The ETRI Framework Document was developed by J. Enrique Hinostroza in 2020, under the overall guidance of Cristobal Cobo and Sergio Venegas Marin. The document was later updated by Sergio Venegas Marin in 2021. The document was further elaborated by the World Bank’s Education Global Practice as part of the EdTech Readiness Index. Version 3.0. Published on 13th of April 2023. It is meant to offer a brief overview of how the Literature Review translates into the proposed framework for the EdTech Readiness Index. For further information please contact: ETRI@worldbank.org.
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1 Introduction

Many countries have made significant efforts to enable, guide and foster the use of digital technologies in education, aiming at improving educational outcomes and preparing students to live and work in the 21st century. Yet, after decades of investment, there is no consistent evidence of learning improvements at a system level that can be, reasonably, attributed to the use of technology (OECD, 2015). However, results of different meta-analyses of impact evaluations involving EdTech interventions (Chauhan, 2017; Escueta, Nickow, Oreopoulos, & Quan, forthcoming; Escueta, Quan, Nickow, & Oreopoulos, 2017; McEwan, 2015; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011; Tamim, Borokhovski, Pickup, & Bernard, 2015) show that they (can) have a positive impact on students’ learning outcomes.

In addition, there is international agreement on the relevance and urgency of the development of information and communications technology (ICT) skills as part of the Sustainable Development Goals (i.e. SDG 4.4.1). To realize this goal, the adequate availability, access and use of ICT in the schools are essential conditions to enable the development of ICT skills among youth.

However, in many low- and middle-income countries, policymakers who are working to realize the potential of ICT to improve educational outcomes and prepare students to succeed in the 21st century, often find themselves lacking information on the crucial factors in between—the practices, policies, and politics—that help to realize this potential, evidencing the need for a set of key indicators to help monitor related progress (or lack of it) and inform related policy and investment decisions.

For this, the World Bank is collaborating with Imaginable Futures to prototype an EdTech Readiness Index that could be used to inform countries of where they stand on EdTech, linked with the World Bank’s larger Global Education Policy Dashboard initiative.

A common concern with education technologies is that they tend to be thought of in isolation, when in reality their success in achieving higher student achievement is determined by the extent to which these initiatives are integrated into a broader education strategy that is tailored to the needs of the country. This creates a need to measure the extent to which education technologies, as well as the efforts of multiple actors within a larger EdTech ecosystem, are integrated with broader education system politics, policies and practices (teacher training, curriculum, infrastructure, etc.). The EdTech Readiness Index goes beyond data relating to availability of devices and the level of connectivity – the typical first order infrastructure-related indicators most commonly considered around the world – to better capture the key elements of the larger ‘ecosystems’ within the education and technology sectors in a given country whose development are considered critical if investments in ‘edtech’ are likely to bear fruit.

2 EdTech Readiness index as part of the Global Education Policy Dashboard

The indicators of the EdTech Readiness Index are organized around the dimensions of the Global Education Policy Dashboard—that is practices (or service delivery), policies, and politics that impact in the desired access and learning outcomes (Figure 1).
In the case of EdTech, the outcomes include the learning of traditional subject areas as well as the development of digital competences. In this sense, it is expected that EdTech policies help to improve students’ learning outcomes (Archer, et al., 2014; Bernard, Borokhovski, Schmid, & Tamim, 2018; Bulman & Fairlie, 2016; Chauhan, 2017; Escueta, et al., forthcoming; Escueta, et al., 2017; McEwan, 2015; Tamim, et al., 2011; Tamim, et al., 2015) and support the development of students’ digital skills (Escueta, et al., 2017; Fraillon, Ainley, Schulz, Friedman, & Duckworth, 2019).

The practices include the activities and conditions associated to the use of digital technologies (ICT devices)\(^1\) in the schools, considering basic inputs and infrastructure (equipment, connectivity and digital educational resources), and the conditions to support and foster the integration of ICT in teaching and learning associated to the school management team, teachers and students.

The policies include how the system defines, articulates and implements strategies to foster desired practices. Finally, politics includes the political context and bureaucratic capacity of the system, including how the EdTech ecosystem is articulated, the norms that rule the interaction among different actors, the capacity to understand and implement technical decisions related to ICT, and the existence of mechanisms to adapt and correct the policy using evidence.

The following sections describe the main factors associated to the areas to be considered in the Practice, Policy and Politics dimensions of the EdTech Readiness Index that emerged from the literature review (available in a separate document).

2.1 Practice

2.1.1 School Management

Within school management at the school level, the evidence points at two elements are key to fostering the use of digital technologies in teaching and learning. First, the integration of ICT in the school’s vision and strategic plans has been recognized as one of the key conditions that

\(^1\) This includes desktop computers, notebook or laptop computers, netbook computers, tablet devices or smartphones, except when being used for talk and text.
facilitates the implementation and sustainability of ICT based innovations in schools (Fullan, 2012; Law, Pelgrum, & Plomp, 2008).

Second, there is consensus that principals’ e-leadership, which refer to leadership approaches and practices that aim to realize the vision and goals for e-learning (Chen, Ho, & Ng, 2013), has a positive effect in the use and integration of digital technologies in teaching and learning (Wu, Yu, & Hu, 2019). In this regard, studies have shown that in schools with clear and consistent e-leadership based on the provision of stronger levels of technology support, teachers are more prepared to integrate the use of ICT in their teaching activities (Olszewski & Crompton, 2020; Wu, et al., 2019).

Based on this evidence, the indicator for the EdTech Readiness Index that relates to school management assesses the readiness of the school management to use and promote the use of ICT in education. The indicator tracks three aspects: 1) the existence of an ICT strategy, 2) the presence of leadership practices to ensure a broader set of stakeholders are part of the ICT strategy, and 3) the prioritization of ICT as it relates to student outcomes.

### 2.1.2 Teachers

The key factors associated to the use of ICT in the classroom are teachers’ perception of their ability to use ICT for teaching, self-efficacy practice (Law, et al., 2008; Lawrence & Tar, 2018), and the extent of collaboration among teachers (Fraillon, et al., 2019; Gil-Flores, Rodríguez-Santero, & Torres-Gordillo, 2017).

Regarding the use of ICT in teaching and learning activities (i.e. CAL: Computer-Assisted Learning models)\(^2\), results indicate that the use of ICT to support students to develop particular skills have the potential of improving students’ learning outcomes (Archer, et al., 2014; Bernard, et al., 2018; Chauhan, 2017), particularly in Mathematics (Bulman & Fairlie, 2016; Escueta, et al., 2017) and when used as a support for instruction (Tamim, et al., 2011). In this case, the evidence highlights that the use of ICT is more effective when students use the digital educational resources, the quality of the implementation is sustained and appropriate teacher training and professional development is provided (Archer, et al., 2014; Bernard, et al., 2018; Chauhan, 2017). Similarly, Ma, Fairlie, Loyalka, and Rozelle (2020) found that the impact cannot be associated to the use of technology only, but the combination of the use of software and other components, such as more time on learning and instructional support by facilitators.

Based on this evidence, the indicator for the EdTech Readiness Index that relates to teachers and teaching captures self-efficacy in the use of ICT as well as the use of ICT to prepare the lessons and to conduct them.

### 2.1.3 Students / Learners

ICILS 2018 found that students’ daily use of ICT devices at home and experience with ICT were consistently and strongly related to Computer and Information Literacy (CIL), also their use of productivity software was positively associated with student CIL and their confidence in using general ICT applications. However, they found no clear relation between the use of ICT for school-related purposes and CIL score (Fraillon, et al., 2019).

\(^2\) The term “computer” is used based on the traditional concept of “Computer Assisted Learning/Instruction”, however nowadays it includes the use of a variety of ICT devices.
In addition, other studies have shown that the use of CAL is more effective as part of a blended approach that combines traditional teaching and the use of CAL is more effective than substituting one for the other (Bettinger, et al., 2020).

Based on this evidence, the indicator for the EdTech Readiness Index that relates to students assesses the performance of grade 4 students in using ICT in and outside school. The indicator tracks three aspects: 1) the self-efficacy of students in using ICT, 2) the use/frequency with which students use ICT inside the school, and 3) the use/frequency with which students use ICT outside the school.

### 2.1.4 Devices

Results of different studies have shown that insufficient access to technology is one of the main factors hindering ICT integration to teaching (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Kim, Kim, Lee, Spector, & DeMeester, 2013; Tondeur, et al., 2012), however, how much technology and what type of applications should be available for the use by teachers and students is less clear.

In this regard, as highlighted by the different digital adoption frameworks described in the literature review (ISTE, 2020; Kampylis, Punie, & Devine, 2015; Kennisnet, 2015), a basic condition is the effective availability of ICT devices that can be used in teaching and learning activities when and how is required (Martínez & Ramos, 2020). In addition, these frameworks highlight the relevance of the availability of appropriate technical support for its use.

Based on this evidence, the indicator for the EdTech Readiness Index that relates to devices assesses the readiness of use digital devices in teaching and learning and their availability in schools. The indicator tracks three aspects: 1) the availability of devices, 2) students’ access to the devices, and 3) the existence of technical support.

### 2.1.5 Digital Educational Resources

Another key factor associated to the use of ICT in the classroom is the availability of digital educational resources – DER (Gil-Flores, et al., 2017), that are aligned to the curriculum and pedagogical practices defined by the school (ISTE, 2020; Kennisnet, 2015).

In order to ensure this, schools should develop the capacity to search, identify, select and purchase appropriate software and/or resources from the Internet, to ensure the appropriate availability of DER to teach different subjects.

Based on this evidence, the indicator for the EdTech Readiness Index that relates to digital educational resources assesses the readiness of school to use quality digital educational resources. The indicator tracks three aspects: 1) access to digital resources, 2) use of digital resources, and 3) quality of digital resources.

### 2.1.6 Connectivity

The availability of good quality Internet connection is a basic condition to realize the potential of ICT in teaching and learning. In this regard, the connection speed is a key factor to enable its use.

Since at the practice level there are many factors that can alter the download speed during the implementation of some activities at a given moment or day, the users’ general perception of the quality of the Internet connection can provide a reasonable measure.
Based on this evidence, the indicator for the EdTech Readiness Index that relates to connectivity assesses the readiness of schools to connect students to internet. The indicator tracks three aspects: 1) the level of connectivity available, 2) student access to the internet, and 3) the perceived quality of the connectivity.

2.2 Policy

2.2.1 School Management

As shown in section 3 of the literature review, there is a tendency to define and use digital technology adoption frameworks for the schools to guide them in the definition and progression of the different elements that need to be considered to integrate and use ICT (Kampylis, et al., 2015; Kennisnet, 2015; Mominó & Carrere, 2016). In particular, among the dimensions considered in these frameworks, the roles and responsibilities of the school management team are to define the role of ICT in the schools’ strategic plans and to implement strategies for the organization-wide integration and effective use of digital technologies in respect of its teaching/learning mission and activities, which some authors call e-leadership (Wu, et al., 2019).

Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding school management will track three aspects: 1) the responsibility assigned for the integration of the use of ICT if there is an ICT strategy, 2) the presence of guidance for incorporating ICT into teaching and learning, and 3) the support through training.

2.2.2 Teachers

It is a consensus that a key driver for the effective use of digital technologies is teachers’ ability to integrate them meaningfully into daily teaching practice and tailor them to specific subjects and specific activities within those subjects (Conrads, Rasmussen, Winters, Geniet, & Langer, 2017; OECD, 2019). In this regard, EdTech policies should:

- Promote the definition of digital competence frameworks for teachers (Redecker & Punie, 2017; UNESCO, 2018b and others described in section 4 of the literature review), ideally including initial teacher training institutions also.
- Implement teacher professional development programs to support teachers to acquire the competences that meet accepted quality standards (e.g. Chai, 2019; Darling-Hammond, Hyler, & Gardner, 2017; Koh, Chai, & Lim, 2017).
- Incorporate incentives for teachers to participate in teacher professional development (TPD) programs and meet the standards (Popova, Evans, Breeding, & Arancibia, 2018).

Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding teachers will track three aspects: 1) the existence of standards/competency framework, 2) the presence of a support system for teachers through training and professional development, and 3) the presence of an evaluation system.

2.2.3 Students

Many countries are incorporating the development of 21st century skills in the curriculum and in particular, digital competences. However, the type and scope the competences defined by each country varies. Based on this, it is important to adopt a definition of these competences based on a consolidated framework (e.g. European Union, 2019; Fraillon, et al., 2019; Laanpere, 2019; Law,
Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding students will track three aspects: 1) the existence of a competency framework for students, 2) the integration of ICT in activities in the curriculum and outside the school and 3) the existence of an assessment of ICT competencies.

### 2.2.4 Devices

In general, despite the particular provision model used to enable the use of ICT devices in the schools (see section 8 of the literature review), it is important to provide guidance on the expected standards that schools should meet to ensure enough availability and access of ICT devices (Kampylis, et al., 2015), including:

- Type of organizational arrangements to ensure the availability of the ICT devices (e.g. timetables or other types of mechanisms to organize the use).
- Conditions for the provision of technical and pedagogical support for the use of the equipment by teachers and students.
- Requirements for the administration and maintenance of the technological infrastructure.

In addition, EdTech policies should include a technology renewal strategy.

Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding devices will track three aspects: 1) the existence of availability standards, 2) the existence of monitoring tools and 3) the existence of technical support.

### 2.2.5 Digital Educational Resources

Despite the strategies that countries use to enable and foster the use of digital resources to support learning, it is important to define standards that ensure the quality of digital educational resources and a mechanism to evaluate them. Some of the key aspects to consider in the evaluation are:

- Technical quality: functional and usability aspects
- Inclusiveness: free of any cultural, gender or other form of bias
- Responsive: possible to be used in multiple devices, including mobile phones.
- Curriculum alignment: content and pedagogy

Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding digital educational resources will track three aspects: 1) the existence of digital resources, 2) the creation of digital resources and 3) the quality standards.

### 2.2.6 Connectivity

Considering the inequalities in the access to Internet (section 7 of the Literature review), EdTech policies should define strategies to ensure equitable and quality access to Internet, including:

- Definition of strategies to ensure the availability of Internet in both, urban and rural schools
- Develop a mechanism/strategy to moderate the cost of its use in education to make it affordable.
• Define standards for the quality of the connectivity to Internet and a strategy to meet them. Regarding the quality, using a very simplified model, and considering that the recommendations vary enormously\(^3\), it is possible to estimate four scenarios of connectivity based on the availability of computers in the school and the type of activities or intensity of the use of Internet (e.g. basic: web browsing v/s intensive, video streaming).

**Table 1 Minimum download speeds based on the availability of computers and type of activities**

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic use (e.g. web browsing, no video)</td>
</tr>
<tr>
<td></td>
<td>Normal use (e.g. web browsing, light video streaming)</td>
</tr>
<tr>
<td>1 Computer Lab (20 PCs)</td>
<td>2 Mbps (100 Kbps per PC)</td>
</tr>
<tr>
<td>Individual ICT devices (200 students)(^*)</td>
<td>20 Mbps (100 Kbps per student)</td>
</tr>
</tbody>
</table>

\(^*\) In this scenario it is assumed that the simultaneous use of heavy resources is lower than in a computer lab.

These figures represent a minimum internet download speed for a school with only one computer lab (20 PCs) or with 200 students with individual laptops, but the concrete speed requirement needs to be adjusted to the real number of students and/or computers and the network configuration of each school (i.e. the use of proxies, cache, re-use rate, etc.).

Based on the evidence, the de jure and de facto policy indicators that are part of the EdTech Readiness Index regarding connectivity will track three aspects: 1) the existence of a connectivity plan, 2) the existence of monitoring tools and 3) the existence of technical support.

### 2.3 Politics

In relation to financing, in many cases the acquisition of goods (e.g. hardware, software) and services (e.g. training, Internet connectivity) can result in extended and/or inefficient acquisition processes that bring extended delays or unnecessary high costs in the implementation of the EdTech policy. In this regard, apart from securing enough and stable funds, clear and transparent procurement procedures are needed.

Having a healthy political context is key to minimize political clientelism or undue influence from any single interest group in order to foster cross-industry, public and private sector partnerships.

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\(^3\) In the USA the current goals are to provide at least 1 Mbps per student and the recommendation of SEDTA is between 1.4 and 2.8 Mbps per user depending on the size of the district (Fox & Jones, 2019). In Chile the recommendation of the Ministry of Education for the schools that have Internet in all classrooms and 400 or more students is 50 Kbps per student. See [http://innovacion.mineduc.cl/wp-content/uploads/sites/108/2019/09/Orientaciones_para_el_Estandar_Aulas_Conectadas_2022.pdf](http://innovacion.mineduc.cl/wp-content/uploads/sites/108/2019/09/Orientaciones_para_el_Estandar_Aulas_Conectadas_2022.pdf).

The UIS-Cetic.br “Practical Guide to Implement Surveys on ICT Use in Primary and Secondary Schools” defines three groups of connection speeds: up to 2Mbps, between 3 and 20 Mbps, and higher than 20 Mbps (Martínez & Ramos, 2020).

The Project Connect that is part of the initiative “GiGA – Connecting Every School to the Internet” aims to map every school in the world to provide real-time data assessing the quality of each school’s Internet connectivity uses 3 Mbps threshold connection speed. For other reviews see: Ford and Herselman (2017)
(Pouzevara, 2019). In addition, since technologies change and evolve constantly, skilled and updated professionals play a key role.

Regarding the institutional arrangement, some of the key lessons drawn from the experience are the convenience of having a national ICT/education agency outside existing governmental institutions that has clear and strong leadership, enabling legislation, funding and financial autonomy as well as flexibility and innovativeness (Trucano & Dykes, 2017).

Complementing these conditions, the capacity to adapt and improve the aims and strategies of the EdTech policy is also very important given the dynamic nature of educational technology, its users and education systems themselves. Therefore, quality assurance mechanisms are key elements to ensure that the required adjustments are implemented. Ideally, countries should implement a virtuous cycle of research, innovation, evaluation and progressive improvement (OECD, 2007; Slavin, 2019) using the evidence generated through a well-established monitoring and evaluation system.

The politics and bureaucratic capacity dimension is captured through the Global Education Policy Dashboard through its Survey of Public Officials, where public officials at all levels of the education bureaucracy are interviewed to assess the characteristics of the bureaucracy, impartial decision-making, the national learning goals (and how they guide the day-to-day workings of the bureaucracy), the specificity and clarity of roles and accountability mechanism, as well as the financing of the system. In countries where the ETRI and GEPD are implemented (together or separate), the GEPD Politics information will complement the ETRI. However, in countries where the ETRI is implemented by itself, there will not be a separate Survey of Public Officials, and thus reporting on Politics will not be possible.

3 Summary

Based on the evidence and proposals described in the previous sections, Table 2 specifies the factors associated to the different dimensions to consider. The Table uses as a reference some of the key dimensions included the Global Education Policy Dashboard, but emphasize elements that are considered critical enablers for policy implementation regarding education technologies.

Synthetizing, as shown in Table 2, the proposed EdTech readiness index would include the following dimensions:

1. School Management - Practices
2. School Management - Enabling Policies (De Facto and De Jure)
3. Teaching - Practices
4. Teaching - Enabling Policies (De Facto and De Jure)
5. Students - Practices
6. Students - Enabling Policies (De Facto and De Jure)
7. Devices – Practices
8. Devices – Enabling Policies (De Facto and De Jure)
9. Connectivity – Practices
10. Connectivity – Enabling Policies (De Facto and De Jure)
11. Digital Educational Resources – Practices
12. Digital Education Resources – Enabling Policies (De Facto and De Jure)
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Practice Level</th>
<th>Policy Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Management</td>
<td>Captured by: 1) the existence of an ICT <strong>strategy</strong> 2) the presence of <strong>leadership</strong> practices 3) the <strong>prioritization</strong> of ICT</td>
<td>Captured by: 1) the <strong>responsibility</strong> assigned for the integration of the use of ICT if there is an ICT strategy 2) the presence of <strong>guidance</strong> for incorporating ICT into teaching and learning 3) policy outlining <strong>support</strong> through training</td>
</tr>
<tr>
<td>Teachers</td>
<td>Captured by: 1) <strong>Self-efficacy</strong> in the use of ICT 2) Use of ICT to <strong>prepare</strong> lessons 3) Use of ICT to <strong>teach</strong> and assess</td>
<td>Captured by: 1) the existence of <strong>standards/competency framework</strong> 2) the presence of a <strong>support</strong> system for teachers through training and professional development 3) the presence of an <strong>evaluation</strong> system</td>
</tr>
<tr>
<td>Students</td>
<td>Captured by: 1) the <strong>self-efficacy</strong> of students in using ICT 2) the <strong>use/frequency</strong> with which students use ICT inside the school 3) the <strong>use/frequency</strong> with which students use ICT outside the school</td>
<td>Captured by: 1) the existence of a competency <strong>framework</strong> for students 2) the integration of ICT in activities in the <strong>curriculum</strong> and outside the school 3) the existence of an <strong>assessment</strong> of ICT competencies</td>
</tr>
<tr>
<td>Devices</td>
<td>Captured by: 1) <strong>students’ access</strong> to the devices 2) <strong>students’ use</strong> of the devices 3) the existence of <strong>technical support</strong></td>
<td>Captured by: 1) the existence of availability <strong>standards</strong> 2) the existence of monitoring tools 3) the assignment of <strong>responsibilities</strong> for maintenance and support</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Captured by: 1) the <strong>availability</strong> of connectivity 2) <strong>student access</strong> to the internet 3) the perceived <strong>quality</strong> of the connectivity</td>
<td>Captured by: 1) the existence of a connectivity <strong>plan</strong> 2) the existence of monitoring tools 3) the existence of technical <strong>support</strong></td>
</tr>
<tr>
<td>Digital Education Resources (DER)</td>
<td>Captured by: 1) <strong>access</strong> to digital resources 2) <strong>use</strong> of digital resources 3) <strong>quality</strong> of digital resources</td>
<td>Captured by: 1) the existence of guidance to ensure alignment with the curriculum 2) the existence of a strategy to ensure access to digital education resources 3) the existence of legislation/policy defining quality <strong>standards</strong> for digital education resources</td>
</tr>
</tbody>
</table>
4 References


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