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Ed-Tech landscape and challenges in Latin America and the Caribbean

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Abstract

The COVID-19 pandemic brought particular educational challenges in Latin America and the Caribbean (LAC), where improvements in learning outcomes were already stagnant. The move to remote and online solutions during the pandemic exacerbated inequalities, despite mitigation efforts put in place. This study explores the design and implementation of education technology (ed-tech) programmes and policies in LAC to understand to what extent and how technology fosters learning, and reduces inequalities, in primary and secondary education in the region, using an issue-specific political economy framework.

The study finds that although there is significant regional variation in progress on the digitalisation of education, ed-tech interventions have gradually transitioned from the provision of digital learning devices and internet access, towards enhancing digital literacy among teachers and students. It also finds that the integration of technology in education demands a pedagogical shift towards more personalised learning, targeting the specific needs of students and teachers. Relatedly, efforts to combat educational inequalities must also take into account excluded groups, particularly along lines of gender and disability. While opinion varies in terms of how to best support a sustainable ed-tech environment, the issue of governance is central. The presence of multiple stakeholders requires an effective governance system to ensure the efficient use of resources, prevent overlapping functions, and to ensure policy continuity.

Authors

Dante Castillo-Canales is the director of innovative policies and practices at SUMMA. He has worked in social research in both the public and private sectors. He is a sociologist from the University of Chile, has a master's degree in Culture and Society from the London School of Economics and Political Science (LSE).

Liz Mejías is an independent consultant from UNESCO and SUMMA. She has a master's degree in Development Economics from the University of Paris, Panthéon-Sorbonne, France.

Ernesto Roque-Gutierrez is interested in several aspects of language learning, cognition, and education in different international settings, especially in the Global South. He is currently a research officer for TalkTogether, a UKRI GCRF-funded research project based at the Department of Education at the University of Oxford.

Arianna Valentini holds a BA in political science, an MSc in Development studies and has recently graduated from the GLOBED MA. She has expertise in project management of education projects. She currently works as a policy analyst for UNESCO IESALC and as an independent consultant for SUMMA.

Johanna Rübcke is the program specialist at the German Commission for UNESCO and an independent consultant at SUMMA. She has a master's degree in International Relations and Affairs from University of Warsaw, Poland.



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Acronyms and abbreviations

CSOs	Civil Social Organisations
ECLAC	Economic Commission for Latin America and the Caribbean
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
LAC	Latin America and the Caribbean
NGOs	Non-Governmental Organisations
PEA	Political Economy Analysis
PNTED	Digital Education Transformation National Programme (Programa Nacional de Transformación Educativa Digital)
PPP	Purchasing Power Parity
ToC	Theory of change model
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

Key concepts

Key concepts	Definition
Ed-tech	Ed-tech is defined as the application of information and communication technologies in education that can facilitate the delivery of instruction and learning processes (Rodriguez-Segura 2022). This includes both low and high technology. Low technology refers to analogue technology (such as radio and TV) and is not interactive. High technology refers to more complex, interactive digital technology and software, and includes hardware (such as smartphones, tablets, and laptops), software for student/teacher and management, monitoring and evaluation use, infrastructure (electricity, local connectivity, internet), and other digital applications (such as open licensing, open innovation, crowdsourcing) (Haßler et al. 2020).
Civil society organisations	An ed-tech programme can be implemented by governments but also by other actors from civil society organisations (CSOs) such as non-governmental organisations, foundations and other non-state associations. Cortina and Lafuente (2018, pp. 4–5) define civil society “as the sphere of social interaction between the market and the state, composed of families, associations, social movements, and all forms of public debate, with diverse degrees of formalisation and access to political and economic resources”. In this sense, CSOs remit to those voluntary organisations, generally on a not-for-profit basis, to promote the common good. CSOs can operate at the local, national or international level to provide essential services to communities, such as health care, education and social assistance.
Political economy	Political economy is an “interdisciplinary area of study that explores the relationship between individuals and institutions, the market, and the state occurring at different interconnections, as well as the specific (policy) outcomes of these relationships” (Verger et al., 2016, p. 15). In the field of ed-tech, Pellini identified an issue-specific political economy framework that “can, and usually does, include elements of sectoral political economy such as mapping the key actors and their relationships within a given sector, such as education, and the power and interests of different groups in a sector” (Pellini et al., 2021, p. 12).
Policy (public policy)	“Policy” is defined as the specific action of governments to address social problems, that is “a standing decision by an authoritative source such as a government [...] modern democratic process designate people to make policy, to make decisions, on behalf of their polity” (Shafritz, 2004, p.194). A well-established definition describes the policy-making process as consisting of five stages: problem definition, agenda setting, policy adoption, implementation, and evaluation (Mintrom & Williams, 2012).
Theory of change	A theory of change (ToC) is an approach that explains how a given intervention, or set of interventions, is expected to lead to specific changes. A ToC provides a working model that can be used to test hypotheses and assumptions about which actions will be best suited to enable the intended outcomes. Thus, interventions, which can be activities and outputs of any sort, are mapped to the pathway of outcomes to demonstrate stakeholders’ thoughts on what it takes to reach the changes (Taplin et al., 2013).

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Introduction

The development and implementation of educational technologies (ed-tech) in Latin America and the Caribbean (LAC) has been severely limited by inequalities and other structural factors. Despite the proliferation of policies and programmes promoting the adopting of ed-tech practices in many LAC countries, schools, teachers, and students in poorer and rural areas reap fewer benefits from the adoption of digital technologies in the classroom. This is because disparities in key infrastructure such as reliable power, internet access, ed-tech devices and platforms to facilitate digital learning substantially impact the success of ed-tech among those populations. Across the LAC region, government transitions and complex public-private relationships in the ed-tech sector result in a problematic gap between the conception of ed-tech policies and interventions and their practical implementation.

The increased reliance on ed-tech and digital technology resources during the COVID-19 pandemic saw these pre-existing challenges magnified. Unequal access to ed-tech resources due to infrastructural and wealth inequalities has meant that LAC countries have, in many instances, been unable to translate the promise of ed-tech in aiding learning outcomes into concrete improvements in enrolments, test scores, and graduation rates. Many teachers struggle to implement new digital learning technologies into their teaching practices (due to, for example, connectivity issues, lack of skills and resources, or non-tailor-made training). Furthermore, marginalised



The future of ed-tech in the region is uncertain.

There is emerging evidence on the effects the shift to technology-mediated teaching and learning has had on educational outcomes during the pandemic.

students (for example those from remote/rural or indigenous communities, or low-income students) with lower digital literacy and internet access, have not enjoyed the benefits of new learning modalities enabled by ed-tech.

This study explores the current state of ed-tech initiatives in the LAC region. By mapping and comparing the progress of key ed-tech policies and programmes in six¹ LAC countries, it aims to understand key trends in the adoption of digital learning technologies in the region, and the critical challenges facing the advancement of the ed-tech agenda.

The study aims to outline the main ways in which ed-tech has been implemented, highlighting what the focus of ed-tech policies in the region has been. It explores both the factors that have facilitated the development and implementation of these policies such as the technical and financial support of international organisations, as well as those which have acted as barriers to the successful implementation of ed-tech initiatives such as the lack of effective governance systems, or the lack of funding. It demonstrates the impact that the COVID-19 pandemic had on the progress of the ed-tech agenda, and identifies key areas for further study, which will be essential for the adoption and successful implementation of digital learning technologies in the region in the post-pandemic era.

Existing research on ed-tech predominantly examines the impact of specific tools on educational results, such as those that increase access to technology, interventions that aim to impact on students behaviour, to improve the instruction and those that develop self-led learning processes (Rodriguez-Segura, 2022; Burns, 2021). However, there is little research into the political and policy decisions that seek to integrate technology into education. This study aims to bridge this gap, exploring the design and implementation of ed-tech programmes and policies in LAC. It aims to understand to what extent and how technology fosters learning and curbs inequalities in primary and secondary education in the region by posing the following research questions:

1. How important have ed-tech policies and interventions been in the region?
2. What are the priorities of ed-tech policies within the region and in what ways has ed-tech been used?
3. What factors have facilitated the development and implementation of ed-tech policy within the region?
4. What factors have acted as barriers to the development and implementation of ed-tech policy within the region?

1 Honduras, Paraguay, Jamaica, Bahamas, Mexico, and Costa Rica.

- v. How has the ed-tech landscape changed in the region since the COVID-19 pandemic (e.g., lessons learned, challenges, opportunities) and what is the future of ed-tech in the region in light of those changes?

The study adopts an issue-specific political economy framework that identifies key actors within the education sector, their relationships, power dynamics, and interests (Pellini et al., 2021). An actor-based approach aims to understand the type of interests, expectations, and values at stake in the field of ed-tech in LAC. The framework comprises five elements: (i) an issue or specific problem to address by programmes and policies; (ii) the structural factors for policy decision-making; (iii) the rules of the game that influence the behaviour of the actors; (iv) the stakeholder interests and power dynamics that influence the policymaking; and (v) the opportunities open to the actors. Using a political economy analysis of ed-tech initiatives in LAC countries, this study seeks to identify the main challenges for ed-tech policies and programmes to be effective in reducing inequalities of education systems, such as barriers related to public funding, political complexity due to the lack of continuity of policies, absence of a common vision about the role of technology in education, and other issues related to governance.


Two complementary perspectives are used to capture the diversity of contexts and policies within the region. First, a design-actuality gap model (Heeks, 2002; Palvia et al., 2015) is used, which helps to identify potential disparities between the current state of the context (actual situation) and the desired outcomes envisioned for ed-tech programmes or policies (desired situation). In particular, this approach assesses the extent to which the design of certain information and communication technologies (ICT) policies effectively addresses educational requirements and the challenges faced by students and teachers. Linked to this, the study uses the theory of change (ToC) model (Taplin et al., 2013), which guides the logical model and pathways connecting the activities of a programme to the desired outcomes, specifically, focusing on the intended outcomes of the ed-tech policy or programme.

Education, inequality, and ed-tech integration in Latin America and the Caribbean

Global consensus has tended to underscore that digital technologies for education—referred to here as “ed-tech”—can play a significant role in boosting education and learning (Burns, 2021; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2021; United Nations [UN], 2015; Economic Commission for Latin America and the Caribbean [ECLAC], 2022b). However, before the COVID-19 pandemic, learning outcomes were already stagnant in Latin America (ERCE, 2019).

The move to remote and online platforms exacerbated existing educational inequalities. Efforts introduced in the region during the COVID-19 pandemic such as teacher capacity building, increased provision of digital devices, development of learning platforms, and inter-sectoral partnerships, among other measures (The Dialogue, 2021; Soletic & Kelly, 2022), could not prevent the widening of educational gaps due to unequal access to online resources (Patrinos et al., 2022; World Bank et al., 2022b). Thus, the COVID-19 pandemic in fact seems to represent "an ed-tech tragedy", as a recent UNESCO report highlights (West, 2023). This tragedy not only resulted in educational exclusion and the exacerbation of pre-existing inequalities in learning opportunities due to the shift towards technology-mediated learning, but also led to various undesirable unintended consequences (West, 2023).

In LAC, high levels of inequality in education seem to be a reflection of broader structural inequalities in the region, where on average, 54% of national income is held by the top 10% of income earners (United Nations Development Programme [UNDP], 2021). This inequality was exacerbated by the 2020 economic downturn that occurred as a result of the COVID-19 pandemic. As the region faced the world's longest school closures (World Bank et al., 2022), the shift towards remote learning exposed several disparities in internet accessibility for students, and caused significant learning loss (Jordan et al., 2021; SUMMA, 2021; UNESCO Institute for Statistics et al., 2022; ECLAC, 2022b).



Students from poorer families and those who live in rural areas in LAC are more likely to have poorer learning outcomes, as are students from indigenous and afro-descendant groups.

The future of ed-tech in the region is uncertain. On the one hand, there is emerging evidence on the negative effects the shift to technology-mediated teaching and learning had on educational outcomes during the pandemic, and how the closure of schools impacted on learning (World Bank et al., 2022a). On the other hand, historical trends have not shown significant changes in the level of access and use of ed-tech tools across LAC education systems (ECLAC, 2022b). Regional policy agreements on ed-tech that promote stronger institutions, inter-sectoral dialogues, and updated regulatory frameworks, such as the eLAC2024 Digital Agenda (2022) do not appear to have been successful in mobilising and establishing long-term ed-tech programmes across LAC.

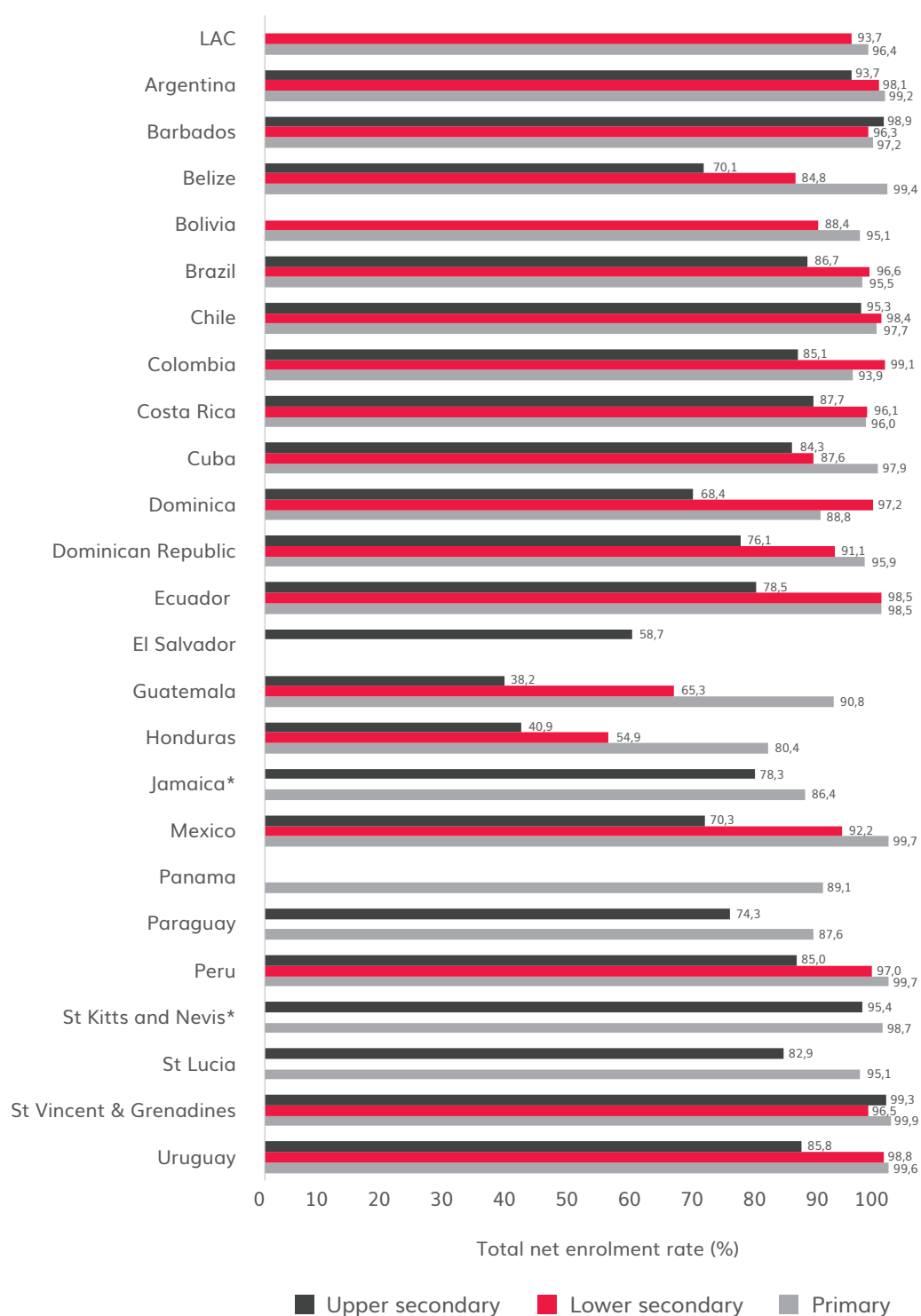
One of the four action points outlined by the Transforming Education Summit (UN, 2022) refers to the use of digital transformation as a mechanism to accelerate learning recovery, improve the quality of education and reach excluded populations (ECLAC, 2022b). Nevertheless, the complex structural contexts of LAC countries make it difficult to ensure widespread internet provision. Low population density, rurality, or extreme isolation became critical when considering bidding procedures or public-private contracts to extend connectivity in low financially-profitable zones (Inter American Development Bank [IDB], 2022). These factors are further detailed in the cases studied, specifically by looking at structural factors that condition policy making, the regulations that organise the behaviour of actors, and their interests and power relationships.

A region characterised by unequal access to education

Before the massive school closures associated with the pandemic, the percentage of students without access to primary and secondary education in the LAC region was estimated at 10.4 million (UNESCO et al., 2022), and attendance rates did not change significantly between 2019 and 2020 for primary and secondary education (Huepe et al., 2023). In 2020, primary education enrolment (1st-6th grades, ages 6 to 11 years) had reached an average of 96.4% in the region (Figure 1). While most countries achieved rates above 90%, Honduras fell below this benchmark with a rate of 80.4% in 2020. In terms of lower secondary education (7th-9th grades, ages 12 to 14 years), attendance is significantly below that of primary education, with Guatemala and Honduras recording the lowest levels at 65.3% and 54.9%, respectively. Upper secondary education shows considerable heterogeneity; while in 2020 Argentina, Barbados, Chile, Saint Kitts and Nevis, and Saint Vincent and the Grenadines had enrolment rates above 90%, rates in countries such as El Salvador, Guatemala and Honduras were below 60%. In general, access to education gets progressively lower the higher the grade, with particularly acute challenges in Central America.

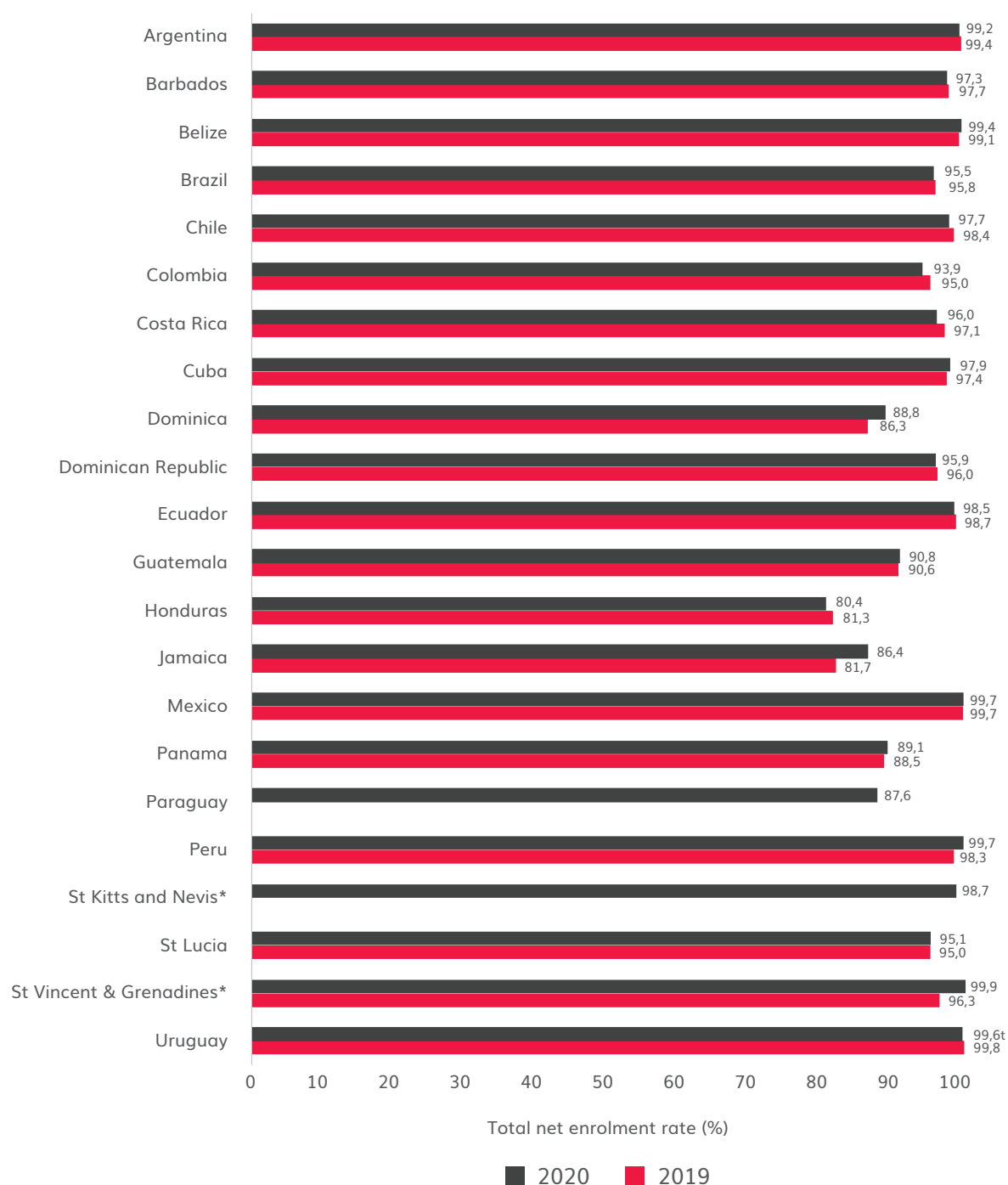
There is no significant change in enrolment rates at the primary level between 2019 and 2020 (Figure 2), with decreases of only 1 or 2 percentage points on average, and some countries even increasing their enrolment rates. At the upper secondary level, the largest downward trends between 2019 and 2020 are found in Costa Rica, Dominica, Dominican Republic, Guatemala, Jamaica, and Mexico (Figure 3).

Figure 1. Total net enrolment rate for primary education, lower secondary education, and upper secondary education, Latin America and the Caribbean (24 countries), 2020



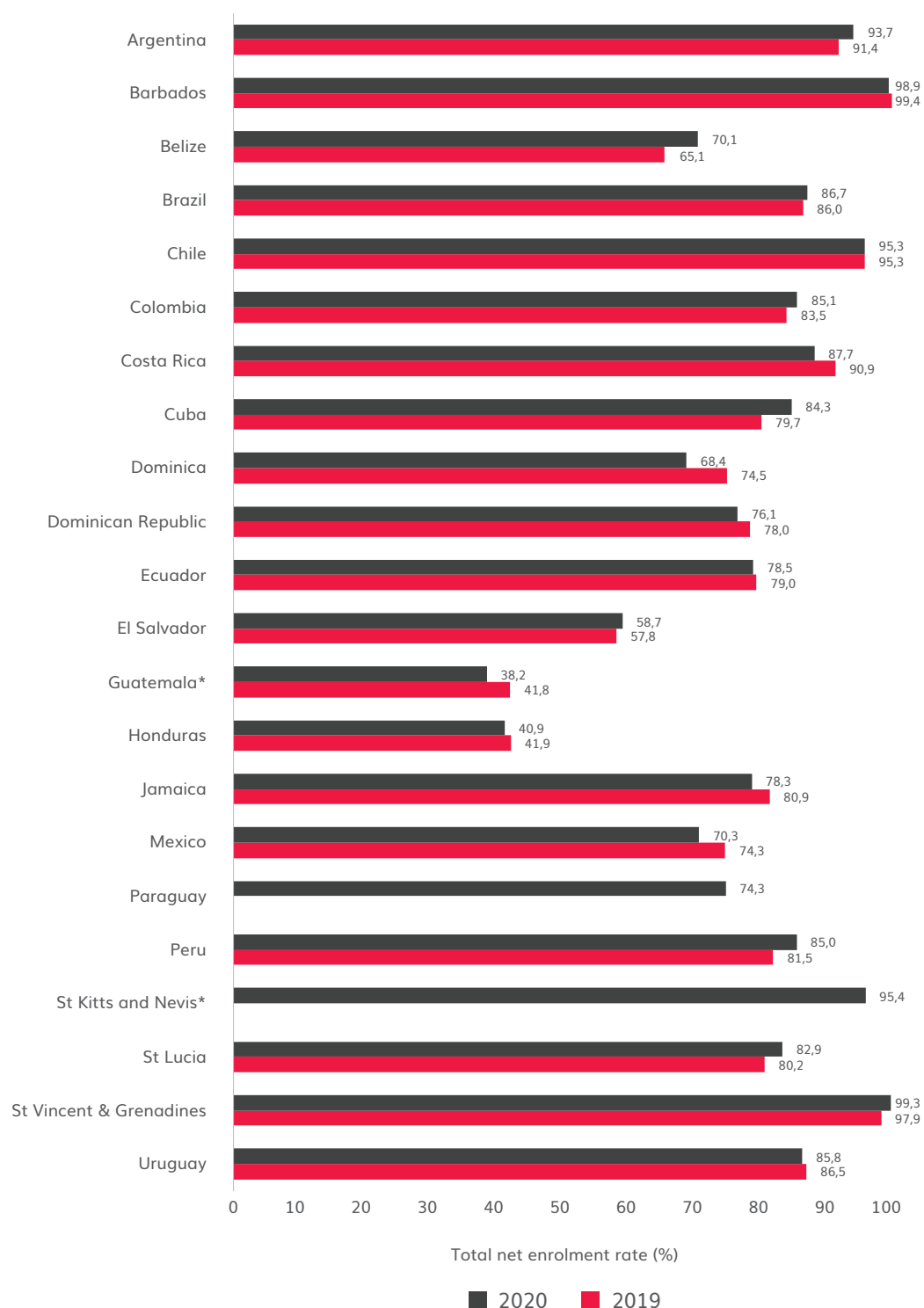
Note. *Country data for 2021. Authors' own elaboration based on data from UNESCO Institute of Statistics (UIS) database by UNESCO (2021).

Figure 2. Total net enrolment rate for primary education , Latin America and the Caribbean (22 countries,)2019 and 2020



Note. *Country data for 2019 and 2020. Authors' own elaboration based on data from UNESCO Institute of Statistics (UIS) database by UNESCO (2019-2020).

Figure 3. Total net enrolment rate for upper secondary education, Latin America and the Caribbean (22 countries), 2019 and 2020



Note. *Country data for 2018 and 2020. Authors' own elaboration based on data from UNESCO Institute of Statistics (UIS) database. <https://apiportal.uis.unesco.org>.

While enrolment rates provide a measure of initial access to education, real learning benefits can only be achieved if students stay in the education system, which was very challenging during the pandemic especially among upper secondary students. Between 2015 and 2020, school completion rates in the region for primary level increased slightly from 92.7% to 93.3%, and for lower and upper secondary education reached 79.1% and 63.7% in, respectively (UNESCO, 2022). However, major disparities emerge by income level in upper secondary education (ECLAC, 2022b). For instance, while almost 90% of students in the highest income quintile completed this level, only 50% of students from the first quintile managed to do so (ECLAC, 2022b). Furthermore, the attendance rate gap in upper secondary education is higher between richer and poorer students than the corollary gap between students from urban and rural areas, but which nevertheless significantly narrowed between 2015 and 2019 (Table 1). It is also worth noting that countries such as Costa Rica, Guatemala, and Nicaragua have significantly improved their completion rates for all educational levels (UNESCO, 2022).

Table 1. Total net attendance rate by income quintiles and area. Upper secondary education (household survey data), Latin America and the Caribbean (13 countries)

	2010			2015			2020		
	Rural	Urban	Gap	Rural	Urban	Gap	Rural	Urban	Gap
Quintile I	73.6	83.1	9.5	74.3	82.2	7.9	77.8	86.1	8.3
Quintile V	77.7	92.6	14.9	83.1	92.7	9.7	84.6	93.0	8.4
Gap	4.1	9.5		8.8	10.6		6.8	7.0	

Note. Authors' own elaboration based on data from *UNESCO Institute of Statistics (UIS) database* by UNESCO (2010; 2015; 2020).

Stagnated learning outcomes

Learning outcomes in LAC countries have remained far below expected performance levels. Measured through the World Bank and UNESCO concept of learning poverty, which measures the number of students unable to read and understand a simple text by age 10². The LAC region is estimated to have risen from a rate of 52% before the pandemic, to 79% after the pandemic, which captures what has been termed a learning crisis (World Bank et al., 2022b; Huepe et al., 2023). Significant progress in enrolment and completion rates over the last two decades has not translated into learning improvements. According to the Regional Comparative and Explanatory Study (ERCE,

² <https://www.worldbank.org/en/topic/education/brief/learning-poverty-measure>

2019) conducted in 16 countries,³ a general stagnation in learning was observed between 2013 and 2019. By 2019, reading results at third grade level remained nearly unchanged in six of the twelve countries studied in this research (Colombia, Costa Rica, Ecuador, Honduras, Mexico and Uruguay) and less than 20% achieved the minimum level in maths. In other words, the region's educational performance was already poor before the pandemic, making it more vulnerable to its effects.

However, some countries have seen marked improvements. Peru, for example, has shown substantive progress in both reading and maths, following the implementation of an array of educational policies as a result of the increased education budget between 2011 and 2015 which allowed greater pedagogical support and higher teachers' salaries, along with the implementation of accountability mechanisms and performance-based incentives (Rivas & Scasso, 2020). The Dominican Republic also showed significant improvements in reading, maths, and sciences, for both third and sixth grades (UNESCO, 2019).

Regional learning outcomes from ERCE 2019 also revealed inequalities based on socioeconomic status. Students from poorer families and those who live in rural areas are more likely to have poorer learning outcomes, as are students from indigenous and afro-descendant groups.

Overview of inclusion in educational systems

Gender

The region shows significant but varied gender gaps in access to education, mainly among secondary education students. According to UNESCO's Gender Parity Index (GPI),⁴ in 2020 the gender gap was fairly small in primary education for most LAC countries, but was higher for upper-secondary students, in favour of female students. At this educational level, higher female than male enrolment rates were recorded in Argentina, Belize, Cuba, the Dominican Republic, Honduras, Mexico, Paraguay and

3 Argentina, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Dominican Republic and Uruguay. Bolivia and Chile did not participate in the ERCE 2019 evaluation due to socioeconomic and political circumstances that affected the implementation in 2019.

4 GPI measures the relative access to education by gender and ranges from 0 and 1, where 0 indicates total disparity in favour of male students, 1 indicates absolute gender equity, and values greater than 1 signify disparity in favour of female students. For more details see: <https://learningportal.iiep.unesco.org/en/glossary/gender-parity-index-gpi>.

Uruguay. On the other hand, the largest gender gaps in enrolments at secondary level with higher male than female rates were found in a subgroup of Caribbean countries (Dominica, St. Kitts and Nevis, and St. Lucia). This means that the region faces national specificities that should be addressed in order to advance to more gender-equal educational systems.

Groups with disabilities

In 2020, attendance rates were lower for students with than without disabilities. This is true at all levels of education (pre-primary, primary and secondary) (ECLAC, 2022b). However, the completion rate for upper secondary education is particularly significant, with only 61% of students with disabilities completing, which implies a gap of 14 percentage points compared to students without disabilities.

Indigenous students

The region exhibits significant levels of exclusion of indigenous communities (Hernandez-Zavala et al., 2006). Recent figures for Colombia and Guatemala show that children who speak an indigenous language are overrepresented in non-attendance figures, making up over 70% of the total number of children not attending school (ECLAC, 2022b). In the case of Mexico, only 25% of indigenous school-aged children attending school speak an indigenous language, which contrasts with 40% or more of those children not attending. This means that the school systems are not equipped to offer learning opportunities for those children and adolescents who speak an indigenous language. This may partly explain why, in terms of educational achievement and based on a small sample of LAC countries, evidence shows a greater difference in scores⁵ between non-indigenous and indigenous students in language compared to mathematics.

The remainder of this study is organised as follows: section 2 describes the methodology used for data collection and analysis; section 3 presents the findings from the literature review on ed-tech in the region; section 4 presents analysis of seven ed-tech programmes and policies; section 5 provides conclusions and answers to the research questions.

⁵ Using test score data for 3rd and 4th year primary school pupils in Guatemala and Peru, and 5th grade pupils in Mexico.

Methodology

Methodological approach

This study employs a qualitative, multi-method approach based on both secondary and primary data collection, in which documentary analysis is combined with a case-study approach.

Firstly, documentary analysis of 38 existing ed-tech policies and programmes was undertaken to map the status-quo of digital learning in the region and select relevant programmes for further analysis. This documentary analysis was accompanied by a comprehensive review of the academic literature, with texts sourced using the Web of Science and Emerging Source Citation Index databases. Following Gough et al.'s (2013) systematic literature review process, we defined a set of keywords,⁶ determined Latin America or the Caribbean as specific geography or location, and set a search period of 2010 to the present. Only empirical studies were included (essays and theoretical papers were excluded).

Efforts to implement remote learning during the pandemic largely relied on access to computers and internet connections at home, but both resources are highly unequally distributed across the LAC region.

The literature review search resulted in the identification of 106 papers, which were screened to apply further inclusion criteria, such as a focus on primary and secondary education, and specific information about LAC countries like data availability. A final list of 25 papers were analysed. In addition, grey literature from International Organisations (IOs) such as the World Bank, ECLAC, UNESCO Regional Office of Education for Latin America and the Caribbean (OREALC/UNESCO), IDB, and UNICEF was consulted; and a comprehensive web search was undertaken to obtain material from relevant government ministries on the specific characteristics of the programmes and policies under study.

⁶ In English, Spanish and Portuguese: "digital technologies", "education", "primary or secondary", "policy" or "intervention" or "programme" or "initiative"

The results of these document reviews were used to select seven ed-tech programmes and policies implemented before and during the COVID-19 pandemic for analysis. Two of these ed-tech programmes were then analysed further as exploratory case studies: the Digital Education Transformation National Programme (Programa Nacional de Transformación Educativa Digital, PNTED) from Honduras, and the Improving learning conditions through the incorporation of ICTs in educational centres programme (called "ICT Programme") from Paraguay.

The rationale for the selection of these cases was based on a number of different criteria:

1. Institutional trajectory with ICTs: Both countries have, for more than 10 years, had objectives relating to the adoption of ICTs in their sectoral plans, Honduras since 2008 through the public educational portal "Educatrachos", and Paraguay since 2010 with the "National diagnosis of ICTs" in 2013, part of the project of the "Integration of ICT in the National Education System".
2. The role of ICTs in learning: Both cases embrace the idea in their policy agendas that introducing ICTs will lead to improved learning. They assume these benefits, therefore they have focused efforts mainly on equity and access.
3. Socioeconomic diversity: Both cases represent new ways in which governments translate discourse around the potential benefits of ed-tech into reality in contexts with high levels of inequality and low connectivity. Honduras is one of the poorest countries in the region, while Paraguay is a low-middle-income country with a long-standing national programme to introduce ICTs in the education system. These diverse circumstances represent complex environments to coordinate resources, partnerships, local and international actors, and decisionmakers.
4. COVID-19 response: Both cases can be studied as programmes that arose or were adjusted in response to the context of the COVID-19 emergency.

The case study method involves an in-depth examination of a specific event or phenomenon within its real-life context (Bryman, 2016; Stake, 1995), allowing for direct observations to record and witness interactions in their real setting (Mulhall, 2002). Field observations were conducted to better understand both settings, and the actors and activities involved in these programmes (Mulhall, 2002).

Semi-structured interviews were undertaken to understand experiences, interests, and expectations of key actors in the field of ed-tech. This type of interview is an adaptable and open-ended method of collecting data, where the researcher prepares a predefined set of key questions or topics, while still allowing the flexibility for follow-up questions and discussion. This approach facilitates an organic and thorough investigation of the

research subject, enabling interviewees to articulate their thoughts and experiences in their unique expressions (Brinkmann, 2014).

In total, 38 experts, official representatives, academics and other stakeholders were interviewed for this study. For the two selected ed-tech programs 25 people were interviewed, including policymakers, designers, experts and users (Table 2). Seven interviews were undertaken with regional experts to provide a broader context and comparison of the ed-tech trends in LAC. Finally, 6 Interviews with other representatives were conducted to characterise and understand other programmes in the region. All the interviews were conducted from 10 April to 5 July, 2023.

Table 2. Stakeholder and actor interviewed, by type

Type of actor interviewed	N°
Regional experts	7
International Agencies team	5
Government Authorities of MoE	4
Government Technical Teams of MoE.	12
Academics/Scholars	3
Private Sector	2
School Leaders and Teachers.	5
Total	38

Note. Elaborated by the authors

Country case selection

Secondary data on economic and socio-demographic indicators were used to identify a representative country sample of the LAC region. Using gross domestic product (GDP) per capita level (low-middle, upper-middle and high) and internet access indicators, an initial list of twelve countries was identified and classified by GDP and subregion (Table 3).

Although this study is focused on developing economies, high-income countries were included into the analysis to demonstrate that there are some inequalities omitted by the overall GDP such as low connectivity in rural areas where technological resources are unable to be delivered, and to highlight the growing knowledge transfer of ed-tech experiences from high-income to low-income countries within the region. The aforementioned list of countries was reviewed to ensure data reliability and diversity

of ed-tech realities in the region, and then adjusted by geographical characteristics (Bolivia was added to account for the andean region).

Table 3. Selection through quantitative indicators (first stage) and validation (second stage)

Regions	Low-middle income	Upper-middle income	High income	Total
Caribbean		Dominican Republic, St. Vincent & the Grenadines, Jamaica	Bahamas	4
Central America	Honduras	Colombia, Mexico, Costa Rica	Panama	5
South America	Bolivia*	Paraguay	Uruguay	3
Total	2	7	3	12

Note. Based on classification from: <https://www.worldbank.org>, based on GNI per capita (USD): low- or middle-income country (LMIC) (1,046 - 4,095); upper middle-income country (UMIC) (4,096 -12,695); high income-country (HIC) (> 12,695). Mexico is included in the Central America subregion to simplify the classification. * Andean region.

A correction for sub-regional representativeness was applied to improve the sampling balance between the Caribbean and the Andean regions. Due to their similar income levels and geographical proximity, no major difference was found between Panama or Costa Rica. On the other hand, demographic characteristics—such as total populations, or percentage of rural populations— became particularly important for this research as representativeness must be consistent with the size of the subject of study. For this reason, Brazil was added to the list of the case studies. The final sample of countries is shown in Table 4.

Table 4. Correction for socio-demographic representativeness (third stage)

Regions	Low-middle income	Upper-middle income	High income	Total
Caribbean		Dominican Republic, Jamaica	Bahamas	3
Central America	Honduras	Colombia, Mexico, Costa Rica		4
South America	Bolivia*, Ecuador*	Paraguay, Brasil	Uruguay	5
Total	3	7	2	12

Note. Based on classification from: <https://www.worldbank.org>, based on GNI per capita (USD): LMIC (1,046 - 4,095); UMIC (4,096 -12,695); HIC (> 12,695). Mexico is included in the Central America subregion to simplify the classification. * Andean region.

Selection of ed-tech programmes and policies and first phase of data collection

Once the sample of countries was determined, official documents from ministries of education⁷ and technology were reviewed to map existing ed-tech programmes and policies in the region, which resulted in a total of 38 initiatives (see Annex 1). Then, a first phase of interviews with seven regional experts and key actors involved in the ed-tech ecosystem were conducted to get an overview of the region's policies and to get an idea of institutional capacities, and any conflicts or tensions that may arise through a political economy perspective. The preliminary findings provided an understanding of some of the sub-regional challenges, identified key programmes and policies, and helped to refine the sample of interviewees at the national level. In addition, the interviews helped to map the state of the region's digital transformations and to understand the (un) common characteristics throughout the regional area.



A lack of government funding also affects the ed-tech policy context, and it is important to examine the effect of the pandemic on education budgets in the region.

This first phase of interviews allowed further narrowing of the selection of representative programmes and policies, based on four criteria: i) programmes and policies targeting primary or secondary schools; ii) diversity of providers (public, private, partnerships and international organisations); iii) programmes and policies recognised as interesting case studies by the interviewed experts for their scalability potential; and iv) programmes with readily available background information. Ranking the programmes according to these metrics resulted in the prioritisation of 26 initiatives (see Annex 1).

Key actors and project managers of the 26 shortlisted initiatives were identified and interviewed to characterise the programmes through a ToC approach. Evidence from the document review also found that some programmes are linked to the same policy over time. After ensuring consistency with the four selection criteria, a final list of seven

⁷ Or secretaries of education in some cases.

programmes and policies was set (Table 5). The final step was to select two cases for field visits to serve as case studies: Honduras (PNTED), and Paraguay (ICT Programme).

Table 5. List of seven selected ed-tech programmes and policies

Name	Country	Objective	Agency/Implementer	Years of operation
Digital Education Transformation National Programme (PNTED)	Honduras	Improve connectivity; use of technological devices and educational platforms; teacher training; a new institutional design where education is recognised as a multi-sectoral responsibility.	Secretary of Education of Honduras, supported by IDB and "Red Solidaria" (Public-Private)	2021-2024
Improving learning conditions through the incorporation of ICTs in educational centres (ICT Programme)	Paraguay	Improve learning conditions and educational management in the education system by incorporating ICTs in pedagogical and administrative processes.	Minister of Information and Communication Technology (MITIC) – Minister of Education and Sciences (MEC) – Koica. (Public-Private)	2016 – 2024
One on One	Jamaica – Bahamas	Help students, teams, governments, and enterprises across the Caribbean to fully digitise education and record-keeping systems and expand the existing virtual learning network.	One on One Educational Services Ltd. (Private)	2019 – ongoing
Giga	Caribbean	Connect every school to the internet, and every young person to information in LAC countries, with projects in El Salvador, Honduras and Eastern Caribbean States.	UNICEF, ITU and OECS (Public-Private)	2019 – ongoing
Digital Inclusion and Literacy Programme (PIAD)	Mexico	Strengthen the education system by providing personal devices, promoting the reduction of the digital divide and the use of ICTs in the teaching-learning process.	Secretary of Public Education of Mexico (Public)	2019 – ongoing
Educational Computing National Programme (PRONIE) – (PNTM)	Costa Rica	Contribute to the development of Costa Rican education through the inclusion of mobile digital technologies in teaching and learning processes, in support of the national curriculum.	MEP – "Omar Dengo" Foundation, Profuturo, Teach United project. (Public-Private)	1988 – 2023
ProFuturo	LAC	Digital education programme with the mission of reducing the educational gap by providing quality digital education to girls and boys from vulnerable backgrounds.	"Telefónica" and "Ia Caixa" Foundation (Private)	2016 – ongoing

Note. Elaborated by the authors.

Case study data collection

After the final list of programmes and policies was drafted, and the selection of two cases to visit was defined. The first field visit was made to the city of Tegucigalpa, Honduras, from 27-28 April 2023, to learn about the "Digital Education Transformation National Programme (PNTED)" implemented by the Secretary of Education and the "Red Solidaria" (public government programme to address poverty). The second visit was made to the city of Asuncion, Paraguay, from 3-5 July 2023, with the purpose of further understanding the "Improving learning conditions through the incorporation of ICTs in educational centres Programme (ICT Programme)". During both visits, efforts were made to ensure interviews were carried out with a range of stakeholders involved in the whole project cycle (i.e., those who design the policy, funders, implementers and facilitators, and finally, users in schools). The visible tensions and concerns identified during the field visits helped build a solid analysis based on a political economy approach.

Data analysis and information integration

The priorities of ed-tech policies and how ed-tech has been used (RQ2) and the change in the ed-tech landscape since the COVID-19 pandemic (RQ5) were analysed with the assistance of the design-actuality gap model (DAGM) developed by Heeks (2002) in order to understand the distance between what the surveyed ed-tech policies initially promised and what they have actually achieved. The main benefit of the DAGM model is to identify possible gaps between existing conditions and those desired or intended by programmes and policies. A ToC approach, for its part, attempts to logically model pathways from an activity to its outcomes. It helps to explain how a given intervention, or set of interventions, is expected to lead to specific changes. A ToC provides a working model that can be used to test hypotheses and assumptions about which actions will be best suited to enable the intended outcomes (Taplin et al., 2013). The DAGM and ToC were also critical lenses to conduct the selection process for the final seven initiatives analysed.



The pandemic revealed the importance of digital skills and the responsible use of digital tools, shifting from a focus on access to devices to a more comprehensive approach to learning environments, encompass infrastructures and quality connectivity.

A political economy analysis (PEA) provides a more detailed view of the contextual factors that influence the implementation and impact of ed-tech programmes in LAC countries. Through this approach, the importance of ed-tech policies and interventions in the region (RQ1) and the factors that have facilitated, or serve as barriers, in the development and implementation of ed-tech (RQ3 and RQ4) were analysed by focusing on the conditions in which ed-tech is implemented. We identified the strategies, interests and expectations of key stakeholders when configuring ed-tech initiatives. In their "issue-specific political economy analysis", Pellini et al. (2021) identified five core elements of analysis, three of which are of interest to this research: the issue, that refers to a specific policy challenge, in this case ed-tech programmes and policies; structural factors that point to institutional structures where decision

making occurs; and the rules and norms that actors apply and the role of stakeholder interests and power relations in the ed-tech domain (see Table 6 for description of methodological and analytical framework).

All the information gathered from the seven cases analysed was systematically examined to identify patterns, themes, and trends. Interviews were analysed using the qualitative analysis software Taguette, involving codification using pre-defined key concepts based on the proposed conceptual framework. The 17 different codes (see Annex 2) could be grouped into five main themes that structure the analysis of this study: (i) governance and policy continuity; (ii) digital citizenship; (iii) equity; (iv) stakeholders' interests; and (v) frameworks (rules of the games, belief, ideas, etc.).

Table 6. Research questions, analytical frameworks, and methods

Research Questions	Analytical framework	Methods and Techniques
How important have ed-tech policies and interventions been in the region?	Analysis of national regulations, policy agendas, and what key actors and stakeholders advocate in ed-tech (PEA). This implies observing the ed-tech policy domain at regional and national levels and how they have changed over time.	<ul style="list-style-type: none"> • Regional and national expert interviews • Literature review • Document analysis
What are the priorities of ed-tech policies within the region and in what ways has ed-tech been used?	Analysis of identified gaps and challenges that ed-tech policies and programmes try to address (DAGM). Also, by identifying the implicit or explicit ToCs of those policies and programmes.	<ul style="list-style-type: none"> • Regional and national expert interviews • Literature review • Document analysis
What factors have facilitated the development and implementation of ed-tech policy within the region?	Analysis of the structural factors linked to institutional configurations where decision making occurs; regulations, rules and norms that actors follow in their actions and the interests they pursue when taking part in the ed-tech policy domain at a national level (PEA).	<ul style="list-style-type: none"> • National expert interviews • Case studies • Field visits
What factors have acted as barriers to the development and implementation of ed-tech policy within the region?		
How has the ed-tech landscape changed within the region since the COVID-19 pandemic (e.g., lessons learned, challenges, opportunities) and what is the future of ed-tech in the region in light of those changes?	Analysis of the identified gaps that policies and programmes try to address (DAGM). Also, by identifying the implicit or explicit theories of change of the policies and programmes (ToC).	<ul style="list-style-type: none"> • Regional and national expert interviews • Literature review • Document analysis • Case studies

Note. Elaborated by the authors.

Long-established and emerging trends in ed-tech policies and programmes in LAC

The review of the literature on ed-tech policies and initiatives in LAC countries revealed long-established trends concerning digital ecosystems, learning platforms and management systems, new emerging trends concerning digital skills training and education initiatives from/to the local level and changes in the aftermath of the COVID-19 pandemic.

In analysing digital access inequalities in LAC, the literature consistently points to income distribution as the main factor shaping these disparities (Hilbert, 2010; Gasparini et al., 2016; Gasparini & Bracco, 2023). This central finding underscores how inequalities in income levels critically influence the availability and utilisation of digital devices and internet services. Further, the review highlights how these technological disparities perpetuate and exacerbate existing socioeconomic, ethnic, and gender inequalities in the region (Martinez Tessore, 2021).

The review also brings to light several key challenges, including: the integration of digital technologies in educational settings, particularly in areas with limited ICT infrastructure; the varying success of initiatives providing personal digital devices; the need for digital skills training for both educators and learners; and the specific needs of indigenous and rural communities in relation to ed-tech adoption. Moreover, it underscores the profound impact of the COVID-19 pandemic in magnifying these existing disparities and the urgent need for comprehensive policy action to bridge these digital divides.

Established ed-tech trends: Building digital ecosystems, learning platforms and management systems

Private entrepreneurs and international NGOs have taken the lead in driving the modernisation of information systems and learning platforms in some parts of the region, particularly the Caribbean. For example, in Jamaica and the Bahamas, One on One Educational Services Ltd, in collaboration with ministries, local stakeholders, and international partners, has been at the forefront of efforts to bridge the digital divide in schools. The importance of this initiative grew markedly following Hurricane Dorian in 2019, which devastated the Bahamas and whose challenges were later exacerbated by the pandemic (UNICEF, 2019). The specific outcomes and impacts of these efforts, including quantitative and qualitative measures of success, are further elaborated in Box 1 and detailed in the following section of this study.

Box 1. One-on-One Educational Services Ltd., Jamaica and the Bahamas

The partnership between One-on-One Educational Services Ltd (OoO), a private company, and the ministries of education in Jamaica and the Bahamas in 2020 and 2019, respectively, has emerged from a shared public-private partnership to advance educational technology in the Caribbean. Recognising the potential of technology to transform learning experiences, OoO collaborated with the respective ministries to address the digital divide and promote inclusive education through the full digitisation of the education and administrative systems, and the expansion of the existing virtual learning networks.

Significant progress has been made through this partnership. Access to online education content has been significantly improved with the establishment of learning platforms. For example, in the Bahamas an Education Management Information System (OpenEMIS) was successfully developed and adopted, with the support of Community Systems Foundation, whose team provided support to One on One in the on-the-ground execution. As of December 2022, the Department of Education was able to generate over 40,000 digital reports on time, which marked a major milestone in the government's efforts to fully digitise its education and administrative systems. In Jamaica, OoO deployed its platform offline during the pandemic to better serve students in rural areas with no internet connectivity. Other initiatives have included the provision of free student access to summer schools, short courses, extra lessons and digital interactive resources that complement the existing curriculum. Teachers have also benefited directly as they have had the opportunity to deliver classes privately through a dedicated platform, and can enrol on IT training courses. Ricardo Allen, the CEO of OoO estimates that their platform has been used by more than 1500 Jamaican teachers since it became available to them.

Implementation hurdles, resource constraints, and the need for continuous capacity building have presented obstacles to the full realisation of the partnerships' objectives. Another challenge for OoO is working in spaces where digital inclusion has not been a priority in education policy, where policymakers do not agree with or understand the transformative power of technology, or where Ed-tech policies and programs emerge as political initiatives, which means they are discontinued with a change in government. The partnerships with governments differ, and tensions often arise on both sides relating to operationalisation, deadlines that respond to continuous emerging needs, or unforeseen circumstances (e.g., Hurricane Dorian in the Bahamas).

Nonetheless, OoO seeks to continue to help close the digital divide by working directly with students, teams, governments, and other enterprises in the Caribbean. Based on their experiences in Jamaica and the Bahamas, they remain committed to empowering other Caribbean communities by providing digital education and training solutions that impact socioeconomic growth.

For more information, please visit the website: <https://www.oneononelms.com/>

While new digitised learning systems are in place or being tested, achieving accessibility in technology-mediated learning is a complex undertaking that requires

an integration of technological, pedagogical, and administrative perspectives (Cueva Gaibor, 2020; Mateus et al., 2022). Ensuring accessibility is a dual challenge: it is crucial for an e-learning platform to be technically accessible, but the true key to an effective solution lies in ensuring the accessibility of the e-learning content itself (Cueva Gaibor, 2020). This differentiation is vital; platform accessibility is about having the infrastructure to access the platform, such as internet connectivity and devices, while content accessibility is about the appropriateness and usability of the content for different types of students, including those with diverse needs and abilities.

The expertise of technical staff within educational institutions in understanding accessibility standards and assistive technologies is crucial in addressing these challenges (Cueva Gaibor, 2020). Their knowledge influences the design and delivery of both platforms and content. This is particularly important considering the varied control they have over systems and content, which can significantly impact the efficacy of e-learning solutions. Furthermore, understanding the diverse needs of students is essential for teachers, tutors, and instructional designers (Cueva Gaibor, 2020; Mateus et al., 2022). This understanding informs the development of content that is not only accessible but also engaging and relevant to all students, regardless of their background or abilities.

In the broader context, the literature indicates that ed-tech in Latin America has evolved over time, with varying degrees of improvement influenced by policy initiatives and socioeconomic factors (Hilbert, 2010; Muñoz, 2010; Mateus et al., 2022). For instance, initiatives like One on One Educational Services Ltd in Jamaica and the Bahamas, or Giga's mission in El Salvador and Honduras, are part of a larger trend towards increasing digital inclusivity in education. However, the trajectory of ed-tech development is intertwined with broader socioeconomic conditions in the region, such as disparities in income, internet access, and educational opportunities (Amado-Salvatierra et al., 2016; Martinez-Dominguez & Mora-Rivera, 2020). Legislation—or the lack thereof—also plays a significant role in shaping the accessibility and effectiveness of ed-tech initiatives (Amado-Salvatierra et al., 2016).

Integrating computers and connectivity into schools

Although many LAC countries acknowledge the strategic benefits of virtual learning environments in fostering communities of learning, its widespread adoption is hindered by inadequate ICT infrastructure in schools and households across the region (Hilbert, 2010; Muñoz, 2010; Mateus et al., 2022). Mateus et al. (2022), report that education systems in countries such as Argentina, Ecuador, Chile, and Peru share similar technological limitations. These limitations are not limited to a mere shortage of devices or lack of connectivity but also include issues like unstable or slow connectivity

speeds. Indeed, this unstable or insufficient connectivity can be just as debilitating for the implementation of ed-tech initiatives as having no connectivity at all, as it undermines the reliability and effectiveness of these digital learning environments.

The lack of adequate and standardised internet access in schools can significantly exacerbate existing disparities. This issue is particularly pronounced in relation to access disparities between urban and rural areas. In rural areas, where population densities are low, there is often less incentive for investment in telecommunications infrastructure, leading to poorer internet access. Limitations in ICT infrastructure are often a reflection of constrained national budgets. In many LAC countries, the allocation of resources to ed-tech is impacted by broader economic conditions and fiscal priorities. This creates disparities in the provision of devices and infrastructure, particularly noticeable between urban, rural, and indigenous areas.

This disparity extends to homes, where the lack of reliable internet access can widen the educational divide, especially in communities already facing socioeconomic challenges, as demonstrated by Martinez-Dominguez and Mora-Rivera (2020) in their comprehensive analysis of internet diffusion in rural areas of Mexico. Their results are echoed by others. Botello-Penalzo (2015) concludes in his analysis of internet use in Ecuadorian households that individual income and education levels have the most significant positive impact on internet usage. Gender disparities in digital inclusion and ICT access are also a significant concern, with these gaps being more pronounced in rural compared to urban areas, primarily due to infrastructure limitations (Botello-Penalzo, 2015). Specifically, women in these areas tend to have less access to the internet compared to men. This disparity is largely attributed to socio-cultural factors, economic barriers, and lower levels of digital literacy among women. Such gender-based digital exclusion was notable even before the COVID-19 crisis, further highlighting the entrenched nature of these disparities (Cortés et al., 2021). While we are still understanding the full impact of the pandemic on access to, and participation in ed-tech, all signs point to an intensification of these challenges, making it even more imperative to address gender inequalities in digital access and literacy.

One important regional initiative that has sought to improve existing networks and school connectivity is Giga. Giga is a global initiative stemming from a partnership between UNICEF, ITU and other international organisations and governments to connect every school to the internet (Giga, 2021). In the Eastern Caribbean, a collaboration with the Organisation of Eastern Caribbean States (OECS) aims to investigate viable models for leveraging schools as hubs to facilitate connectivity within local communities. Although still in its early stages, Giga has begun to make progress in El Salvador and Honduras (Giga, 2021). However, the advancement of the initiative has been gradual,

and its intended impact on enriching young people through access to information, opportunities, and choices has been somewhat limited thus far. Despite the increase in the number of schools with internet connections, challenges remain concerning the quality of these connections. There is an additional ongoing issue in ensuring that this connectivity is evenly distributed among all members of the school community, including teachers and students.

Box 2. GIGA, LAC region

Giga is a UNICEF-ITU global initiative launched in 2019 to connect every school to the internet, and every young person to information, opportunity, and choice. Giga is highlighted in the UN Secretary General's Roadmap for Digital Cooperation as a Key Way Forward to achieve Universal Connectivity. In Latin America and the Caribbean, GIGA works in El Salvador, Honduras, and Eastern Caribbean states. Giga acknowledges that schools, as central pillars of communities, have the potential to serve as hubs connecting people within the local community. Their aim is to explore sustainable models that leverage schools in this way, which could help governments of the Organisation of Eastern Caribbean States (OECS) overcome existing community constraints such as slow speeds, high costs, and unreliable internet connections. By utilising schools as hubs, Giga envisions expanding access to bridge the digital divide in the region.

Giga is supporting OECS to ensure regional harmonisation and sharing of best practices. Some of Giga's priority areas for collaboration in OECS include (i) building capacity of OECS regional initiatives around harmonising and strengthening regulation and policy in line with the 2028 Development Strategy; (ii) seeking funding and pricing discounts for digital education services and products for humanitarian uses, among others; (iii) supporting OECS Member States to adapt global digital public goods (DPG) resources and scale up the use of digital textbooks and content. Among their objectives—still yet to meet in the short term—is the development of DPG for learning, content and information, and dissemination to children, teachers, and administrators to empower young people with skills. However, significant progress has been reported in providing connectivity to numerous schools across the nine member states. With an annual operational expenditure funding of USD 1.7 million, the promise is to ensure enhanced service quality in 460 public and government-assisted schools. This improvement is expected to positively impact learning outcomes for over 129,000 students and teachers, as well as connect an additional 250,000 underserved members within their local communities. These figures are based on the Giga Annual Report 2020, 2022 and the Impact Outlook 2021.

Giga is a young project, and while the UN regards it as a potentially transformative model, progress has been slow and the direct impact they seek to have on young people by providing them with information, opportunity and choice has been moderate so far. Even when more schools are connected, there are still limitations to the quality of internet connectivity, and equal distribution of that connectivity to all school members, especially teachers and students.

For more information, please visit the website: [Giga/latin-america-and-the-caribbean/](https://giga.unicef.org/latin-america-and-the-caribbean/)

Provision of personal devices

Governments in low- and middle-income countries may not have the resources to provide personalised access to devices for everyone, even if they were to choose the most affordable options available (Hilbert, 2010). In the case of Bolivia, the initiative of providing one laptop per teacher aimed at ensuring access to technology and enhancing ICT skills for effective lesson planning and delivery. No evaluation of the effectiveness of the programme is available, however, studies of the perceptions of Bolivian teachers towards the use of technology in class—including some of those who have received the laptops—find that teachers refrain from using the laptops in the classroom for various reasons, such as their inapplicability for certain subjects or grade levels, or due to inadequate school infrastructure (Blass & Koehler, 2019). For instance, teachers found the laptops less applicable for subjects that rely heavily on practical or hands-on activities, such as art or physical education, or at elementary grade levels where traditional teaching methods are often favoured. Furthermore, the school infrastructure posed significant challenges, including issues like unreliable power sources for charging the devices and intermittent or absent internet connectivity, which limited the use of laptops in classroom settings (Blass & Koehler, 2019). Even when the delivery of laptops to teachers and students has increased the use of computers at home and school, such as the case of Peru, this has not always improved academic attainment (Cristia et al., 2017). A regional initiative which has been working since 2016 on the delivery of devices, platforms and teacher training is ProFuturo (see Box 3).

Box 3. ProFuturo, LAC region

The ProFuturo programme was created in 2016 as a response to the global educational gap. The programme was started with the aim of providing quality digital education to children from vulnerable backgrounds in Latin America, the Caribbean, Africa, and Asia. It is implemented by the "Telefónica" and "la Caixa" Foundations in cooperation with country-specific partners, including public and private institutions. The programme combines technical and pedagogical training for teachers, school directors and coaches, and support through content and technological resources, including a learning platform and technical kits that enable personalised learning online and offline. Within a global framework, multiple operational activities are provided to countries through three main areas: i) the Open Model, focusing on large-scale teacher training in digital competencies; ii) the Comprehensive Model, including interventions and products such as laptops and servers, as well as educational content and resource services at school level; and iii) the Refugee Model. ProFuturo emphasises the need to adapt these interventions to countries' needs, to foster the institutionalisation, transfer, and sustainability of its program at national level.

Nine LAC countries have implemented ProFuturo so far: Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela. Program implementation and ownership of the necessary modifications is highly varied among stakeholders, activities, resources, and results, partly due to country specific socio-political contexts such as the peace agreement in Colombia. While the countries have taken up the opportunity to modify their interventions, different implementations of local ad-hoc designs of the activities, differing inputs for delivering each intervention, and different management mechanisms emerged. While Peru, Ecuador, Chile, Brazil, and Colombia institutionalised ProFuturo as part of a public policy, Peru, Mexico, Ecuador, Chile, Brazil, Colombia, and Venezuela built on public and private sector alliances to enable local implementation. Uruguay relied entirely on the private sector to implement the program, as state support centres around an existing state-run program responding to similar needs (The Ceibal Plan). Decisions around alliance building are also strongly influenced by the country's socioeconomic contexts. In Venezuela and Argentina, high uncertainty due to unstable economic situations and high levels of inflation generate alliances with the private sector, as state actors are less likely to collaborate with programs from foreign institutions. The COVID-19 pandemic enabled ProFuturo to expand its teaching training model globally, and to create long-term plans to start working on a teacher training degree that is associated with digital education in many countries.

The flexibility of the global ProFuturo Program and its activities has enabled it to reach 2.576 schools, 470.979 students, and 195.148 teachers. In the case of Ecuador, teacher training was particularly successful as the Ministry of Education promoted ProFuturo's training courses through its platform, and linked completion to teachers' salary scales. The Program's guidelines and approaches are diverse, and leave space for local interpretation. Yet to be addressed in this highly complex program is how to articulate the global approach with local implementations in a standardised and monitored way, to determine how the program improves digital skills among teachers and students, and ultimately improves learning outcomes. The lack of common terminology and the heterogeneity in the discourse of local teams may impede the coherence of the program's implementation.

For more information, please visit the website: <https://school.profuturo.education/>

In contrast, Uruguay's initiative, Plan Ceibal, implemented a similar approach of distributing laptops to teachers and students, but with greater success since its launch in 2007 (Moscatelli, 2016). The plan sought to equip every student and teacher in primary and lower secondary public education with a personal computer, and to provide internet access in schools so they could engage with educational materials and receive direct support (Ripani, 2020). The initiative has delivered over 100 000 laptops to different types of schools (private, public, special education) every year since 2013, even during the COVID-19 pandemic (Ceibal, 2023). Key factors contributing to the success of this plan included strong support from the executive branch, ensuring consistent funding and policy backing, bipartisan support across the political spectrum, which provided stability to the initiative, and active collaboration with local stakeholders such as teachers

and community leaders to adapt the program to local needs (Robinson et al., 2020). The outcomes of the plan demonstrate its transformative impact: it has improved digital literacy among students and teachers, helping to bridge the digital divide. By democratising access to information and educational resources, Plan Ceibal has made learning opportunities more equitable across various socioeconomic groups, showcasing how technology can be a driving force in addressing educational challenges and transforming pedagogy (Brechtner, 2019).

The varying outcomes of these initiatives in Bolivia and Uruguay also highlight the role of political consensus in enabling the rollout of ed-tech programs. In Uruguay, cross-party support and unified political will were pivotal in the success of Plan Ceibal, whereas in Bolivia, political disagreement may have contributed to challenges in using the laptops provided effectively.

Emerging ed-tech trends: Digital skills training and initiatives for education from/to the locality

There is evidence from a number of ed-tech initiatives in the LAC region that digital literacy among teachers and students must be improved, in order for the potential benefits of these technologies to be recognised and realised through effective implementation in the classroom. Factors such as having internet access at home, higher parental education, greater digital skills, area of residence, language spoken, disability, and receiving active parental support have been linked to increased online opportunities (see overview by Cabello-Hutt et al., 2017). We discuss below two recent trends in how researchers and implementers are thinking and doing ed-tech.

Provision of digital skills training to teachers, students, and staff

The provision of digital skills training necessary for the effective use of ed-tech is a critical aspect that has often been overlooked. In their comparative study examining teachers' perspectives on media education in the post-COVID-19 era, Mateus et al. (2022) highlight that beyond addressing technological shortcomings, there is a crucial need for teacher training to go beyond just learning how to use digital tools. This means that training should not only focus on how to operate technological devices or software but also on developing a deeper understanding of the educational potential and pedagogical applications of these technologies. This speaks to a need to equip educators not just with technical skills, but also with pedagogical knowledge and insights into the digital world. It involves training teachers to understand and leverage the ways in which students engage with digital environments—not just how they use digital tools, but how they interact, communicate, and learn within these spaces. It also highlights how, by

understanding student dynamics in social media, online forums and other spaces, teachers can more effectively integrate digital tools into their teaching methods, making the learning process more relevant and engaging for students.

In Colombia, for example, a study of the technological infrastructure in public schools in different regions (Sanchez et al., 2017), shows that although there are varying levels and types of technological resources available to schools across the country, there is no relationship between this and educational attainment. Although various public policies have been implemented to address the digital divide, there remains a tendency to narrow down the focus of digital literacy to basic technological usage (Cueva Gaibor, 2020). This overlooks the potential to foster critical thinking, empowerment, and creativity among users, limiting their ability to apply digital skills in diverse contexts, beyond academic settings and in their everyday lives (Mateus et al., 2022).

In this way, a prevailing trend appears to be prioritising technology itself, rather than harnessing its potential to drive innovative pedagogical approaches (Sanchez et al., 2017). Rodriguez-Zidan et al. (2019) point out that the main obstacles in developing new mobile-based pedagogies are the lack of experience of teacher trainers, and the absence of critical reflection on using technology as catalysts for learning. Indeed, even in relation to Plan Ceibal, which has been unarguably successful in promoting accessibility to technology through device distribution and educational content creation, concerns remain in relation to the encouragement, training, and support of digital skills (Rodriguez-Zidan et al., 2019).

Key elements for effective digital skills training include contextualisation, pedagogical integration, continuous professional development, and fostering a culture of innovation. Contextualisation ensures that training is relevant to the local educational system (Rueda-Ortiz & Uribe-Zapata, 2022). Pedagogical integration refers to enhancing and complementing traditional teaching methods through the incorporation of digital tools (Mateus et al., 2022). Continuous professional development for educators involves ongoing support and learning opportunities, and can help in adapting to the evolving digital education landscape (Cueva Gaibor, 2020). Lastly, a culture of innovation and experimentation can encourage both educators and students to explore new approaches and learn from successes and failures (Robinson et al., 2020).

Local and community-centric digital education initiatives

Critical scholars in Latin America are challenging old discourses around accessibility and the digital divide. New voices are emphasising the agency of citizens as creators of knowledge (Robinson et al., 2020; Flores-Fuentes & Navarro-Rangel, 2020; Paladines

& Aliagas, 2023), calling for the incorporation of reflective practices and decolonising lenses into research frameworks (Rueda-Ortiz & Uribe-Zapata, 2022), and drawing from local scholarship to re-examine our understanding of digital literacy as part of our multiliteracies (Mendez Cota & Lopez Cuenca, 2020). These perspectives highlight the critical importance of engaging diverse stakeholders and empowering traditionally marginalised communities, such as indigenous and rural community groups, to drive digital development initiatives that are aligned with their self-determined interests.

Specifically, there has been a growing recognition of the importance of including indigenous communities in the decision-making processes of ed-tech programmes and policies. Recent cases have highlighted the need for targeted initiatives to address the specific needs and perspectives of these communities (Robinson et al., 2020). Indigenous and rural community groups in Mexico and Brazil have collaborated to lead digital development initiatives that respond to their needs. These groups have been actively involved in establishing and managing digital infrastructure, services, and applications through various deployment initiatives (Baca-Feldman et al., 2018).



There has been a growing recognition of the importance of including indigenous communities in the decision-making processes of ed-tech programmes and policies.

Additionally, they have made significant efforts to create and implement suitable digital literacy programmes. Many of these projects (for example REDES AC and Rhizomatica in Mexico, and the work by Leal & Brant [2012] in the state of Roraima in Brazil) adopt a non-profit or cooperative organisation model, facilitating community networking and addressing market failure challenges. Indigenous groups and like-minded entities in the region are actively collaborating, such as the cases of Brazil and Mexico mentioned above, and this has become a key element for success in developing digital inclusion policies and culturally relevant digital literacy resources (McMahon, 2020) (see Box 4). This ethos of sharing and cooperation becomes particularly important for knowledge exchange in resource-limited environments (Robinson et al., 2020). The COVID-19 pandemic has further emphasised the importance of enhancing local ownership and the capabilities of community networks, especially in isolated and rural areas.

Box 4. Digital Inclusion and Literacy Programme (PIAD), Mexico

As part of the Pact for Mexico presidential commitment, in 2012 the Secretary of Public Education (SEP) implemented the "Digital Inclusion and Literacy Programme (PIAD)" to accelerate Mexico's integration into the knowledge society, in accordance with the "National Development Plan (PND)". To implement this programme, the SEP signed collaboration agreements with the "Centre for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV)", the "Secretary of Communications and Transport (SCT)" to expand connectivity, the "Federal Electricity Commission (CFE)" to provide charging solutions, and the "Potosino Institute of Scientific and Technological Research (IPICYT)". The programme also received support, monitoring, and feedback from international organisations such as the IDB, World Bank, UNESCO, OECD, and OAS.

Initially, the PIAD targeted 5th and 6th grade students from public primary schools in three states (Sonora, Colima and Tabasco), and was implemented by the Intel/Google/Cisco consortium through DOT (Digital Opportunity Trust), and the Theos company. PIAD projects have included Mi compu.mx (2013-2014), @prende (2014-2016) and @prende 2.0 (2016-2017), which started as an online support platform following the @prende project. Between 2013 and 2016, the programme had the goal of providing schools, teachers, students, and families with electronic devices. While the Mi compu.mx project provided laptops to schools in five states, the @prende project delivered tablets directly to students to reduce costs and increase coverage to fifteen states, and delivered 1,073,174 devices and training to 65,335 educators, amounting an investment of USD 930 million dollars. However, technical failures were encountered by students in the use of the tablets, and device content was not directly related to textbooks. Additionally, laptops and tablets were lost as they had reached the expiration date established by the SEP without any return on the investment made.

As a consequence of these issues, between 2016 and 2017, the federal government implemented the @prende 2.0 program aimed at primary school students from 1st to 6th grades, where equipment is left at schools. This program consisted of six components: 1) teacher professional development; 2) digital educational resources (RED) such as videos and applications available without internet; 3) strategic initiatives; 4) equipment; 5) connectivity; and 6) monitoring and evaluation. Although with better results than previous experiences, the program also faced some challenges such as: lack of formal agreements with state educational entities, insufficient RED to meet learning needs, interruptions in connectivity, lack of a pedagogic use model, and lack of a comprehensive assessment model to evaluate students' digital learning.

The @prende 2.0 programme was active until 2021, and its platform, developed by the "Director-General for Educational Television (DGTVE)" became "MéxicoX" within the framework of the new "Agenda Digital Educativa", designed to integrate and coordinate public policies related to information technologies, communication, knowledge, and digital learning (TICCAD) in the National Education System. In 2016, this platform received the WSIS 2016 (The World Summit on the Information Society) international award under the "ICT E-Learning Applications" category in the education sector, and is still in operation today.

For more information, please visit the website: <https://mexicox.gob.mx/>

Research on the intersection of indigenous knowledge and ICTs, while more extensive in regions like Africa, has also yielded important insights in Latin America, albeit to a lesser extent. Key literature in this area emphasises the need for ed-tech initiatives to be deeply rooted in the cultural, linguistic, and social contexts of indigenous communities. For instance, Flores-Fuentes and Navarro-Rangel (2020) advocate for the development of technological prototypes that are not merely functional but also culturally resonant. They identify three critical needs for such prototypes: i) effective management of indigenous knowledge, ii) preservation of this knowledge, and iii) creation of content that is both culturally relevant and digitally inclusive.

Expanding on these needs, studies have shown successful examples of technology being leveraged to document and preserve indigenous languages, thereby contributing to the cultural heritage and identity of these communities. For instance, digital platforms have been used in Mexico to create repositories of indigenous languages, incorporating audio-visual materials that are accessible to both community members and external audiences (Méndez Cota & Lopez Cuenca, 2020). Furthermore, there is consensus in the literature that designing ed-tech, science, art initiatives for indigenous communities requires a participatory approach (Salazar, 2007; Athayde et al., 2017). This involves collaborating with community members at all stages—from conceptualization to implementation—to ensure that the technology aligns with their educational goals and cultural values. Such collaboration has been found to enhance the relevance and effectiveness of the technology, as it is more likely to reflect the community's unique ways of knowing and learning (Athayde et al., 2017).

Additionally, the integration of multilingual and intercultural literacies alongside digital literacy is highlighted as a priority. For instance, Méndez Cota and Lopez Cuenca (2020) argue for the inclusion of these literacies in educational research agendas to ensure that ed-tech initiatives are not only technologically sound, but also linguistically and culturally inclusive. This approach recognises the diversity within indigenous communities and seeks to provide educational resources that resonate with their varied experiences and knowledge systems.

The success of local- and community-centric digital education initiatives is also tied to the states' administrative capacities. In some LAC countries, despite economic resources being available, there is a lack of administrative capacity to implement ed-tech effectively. This gap affects the adoption and sustainability of ed-tech, particularly in indigenous and rural communities where administrative support is crucial for addressing unique educational needs.

Digital literacy and digital rights as concepts have been absent in ed-tech policies and interventions in the region. This is a notable conceptual gap, as the effective and

responsible use of technology, which lies at the heart of digital citizenship, forms a critical component of contemporary learning environments. Despite this absence, policy narratives in the region advocate for the empowerment of individuals to participate fully in contemporary society, promoting inclusivity, and emphasising the principle of equitable access to digital resources and opportunities.

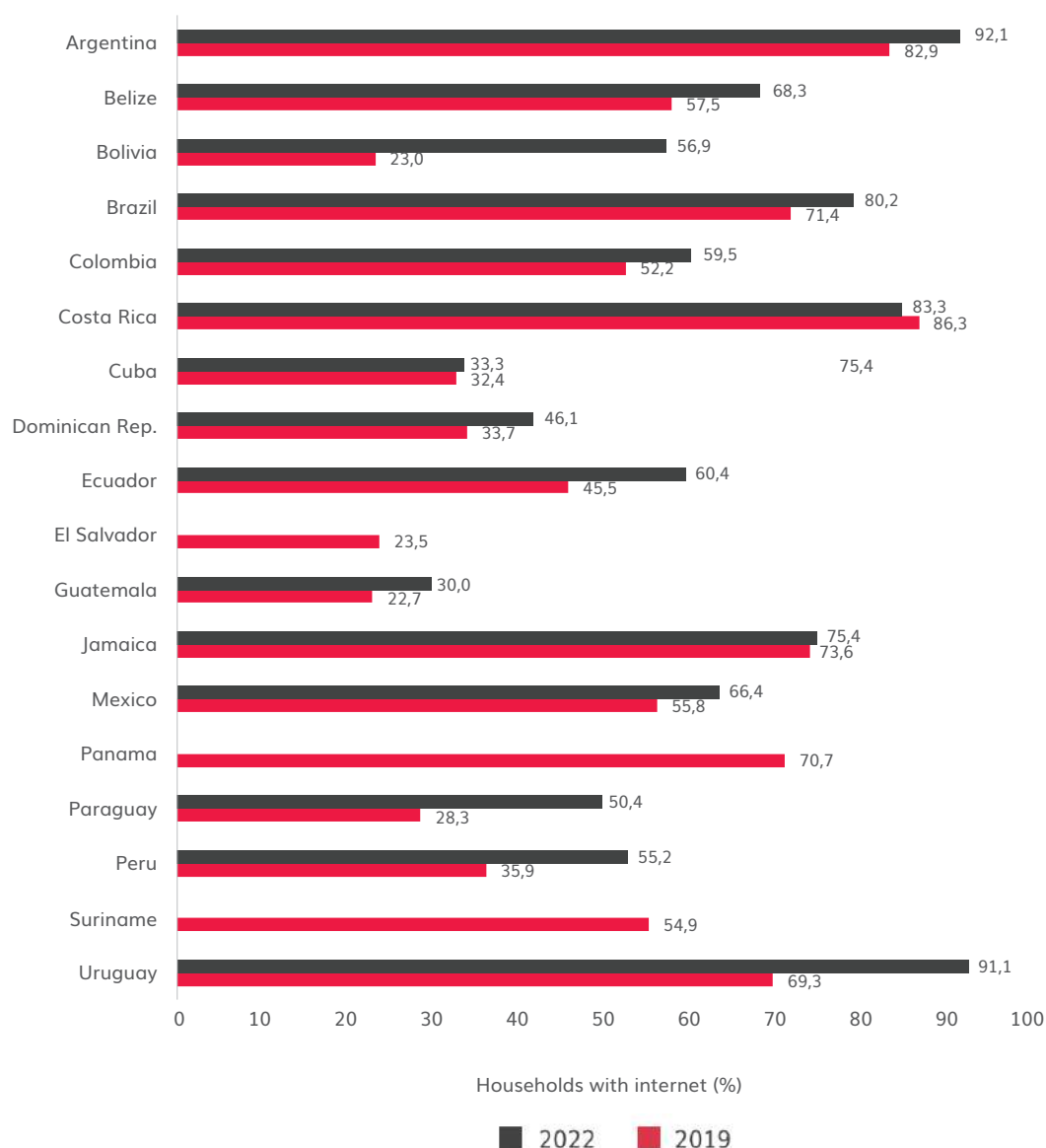
The regional ed-tech landscape in the aftermath of COVID-19

Some of the most important trends in ed-tech programmes in the region reported in the literature can be summarised as follows (see Robinson et al., 2020; Martinez Tessore, 2021). First, effective public policies aimed at reducing inequalities should address the provision of networks, devices, and digital skills training. Second, sustainable and long-lasting impacts can be achieved by implementing these policies early through educational institutions. Third, rural-urban disparities are expected to persist, requiring collaborative efforts and community participation to promote digital inclusion in rural areas. The COVID-19 pandemic has further exacerbated these differences, particularly with stay-at-home orders and increased reliance on digital technologies. In the aftermath of the pandemic, ensuring internet access and providing suitable devices to those facing digital exclusion becomes crucial.

Remote learning and a shift towards online learning pose challenges for low- and middle-income countries because of technological disparities that became more marked during the pandemic (Artopoulos et al., 2020; Robinson et al., 2020; Martinez Tessore, 2021). Governments have turned towards establishing learning platforms, training teachers in new multimodal strategies, and creating conducive learning environments. Educational apps and websites have become essential tools requiring specialised teaching approaches (Artopoulos, et al., 2020).

Prior to the COVID-19 pandemic, on average two or more students shared a computer in LAC schools compared to one student per computer in OECD countries (OECD, 2018). Also, major gaps in access to digital infrastructure and equipment both in schools and households were exposed (Huepe et al., 2023). Efforts to implement remote learning during the pandemic largely relied on access to computers and internet connections at home, but both resources are distributed highly unequally across the LAC region. In 2019, the region's lowest rates of internet access at home were found in Bolivia (23%), Cuba (32%), the Dominican Republic (34%), El Salvador (24%), and Guatemala (23%), whereas access among households in Argentina and Costa Rica was above 80% (see Figure 4). Nonetheless, 2022 data show there have been significant leaps in home internet access in a large number of countries after the pandemic (Argentina, Belize, Bolivia, Brazil, Colombia, Dominican Republic, Ecuador, Mexico, Paraguay, Peru and Uruguay).

Figure 4. Percentage of households with internet access at home, Latin America (18 countries), 2019 and 2022

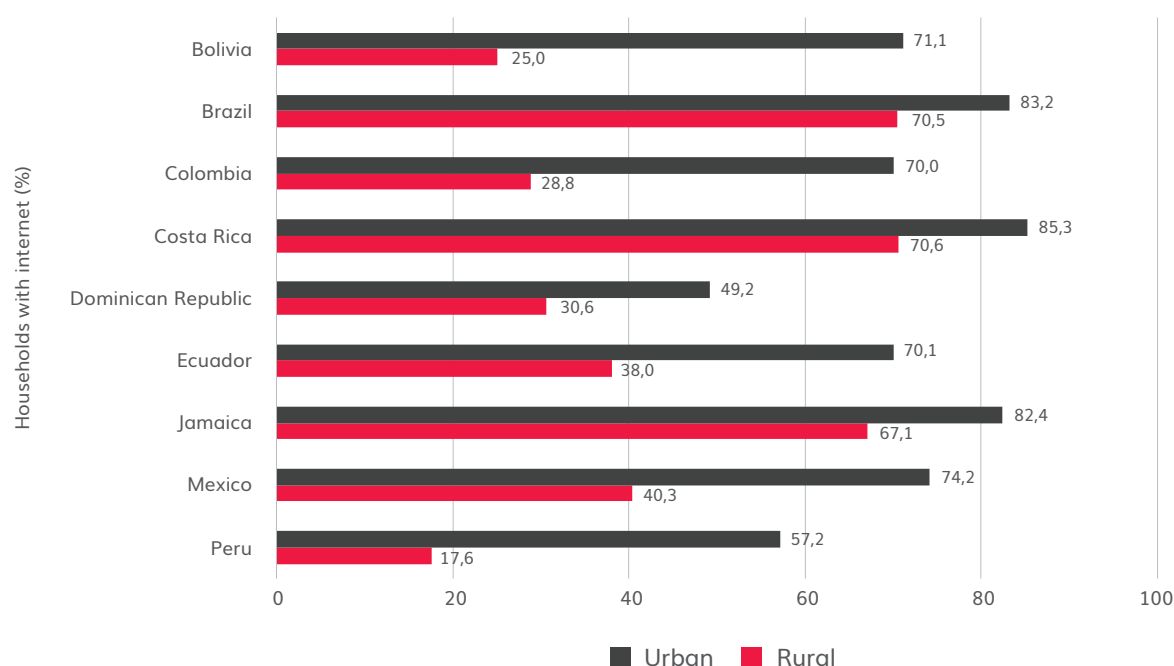


Note. Year 2022 replaced with data from 2021 for Belize, Bolivia, Cuba, Dominican Republic, Guatemala, Jamaica and Mexico.
 Authors' own calculations based on *ITU databases* by ITU (2019; 2022).

Furthermore, a significant urban-rural gap is observed, especially in Colombia, Bolivia and Peru (Figure 5). While in Colombia and Bolivia internet access in urban areas exceeds 70%, in rural areas it does not even reach 30%. In Peru, only 17.6% of households from rural areas have the internet. Besides this geographical gap, connectivity is also affected by household income. The average percentage of households from the poorest

quintile with internet access is 55%, compared to 94% of households from the richest quintile (ECLAC, 2022b). Overall, the COVID-19 pandemic exposed major access gaps in digital infrastructure and equipment among both schools and households.

Figure 5. Percentage of rural and urban households with internet access at home, Latin America (7 countries), 2020



Note. Authors' own calculations based on ITU databases by ITU (2020).

Despite significant progress witnessed in enrolment and completion rates over the past two decades in the region, there is still a critical challenge: the difficulty of transforming these gains into learning improvements. Findings from the Regional Comparative and Explanatory Study (ERCE, 2019) revealed a general stagnation in learning from 2013 to 2019. Six out of the twelve countries analysed exhibited virtually no improvement in reading results at the third-grade level by 2019. Additionally, less than 20% of students achieved the minimum proficiency level in mathematics. This indicates that the educational performance of the region was already low prior to the onset of the pandemic, rendering it more susceptible to the adverse effects of the global health crisis.

Income disparities persistently affect attendance rates, sustaining educational inequalities across different economic groups and geographical areas. Additionally, gender gaps remain at the upper secondary education level in Caribbean countries, and students with disabilities show lower attendance rates compared to those

without disabilities, both at the primary and secondary levels. Indigenous communities also continue to face significant challenges in achieving equal educational outcomes in the region.

Education budgets of LAC countries were significantly affected by the COVID-19 pandemic, with large reductions in GDP caused by trade restrictions reducing the funds available to support education initiatives. In 2020, the region faced an average decrease in GDP of 6.6% due to the pandemic (World Bank, 2021), but there were important regional differences. According to World Bank data (2021), Paraguay, Brazil and Costa Rica experienced lower economic contractions than the region average (2.9% GDP), while the Bahamas, Jamaica and Honduras were significantly more affected (14.3% GDP). In this context, it is worth noting how public resources might have affected education budgets in the region.

In 2019, seven of the 17 countries with available data allocated less than 3% of GDP to finance primary and secondary education (Table 7). Of these, Ecuador and Guatemala had the lowest levels of investment (1.9% and 2.2%, respectively). On the other hand, in countries such as Bolivia and Costa Rica educational expenditure was fairly high relative to GDP (5.8% and 4.7% respectively), a ratio that remained relatively constant in 2020. Since most countries in the region experienced a decrease in their GDP between 2019 and 2020, a rise in educational expenditure as a percentage of GDP might not represent a real increase in public educational expenditure, but rather a greater part of a smaller total.

When looking at government expenditure per student using purchasing power parity (PPP), 11 out of 15 countries with available data have reduced their spending in 2020-21 compared to 2019 (see Annexes 3 and 4). For example, Colombia, Dominican Republic, and Guatemala increased their education budgets, while Argentina, Bolivia, Uruguay, Costa Rica, and Ecuador, among others, decreased expenditure (Table 7).

Table 7. Government expenditure on primary and secondary education as a percentage of GDP Latin America and the Caribbean (17 countries), 2019-2021

Country	2019	2020	2021
Argentina	3.2	3.4	-
Bahamas	-	-	-
Bolivia	5.8	6.1	-
Brazil	3.9	-	-
Chile	3.2	-	-

Colombia	3.5	3.8	-
Costa Rica	4.7	4.4	-
Dominican Republic	3.2	3.9	-
Ecuador	1.9	1.9	1.7
El Salvador	2.7	2.6	-
Guatemala	2.2	2.3	2.1
Jamaica	3.8	-	-
Mexico	2.9	-	-
Paraguay	-	2.8	-
Peru	2.5	2.9	2.7
Saint Lucia	2.4	2.4	-
Uruguay	2.8	2.6	-

Note. Authors' own calculations based on *UIS.stat databases* by UNESCO (2019-2021)

Summary of findings from the literature review

The literature reveals significant progress in ed-tech initiatives across the LAC region, with strategies aimed at bridging the digital divide and promoting equality. However, it is evident that providing devices and internet connectivity alone is not sufficient. To effectively realise the potential of ed-tech, a comprehensive, multifaceted approach is needed. The end goal is robustly implemented ed-tech that enhances educational outcomes and bridges socioeconomic disparities in line with SDG4 (Quality Education) and SDG10 (Reduced Inequalities).

From this end goal, we can map key components when implementing ed-tech initiatives. These include:

1. **Sustainable infrastructure:** Planning for the long-term maintenance and replacement of equipment is crucial for the sustainability of these initiatives.
2. **Collaborative efforts:** Involving a range of stakeholders (governments, NGOs, private entities, and local communities) in the planning and implementation phases.
3. **Continuous professional development for educators:** Ensuring educators are equipped with the skills and knowledge to integrate technology into teaching.
4. **Comprehensive digital literacy:** Beyond basic technological proficiency, digital literacy should encompass critical thinking, creativity, and the ability to leverage technology for diverse educational needs.

5. **Local adaptation:** Ed-tech initiatives must be tailored to the unique needs of communities, particularly in indigenous and rural areas, balancing technological advancements with cultural preservation.
6. **Inclusivity and socio-cultural awareness:** Recognising and addressing the diverse cultural and socioeconomic backgrounds of students to ensure equitable access and engagement.

Despite the alignment of most regional policies with principles of equity, challenges remain. Legislation regarding online education access lags behind (Amado-Salvatierra et al., 2016), and there are knowledge gaps that need addressing, such as enhancing parents' digital skills, providing student training in ICTs, expanding educational outreach with businesses, and improving disability education. Building comprehensive and inclusive digital policies requires empirical foundations that inform decision-making and involve various sectors. The political economy of ed-tech in LAC countries plays a crucial role. Academic literature suggests that the effective implementation of ed-tech not only requires a comprehensive approach, but also depends on the economic and administrative realities of each country. Limited budgets, political dynamics, and administrative capacities are key factors that influence the extent to which these preconditions can be met.

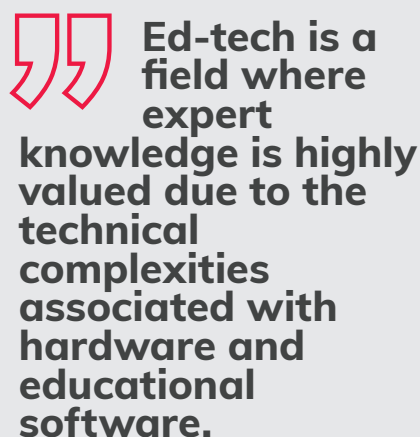
Analysis of ed-tech programmes and policies in Latin America and the Caribbean

Using a political economy analysis, this section seeks to understand the type of actors, discourses, expectations, and power dynamics in the field of educational technologies in LAC taking as data source the seven cases selected and systematised. This framework is used as an exploratory lens to first describe and understand the state of ed-tech programmes and policies in the region, and second, to identify opportunities for future research. This analysis focuses more on digital technologies (high-tech) than analogue technology such as radio or TV (low-tech).

Based on Pellini et al. (2021) this framework identifies five core elements for political economy analysis: (i) the issue, which refers to a specific policy challenge; (ii) structural factors and institutional settings where decision making occurs around that issue; (iii) the rules of the game that influence the behaviour of the actors; (iv) stakeholder interests and power relationships in policymaking; and (v) the opportunities open to actors. These dimensions provide the analytical lenses to interrogate the data on ed-tech initiatives collected in the study.

Analysis of the selected ed-tech initiatives shows a scenario in which a wide range of factors, including the role of the state or political factors, the structure of the economy and the distribution of income, and the relationship between different social groups, yield a particular political economy configuration. This is characterised by:

1. Multiple actors taking part in ed-tech: governments, private companies/internet providers, NGOs, and very importantly, international bodies such as the IDB, UNICEF, among others. These actors operate with varying degrees of influence, depending mostly on the level of public resources and state capacities. For example, ed-tech is a field where expert knowledge is highly valued due to the technical complexities associated with hardware and educational software; this determines who has a legitimate voice in these types of decisions.
2. Disputes around the meaning and role of digital technologies in education: This relates to the institutional form that digital citizenship adopts in a country, which shapes and conditions the public resources and efforts targeting the development of digital skills, teacher and student digital literacies, the guarantee of digital rights, and so on.
3. A political dynamic that affects policy continuity and stability in key reforms, such as those related to ed-tech. It also shows a governance system with deficits in terms of coherent coordination between ministries, private companies, and civil society organisations (CSOs).
4. Challenges in harnessing technology to transform long standing socioeconomic and educational disparities. The integration of equity and inclusion priorities into ed-tech relates to the intricate interplay of socioeconomic factors, geographical disparities, cultural norms, and educational history.



Ed-tech is a field where expert knowledge is highly valued due to the technical complexities associated with hardware and educational software.

Based on the issue of how ed-tech programmes and policies in the region can help advance learning and reduce inequalities in primary and secondary education, this research has identified a number of critical dimensions associated with the ed-tech political economy configuration in LAC.

The issue in ed-tech is much more than learning outcomes

The analysis of ed-tech interventions in LAC offers significant insights into the evolving landscape of educational technology in the region. It also reveals narratives of missed opportunities for learning improvement, but perhaps most importantly, it shows the search for strategies capable of achieving a more holistic integration of technology in education.

What the literature has shown in the field of ed-tech, particularly since the pandemic, is an expansion of digital educational contents, a diversification of formats, and growth of virtual platforms dedicated to the management of teaching and learning. This shift seems to show that technologies are not isolated resources or tools to be integrated, but rather integrated environments to facilitate teaching and the learning process (Soletic & Kelly, 2022; Wyss & Myers, 2022). The search for more holistic frameworks encompasses not only the technical skills needed to use digital tools, but also an understanding of digital rights,⁸ online ethics, privacy, and security. Digital literacy is widely recognised as an umbrella term, encompassing a range of skill clusters including ICT literacy, technological literacy, and information literacy, each contributing to active participation in a digitally-driven society (UNESCO-Institute for Information Technologies in Education, 2011).

In LAC the conceptualisation of digital literacy is related to learning, but also it points to additional aspects (Méndez Cota & Lopez Cuenca, 2020). Drawing on a rich scholarship tradition, emphasises multiliteracies and focuses on the distinctive needs and experiences of the oppressed, including indigenous, bilingual, and intercultural communities. This regional emphasis reflects a commitment to addressing the diverse socio-cultural landscape and the specific challenges faced by marginalised communities.

Low digital literacy rates in the region are rooted in a deeper systemic lack of prioritisation of digital skills training for students, teachers, and staff. Teachers are not generally trained in digital skills. Consequently, students are unable to formally develop these skills. In many countries, digital content is not formally included in the curriculum and its development depends on individual teachers. It also reflects the competencies of other education stakeholders, such as the school leaders or administrative bodies in

⁸ Digital rights refers to the human rights and legal privileges that apply in the digital domain, ensuring that individuals have access to, use, and benefit from digital technologies in a way that respects, protects, and fulfils their rights. These rights encompass a range of principles and standards, including, but not limited to, the right to equal access to the internet and digital technologies, and to participate in digital education, culture, and knowledge.

charge of buying technology, as noted by a ministerial official in Paraguay who worked in the national ICT programme:

"Because you can have a university degree and not know how to use a PowerPoint, not be able to make a basic presentation. What we need is technical support that provides teachers with the tools to accompany their learning process. To help those teachers who are there to overcome that fear of change" (Official from Ministry of Education, Paraguay).

Support mechanisms are also needed to promote the effectiveness of digital training initiatives. In Honduras, for instance, regular field visits by pedagogical advisors have been implemented to assist teachers with basic troubleshooting and IT skills (right from turning on the computer to teaching how to use a learning platform). In Paraguay, interviews with course providers show that distance training courses have proved to be somewhat ineffective as most teachers seem to be engaged with household chores during training sessions, which has led providers organising in-person meetings.

Ed-tech initiatives in the region have primarily centred around infrastructural improvements. The focus has predominantly been on equipping schools and communities with the necessary devices and internet connectivity. While an essential first step, this approach overlooks the importance of also addressing the user skills and awareness needed to navigate the digital world responsibly and meaningfully, often resulting in underwhelming outcomes in many technology-driven interventions (see Mateus et al., 2022; Rodriguez-Zidan et al., 2019). However, the global shockwave of the COVID-19 pandemic brought a dramatic shift in this perspective. With the abrupt shift to remote learning, it became starkly evident that access to devices and connectivity is only one piece of the puzzle. The ability to use technology effectively and responsibly emerged as a key aspect of continuity in learning, highlighting the central role of providing and accessing technological infrastructures but at the same time the digital skills to operate confidently in distance or virtual teaching and learning scenarios.

The COVID-19 pandemic demanded a dramatic shift in education systems. It became necessary to tackle issues beyond access to devices or the internet, such as digital literacy, the responsible use of technology and new pedagogies to keep the continuity of teaching and learning. To summarise, recent trends in the region show a renewed emphasis on the development of digital skills, as part of a still embryonic understanding of the importance of digital literacy. Access to technology is now viewed as a first step towards effective use of ed-tech. The pressing challenges brought by the pandemic have compelled a re-evaluation of existing assumptions, and catalysed a shift in focus from mere provision towards proficiency. This approach is gradually permeating ed-

tech policies and practices, encouraging a more holistic view of technology in education that underscores the importance of an informed understanding of the possibilities of technology in education.

Rules of the game and the governance of the system

Ed-tech programmes and policies have become increasingly important in the region since the COVID-19 pandemic. In a context of varying degrees of ed-tech development, countries are facing more complex processes when introducing digital technologies. This complexity points to the issue of governance in ed-tech which demands renewed approaches to: address current challenges of coordination between stakeholders, and delimit the scope and functions between ministries, and the rules and norms by which private companies operate in the education system.

The challenge of governance lies not only in the coordination of a growing number of actors taking part in the process, but also in the tools introduced to the systems and the changes in the curriculum, the teacher competencies needed to apply these tools and resources, and the frameworks that regulate the ed-tech industry. All these institutions and actors require new modes of coordination to address the multiple demands that the new digitalised environment demands. As expert from Brazil who led different programmes in the non-governmental sector said:

"[there are] different sources of production of digital materials, but there is not a central coordination of all these different actors. So, it's very easy that you see duplicated efforts, or something, or funds. Some states are receiving all the funds and, other states don't receive any funding" (Non-governmental sector expert from Brazil).

Along with an increased number of actors, there has been a trend in the region towards a greater awareness of the benefits of integrating digital technology into educational management, and teaching and learning practices. This integration poses additional challenges in countries still lagging behind in the digitalisation of education, mainly in Central America, the Caribbean, and Andean countries such as Peru and Ecuador (Huepe et al., 2023). Ed-tech policy priorities in the region differ in each country depending on the context. For example, efforts in poorer countries are still focused on ensuring electricity in schools, or infrastructure recovery as in the case of the Caribbean countries hit by hurricanes.

According to regional experts, the pandemic not only accelerated the adoption of digital technologies, but more importantly, it strengthened the position of digital

technologies in education agendas (UNESCO, CEPAL, & UNICEF, 2022; ECLAC, 2022a). Although not new, the pandemic pushed this discussion into practice as countries were forced to act. Some countries were more prepared than others to face this challenge, such as Brazil, Uruguay or Chile, where online platforms were in use even before the pandemic, internet provision was extensive in the country, and public-private partnerships were already in place.

A key shared characteristic of recent ed-tech programmes in the region is the search for mechanisms to avoid the risks of political transition and ensure sustainability in implementation. A widely adopted approach in this regard is establishing executive agreements (decrees), which define the partnerships needed to implement the programme and the specific roles and responsibilities of each stakeholder (The Dialogue, 2021). These agreements also include a steering or advisory board to provide a greater diversity of expert views. In this way, representatives from academia, civil society and the private sector are brought together with the aim of building alliances and forming specific working groups around different technical components.

In practice, however, it has proved difficult to fulfil these arrangements due to a diversity of interests. Factors such as the degree of flexibility in procurement processes, the need for faster execution, the designation of trusted teams, and changes in government priorities, are some of the barriers these agreements face. In addition, policymakers and other implementers hold diverse views as to the best way to coordinate these tasks, and the issue of governance is key. One mechanism is to facilitate articulation to allow space for dialogue and flexibility to accommodate small or medium-sized companies that offer interesting solutions, but do not fulfil all the criteria the government asks for. As one interviewee noted:

"I think what we are missing is this two-sided table.... i.e. you have the private sector and the public sector. They need each other, they have complementary competences and they do not dialogue in the best way. Not because of lack of will but because there are no spaces for a proper dialogue" (Expert from the Caribbean).

There seems to be consensus among experts and public officials around the need to have a more centralised body that coordinates at least basic programme components (connectivity, skills, and pedagogical content), as is the case of the Ministry for Digital Transformation in Colombia (MinTIC). This institutional approach facilitates the formulation and implementation of programmes by controlling funds, reducing overlapping functions, and ensuring policy continuity. There is also a growing interest in entrusting internet provision in rural areas to technical bodies rather than ministries of education, since internet connectivity goes beyond the scope of education, and other institutions, such as local health centres, also need internet access.

Box 5. Digital Education Transformation National Programme (PNTED), Honduras

The PNTED was designed in 2020 during the pandemic, and began to be implemented in 2021 with the goal of fostering equitable educational transformation by incorporating the use of information technologies to accelerate learning. Although the PNTED emerged as a response to the educational crisis generated by the COVID-19 pandemic, it is also aimed to ensure that the education system in Honduras would be prepared to provide continuous learning in the event of any disruption caused by social or natural phenomena forcing children to be taken out of school.

Drawing on lessons from the implementation of regional and global ed-tech programs, as well as the strategic advice of Plan Ceibal, two specific objectives are set out in the PNTED: first, to provide electronic devices with technical support and maintenance; and second, to use virtual learning platforms to help narrow the digital divide.

The PNTED had an initial goal of reaching 500,000 students and 5,000 teachers with devices by 2022, with funding drawn mainly from the IDB "Young Project", the "Digital Transformation for Increased Competitiveness" programme and the National Broadband Plan, through the "Telecommunications, ICT Investment Fund" (FITT). In 2021 there was a change in government. Since then, the program has been coordinated by the "Solidarity network" (RS), a new initiative created to support the most vulnerable communities. In August 2022, the program delivered 9,100 new tablets for students and 1,024 laptops for teachers in 72 educational centres (ECs) in 20 communities, to be used exclusively in schools.

Although the program has worked well in schools located in urban areas, the instability of electricity in rural areas has limited the opportunities of internet connection for all the students and teachers. Therefore, considering that connectivity underpins the effectiveness of the programme, the strategy to cover the 72 educational centres relies on: 28 centres financed by PNTED; 29 by municipalities; 9 by the Giga project of UNICEF and ITU; 1 financed by COHEP, 1 financed by private donors, and 4 ECs where internet access is still pending.

The main digital tools featured in the programme's pedagogical component are: free platforms for teachers (Microsoft Forms and Teams, Google Forms and Meet, Zoom, Kahoot, etc.); participation of teachers and students in online training or courses through educational platforms (Ibertel, Coursera, Edx, etc.); learning management environments such as Google Classroom, Passport to Learning, Microsoft Teams or Moodle; and active learning platforms for reading comprehension (Fiction Express), science simulators (PHeT), and maths (ALEKS).

In September 2022, a "concept test" was introduced which includes an evaluation of the provision of devices and internet in schools as well as the ongoing ICT teacher training. Additionally, the IDB is running an impact evaluation of 28 educational centres, whose results will be available in 2024. The results of both evaluations are expected to inform the decisions regarding the continuation and the feasibility of scaling up the program. As of the date of this report, the PNTED is once again hosted by SEDUC, rather than RS.

For more information, please visit: <https://www.se.gob.hn/detalle-articulos-noticias/5/>

Undoubtedly, a context of crisis created the conditions for transversal support for ed-tech that would otherwise have been difficult to achieve. Programmes started at this time could also benefit from previous experience in other countries. For example, in the case of the PNTED programme, which emerged during the pandemic in Honduras (see Box 5), lessons learned from international experiences on the use of platforms, digital content, timeline in policy action, among others, informed its implementation, including Plan Ceibal in Uruguay, the Omar Dengo programmes for digitalisation in Costa Rica, and CIEB in Brazil. Furthermore, the presidency of Honduras backed the policy in order for it to articulate with other actors, and receive significant technical and financial support from multilateral banking agencies.

Conversely, in the case of Paraguay's ICT programme which started before the pandemic (See Box 6), no modifications or adaptations were made during the pandemic as these need a long time to be approved by the relevant ministerial committees before they can be implemented. In this sense, the bureaucratic structure in place made it difficult to quickly adapt to new scenarios, such as the pandemic. For example, interviewees mentioned that recruiting a professional can take up to a year. Therefore, during the pandemic the education system in Paraguay kept running through WhatsApp and other more rudimentary platforms. Subsequently, in 2021, efforts were made to design a television-based education programme, facilitated by technical support from international cooperation.

Box 6. ICT Programme, Paraguay

The "Improving learning conditions through the incorporation of ICTs in educational centres" programme (ICT Programme), was designed in 2014 and began to be implemented in 2016 to improve the learning conditions and educational management in the Paraguayan education system. Given its comprehensive nature, it can be understood as a digital policy rather than a stand-alone programme, with an initial target of 5,000 schools and a budget of \$135 million USD from the publicly-funded "Educational and Research Excellence Fund" (FEEI).

The initiative is composed of nine elements: i) ICT proficient teachers; ii) technological infrastructure in place and operational; iii) educational gateway and learning platform; iv) educational centres and management units of the MEC with technological resources; v) development of research and knowledge innovation on ICTs in education; vi) educational centres and management units of the Ministry of Education and Culture with information technology management systems; vii) quality control of programme processes; viii) strengthening programme management and ix) incorporation of ICTs in educational centres.

To ensure accountability, the agency in charge of managing the programme's financing, FEEL, operates as an autonomous body and is composed of the highest representatives from three ministries (finance, education and health), the Technical Planning Secretary, and the National Council of Sciences and Technology. Additionally, four civil society representatives nominated by the president, and proposed by the CONACYT. This structure implies that each modification of the programme must be approved by all of them which can take a long time.

Although the original deadline for the program was 2019, several difficulties in implementation halted its progress. In 2019, before the pandemic, the programme was reformulated, reducing the target of schools from 5,000 to 2,500, and the deadline was extended to 2024. The main issues were long procurement times, duplication of execution procedures within the ministry, restrictions imposed by the ministry of finance, difficulties encountered in negotiations with private providers, and constant changes of education authority. Another major problem related to the infrastructure available in schools. Prior to the ICT Programme, structural issues in schools revealed that standards were insufficient. An additional change in the 2019 reformulation was aimed at accelerating the program by means of centralising the execution procedures into a single coordinating unit, with significant efficiency gains.

As part of the ICT Programme, at the beginning of 2021 the Ministry of Education and Science, the Ministry of Communication and Technology and the Korean International Cooperation Agency (KOICA), signed a collaboration to create the "Multimedia Education Support Centre in Paraguay" ("MEC Digital"), for a five-year period. With financial and technical support from Koica, this project aims to implement a television channel that broadcasts educational multimedia content for different academic subjects from the open basic education curriculum.

For more information, please visit: <https://feei.gov.py/programas-y-proyectos>

Finally, it is concerning that in the context of increasing engagement of the private sector in providing educational platforms, in many LAC countries there is no legislation that regulates access to educational applications and content. This is particularly worrying because of the risks associated with data use and privacy among children and young people, which demand policies that set the rules and conditions in which technological companies will operate. Among the mapped initiatives, the "Online Protection Policy", currently being developed by OECS as a strategic framework under the Giga project (see Box 2), although still in its early stages, can be seen as a good example of how to address this issue. Based on these findings, governance in the ed-tech ecosystem requires new approaches and frameworks to address current challenges of coordination between stakeholders, the scope of functions and tasks across ministries, and the rules and norms under which private companies operate.

Policy continuity and stability

Historically, the LAC region has been a forerunner in ed-tech adoption. As early as 1968 there were already educational TV channels (for example México Telesecundaria), and by the end of the 1980s, web development was already being taught in high schools in Chile. However, one of the greatest challenges that ed-tech policies have faced in the region over the years is political continuity and the lack of long-term policies. It is common for efforts to be driven by specific people who are fully responsible for programme implementation without enough support staff, technical teams or adequate resources. In such cases, a change in administration means any gains made are lost, as in the case of the E-México policy, for example:



A common solution to the challenge of continuity is to involve external partners from international organisations or CSOs in providing technical assistance.

"... I have seen a constant rotation of government officials, and this means that public policy is not continued over time as the management of the policy depends on the person on duty. This is a great challenge for the region" (CSO representative, Mexico).

Conversely, Plan Ceibal in Uruguay—often cited as an example of best practice in the region—has maintained its institutional framework and instruments over various administrations, since 2007, collecting data, adjusting, and learning from past experiences. Ensuring the continuity of technical teams has been key to the programme's success.

A common solution to the challenge of continuity is to involve external partners from international organisations or CSOs in providing technical assistance. As external entities, there is less risk of their participation being interrupted, meaning they can transfer previous knowledge and learning across changes in administration, allowing some continuity from one government to another. Other solutions are to formally include digital policies in curricula and teacher training programmes.

In the case of the PNTED in Honduras, the programme was able to continue despite a change of government since it had a well-planned strategy, designed by an international

organisation, that included a pilot test in a small group of schools, and intermediate results measurements that would inform policy scaling decisions. Likewise, although the PRONIE programme from Costa Rica has just ended (see Box 7), the case of the Omar Dengo Foundation in Costa Rica is an example of a civil society initiative that was able to collaborate with the ministry of education for a long period.

Box 7. National Educational Computing Programme (PRONIE), Costa Rica

The National Educational Computing Programme (PRONIE) was created in 1988 as a public-private partnership between the Costa Rican Ministry of Public Education (MEP), who financed the program, and the Omar Dengo Foundation (FOD). The intervention aimed to provide Ed-tech coverage and high impact across the country. The program aims to ensure that students and teachers at public schools make the most of digital tools by favouring learning and knowledge production to strengthen skills and to enable active participation in the digital era. PRONIE proposes four different models: i) Educational Informatics and Computational Thinking (LIE), consisting of weekly lessons for students from preschool to 9th grade promoting programming, robotics and big data; ii) Technological Appropriation for Learning with Mobile Technologies (ATM), teaching technological appropriation for teachers and providing tech equipment according to school's context; iii) Entrepreneurship and innovation, offering a practical business simulation for students at technical schools, with the creation of the Labour Operations Centre platform (Labor@); iv) Industry 4.0 employability and the jobs of the future, training for students and teachers that leads to industry certifications.

While the MEP mainly served as a financial support for the program, the FOD became responsible for resource allocation and implementation. The LIE modality has been implemented in 1,280 schools reaching more than 500,000 students. It provides teaching resources for different school levels, workshops, and training for teachers. Partnership with various organisations—including Scratch (a global coding community for children), the python Software Foundation, and the Computer Science Academy Carnegie Mellon University—provides further resources for teachers as well as inspiration. The ATM modality supports teachers' technological appropriation in 2,710 educational centres, and offers them virtual workshops. Laptops and mobile devices delivered to schools enabled 222,977 students to expand their learning while experimenting with technology. For the Labor@ intervention, a methodological partnership with the Directorate of Technical Education and Entrepreneurial Skills of the MEP was created, as well as an alliance with the Banco Nacional to strengthen the initiative. In 2018, Labor@ benefited 231 educational centres and reached 13,686 students.

The MEP and the FOD also formed a partnership with ProFuturo ("Telefónica" and "la Caixa" Foundations) to seek advice, to update the curriculum, and to support teachers in the pedagogical use of digital technologies and educational innovation. Partnerships with the private sector, including Microsoft and Huawei, enabled new initiatives, including "Inspira Tec", a scholarship for teachers who seek to innovate and inspire to participate in the Education Exchange Conference .

The COVID-19 pandemic became a turning point for teacher training and enabled new collaborations between FOD and the private sector to provide virtual training. It also allowed FOD to rethink and redesign the program for 2023 to match new needs. However, while the MEP and FOD had been successfully working together for the past 30 years in breaching the digital gap, recent political trends in the country highlighted some issues in the partnership. The difficulty to evaluate such a comprehensive program in a financially feasible way, and government concerns over a perceived lack of control over resource allocation of the program became central. The government decided to not renew the contract with FOD, and the cooperation ended in May 2023. The MEP announced an evaluation of Ed-tech abilities among students and teachers was to be carried out in 2024.

For more information, please visit the website: <https://fod.ac.cr/pronie/>

Along with the challenge of continuity of ed-tech policies in LAC, the cases show signs of clientelism, with governments providing devices or computers without pedagogical content or a supporting educational project. In Honduras for example, the delivery of almost 50,000 tablets to third grade and high school students in September 2021, two months before the elections, was a paradigmatic case (see Box 5). The current Ministry of Education is unable to use this material to implement educational platforms since there is no record of the number and location of the devices.

All in all, the case studies highlight the key role played by the strategic and long-term vision of the ministries of education and their advisors. There is a need to move beyond the specific actions pursued during one particular political administration, towards an articulation of policies based on longer term outcomes, and to develop dialogues to promote action by different stakeholders.

Dominant conceptions and ideas in the field of ed-tech

Competing beliefs and conceptions about the role of ed-tech among actors participating in the education system are key to understanding the power relationships operating within the system, for example: traditional modes of compartmentalised operation versus collaborative ones; technology understood as a tool rather than as an environment in which students are immersed; pedagogies based on classroom interactions versus hybrid models for teaching and learning. These contrasting views are clearly expressed by an ed-tech expert from Brazil:

"When you talk about educational technology, it's not enough to talk about computers in schools. So, it's not about creating computer labs. You must have

this multidimensional approach that prepares teachers to use it. You must have good educational materials to be used in this technology. And you must have an organisation of the curriculum that makes sense to use technology. It's not just to transfer traditional pedagogical practice into digital, but you have to really transform the way you teach" (Expert from Brazil).

The educational system faces significant challenges when dealing with a rapidly changing technology landscape. Many of the new technological applications or educational platforms come from the private sector, but often do not match with the pedagogical requirements known by technical teams within governments. On the other hand, the private sector has greater involvement with the technological industry (needed for the design of devices), which is distant from the public sector. The emergence of multiple stakeholders such as large and small tech companies, philanthropic initiatives, international cooperation agencies, and CSOs attempting to shape the education policy agenda seems to require a move towards a more collaborative, democratic and transparent system of decision-making (Ball & Junemann, 2012; Cortina & Lafuente, 2018; Lubinski et al., 2022; Verger et al., 2016) In this sense, strategic partnerships are needed to effectively respond to this new scenario, as noted in the case of Brazil for example:

"We have to change the mindset of governments and say, 'how can I sit together with big tech companies or tech and design a new process of acquisition and public funding for these solutions', because otherwise you are just going to reproduce inequalities that are already there between private and public schools" (CSO representative, Brazil).

Based on the cases analysed, while there are well-designed policy frameworks and regulations on paper, the implementation of these into concrete actions has been far from straightforward (ECLAC, 2022a). This discrepancy between policy intentions and implementation highlights the need for a more adaptive and responsive governance framework. To address the challenges posed by the involvement of diverse actors, new governance structures become imperative to enhance efficiency, effectiveness, and responsiveness in public management and policy making.

The existence of competing and conflicting conceptions of the role of digital learning technologies was reported by experts to be a key barrier to the implementation of ed-tech interventions. A shared vision of technology at the national level and within governments is required. For instance, some interviewees view technology as a lever for progress and development, while others perceive it as irrelevant and not a priority because other issues are more urgent to solve. The lack of consensus on the potential and possibilities of digital technologies could lead to weak regulations, and ineffective

models of intersectoral collaboration which are meant to create a more coherent approach to promoting educational technologies. As a representative of an International Cooperation Agency highlighted:

"Some people say there are so many problems in education in Latin America that technology is not the priority. And I think we have to reverse this discourse and say technology can be a lever to face all these problems that we have had historically in education and Latin America" (International Cooperation Agency Representative).

Embracing a more holistic understanding of the role of technology and digitalisation in education can overcome a barrier associated with the role and potential benefits of education technologies. A conceptual shift seems to be expressed in the cases analysed. This shift was evident in the findings from the field visits. For example, the design of technology-mediated programmes has changed now to reflect a multidimensional approach, based on recognition that the key to effectiveness is the right combination of tools, skills, platforms, knowledge, support, and other resources. This mindset also encourages innovation, adaptation, and continuous improvement in technology-related initiatives. This transformation can foster a more inclusive and collaborative environment for technology integration, leading to meaningful advancements in education.

The integration of technology into educational practices also demands a pedagogical shift towards more personalised learning, focused on the specific needs of students and teachers. As one expert from an international cooperation agency noted:

"Before the pandemic, we had a very low level of adoption of technology across all dimensions, but after the pandemic, we could see that vision was very advanced. So, teachers and principals were really believing that technology can play a very important role" (Representative of an International Cooperation Agency).

The pandemic has accelerated this change, moving the focus from hardware to software tools, highlighting the importance of ICT in education to propel new pedagogies. Despite this recognition, ICT teacher training has yet to catch up with demands of effectively integrating technology into their teaching practices. There is a need for comprehensive support and guidance to empower educators to leverage the full potential of technology. The learning curve for technology programmes involves building the necessary competencies to use technology in the classroom effectively. Through strategic investment in professional development and mentorship, educators can become proficient in implementing technology tools that enhance instructional practices and student outcomes.

Stakeholders: who they are and what are their interests

The field of ed-tech in the region is characterised by the participation of multiple actors. Among them, and most important in the policy process, are government ministries, international cooperation organisations, technology companies, NGOs, academic experts, teachers' unions, and schools and teachers as the final users of these technologies. The multiplicity of actors involved in ed-tech creates a complex landscape that requires coordinated actions to articulate the different interests within this policy domain. Thus, there is a need for effective coordination (via a national central unit, or a coordinating system) to integrate these diverse actors and guarantee coherent actions (e.g., activities and investment) in the field of ed-tech.

This underscores the need to move beyond traditional approaches to public management towards more intersectoral approaches to the planning, design, and implementation of ed-tech policies and programmes. Another consequence of this situation is the increasing presence of public-private partnerships that emerged in response to the multi-dimensional nature of ed-tech interventions. Evidence from the cases analysed shows that such alliances are present in all selected countries and serve as a powerful strategy to advance technology-driven initiatives due to the different capacities of each actor in the ed-tech field.

Addressing conflicts and aligning different stakeholders' interests becomes crucial in ensuring successful and effective technological tools in education. For example, conflicts arise from unclear or inefficient institutional functions and responsibilities, in terms of who oversees the provision of connectivity to schools (whether government ministries or the private sector); or over how to regulate profit-driven technology providers versus public agencies oriented towards ensuring equity and inclusion. These types of conflicts and tensions hinder the development of projects, as different areas of intervention with different target groups are variously prioritised. In this sense, for example, private companies may be less interested in investing in infrastructure in areas with low population density, and bottlenecks around procurement processes can complicate the adoption of educational technology and limit the access and availability of technologies.

Most available ed-tech content and platforms in the region are designed and produced in the private sector (Global Education Monitoring Report, 2023). While experts consider that private sector involvement should not be a matter of philanthropy or corporate social responsibility, this is how this relationship has been framed in practice, as one respondent from an international agency noted: "The problem with this type of cooperation is that it is not sustainable over time" (interview with representative of an international agency). What some private actors encourage is that interventions be

designed in collaboration with the public sector, to build joint agendas. By doing so, the private sector can be engaged in the priorities of the public sector by helping to develop solutions for issues not fully addressed by the state. One such mechanism mentioned in the study points to facilitating purchasing and tendering procedures that maintain rigour but also allow space for dialogue and flexibility, as sometimes small- or medium-sized companies hold interesting solutions but do not meet all the criteria the government would normally require.

Additionally, and very importantly for lower-income countries that rely on international cooperation, international agencies have an important role, specifically in terms of how their agendas influence the dynamics of ed-tech design and implementation. For instance, the IDB is the most important partner and sponsor of the PNTED in Honduras. However, some actors perceive international cooperation as restricted and determined by the agency's own interests and beliefs about what is the best investment for the country. As an interviewee from Honduras noted:

"...the IDB is the one who is financing the programme. However, there is another problem, they have come here to cooperate and finance programmes, but only in what they believe in. They do not ask what you need" (Government official, Honduras).

The lack of resources represents another area of conflict. Due to limited budgets, many educational units are often forced to creatively manage the demands of implementation within the available funding, and this was precisely the case during the pandemic. The high costs associated with ed-tech interventions require schools to devise strategies for procurement, even in situations where they have limited bargaining power. A clear example is seen in Paraguay, where the program under study was not able to provide connectivity to every school, and some principals gathered funds independently to pay for internet services, while the government provides digital devices. These financial constraints present significant obstacles to the successful integration of technology in education.

The challenges faced in the implementation of ed-tech programmes have given rise to a new type of actor characterised by a strong sense of leadership. They take on the responsibility of positioning the programme, seeking alternative solutions to ensure its continuity, even relying on volunteers to support its implementation (interviews with international experts). Although very valuable to the programme, these entrepreneurial actors highlight the need to ensure sufficient financial resources to provide the programme with good technical expertise to facilitate the integration of technology in education. These actors are motivated to address shortcomings and undertake initiatives against all odds and generally without enough support, meaning success

depends purely on this individual dedication and effort. It is important to acknowledge and try to understand the contribution of these entrepreneurial actors to the success or failure of ed-tech implementation in low-income countries, as one interviewee noted:

"These digital policies...the efforts have been focused on the figure of individuals who are sometimes visionaries, innovators who reach a ministerial position and give it a strong boost, and then when that government falls, or the person is replaced, that vision is abandoned" (Representative of an international cooperation agency).

Conclusions and implications

The LAC region is one of the most unequal regions in the world. Among the myriad ways this inequality manifests is in unequal access to technological infrastructure and devices, learning opportunities and educational outcomes. Critical gaps are observed between students from different socioeconomic backgrounds, geographical locations, gender, ethnicity, and abilities. Additionally, the region is characterised by low levels of public spending on education, and significant gaps in connectivity and access to digital technologies at the community, regional and national levels. Therefore, the extent to which technology and digital tools can be harnessed to address some of these critical questions is limited by challenging contexts.

The relationship between equity and ed-tech is seen at the same time, and paradoxically, as a major problem but also as a promising opportunity to improve learning outcomes and reduce learning gaps. Analysing the role of ed-tech in promoting equality and social inclusion in the LAC region provides a nuanced perspective on the complexities of leveraging technology to address longstanding socioeconomic and educational disparities. These inequalities manifest in gaps in access to quality education, availability of resources, and learning outcomes among different groups. Rural areas and marginalised communities in particular face significant barriers to education, including limited access to trained teachers, learning materials, and infrastructure such as electricity or internet connectivity. The complex interplay between inequality and the implementation of ed-tech policies in LAC countries highlights the need for policy design and implementation to adopt an equity lens firmly grounded in the local contexts

This study has found that the focus of ed-tech interventions in the region has transitioned gradually from the provision of digital learning devices and internet access towards enhancing the digital literacy of teachers and students in order to improve

the returns of ed-tech investments. While at the beginning of this century, the ed-tech agenda aimed to increase the number of computers per student and their efficient utilisation for learning, today it aims to strengthen the use and appropriation of digital tools and resources to facilitate curricular adaptation, connectivity, and teacher training for more flexible educational contexts in the digital age (eLAC2024).

A new consensus around the benefits of introducing technology in education seems to have emerged notably as a result of the COVID-19 pandemic. Calls range from expanding the use of digital technologies (provided by the state or by families themselves), to harnessing the power of technology to transform learning outcomes. This political mood has mostly focused on reducing inequalities associated with access to devices, internet connectivity and digital competences. In this scenario, it is assumed that ed-tech investments will improve learning. However, political will has not been backed up by scientific evidence on the impacts of digital technologies on education (Global education monitoring report, 2023; Burns, 2021). Overall, policy decisions in the region can be characterised as emphasising connectivity and devices in relation to learning environments, which also points to digital skills, competences for teaching and learning, and more student-centred and personalised learning solutions.



Today ed-tech aims to strengthen the use and appropriation of digital tools and resources to facilitate curricular adaptation, connectivity, and teacher training.

There are both contingent factors and longstanding trends that have facilitated the development of ed-tech policies. First, these programmes and policies have gained prominence due to the COVID-19 pandemic. The pandemic led to a growing awareness in the region about the need to integrate digital technology into educational management and teaching practices to address potential disruptions of in-person teaching. Building on their prior experience in digital education, countries like Brazil and Uruguay have further intensified their efforts due to school closures. Longstanding societal expectations relating to the digitalisation of social life, the functioning of the technological industry, and skills for future work have led governments to develop ed-tech policies and invest more in digitalisation. These trends suggest countries are moving towards information and knowledge societies.

Barriers related to public funding, political complexity due to the lack of continuity of policies, absence of a common vision about the role of technology in education,

and issues of governance are some of the main challenges for ed-tech initiatives to be effective in reducing inequalities in education systems. In this sense, tailoring effective strategies to address the issues and needs that each country faces at the national or local level is crucial to fostering the potential of technology to promote inclusion and equity in a context of deeply rooted disparities.

One important way in which the ed-tech landscape has changed substantially in the region is the gradual involvement of a more diverse array of actors, including government ministries, international organisations, tech companies, NGOs, experts, teachers' unions, schools, and teachers as end users. This complexity calls for more coordinated actions to align diverse interests in the field of ed-tech. Also, the multiplicity of stakeholders, with diverse agendas and interests, demands more agile governance frameworks. Current bureaucratic approaches reveal themselves to be inefficient, and need to be modernised to improve contemporary public management and policy making, enhancing efficiency and responsiveness.

In the light of these changes, the future of ed-tech in the region seems to be marked by a more complex landscape of actors, interests and demands, and this new reality requires a better understanding of the type of mechanisms that can promote better governance systems. Strategic partnerships with CSOs and international organisations with high levels of technical expertise can help to retain and enhance learning from previous experiences, as well as ensure the continuity of government actions. It is also important to consider how understandings of ed-tech change over time, and how they influence the design and implementation of educational technology initiatives in diverse educational settings. Importantly, designing ed-tech programmes or policies requires policymakers to build bridges of cooperation and establish information flows that avoid stifling the development of initiatives.

Although involving several public bodies in a given programme sends a clear signal of integration and support for the initiative by the government in office, this often leads to governance issues and duplicity of efforts. According to interview data, it is preferable to simplify coordination mechanisms, and clearly identify the competences, responsibilities, and source of funding of each implementing body. Defining which institution or department should, for example, oversee the pedagogical aspects, and which should take responsibility for the operational or logistical activities (and why), are decisions that require careful consideration based on each country's context and previous policy learning. Furthermore, clear planning based on results can help to organise the activities delivered by each body in the process of designing policies, by trying to strategically coordinate products and results over time. Specifically, investment in infrastructure follows different paces: increasing connectivity takes much longer

than simply purchasing equipment, but the latter also has a limited lifespan. Ed-tech initiatives are multidimensional in their configuration, and there is no single recipe for their successful implementation in the LAC region.

Finally, there seems to be an overly optimistic view among policymakers about the effects of introducing technology through tools and devices on improving learning outcomes. More evidence is needed about the real effects of digital technologies on educational outcomes. For instance, there are almost no studies in the region on how ed-tech can address gender, intercultural or disability inequalities. In this regard, more research is needed in the region to understand how ed-tech initiatives should be designed and implemented to effectively address the challenges of equality and social inclusion in education systems, and how teachers can be active in the adaptation of pedagogical practices relating to the integration of ed-tech. From a programme design point of view, another research gap concerns understanding how prevailing beliefs and conceptions about ed-tech can influence the design and implementation of public policies in diverse educational settings, and how the support of international cooperation has influenced the development of ed-tech policies in the region. Last but not least, it is important to explore new methods to measure the impact of these policies in order to provide a solid basis for public policy decisions.

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Annexes

Annex 1. Interventions list: Ed-Tech programmes and policies in LAC (38)

N°	Intervention aim	Name of intervention	Country	Implementing Agency
1	Global programme	Education Transformation National Programme (PNTED)	Honduras	Secretary of Education + RED Solidaria
2	Global programme	Improving learning conditions through the incorporation of ICTs in educational centres (ICT Programme)	Paraguay	Ministry of Education and Science (MEC) + Ministry of Information and Communication Technologies (MITIC)
3	Web platform	One on One Educational Services Ltd.	Jamaica and Bahamas	One on One Educational Services Ltd.+ Ministries of Education
4	Internet accessibility		Jamaica	UNICEF and ITU
5	Global programme	Digital Inclusion and Literacy Programme (PIAD)	Mexico	Secretary of Public Education (SEP)
6	Global programme	Educational Computing National Programme (PRONIE)	Costa Rica	Ministry of Public Education (MEP) + Fundación Omar Dengo
7	Delivery of technological devices	Profuturo	LAC region	Profuturo in partnership with ministries of education
8	Global programme	Digital Republic	Dominican Republic	Ministry of Education (MINERD)
9	Mobile applications	Clique Ecola	Brasil	Secretary of Primary Education, Ministry of Education (MEC)
10	Global programme	Education Technology National Programme (ProInfo)	Brasil	Ministry of Education (MEC)
11	Delivery of technological devices	One laptop per teacher	Bolivia	
12	ICT teacher training	Diploma/Course in Science, Technology and Society	Paraguay	National Council of Science and Technology (CONACYT) + OEI + FLACSO
13	Educational television programming	Multimedia Education Support Centre	Paraguay	Ministry of Education and Science (MEC) + Korea International Cooperation Agency (KOICA)

14	Web platform	Educate Ecuador	Ecuador	Ministry of Education
15	Mobile applications	Mobile Science Lab	Paraguay	Universidad Nacional de Caaguazú (UNCA) + Regional Research Institute
16	Web platform	Virtual Classroom for Education (AVE)	Uruguay	National Education Department (Ministry of Education and Culture)
17	Global programme	Plan Ceibal	Uruguay	Plan Ceibal Foundation
18	Educational television programming	Awareness-raising campaign: building digital citizenship	Uruguay	AGESIC, Ceibal Foundation and the National Youth Institute (INJU) from Ministry of Social Development (MIDES)
19	Global programme	Applied Educational Technologies National Coordination	Uruguay	Department of Applied Educational Technologies and Virtuality
20	Delivery of technological devices	Computers for Education	Colombia	Ministry of Information and Communication Technologies, Ministry of National Education and SENA.
21	Global programme	Technologies for learning	Colombia	Ministry of early childhood, primary and secondary education
22	Internet accessibility	Full Connection Programme	Colombia	Ministry of National Education under the direction of the Technology and Information Systems Office
23	Web platform	Colombia Learns Gateway	Colombia	Information and Communications Technology Department (TIC)
24	Delivery of technological devices	Vive Digital Plan	Colombia	MinTIC
25	Global programme	Digital Education Agenda	Ecuador	National Department of Technologies for Education at the Ministry of Education
26	Web platform	Mobile Digital Classroom Project	Ecuador	Ministry of Education + Telefonica Foundation + ProFuturo
27	ICT teacher training	Novos Caminhos	Brasil	Secretariat of Professional and Technological Education (SETEC)
28	Global programme	Integrated school and community technology system SITEC	Ecuador	Ministry of Education
29	ICT teacher training	EducaInnova	Bolivia	Ministry of Education
30	ICT teacher training	EducaTigo	Bolivia	Ministry of Education + TIGO

31	Mobile applications	BTVI ICT project	Bahamas	Ministry of State
32	Global programme	Institutional Strategic Plan 2021-2024	Dominican Republic	Ministry of Education (MINERD)
33	ICT teacher training	IT Training Centres (CCI)	Dominican Republic	Ministry of Education (MINERD)
34	Global programme	Mobile Technologies National Programme (Tecno Aprender)	Costa Rica	Ministry of Public Education (MEP)
35	Educational radio programming	Aventura BikëtSö	Costa Rica	Ministry of Public Education (MEP)
36	Web platform	Educatrachos	Honduras	Secretary of Education
37	Educational television/radio programming	Learning at Home	Mexico	Secretary of Public Education (MEP)
38	Internet accessibility	Mexico connected	Mexico	Ministry of Communications and Transport

Annex 2. Coding for analysis (Taguette)

Tag	Sub concept
Challenges and barriers	Financial, political, regulatory, socio-cultural, technological
Competencies	
COVID19	Adoption, new technology, lessons learnt
Equity	Digital divide, marginalised groups, rural vs urban, SE disparities
Financing	Investment in infrastructure, investment in training, partnership funding, private funding, public funding.
Gender disparities	
Governance	Educational policy changes, political consistency, political stability, political will, regulatory environment
Infrastructure	Access to internet, device availability, device quality, internet quality
Initial design	
Outcomes and impact	Impact school admin, impact on teaching practice, learning outcomes

PPP	Challenges, presence, scope, success
Privatisation	Controversies, impact, private sector role
Rules of the game	Capacity, formal legal frameworks, incentives, power dynamics, relationships
Stakeholder interests	Administrator, government, private ed-tech companies, private telcos, schools, student, teacher
Stakeholder tensions	Government and IOs, government and private, rural vs urban, students vs administration, students vs teachers, teachers vs administrators
Structural factors	Country-level policy structures, policy environment
Training	Opportunities for directors, opportunities for teachers

Annex 3. Latin America and the Caribbean (22 countries): Government expenditure per student in primary education (in constant PPP USD)

Country	2016	2017	2018	2019	2020	2021
Argentina	\$ 3,723	\$ 3,722	\$ 3,200	\$ 3,302	\$ 3,090	
		0.0%	-14.0%	3.2%	-6.4%	
Barbados	\$ 3,676			\$ 3,702	\$ 3,491	\$ 3,665
					-5.7%	5.0%
Belize	\$ 1,263	\$ 1,268	\$ 1,297	\$ 1,301	\$ 1,349	
		0.4%	2.3%	0.3%	3.7%	
Bolivia	\$ 2,297	\$ 2,421	\$ 2,502	\$ 2,546	\$ 2,463	
		5.4%	3.3%	1.8%	-3.3%	
Brazil	\$ 3,160	\$ 3,117	\$ 3,117	\$ 3,184		
		-1.4%	0.0%	2.1%		
Chile	\$ 4,845	\$ 4,866	\$ 5,031	\$ 5,148		
		0%	3%	2%		
Colombia	\$ 2,748	\$ 2,806	\$ 2,667	\$ 3,088	\$ 3,448	
		2.1%	-4.9%	15.8%	11.7%	
Costa Rica	\$ 5,319	\$ 4,863	\$ 4,627	\$ 5,712	\$ 4,782	
		-8.6%	-4.9%	23.4%	-16.3%	
Dominica				\$ 2,556	\$ 2,055	
					-19.6%	

Dominican Republic	\$ 2,577	\$ 2,451	\$ 2,873	\$ 3,229	\$ 3,942	\$ 3,800
		-4.9%	17.2%	12.4%	22.1%	-3.6%
Ecuador	\$ 1,159		\$ 1,369	\$ 1,331	\$ 1,228	\$ 1,133
				-2.8%	-7.7%	-7.8%
El Salvador	\$ 1,414	\$ 1,427	\$ 1,465	\$ 1,509		
		0.9%	2.7%	3.0%		
Guatemala	\$ 952	\$ 1,002	\$ 1,076	\$ 1,172	\$ 1,236	\$ 1,199
		5.2%	7.5%	8.9%	5.4%	-3.0%
Jamaica	\$ 2,149	\$ 2,334	\$ 2,172	\$ 2,324		
		8.6%	-6.9%	7.0%		
Mexico	\$ 2,807	\$ 2,703	\$ 2,642	\$ 2,747		
		-3.7%	-2.3%	4.0%		
Paraguay	\$ 1,497				\$ 1,952	
Peru	\$ 1,503	\$ 1,541	\$ 1,511	\$ 1,481	\$ 1,454	\$ 1,589
		2.5%	-2.0%	-1.9%	-1.8%	9.3%
Saint Kitts and Nevis						\$ 1,911
Saint Lucia	\$ 2,194	\$ 2,178	\$ 2,075	\$ 2,090	\$ 2,117	
		-0.7%	-4.8%	0.7%	1.3%	
Saint Vincent and the Grenadines	\$ 2,317	\$ 2,284	\$ 2,284			
		-1.4%	0.0%			
Trinidad and Tobago					\$ 3,647	\$ 2,177
						-40.3%
Uruguay	\$ 2,734	\$ 2,843	\$ 3,019	\$ 3,341	\$ 2,989	
		4.0%	6.2%	10.6%	-10.5%	

Note. Elaborated by the authors based on data by UNESCO(2016-2021).

Annex 4. Latin America and the Caribbean (22 countries): Government expenditure per student in secondary education (in constant PPP USD)

Country	2016	2017	2018	2019	2020	2021
Argentina	\$ 5,281	\$ 5,125	\$ 4,154	\$ 3,935	\$ 3,651	
		-3.0%	-18.9%	-5.3%	-7.2%	
Barbados	\$ 3,445			\$ 3,271	\$ 3,242	\$ 3,274
					-0.9%	1.0%
Bolivia (Plurinational State of)	\$ 1,869	\$ 1,980	\$ 2,027	\$ 2,081	\$ 1,955	
		5.9%	2.4%	2.7%	-6.1%	
Brazil	\$ 3,160	\$ 3,117	\$ 3,117	\$ 3,184		
		-1.4%	0.0%	2.1%		
Chile	\$ 3,432	\$ 3,468	\$ 3,444	\$ 3,465		
		1.1%	-0.7%	0.6%		
Colombia	\$ 2,463	\$ 2,715	\$ 2,770	\$ 3,087	\$ 3,426	
		10.2%	2.0%	11.4%	11.0%	
Costa Rica	\$ 5,141	\$ 5,386	\$ 4,697	\$ 5,410	\$ 5,212	
		4.8%	-12.8%	15.2%	-3.7%	
Dominica				\$ 3,198	\$ 3,177	
		4.8%			-0.6%	
Dominican Republic	\$ 2,431	\$ 3,139	\$ 2,680	\$ 2,547	\$ 2,915	\$ 2,673
		29.1%	-14.6%	-5.0%	14.5%	-8.3%
Ecuador	\$ 644		\$ 821	\$ 799	\$ 729	
				-2.7%	-8.8%	
El Salvador	\$ 1,314	\$ 1,382	\$ 1,372	\$ 1,330		
		5.2%	-0.7%	-3.1%		
Guatemala	\$ 440	\$ 449	\$ 491	\$ 505	\$ 465	\$ 509
		2.0%	9.4%	2.7%	-7.9%	9.6%
Jamaica	\$ 2,725	\$ 2,704	\$ 2,978	\$ 2,912		
		-0.8%	10.1%	-2.2%		

Mexico	\$ 2,968	\$ 2,756	\$ 2,510	\$ 2,666		
		-7.1%	-8.9%	6.2%		
Paraguay	\$ 1,529				\$ 1,978	
Peru	\$ 1,823	\$ 1,985	\$ 1,972	\$ 1,993	\$ 1,976	\$ 2,046
		8.9%	-0.7%	1.1%	-0.9%	3.6%
Saint Kitts and Nevis	\$ 4,781					\$ 3,669
Saint Lucia	\$ 3,318		\$ 3,207	\$ 3,338	\$ 3,383	
				4.1%	1.3%	
Saint Vincent and the Grenadines	\$ 2,630	\$ 2,556	\$ 2,628			
		-2.8%	2.8%			
Trinidad and Tobago					\$ 5,079	\$ 3,371
						-33.6%
Uruguay	\$ 3,520	\$ 3,635	\$ 3,609	\$ 3,759	\$ 3,329	
		3.3%	-0.7%	4.2%	-11.4%	

Note. Elaborated by the authors based on data by UNESCO (2016-2021).



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