish/promote agreements with the scientific and technological systems to include vacancies in research programs.</p> <p>6.3. Share experiences and opportunities for child protection online</p>	<p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education; CSOs</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Justice; Ministry of Education</p> <p>Ministry of Education; Scientific system and academia.</p>	<p>High-level national, subnational and international consensus. Sustained agreements with the private sector and CSOs.</p> <p>Sustaining and strengthening the importance of the protection issue on the agenda. Normative commitments at the national, subnational and international levels.</p>

Level 1 Roadmap
First steps - Interoperable information systems

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There is no directionality in the development of information systems in education. Existing management systems operate autonomously and with limited scope. There is no standardization of information production for decision making, early warning systems for consolidated risks, source authentication or a digital identity and age certification system. In relation to the EMIS of students, educational centers and personnel management there are partial records in different digital formats. There is partial or outdated information on infrastructure and equipment of the education system. In relation to interoperability, there are no guidelines for the development of integrated or interoperable systems.</p>	<p>There is a base of developed management systems with a scope of less than 50% that operate autonomously. There is information on the central variables of the education system. There are partial or scattered nominal records of students and teachers.</p>	<p>The pandemic made visible the need to identify students who were excluded from the education system. There is international experience in the development of educational information systems and projects of international lending and cooperation agencies that promote the improvement of the EMIS. The various stakeholders in the system demand and support the need for systems development to alleviate the burden of administrative tasks.</p>	<p>What is the degree to which technologies are used for educational management processes? What is the degree of development of true source systems and systems integration and interoperability? What are the criteria for system development? What is the budget allocation to finance a development plan?</p>	<p>Lack of a strategic information systems plan for educational management Weak IT security mechanisms Lack of a nominalized student management system Dispersed, disintegrated and incomplete administrative management systems Weak interoperability of the different systems. Insufficient technological infrastructure for the deployment of the new functionalities required.</p>	1. Have a strategic plan for the development of an educational management information system (EMIS) with general guidelines and a vision of data integrity.	<p>1.1. Establish institutional agreements for the management and development of a strategic plan for information systems.</p> <p>1.2. Survey and diagnose the status of the information systems, focusing on student follow-up and the digitalization of management processes.</p> <p>1.3. Define a strategic information control board for management and decision making.</p> <p>1.4. Strengthen the central technology unit to sustain the changes (technological resources—technology floor, connectivity and equipment—, software and support technology in the cloud, human resources to deal with the change).</p> <p>1.5. Training plan for systems areas</p>	Educational authority	Budget constraints Professional expertise Data management under data protection standards
					2. Implement a basic cybersecurity strategy for the systems and information of the education system and its participants.	<p>2.1. Diagnose and analyze the initial situation, in terms of mechanisms and risks.</p> <p>2.2. Elaborate a security strategy for the EMIS and participant data.</p> <p>2.3. Develop a plan of initiatives to be implemented to systematize, protocolize and manage student data.</p> <p>2.4. Evaluation of the results of the strategy</p>	Educational authority; Systems area	
					3. Implement a nominal student system	<p>3.1. Develop an IT solution to register and track students by name in an approved database.</p> <p>3.2. Develop methodologies and protocols for updating data per student</p> <p>3.3. Develop protocols for the migration of available databases</p> <p>3.4. Train and implement the solution at the facility level, with advice at the intermediate level.</p> <p>3.5. Provide technical assistance for the support and permanent updating</p> <p>3.6. Implement models for quality assurance of information and data use.</p>	Ministry of Education; Educational Evaluation Area	
					4. Digitize the priority processes of educational management	<p>4.1. Analyze and diagnose available management systems and identify key gaps</p> <p>4.2. Develop a technological solution on key vacancies for developments</p> <p>4.3. Enhance current systems with key functionalities</p>	Ministry of Education; Educational Evaluation Area	
					5. Set up a layer of integration of available information, make information available in a dashboard and or initiate the process of opening government data, with the availability of ICT policy information (accountability and transparency).	<p>5.1. Install a higher-level systems layer to integrate the information available from the various subsystems.</p> <p>5.2. Develop data services from existing systems</p> <p>5.3. Install information board services to make information available in the different subsystems and according to the requirements of different stakeholders.</p> <p>5.4. Build a public repository of information, define data standardization and publish datasets of management information from the education system, safeguarding the privacy of personal data.</p>	Ministry of Education; Educational Evaluation Area	
					6. Strengthen technology units at the central and decentralized levels in terms of technological floors, computer equipment and technical-professional skills	<p>6.1. Survey technological availability</p> <p>6.2. Define infrastructure, equipment and connectivity requirements to install upgrades or new applications with a medium-term perspective.</p> <p>6.3. Define and implement an infrastructure, equipment and connectivity procurement plan based on the technological deployment model.</p> <p>6.4. Strengthen technical teams for the implementation of new functionalities.</p>	Ministry of Education; Educational Assessment Area	

Level 2 Roadmap
Consolidation of progress - Interoperable information systems

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
<p>There are people in charge of the different management subsystems, but there are no general and integral guidelines. There are projects with greater scope in educational management processes. There are educational indicators that are integrated and have limited use. Ad hoc reports are produced, and source authentication systems are in incipient development. In relation to the EMIS of students, educational centers and personnel management, there are computer modules, but they are not integrated and are not used in daily management or are not used at all levels of the system. There is information to measure the relationship between infrastructure supply and demand, but it is partial or outdated. In relation to interoperability, there are guidelines for the development of integrated or interoperable systems within the public administration.</p>	<p>Between 50 and 80% of the central processes of educational management are digitized. Management information is available on: supply, education (trajectory), positions, absenteeism, expenditures, school buildings and equipment, investments, results of standardized tests, academic results, school environment. Teachers, inspectors, technicians and officials have strengthened their data management skills and intend to make better use of available data.</p>	<p>There is international experience on the development of educational information systems and their importance for the improvement of the education system There is technical cooperation and funding from international organizations for the advancement of the EMIS</p>	<p>What is the state of progress of digital transformation in education in the country? How have information integration mechanisms been developed? How are information dashboards defined and developed? What technical availability does the country have in terms of infrastructure, equipment and technical/professional resources?</p>	<p>There are computerized management systems, but they are not integrated; although there are development plans, there is no strategic plan for systems development or it is not updated, which leads to disjointed developments that are difficult to integrate. There are critical educational management processes that are not computerized. There are strong weaknesses in the production and use of information for decision making. The functionalities of the student system are limited to tracking the trajectory, and access to information is limited. Weaknesses in the area of cybersecurity.</p>	1. Update the strategic plan for the development of educational information and management systems, with special emphasis on the readjustment or development of the digitalization of the central processes of the education system.	1.1. Re-establish management agreements for the development of a strategic plan for information systems. 1.2. Diagnose the status of the information systems, focusing on services and the digital transformation of management processes. 1.3. Update the strategic information dashboard for management and decision-making purposes. 1.4. Strengthen the central technology unit to sustain the changes (technological resources -technology floor connectivity and equipment-, software and cloud support technology, human resources to cope with the change 1.5. Establish guidelines, regulations and protocols for authentic source management systems for the education system's critical data, generating the basis for the interoperability of all applications.	Ministry of Education; State Authority for Technological Innovation; Systems Area	<p>Budgetary restrictions Professional expertise Data management under data protection standards</p>
					2. Complete the digitalization of critical educational management and system administration processes: school, personnel, resource, infrastructure and equipment management systems.	2.1. Analyze and diagnose available management systems and identify key gaps 2.2. Develop a technological solution on key gaps for developments 2.3. Enhance current systems with key functionalities	Ministry of Education; State Authority for Technological Innovation; Systems Area	
					3. Develop an updated monitoring and control system that consolidates management indicators on: supply, education (trajectory), positions, absenteeism, expenditures, school buildings and equipment, investments, with cross-referencing of variables, standardized test results, academic results, school environment.	3.1. Survey, analyze and establish the requirements of a management follow-up and control system covering the different dimensions of the education system. 3.2. Develop processes to integrate the information available from the different subsystems and arrange for its visualization in an environment suitable for different audiences. 3.3. Exploit data analysis systems for decision support. 3.4. Advance with the standardization of data and publish datasets of management information of the education system, safeguarding the privacy of personal data.	Ministry of Education; Evaluation Department; Systems Department	
					4. Expand the functionalities of the student system	4.1. Evaluate the use and survey new requirements of the nominal student system. 4.2. Include functionalities for monitoring educational trajectories, with warnings of dropout risks per student, spaces for accompaniment, assistance, inclusion in special projects. 4.3. Develop a public review module. 4.4. Include first for the development of artificial intelligence systems for student support. 4.5. Train and implement the solution at the facility level, with advice at the intermediate level. 4.6. Provide technical assistance for the support and permanent updating of the	State Technology Innovation Authority; Ministry of Education; Evaluation Area; System Area	
					5. Establish a system of identity and digital age certification.	5.1. Develop and implement protocols and functionalities related to identity and age certification, in digital form and based on single source.	Ministry of Education; Systems Area; Ministry of Education; Evaluation Area	

Level 3 Roadmap
Reaching system maturity - Interoperable information systems

Starting situation	Strengths	Opportunities	Guiding questions	Critical nodes	Objectives	Lines of action	Responsible Actors	Conditions and risks
There is a strategic vision of educational management information systems, with development regulations and a strategic plan for the digital transformation of the education system. The development of systems covers more than 80% of management processes. It is used and leveraged for information for management and policy definition. There is a comprehensive and nominalized student management system, with multiple functionalities and some artificial intelligence lines have been implemented. There is a comprehensive management system based on a single registry of educational centers, personnel and other resources, which is used in daily school management. There is a consolidated policy for the development of integrated systems or interoperable within the public administration.	Extensive development of systems in practically all levels of management of the education system Clear directionality of strategic development of systems Production and use of information by all levels of management Access to public data and information The educational information and management systems are interoperable at different levels and with other government systems. Information services are in place for community access.	international lending and cooperation agencies that promote the improvement of EMIS. Maturity of the Edtech ecosystem.	What is the state of progress of digital transformation in education in the country? Are digital intelligence tools used to promote better learning opportunities and improvement of the education system? How to generate information with a prospective view on the growth/ development of education systems? What other information is relevant to ensure better learning? What technical availability does the country have in terms of infrastructure, equipment and technical/professional resources? What opportunities and assets are available in the Ed Tech ecosystem?	Promote and ensure the digital transformation of the education system. Ensure continuous improvement of systems Using information platforms as a key element for the improvement of the education system	1. Consolidate the digital transformation of the education system, focusing on the management of institutions to provide information to all levels of government and to improve the education system. 2. Develop a strategic plan for the digital transformation of the education system, with secured funding for permanent improvement and sustainability. 3. Add functionalities, with early warning systems for risk and data analysis, based on management indicators, prospective analysis of school supply and demand, and information for service programming.	1.1. Review and analyze international experience of global digital transformation of education systems. 1.2. Define a model for the digital transformation of the school, intermediate and central spaces, focusing on the management of the institutions. 1.3. Promote developments in line with the digital transformation of the edtech ecosystem. 2.1. Define a strategic development plan at all educational levels and areas to ensure digital integration and transformation. 2.2. Develop a detailed costing of necessary medium- and long-term investments 2.3. Contract or develop systems in line with the digital transformation of the system. 3.1. Evaluate the use and survey new requirements of the nominal student system. 3.2. Include tracking functionalities for educational trajectories, early alerts and warnings of dropout risks per student, spaces for accompaniment, assistance, inclusion in special projects, etc. 3.3. Develop a public review module. 3.4. Include artificial intelligence systems for promotion of activities and development of on-line evaluation and self-evaluation. 3.5. Train and implement the solution at the with advice at the intermediate level. 3.6. Provide technical assistance for the support and permanent updating of the	Central Government; Educational Administration; State Innovation Area Central Government; Educational Administration; State Innovation Area State Technology Innovation Authority; Ministry of Education; Evaluation Area; System Area	Budgetary restrictions Professional expertise Data management under data protection standards

