

# From paper to the cloud

## Guiding the digital transformation of Education Management and Information Systems (SIGEDs)

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Education Division

Social Sector

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Digital  
Education

AUGUST 2019

# FROM PAPER TO THE *CLOUD*

Guiding the digital transformation of Education  
Management and Information Systems (SIGEDs)



ELENA ARIAS ORTIZ, JAVIER EUSEBIO, MARCELO PÉREZ ALFARO,  
MADIERY VÁSQUEZ AND PABLO ZOIDO



# Abstract

The objective of the Digital Education project on Education Management and Information Systems (SIGED) is to identify how daily management processes are carried out and the extent to which they take advantage of automation and digital technologies to improve their efficiency. Broadly speaking, the study seeks to identify opportunities for management improvements related to organizational development, process optimization and the generation of information as constant feedback for all levels of management. The project is based on a comparative analysis of 17 case studies of the region. This technical note presents a brief motivation for the project, the conceptual framework and the measurement instrument applied in the case studies.

*JEL classification: D02, I20, O57*

*Key words: efficiency in educational management, education management and information systems, process automation, digital technologies, case studies, comparative analysis.*



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# 1 ■ Introduction

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Since the 1990s, educational coverage in Latin America and the Caribbean (LAC) has expanded greatly. In primary education, it is practically universal and, in secondary education, increased from 69% in 2005 to 77% in 2017 (CIMA, 2018). This has been accompanied by growth of investment in education, which rose from 4% of GDP in 2005 to 4.6% in 2015. However, the evidence shows that, in LAC, learning outcomes are low compared to the Organisation for Economic Co-operation and Development Económicos (OECD) average and differ by socioeconomic level (Bos et al., 2016). These long-term trends, combined with budget constraints and the greater demands placed by society on the use of public resources, mean that there is great pressure to improve the efficiency, quality and transparency of the region's educational systems (Izquierdo, Pessino and Vuletin, 2018).

Efficiency - the relationship between investment and educational outcomes - depends on a chain of actions that range from the design of educational policies and the distribution of inputs (human, physical and financial resources) to the delivery of education in the classroom. In the middle of this chain from policies to services, there is a key step: implementation of the policies and management of all the processes necessary for the operation of an educational system. This is what we refer to as an Educational Information and Management System (SIGED<sup>1</sup>). A SIGED must permit management of all the educational system's processes in an integral and efficient manner at all levels (central, regional and school), incorporating new technologies to permit the automation of processes that have traditionally been carried out manually or with little systematization and interoperability, such as student enrolment and the composition of classes, registration of attendance, recording student grades and certificates and the recruitment and management of teachers. Digital transformation can trigger innovation across a wide range of activities, and education is a propitious field for this (Pombo, Gupta and Stankovic, 2018). The gains from an effective SIGED are seen in a number of ways: i) the availability of timely high-quality information for management; ii) time saving on administrative tasks carried out

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1 From the name in Spanish: Sistema de Información y Gestión Educativa.





manually and inefficiently; and iii) cost savings. For example, access to new information permits better management of enrolment, human resources and complementary services such as transportation and food, with the resulting cost savings. Moreover, personnel at all levels (central management, intermediate levels, directors and teachers) can devote the time freed to their core role. Directors will be able to devote more time to supporting and supervising teachers and building relationships with the community, while teachers will have more time for teaching-learning activities. The availability of timely and reliable data about students' performance reduces the time required to issue grades and certificates at the central, intermediate and school level. Similarly, automation of the process of allocating teachers to schools reduces the hours of work required for this purpose.

Currently, there are very few SIGEDs in LAC with efficient processes that effectively manage the key variables involved in the teaching and learning process such as school syllabus, teachers, schools and school infrastructure. This is because the region's SIGEDs were developed without a holistic vision and have generated disperse low-quality information (Cassidy, 2006). As a result, newspapers in LAC often carry headlines such as: "Education Ministry administers enormous payroll manually, despite spending millions on payment system"<sup>2</sup> or "Bureaucracy in the school".<sup>3</sup>

Despite the importance of SIGEDs, there is no systematic diagnosis of their current state in the region and the scant evidence available shows that there is still a long way to go. An analysis of educational monitoring and evaluation systems found that, as of 2014, only two of the 17 countries had information systems that functioned in a coordinated manner and provided effective and efficient information (Elacqua and Alves, 2014). However, no study so far has analyzed in detail and comparatively the integrality of SIGEDs at the national and subnational levels. The World Bank's SABER-EMIS initiative, which evaluates educational information systems at the institutional level and policies related to the quality of data collection and its use, is a step in this direction (World Bank, 2018). The Inter-American Development Bank (IDB), for its part, is seeking to contribute to closing the knowledge gap on LAC's SIGEDs, with a focus on policy implementation and the management of educational processes, interoperability and the generation of information through efficient management.

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2 <https://www.nacion.com/el-pais/educacion/mep-administra-a-mano-su-enorme-planilla-aunque/2ORVE2ML2N-GOLD35IZHTYS7QQ/story/>

3 <https://www.lacapital.com.ar/educacion/burocracia-la-escuela-n1512463.html>



In this context, the IDB has launched the Digital Education project that aims to consolidate a body of knowledge about the state of development of SIGEDs in LAC, putting forward plans for their improvement in a bid to promote a new generation of educational management platforms that enhance the quality and efficiency of education in the region. To this end, Digital Education has four main outputs: i) a conceptual framework that identifies and defines the main characteristics of a highly effective SIGED, along with an instrument for comparative measurement; ii) detailed analysis of the strengths and weaknesses of SIGEDs in 18 case studies<sup>4</sup> in the region, using the methodology and instrument designed for this study; iii) a critical roadmap for strengthening the SIGEDs; and iv) publication and dissemination of best practices and the lessons learned from the case studies about the design and implementation of a SIGED.

This technical note briefly describes the reasons for the project, the conceptual framework of the SIGEDs as platforms for improving management of the educational system and the instrument used for measurement in the case studies. In the planning stage and the review of documents as well as in each of the case studies, this report benefited from interaction with colleagues in the Education Division and their comments. The results of the case studies will be published in the second half of 2019. This document is structured as follows: Section 2 documents the importance of good management and Section 3 presents a conceptualization of the SIGEDs while Section 4 summarizes the methodology used by the IDB in its diagnosis of the region's SIGEDs and, finally, Section 5 sets out the main conclusions.

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4 As of April 2019, 11 case studies had been carried out: Mendoza (Argentina), Bogotá (Colombia), Costa Rica, Espíritu Santo and Florianópolis (Brazil), El Salvador, Honduras, Panama, Peru, the Dominican Republic and Uruguay (Consejo de Educación Inicial y Primaria). A further seven are scheduled for 2019: Córdoba (Argentina), Chile, Ecuador, Jamaica, Paraguay, Suriname and Uruguay (Consejo de Educación Técnica y Profesional).



## 2. The importance of educational management

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**Despite an increase in investment in education, student performance in LAC remains low.**

Between 2005 and 2015, public spending on education rose from 4% to 4.6% of GDP (CIMA, 2018).<sup>5</sup> However, learning outcomes are well below those seen in OECD countries. The ten Latin American countries that participated in the Programme for International Student Assessment (PISA) in 2015 all ranked in the lower third of the distribution out of a total of 70 countries (Bos et al., 2016). Student learning in LAC is, moreover, below that in countries with a similar level of income, such as Vietnam, Georgia and Moldova (Bos et al., 2018). In other words, the region faces great challenges as regards the efficient use of resources in the education sector.

**Efficiency increases when better results are achieved for a given set of resources or when comparable results are obtained using fewer resources.** In a context of fiscal constraints, the challenge of improving educational outcomes calls for improvements in how inputs are transformed into products, that is, in policies, the management of resources or the provision of services. Using the conceptual frameworks developed by institutions like the OECD and the World Bank,<sup>6</sup> Figure 1 shows the relationship between investment and educational outcomes. The educational production function depends fundamentally on: i) policies and institutions; ii) policy implementation; and iii) provision of education or the delivery of the educational services.

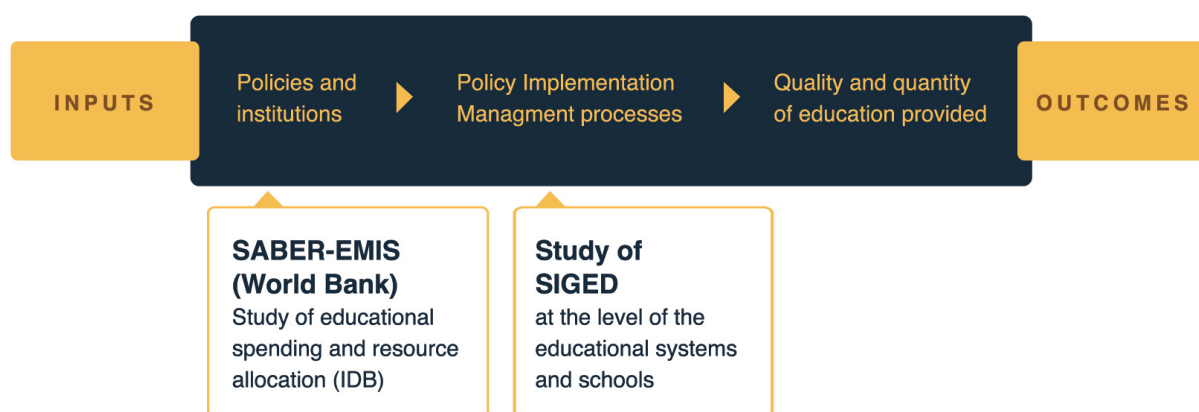
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5 In many countries such as Argentina, Brazil, Costa Rica, the Dominican Republic and Uruguay, these levels of investment are backed by laws stipulating a minimum allocation to education.

6 See the OECD study of school resources or the World Bank's SABER-EMIS initiative.



**Figure 1.** Conceptual framework – Management efficiency for better educational outcomes



In recent years, the IDB has built up an important body of evidence about the role of policies and institutions in improving efficiency in financing the region's education sector (see, for example, Bertoni et al., 2018a; Elacqua, Cavalcanti and Brant, 2019). Rules on the collection, governance, allocation and monitoring of educational resources are referred to as school finance systems and resource allocation (Elacqua and Martinez, 2018; Bertoni et al., 2018b). In particular, there is debate about the efficiency gains that can be achieved in the so-called four dimensions of finance systems: (i) sources of financing and transfers between different levels of government; (ii) decision-making authorities at different levels of government; (iii) information systems and accountability; and (iv) resource allocation rules. The literature has identified challenges in the implementation of different financing and resource allocation systems as well as gaps in knowledge about the related benefits.

The second step in the production function, **the implementation of educational policies**, can be seen broadly as the planning, management and distribution of educational resources and inputs. These processes take place in a political and institutional context and are indispensable for educational delivery. They include the enrolment of students, the recruitment, allocation and payment of teachers, the issue of grades certificates, the provision of information for each decision-making level and the construction and maintenance of school infrastructure. In other words, this part of the production function encompasses all the management processes under a certain set of policies and norms for the support of educational delivery.



The final step is the delivery of educational services and is related to everything that happens in the school itself and the classroom on a daily basis. Although policies can define the frameworks in which the teaching-learning process must take place, many pedagogical practices remain at the discretion of teachers and, to a lesser extent, directors. Moreover, due mainly to the limited availability of information about what happens inside the classroom, the evidence on best teaching practices is mixed and scarce (Molina et al., 2018; IDB, 2017).

The level of government at which policies are defined and implemented depends on the educational system's level of centralization. In centralized governments, national ministries not only define and supervise policies, but are also responsible for the delivery of services. In some countries, such as Costa Rica, Ecuador, El Salvador, Panama, Peru and the Dominican Republic, human resources are managed almost entirely at the central level and, in these cases, the ministry is responsible for recruitment, allocation, professional development and the payment of remunerations. This is also the case for the management of school infrastructure. On the other hand, in countries with more decentralized models, such as Brazil and Argentina, policies tend to be implemented by regional, provincial or municipal governments which are, in turn, directly responsible for service delivery. Colombia is an intermediate case where the financing of human resources is handled at the central level but local governments are responsible for managing infrastructure and schools. There are also countries, such as Belize and Chile, where management is decentralized at the level of networks or schools.

## The focus of the Digital Education project is the implementation and management of services.

The project seeks to identify how daily management processes are carried out and the extent to which they take advantage of automation and digital technologies to improve their efficiency. Given that educational management can occur at different levels of government, this project takes as its main unit of analysis the institution responsible for managing schools, human resources and infrastructure. Broadly speaking, the project seeks to determine the level of development of SIGEDs in the region and identify opportunities for management improvements related to organizational development, process optimization and the generation of information as constant feedback for all levels of management.

The improvement of management processes is related to efficiency gains in the education sector because it: i) provides access to timely high-quality information for management; ii) saves time on administrative tasks that were carried out manually and inefficiently; and iii) implies cost



savings. The availability of new, timely and high-quality information permits improvements in the management of enrolment, human resources and complementary services such as transportation and food. These improvements, in turn, result in cost savings. Structural improvements in the management system also have a direct impact on the delivery of educational services. For example, the time that teachers devote to low-value administrative tasks, such as passing attendance lists or transcribing grades and evaluations, is freed for teaching purposes. Similarly, directors will have more time for supporting and supervising teachers and for relations with the community. To date, there is no known systematic study at the regional level that analyzes in detail how to improve efficiency and accelerate the digital transformation in educational processes. The World Bank's SABER-EMIS initiative is a step in this direction in that it evaluates educational information systems comparatively. However, it focuses on policies and the process of gathering information and its quality and use (World Bank, 2018) while the focus of the IDB project is on the set of management processes and the systems that support them.

## What are the challenges of current management of educational systems?

**Educational systems have concentrated on managing some processes individually and in isolation without interoperability and in a context of duplications of functions.** As a result, the information generated is disperse, inconsistent, low-quality and not aligned with the current needs of educational systems. Experience in LAC<sup>7</sup> shows that the institutional development of many educational systems has occurred in silos, with different departments responsible for ensuring the (often precarious) availability of different inputs: infrastructure, resources, books and educational materials, enrolment, teacher lists and attendance/absence. As a result, each department tends to create its own management tools independently in response to internal needs, often barely using spreadsheets. This has led to fragmented SIGEDs in which multiple digital platforms coexist.<sup>8</sup> In many cases, these platforms generate databases that do not communicate with each other, due to both conceptual and technological differences, implying lost opportunities and costly inefficiencies. It is indeed common to find educational systems with two or more sets of “official figures” for data as basic as the total number of students, teachers, schools, courses and even buildings. In some cases, it is not possible to determine the number of teachers, only the number of teaching positions.

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7 Conclusions based on the 11 SIGEDs observed so far.

8 Peru, for example, has over 130 information systems with a very low level of interoperability.



**Management of the educational system has not been defined by a strategic vision at the central level.** In many LAC countries, ministries do not have a strategic plan<sup>9</sup> that reflects a global vision of the educational system under which management processes and resource allocation can be planned in an integral and efficient manner, identifying the needs of decision-makers at all levels, from the central level to teachers. Current governance of SIGEDs, without a global approach, has rendered them resistant to change, with their evolution in silos empowering individual departments which generally perceive the data they generate, whether administrative or learning-related, as their own and use the privacy of information about students and teachers as an argument to keep the data isolated. These practices create barriers to the interoperability of different systems and processes and to the exchange of information.<sup>10</sup>

**In the past, countries have made efforts to improve management of key educational processes.** Starting in the mid-1990s, countries began to make efforts to improve censuses of student enrolment or teaching staff (the central instrument of information systems at that time). The first SIGEDs were also developed, financed out of the country's own resources as well as by international agencies and organizations (Cassidy, 2006). Because they were of limited use and/or focused exclusively on the production of information, these early efforts did not achieve all their objectives or produce the expected improvements. Indeed, a study of educational monitoring and evaluation systems found that, in 2014, only two of the 17 countries had information systems that functioned in a coordinated manner and provided effective and efficient information (Elacqua and Alves, 2014).<sup>11</sup>

In the 11 case studies carried out so far as part of this study, persistent challenges have been detected. They include: i) processes carried out in a quasi-manual manner, such as enrolment, control of student and teacher attendance and the issue of grades and certificates; ii) an inability to verify easily the location of students and teachers and, in the latter case, whether or not they have students assigned; iii) a lack of integration between processes for paying remunerations and teacher management at the school level; iv) precarious (or manual) management of short and long-term teacher replacement; v) creation of courses with few students; vi) inexistence of mechanisms for communicating with families other than face-to-face meetings or on paper; and vii) unreliable information such as the existence of two or more sets of figures for the number of students, teachers and even buildings. Some of the reasons for these problems are: the absence of a thorough review of key processes, a lack of capacity in national or subnational Education

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9 Strategic planning is an exercise through which to define and establish priority objectives and the courses of action for achieving these objectives (ECLAC, 2009).

10 An alternative vision is that the data belongs to the state and the citizens it serves and all departments within a ministry and even other ministries should, therefore, have access to it as a means of improving management and decision-making.

11 This comparative study is more comprehensive in that it analyzes all the educational monitoring and evaluation system. In this approach, the SIGEDs are an important component.

Ministries<sup>12</sup> to manage the educational system and use information for decision-making, a lack of investment in structural changes in the organization of the educational system and in the training of management and planning teams and a failure to take advantage of the opportunities provided by new technologies.

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<sup>12</sup> Many different names for educational institutions are used in the region. Some are Ministries while others are Secretariats. In this report, Ministry is used generically, regardless of the specific term in a particular country.





## Box 1

### The benefits of efficient management of education

The state of Espírito Santo (Brazil) serves as an example of the benefits of managing education efficiently.<sup>1</sup> Thanks to the availability of data about students individually and about the physical size of schools, the state was able to establish guidelines for tailoring the number of students per class to the size of the classroom, improving calculation of the number of classes required and the distribution of teachers and students.<sup>2</sup> The availability of digital data about all the actors increased the efficiency of the process, avoiding the existence of teachers with idle capacity and improving use of the physical spaces available. The state of Pernambuco also has similar arrangements in place (Elacqua, Cavalcanti and Brant, 2019). Internationally, other studies have also found that improvements in certain aspects of school management, such as monitoring and leadership, result in improvements in learning and/or attendance (Masino and Niño-Zarazúa, 2016 and Duflo, Hanna and Ryan, 2012<sup>3</sup>). Blimpo and Evans (2013) found that, three to four years after the launch of a program to improve school management in the Gambia<sup>4</sup>, student absenteeism had dropped by 21% and teacher absenteeism by 23%<sup>5</sup> Bloom et al. (2015) also found a positive correlation between the quality of management and student performance indicators.<sup>6</sup>

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1. Preliminary findings of the case study of Espírito Santo's SIGED.

2. By using digital data about students, teachers and courses, the georeferencing of schools and the plans of the buildings, it was possible to increase the efficiency of the process, avoiding the existence of surplus teachers and very small classes and improving use of the available space.

3. This paper concludes that monitoring practices, accompanied by a monetary incentive, are related to an increase of 0.17 standard deviations in the results of performance tests.

4. Whole School Development (WSD) is a school management program in the Gambia under which directors, teachers and communities receive training in leadership and school management, community engagement, syllabus management, the professional development of teachers, learning and teaching resources and the school climate.

5. The authors did not find significant effects on learning outcomes.

6. For this study, an indicator of the quality of management was developed based on 20 questions about basic practices in four areas: (i) operations; (ii) monitoring; (iii) definition of goals; and (iv) management of human resources. The sample consisted of 1,800 secondary schools across eight countries: Brazil, Canada, Germany, India, Italy, Sweden, the United Kingdom and the United States. Albeit without identifying causality, the authors found that an increase of 1 standard deviation in the management indicator was related to an increase of between 0.2 and 0.4 standard deviations in student performance.



However, in order for improvements of this type to occur in schools, the educational system as a whole must have the technological infrastructure and applications appropriate for making use of these resources. Efficiency in the management of regional or central entities plays an essential role in providing the basic structure, allocating human and financial resources and ensuring monitoring of the system. Although the context of each country and school system varies, there are processes common to all systems that can be automated as a means of improving efficiency and decision-making.

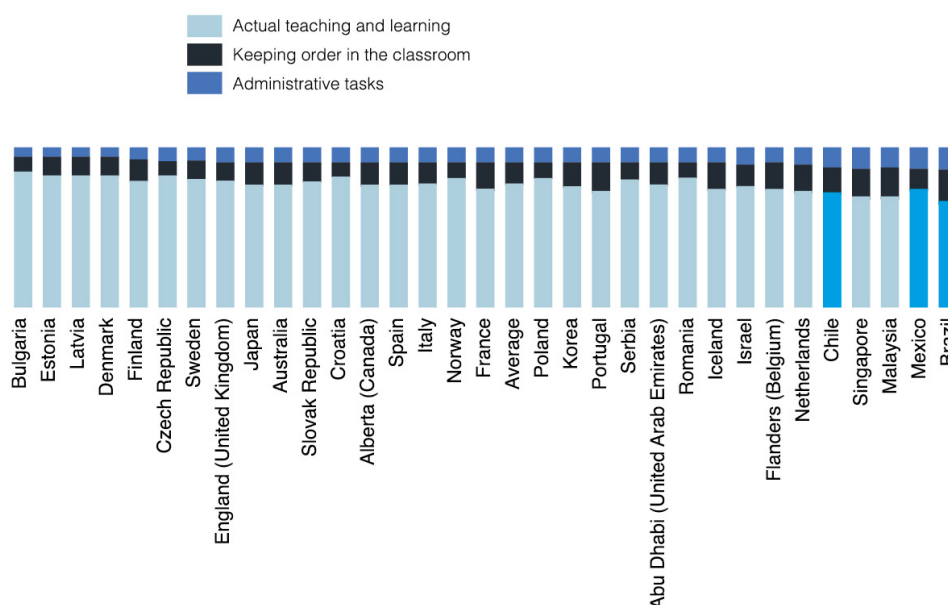
## The role of technology in management

**Technology provides an opportunity for the automation of processes that have traditionally been carried out on paper and by hand.**

**Bruns and Luque (2014) have shown that most of the teaching time lost in LAC is taken up by classroom management activities, such as passing attendance lists, correcting assignments or distributing printed materials.** These activities take up between 24% and 39% of total class time, well above the 15% considered appropriate internationally (Bruns and Luque, 2014). According to the OECD (2014), LAC also shows important differences with other regions. Chile [11%], Mexico [12%] and Brazil [12%] are among the countries where secondary teachers devote a greater proportion of class time to administrative activities, above the average [8%] (Figure 2).



**Figure 2.** Distribution of teaching time during an average class\*



\* Average percentage of the time that first-year secondary teachers reported devoting to each activity during an average class.

Source: OECD, TALIS 2013 Database, Table 6.20.

**The development of new technologies and the decrease in their cost have encouraged the adoption of digital tools as a means of increasing management efficiency.**

The use of technology can save both time and costs, particularly in routine administrative tasks, whilst also improving the quality of processes and the information generated (IDB, 2017). For example, Leisher (2014) estimated that the cost of carrying out a survey could be reduced by 74% using tablets, rather than paper. This is in addition to the advantage of automatically generating databases that can be used to control the quality of the information gathered. In education, one of the most valuable forms of saving is to reduce the time which teachers, school directors and administrative personnel at the different levels of the system spend on management, registration, monitoring and evaluation tasks. With the digitalization of management processes, timely high-quality data can be made available in real time for decision-making at all levels and for the evaluation of policies.

**By automating processes and facilitating the exchange of information, technology offers a solution for some management challenges.**

In Uruguay and the state of Espírito Santo (Brazil), for example, student attendance is verified using mobile phone applications. By eliminating the numerous intermediate steps between the time when the attendance list is passed and when the data is entered in a record, this transition from paper to digital registration improves the



quality, reliability and timeliness of the data. Similar experiences exist with the digitalization of other processes such as the management of replacement teachers, the issue of grades and certificates and the management of building repairs (Bogotá, Colombia; Espírito Santo, Brazil; Mendoza, Argentina; and Uruguay). In the case of the exchange of information, examples include the consultation of human resource records using online applications in Santa Fé (Argentina), communication between teachers and parents through applications in Mendoza (Argentina) and Uruguay and the consultation of student grades through a specific application accessible from mobile phones in Santa Fé (Argentina) and Uruguay. Similarly, El Salvador has been able to move from annual to monthly monitoring of student absenteeism and, at the same time, achieve a significant reduction in the dropout rate in less than two years<sup>13</sup> and the availability of budget execution information at the school level in Pernambuco (Brazil) has permitted identification of idle resources and closer monitoring of the use of resources (Elacqua, Cavalcanti and Brant, 2019).

Educational systems with a high degree of digitalization, such as that of Uruguay, may also have other advanced applications to support learning and prevent student dropout.<sup>14</sup> Through CEIBAL, Uruguay has implemented not only learning platforms in disciplines such as mathematics and language, but also online assessment and learning analytics based on the use of learning management platforms and systems (LMS). This has also permitted the monitoring of individual student performance, providing an early warning to teachers and families in the event of repeated absences and/or low academic performance. In addition, an automatic enrolment process was implemented for the transition from primary to secondary education, satisfying 90% of families' preferences and practically eliminating dropout at this stage.

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13 Preliminary results of the El Salvador case study.

14 CEIBAL, in close coordination with the Administración Nacional de la Educación Pública, became the tool for the introduction of new information and communications technologies in the Uruguayan educational system in a bid to achieve a transformation that contributes to better-quality learning and greater social equity.



## Where is educational management headed?

**Along with the expansion in the coverage of educational systems, the complexity and the diversity of students and teachers have also increased, posing greater challenges as regards catering for the needs of different groups efficiently.** The expansion of coverage has been achieved largely through the incorporation of traditionally excluded groups, such as students of a lower socioeconomic level or those who use a different language at home and at school. These groups may require more personalized educational attention, calling for management systems that are able to identify them and provide services such as digital content in their own language or specific support to guard against dropout.

**In addition, there is growing demand for greater transparency and accountability in the use of public resources.** In recent years, there has been an increase in the number of legal and institutional mechanisms for promoting transparency and accountability in the public sector (Transparency International, 2017; Pareja et al., 2016). More information about the performance of public institutions is associated with citizens who are more active members of their communities and, ultimately, with improvements in the performance of institutions (Capuno and García, 2009). In the education sector, some policies that promote accountability can help to improve the performance of teachers and students (IDB, 2016), particularly when implemented together with the educational community. Society's questioning of the use of the resources devoted to the sector is apparent in the media across countries in Latin America and the Caribbean.<sup>15</sup>

This project aims to address the challenges of current systems of educational management in the face of increased complexity and growing demand for information, both of which call for more sophisticated organizational arrangements and close coordination and integration among the actors.

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<sup>15</sup> See, for example, <https://www.eluniversal.com.co/regional/cordoba/denuncian-alumnos-y-profesores-fantas-mas-en-cordoba-231572-GQEU338248>.



# 3 ■ Towards the digital transformation of SIGEDs

A SIGED can be defined as the set of key educational management processes required for the design, registration, generation, exploitation and dissemination of strategic online information in an integral manner in the framework of specific legal, institutional and technological infrastructure.

**What are the key aspects for advancing towards the digital transformation of SIGEDs and taking advantage of technology in the education sector?**

**Figure 3.** Towards the digital transformation of SIGEDs

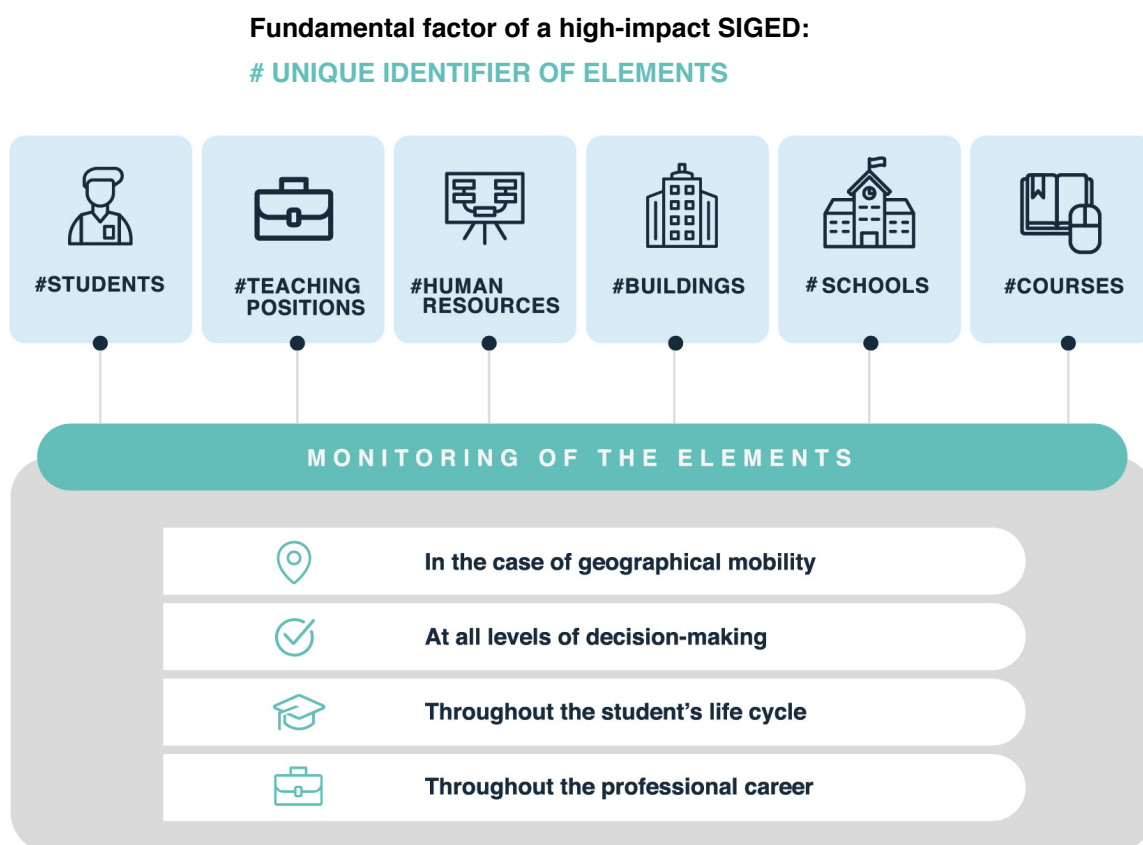


## 1. Interoperability and unique identifiers

Interoperability can be defined as the ability of information and communications technology (ICT) systems and the processes they support to exchange data and share information and knowledge (Lueders, 2004 in Serinco, 2019). The importance of interoperability in education lies in the fact that it permits a one-to-one relationship between all the elements of the system as well as interoperability with other sectors such as health, finance, social assistance (in particular, programs of conditional transfers), social security, the civil registry and the property record. In this way, it is possible to identify the specific inputs (for example, teacher, study plan, classroom, school, building, educational services, infrastructure conditions and equipment) allocated to each student, and even compare them with the results obtained in terms of the student's learning, repetition of a year or dropout.

In general, educational management processes involve the following elements: buildings, schools, classrooms, human resources, teaching positions<sup>16</sup> and students. In order to achieve effective interoperability, the use of a unique identifier is required for each of these units (each building, each position in a school, each student, each teaching unit, each professional development activity, etc.). The currently limited use of unique identifiers is one of the main challenges for the central-level integration of data about the educational system from different sources.<sup>17</sup> A unique identifier is a fundamental requirement of any modern management, monitoring and evaluation practice. The absence of a unique identifier can make it difficult to do something as simple as cross-analysis of administrative and non-administrative data such as infrastructure censuses, national and regional pupil performance tests, teacher surveys, school censuses or records of beneficiaries of social assistance such as transfer programs.

**Figure 4.** Unique identifiers in education



Source: Compiled by authors.

<sup>16</sup> For example, a first-year secondary mathematics teacher in a specific school, hired for a specific number of hours.

<sup>17</sup> IBM (2009) reported this same barrier to integration of data in the business sector.



In order to be effective, unique identifiers must have three characteristics:

**1. They must identify each individual with a specific number so that there are no duplicates.** If this condition is not met, there must be a dictionary of equivalents for the identifiers used in each of the different departments. For example, each student and teacher entering the system must be assigned a unique identifier, such as their ID number, which allows them to be tracked throughout their educational or professional career.<sup>18</sup>

**2. They must be maintained over time and regardless of the territory where the element is located.** This prevents territorial mobility from giving rise to duplication. In particular, students' identifier must not change when they change school or move from one educational cycle to the next. Only in this way is it possible to reliably document, for example, the careers and performance of students and teachers.

**3. They must permit interoperability with related services outside the educational system.** In this sense, use of the ID number provided by the Civil Registry facilitates the exchange of information with other programs that use this number for beneficiaries of, for example, conditional transfers, pensions and health programs. Another example is the use of the codes and survey data of property records which, together with the plans of school buildings, means that this information serves as an input for the allocation of students to schools according to geographical proximity and also facilitates the maintenance of school buildings and the monitoring of any changes they undergo.

In the education sector, the greatest emphasis has been placed on the establishment of unique identifiers for students. The benefits identified include: (i) monitoring of students throughout their educational career; (ii) identification of duplicate records; (iii) confidentiality of student information; (iv) merger of different databases; and (v) creation of a centralized database for higher levels of management (Ahearn and Jackson, 2004). The benefits of unique identifiers have been quantified in other sectors, such as health in the case of unique patient identifiers. Hillestad et al. (2008) suggested that the costs of implementing and maintaining a single non-disclosable patient identifier are much lower than the gains in terms of reduction of errors, efficiency gains and interoperability. The World Bank (2016b) proposed a single transversal identifier for all sectors of the economy as a means of addressing the existence of many disperse services with little communication between them.<sup>19</sup>

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<sup>18</sup> There is wide discussion about the advantages and disadvantages of using ID numbers as students' unique identifier (Ligon, 1997 and Clements and Ligon, 2001). Although it facilitates interoperability between different sectors, it has been criticized on the grounds that it can reveal or permit the tracing of a student's identity or personal information. It is not the purpose of this report to define which type of unique identifier is best.

<sup>19</sup> See also the IDB's conceptual framework for interoperability in the social sector.





The use of unique identifiers is a necessary but not sufficient condition for interoperability. The literature has documented three broad groups of barriers to interoperability: conceptual, technological and organizational (Chen, 2006).<sup>20</sup> Conceptual barriers have to do with semantic and syntactic differences in the information that is exchanged.<sup>21</sup> Technological barriers have their origin in differences in the programming language, database storage and frequency of update of the different IT systems that support management.<sup>22</sup> Organizational barriers are related to differences in the definition of roles, responsibilities, permissions and organizational structures.<sup>23</sup> Therefore, even when educational systems have unique identifiers, it is still necessary to identify the barriers to effective interoperability and implement the necessary reforms.

## 2. High use of technology

**Since the late 1990s, there has been agreement among policymakers that better access to technology in education can foster improvements in learning and the acquisition of new skills (UNESCO, 2013).** As a consequence, in the following decade, LAC countries invested heavily in improving access to technological infrastructure for pedagogical use in schools. Between 2006 and 2012, 20 of the 26 IDB borrowers implemented programs of this type and nearly 10 million laptops have been distributed in the region's public schools (Arias Ortiz and Cristiá, 2014). A rigorous review of the literature shows that technology can have positive impacts on students' learning, providing the resources are geared towards a specific objective. Digital technologies also represent a great opportunity for achieving more efficient information and management systems. The digital transformation that is underway will undoubtedly permit innovation across a wide range of activities. The emerging technologies of the Fourth Industrial Revolution (4IR) can help governments reduce costs and improve the services they provide, and education is a propitious field for this (Pombo, Gupta and Stankovic, 2018). However, quantitative evidence about the benefits of incorporating technology to improve management processes is still quite limited. Even in countries like the United States, the digital transformation of the

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20 In this paper, David Chen developed the Enterprise Interoperability Framework.

21 In the case of educational management systems, the main conceptual difference identified is between different departments in the same institution and between different management levels. One example is the term "school" that can have different meanings for pedagogical areas and infrastructure areas.

22 In many cases, systems were developed over time using different programming tools and databases. Many of the technologies used in the past did not foresee simple mechanisms through which to allow independent solutions to "talk" to each other (e.g. Cobol, Fox Pro, Access, Excel). With the appearance of online services, the new applications that are developed have facilities for inter-system communication. However, many of the systems available in SIGEDs in LAC are based on obsolete technologies that are not interoperable.

23 It is common to find that academic directors adopt certain forms of school organization that are not compatible with the structure of teaching positions that exists in the organization nor with regulation of teachers' working hours.



management of educational systems is still quite recent (Allovue, 2019). The scant literature suggests that technology can be a catalyst for efficient management systems at different institutional levels. Zain, Atan and Idrus (2004) found that the adoption of ICTs had positive effects on management practices in smart schools in Malaysia.<sup>24</sup> They mention better access to information, administrative efficiency gains and greater capacity for budget execution (Shah, 2014). The positive results are seen mainly among school personnel with skills and confidence in the use of technologies (Condie et al., 2007; Cunningham et al., 2004; Shah, 2014). However, they also identify negative effects related to administrative costs and the resistance of untrained personnel. This underscores the importance of training and of a change management strategy when introducing new technologies, particularly in the context of LAC (Allovue, 2019).

Although there is still not significant quantitative evidence, successful experiences have been reported in which technology offers important comparative advantages (Arias Ortiz and Cristiá, 2014). These advantages are summarized in Table 1.

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<sup>24</sup> Smart schools correspond to a model under which systematic teaching-learning and school management practices are applied using ICTs.



AREA	BENEFITS OF TECHNOLOGY	EXAMPLES
Access to information	<p>Less preparation time and better lessons with programs to create and publish materials for digital courses, high level of personalization and adaptability of content.</p> <p>Help for teachers and directors in their planning and in analysis of information about students and teachers.</p>	Smart Sparrow: digital content platform and creation of courses for teachers.
Communication and remote teaching	<p>Real-time communication with remote areas where it is not feasible to deploy a large teaching staff and universal coverage in disciplines where there is a shortage of teachers.</p>	<p>Medias School Centers in Amazonas, Bahia, Piauí and Pará in Brazil.</p> <p>CEIBAL in English, Uruguay.</p>
Collaborative work	<p>Collaboration among teachers to create and share lesson plans or preparation.</p> <p>Between teachers and the school leadership team to manage teacher training.</p>	<p>The Content and Resources for Teaching and Learning (CREA) platform, the LMS of the Uruguayan education system.</p> <p>Teachers-entrepreneurs are leading the development of peer-to-peer markets in response to the increase in standards and the willingness of teachers to pay out of their own pockets for materials that have been proven in the classroom such as "TeachersPayTeachers", "Teacher's Notebook" and "Better Lesson" as well as informal solutions such as private Facebook groups.</p>
New digital content	<p>Support for the teacher's pedagogical role and enrichment of teaching-learning strategies.</p>	<p>Adaptive Mathematics Platform, CEIBAL, Uruguay.</p> <p>Mathematics Platform, National Education Ministry, Argentina.</p> <p>LETRUS Platform, writing in Portuguese, Brazil.</p>



AREA	BENEFITS OF TECHNOLOGY	EXAMPLES
Teacher training	Reduction of costs, greater flexibility in training and collaboration between peers; facilitation of access to international professionals and experts, online training and courses.	The use of technology for talent management and professional development is clearly underdeveloped but there are emerging examples that offer personalized micro-certificates for teachers in the US: Edthena and Bloomboard. Tu Clase in Uruguay, Chile, Colombia and Argentina.
Evaluation and monitoring	<p>Generation of data about learning and records of evaluation and tasks, with online exams that provide immediate feedback for teachers about the results of their students and teacher evaluation processes.</p> <p>Information about students at risk of dropout or repeating the year at the level of the system as a means of enabling parents, teachers, directors and administrators to take corrective action.</p>	<p>Online evaluation: Barranquilla (Colombia), Espíritu Santo (Brazil) and Uruguay.</p> <p>Tuneduc for processing and returning information about the results of evaluations in Brazil.</p> <p>Systems for monitoring educational progress provide the necessary information for decision-making and improving students' success: capture and unification of data about management of the class, attendance, enrolment and grades through LMS platforms or digital course software.</p>
Administration and transparency in the use of resources	Support for administration of inventories, acquisitions and payments, management of personnel and other purposes.	<p>Vision of educational institutions as organizations with ever more complex and sophisticated needs. Two types of vendor: i) large technology companies (Oracle and SAP) which include planning of business resources, business intelligence and other features; and ii) suppliers specializing in a particular functionality such as software for reserving classrooms (for example, Adopt a Classroom and SchoolsPlus).</p> <p>Centralized systems of admission (Chile, Ecuador, CABA and Rio de Janeiro) and of allocation of teachers (Peru and Ecuador) support decision-making on the choice of school. The system is fed using administrative data, along with algorithms to define priorities and digital platforms, to provide personalized information for parents and teachers. In some cases, artificial intelligence and machine learning are being used to provide personalized information that improves decision-making.</p>



**The use of technology in administrative management has a greater potential to generate significant financial savings.** The digitalization of the payment of remunerations in education, for example, is associated with time savings for both teaching and non-teaching personnel, better data for decision-making, direct cost reductions, gains in efficiency and transparency, improved user experience and improvements in security (Deloitte, 2017). Similarly, cloud computing is already widely used in both the public and private sectors. In the United States, for example, the federal government's transition of 20% of its services to a cloud computing model produced important efficiency gains, with the resulting savings estimated to have reached some US\$96 million by 2012 (Figliola and Fischer, 2015). The associated benefits include the availability of computer services, ease of update and adaptation of other technological advances, more robust security, reliability due to the distribution of services across different data centers and privacy as a result of users' greater control over the different types of hardware and software (Oracle, 2016). More recently, technologies such as blockchain have increased the efficiency of management of grades and certificates. A recent report by the European Commission identified various uses of blockchain technology, including academic information systems, trusted systems of certification and reliable management of personal data and payments (Grech and Camilleri, 2017). This latter process is only just being addressed by some Caribbean countries and Uruguay.

**Technologies and new digital content pose specific challenges for their management.** In the era of digitalization, ever more content for students and teachers is presented in digital form. Traditional libraries have gradually become repositories of digital resources (Friedman and Friedman, 2013). Digital pedagogical resources are being developed and can generally be accessed online from any computer or mobile device. These resources support teachers' pedagogical function and enrich teaching-learning strategies. They can be presented as tutorials, simulators, digital platforms, online courses, digital books or didactic games and serve as a support for and extension of the teacher as well as expanding the learning and knowledge available to the student. In addition, they are pedagogical mediators, designed to generate learning in any area of knowledge and at any stage of the learning process. The great volume and potential of these resources for the academic development of students and teachers' professional development warrant their management like any other key process of the educational system. Moreover, LMSs, as well as facilitating the management of digital resources, serve as a platform for exchange and communication between students and teachers and for the delivery, monitoring and evaluation of online educational programs. The Platform of Content and Resources for Teaching and Learning (CREA) provided by CEIBAL is perhaps the most advanced example of this in the region.

**Learning analytics provide a great opportunity to improve the system's quality and efficiency.** The digitalization of SIGEDs through the use of digital devices, learning platforms and digital evaluation systems has exponentially increased the amount and range of data



available. Learning analytics or, in other words, systematization of the measurement, collection, analysis and reporting of the data generated by the system seeks to broaden understanding of the learning process and educational management (García-Peñalvo et al., 2015). Learning analytics are a means, not an end in themselves, and improve the system's efficiency through the definition and understanding of the student profile (El Atia, Ipperciel and Hammad, 2012) and the identification of patterns and trends in teaching processes using digital technologies (Gros, 2012). In this way, new evaluation and monitoring dimensions can be incorporated for the use of political-institutional leaders and teachers in the classroom (Kamenetz, 2015), making it possible to: (i) assess the effectiveness of teaching support strategies; (ii) identify the influence of factors linked to the learning environment; (iii) identify profiles and patterns of behavior; (iv) provide early indicators of success, poor performance or the risk of repeating a year or dropping out of school; (v) identify different forms of learning such as those related to socio-emotional skills; and (vi) focus interventions where they are most needed, maximizing the impact on learning, acquisition of skills and student progress.

**At the same time, the growing use of learning analytics calls for ethical management of data use.** In order to acquire a better understanding of the learning processes, it is necessary to take into account ethical aspects of the use of learning analytics such as: (i) the informed consent of the subjects analyzed, protection of privacy and the ethical use and anonymity of the data; (ii) caution in the interpretation and generalization of data; (iii) the management, classification, storage and governance of the data (Metcalf, Keller and Boyd, 2016); and (iv) the establishment of teams of experts to systematically oversee the data's correct use and interpretation so that the subjects studied are not affected (Slade and Prinsloo, 2013).

**Finally, remote education systems combine digital tools with powerful communication tools.** These can be multipoint or point-to-point and permit real-time communication with remote areas where it is not feasible to deploy a large teaching staff as well as universal coverage in disciplines where there is a shortage of teachers. The Media secondary school centers of Amazonas, Bahia, Piauí and Pará in Brazil are an example of the former, offering first and second-cycle secondary education for isolated populations in the Amazon rainforest and large parts of the Caatinga of Bahia. In Uruguay, CEIBAL has used online English classes with teachers from anywhere in the world, supported by in-person teachers, as a means to universalize English teaching at the primary level, achieving the academic performance expected for that cycle.

**To take full advantage of the transformative potential of technology in educational management, at both the system and classroom levels, schools must have the necessary technological infrastructure.** However, access to internet, particularly a fast connection, remains a challenge in Latin American countries. Many rural or isolated areas have yet to be connected and, where a connection exists, it tends to be slow and expensive (IDB, 2012).



According to the TERCE regional test, 66% of schools had internet access in 2013 and, in many countries such as Paraguay, Honduras and Nicaragua, the figure drops to 30% or less (Arias Ortiz and Viteri, 2019).

## Management of education as an integrated platform

Management processes with interoperable applications and units with unique identifiers make it easier to take advantage of technology and favor the development of educational management systems that function as a platform. Given the differing degrees of decentralization seen in educational systems, there is no single or ideal formula for managing the delivery of services. In order to transform the education sector, it is necessary to offer integral solutions that provide the entity responsible for service delivery (central ministry or regional secretariat) with an overview of the whole set of management processes and the technological systems and tools that support them. With an integrated educational management platform, the data and indicators used to make decisions on a day-to-day basis can be generated simultaneously and automatically. In platforms of this type, users can access data and information as required by their immediate needs and the information that is produced or recorded serves both as an input for decision-making at other levels of management (such as authorities, middle managers, directors and teachers) and as a source of information for students and their families.

**However, the journey from management to the use of the information generated by the system itself is neither simple nor straightforward.** In general, this process of transforming raw data into useful information for different levels of management is not automated and, instead, involves ad hoc processes that are often under-funded and variable in quality and timeliness (Custer et al., 2018). In the absence of automated processes that are integrated across all levels, educational systems have developed information demand models that cascade from central agencies to schools. Moreover, data processing and analysis are usually centralized at the highest levels of management and the resulting information tends not to return to schools or intermediate levels. In the best of cases, it is used in the design of general policies, the monitoring of objectives and the occasional measurement of impact at the aggregate level (Powell, 2006), rather than in daily management and to provide information that is useful for schools. This type of model usually represents a burden for the lower levels of management, especially schools (IBM, 2009) and commitment to its collection and reporting tends to be low (Powell, 2006). In two of the cases observed (Honduras and the Dominican Republic), where there has been little digitalization of management processes, teachers record enrolment, school attendance and their working hours on paper and then enter them into a central government information system.

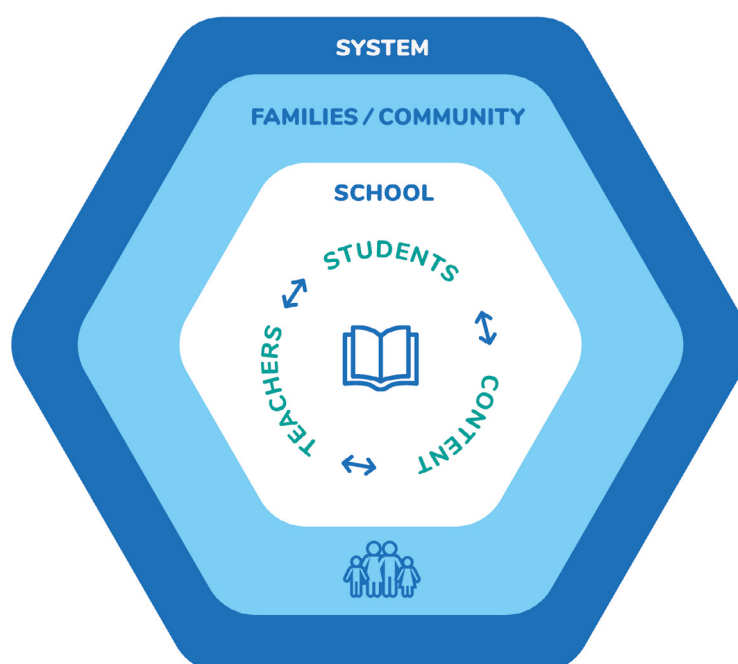


Because connectivity, systems and devices are limited, teachers often have to go to internet centers to upload the information or, failing that, pay someone else to do it, with all the effects on data quality that this implies. This practice duplicates efforts and, in itself, is of no use in the daily operation of schools, so there is no natural incentive for teachers and directors to upload the information, particularly in the absence of compensation for their time and out-of-pocket expenses.<sup>25</sup>

## 4 ■ How to measure and build a high-impact SIGED

In the well-known instructional core, Cohen and Ball (1999) identify the key elements of all teaching processes: students, teachers and content. Interaction between these three elements occurs in a school in a particular community in the framework of an educational system (Figure 5).<sup>26</sup>

**Figure 5.** Elements of the educational system



Source: Compiled by authors based on Cohen and Ball (1999).

25 In some countries, such as Chile, the transfer of financial resources is tied to the registration of data about students in an IT system. Although audits are carried out to verify the information reported, its double registration (on paper and then in the digital system) leads to problems in the quality of the data. The elimination of this practice is a great opportunity to increase efficiency.

26 Some more recent visions expand the boundaries of educational systems to include students' social capital as distinct from their family and community (Freeland Fisher, 2018).



Based on these three elements, six main educational management processes and two structural conditions can be identified (Figure 6).

**Figure 6.** Management processes and structural conditions



Source: Compiled by authors.



## Structural condition 1: Technological infrastructure

Technological infrastructure comprises all the technological arrangements (hardware and software) that support a particular educational system. In this field, a high-impact SIGED must:

### **1. Guarantee a minimum level of connectivity for educational management.**

Connectivity is key, both in schools and at the central level. Minimum demand for connectivity in schools for pedagogical purposes<sup>27</sup> and administrative purposes<sup>28</sup> can be estimated according to the number of students, with a rule of thumb of 1 symmetric Mb per ten students. For schools where access to adequate bandwidth is difficult, a local repository (server) is usually an alternative. At the central level and for administrative areas, minimum connectivity needs are usually calculated according to the number of users and the systems' network load. Connectivity arrangements must be accompanied by measures to control traffic to and from the internet.

### **2. Have cybersecurity and information protection measures.**

Data protection calls for both cybersecurity systems and proper procedures for backing up applications and data. Effective identity protection can be achieved by establishing unique users throughout the system and specific access permissions for each application. Given the sensitivity of the data, SIGEDs must include automatic auditing processes.

### **3. Provide technical and operational documents.**

Clear technical documentation about the design and development of IT systems and their scope as well as a medium-term vision of their development are crucial. Similarly, users of IT systems must be provided with operational documentation such as manuals, videos or other materials.

### **4. Guarantee the compatibility of IT systems.**

A high-impact SIGED must ensure the interoperability of IT systems at the data level since this facilitates not only the presentation of information but also its update and the incorporation of new functionalities for each management process.<sup>29</sup>

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27 Minimum level for the effective use of LMS platforms, educational platforms and portals of teaching resources.

28 Minimum level for the effective use of management systems.

29 Interoperability can exist at the data level or at more aggregated layers. When the former is not possible, important data engineering efforts are often required. Short-term planning and implementation measures include the integration of the available data for aggregated-level presentation.



## Structural condition 2: Governance and institutional framework

This structural condition refers to the normative and institutional aspects that form the framework of a SIGED and give it sustainability. In this field, a high-impact SIGED must:

**1. Have a legal framework.** This framework must define the roles and responsibilities of the departments that operate the SIGED as well as arrangements between departments and the management of data. A solid institutional framework is fundamental for a SIGED's sustainability. Out of the cases analyzed where such a framework is in place, El Salvador stands out for its Digital Transformation Unit and Uruguay for CEIBAL as an agency for educational innovation and digital transformation.

**2. Be supported by a solid strategic vision.** An integral vision of the SIGED as a management platform must be embedded at the highest level of management of the educational system. This must, in turn, be reflected in strategic documents that consider the optimization of institutional processes through the adoption of new technologies and establish objectives, goals and the associated resources for each of the processes, backed by consensus across all the areas they affect and endorsed by the highest authorities. Bogotá, for example, has its Strategic Plan 2016-2020 while Uruguay has its CEIBAL Center Strategic Plan 2017-2020.

**3. Guarantee the availability of resources.** Financial and human resources must always be available for a SIGED's operation in the short, medium and long term. IT departments, for example, must have a budget and trained personnel for management of their support systems. In line with this, Bogotá's Strategic Plan 2016-2020 includes objectives and specific resources for the SIGED and guarantees the projected resources.

**4. Have a change management plan.** This plan must set out the relevant actions, the stipulated dates and the resources required for the development of a high-impact SIGED.<sup>30</sup> It must include central management areas, operational areas and, above all, schools' management teams. It is crucial to draw attention to the benefits of a high-impact SIGED, such as administrative time savings, within the educational system in order to align the different actors.

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<sup>30</sup> It must include familiarization activities, training in the use of new applications, sessions to demonstrate the importance of exploitation of integrated information and support during the implementation process.



## Process 1: Management of physical infrastructure and equipment

Infrastructure and equipment include all the physical spaces, installations and the moveable and immoveable items that make up a school. In this field, a high-impact SIGED must:

**1. Have unique identifiers for all buildings.** Each of the buildings of an educational system must have a unique identifier, without duplicates.

**2. Have a unique record with all the information about buildings.** This should be the repository of all updated data about buildings, their georeferenced location, environment and design, their inventory and the available services (such as water, electricity and internet). The record of physical infrastructure and equipment identifies the schools that operate in each building in each school shift (morning, afternoon, full-day, in-person, virtual or special). With georeferenced information, a range of analyses can be carried out to improve the allocation of students to the different schools, the provision of school transport and the prevention of violence.<sup>31</sup>

**3. Systematize day-to-day management of physical infrastructure.** Day-to-day management of the buildings must be carried out using the unique record of physical infrastructure and equipment. In particular, there must be systematized management of scheduled building maintenance (such as painting and minor repairs) and infrastructure emergencies or, in other words, a standard digital procedure for requesting a repair and assigning a company and budget and for ensuring completion of the repair.

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<sup>31</sup> Information for the record of physical infrastructure and equipment often comes initially from some census of educational infrastructure which is then regularly updated. The update must include the different interventions carried out in the buildings with information about the date of the intervention, the project implemented, the investment and the contractor.



## Process 2: Management of schools

Educational systems may have their own definition of a school. However, in this document, it is defined as the school organization at the territorial level where teaching and learning take place. In this field, a high-impact SIGED must:

**1. Have a unique identifier for all its schools.** Each school must have a unique identifier, without duplicates. A school can occupy different buildings or share the same building with other schools. With a unique identifier for both schools and school buildings, the relationship between them can be clearly identified.

**2. Have a unique record with all the information about schools.** The unique record of schools is the repository of all data about educational and curricular planning, including school syllabus by educational level, functional organic structures, curricular structures, matrix of teaching positions, scheduling of subjects and teaching positions within each school with the allocation of teachers and students to each group/section and the provision of services and educational resources. Using this record, budgets can be drawn up for each school and their costs calculated. This record of schools must be unique, regardless of whether it can be accessed and managed through more than one IT system.

**3. Systematize day-to-day management of schools.** Schools must be managed using the unique record of schools. This calls for standard digital procedures for the operation of schools and, in particular, for management of transfers for current expenses, the emergency assistance fund and the distribution of educational materials to schools. Once information is available at the school level, it can be aggregated for other levels of management.

At the central level, parameters for grouping students by shift (morning, evening, night, weekend or other), criteria for school categorization and regulation of the minimum space required in terms of students per classroom must be established in IT applications for school management. In this way, the group to which each student is allocated can be determined automatically by the IT systems.<sup>32 33</sup>

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<sup>32</sup> IT systems can be used to carry out simulations of changes in the general parameters of the educational system and to measure the impact of educational policies.

<sup>33</sup> IT systems must not only be designed with users at the central level in mind but should also serve as a day-to-day operational tool for the schools.



## Process 3: Management of human and financial/budgetary resources

An educational system's human resources correspond to all the workforce employed in the system that intervenes directly or indirectly in the teaching and learning process while its financial/budgetary resources are all those funds devoted to the sector's operation.<sup>34</sup> In this field, a high-impact SIGED must:

**1. Have a unique identifier for each teaching position within the educational system.** Each position must have its unique identifier, without duplicates.

**2. Have a unique identifier for each person employed in the educational system.** Similarly, each person employed in the educational system must have a unique identifier, without duplicates. ID numbers are commonly used for this purpose. A person may hold different teaching positions and various people can have the same position. Having a unique identifier for both positions and people means that the relationship of one to the other can be clearly identified.

**3. Have a unique record of human resources.** The unique record of human resources is the repository of all the data about the characterization and performance of each teacher, applicant or other employee of the educational system: services, seniority, results in competitive applications for teaching positions, teaching or promotion evaluations, training courses, settlement of complaints and adjustments, information about the school where employed, initial training, school environment and level of satisfaction. This record should be the only source of information for the payment of remunerations.<sup>35</sup>

**4. Systematize day-to-day management of human and financial/budgetary resources.** Day-to-day management of human resources must be carried out using the unique record of human resources. This calls for standard digital procedures to automatically record and validate all types of new work-related information, such as promotions, demotions, sick leave, administrative leave, relocations and participation in competitive applications for teaching positions, in accordance with the jurisdiction's regulatory regime. The IT system used to support management of human and financial resources must classify information about teachers automatically and consistently with regulation and must interoperate with systems for the

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<sup>34</sup> In most LAC countries, remunerations are the sector's single largest item of spending.

<sup>35</sup> The complete unique record of human resources should be available for consultation online, with due security restrictions.



payment of remunerations. Similarly, the SIGED must have systematized procedures for budget administration that serve to define budgets by school and set items and limits for the control of spending. Colombia, Uruguay and Santa Fé, for example, have digitalized teacher replacement processes, based on a list of prequalified candidates, permitting rapid coverage of teacher absences. The District of Bogotá in Colombia has Sistema Aplica, an information system for the management of temporary vacancies which permits the daily replacement of absent teachers, with parameters for the selection of the replacement.

## Process 4: Management of students and learning

Students are the direct beneficiaries of any educational system. Management of students and their learning by a high-impact SIGED must:

**1. Have a unique identifier for each student.** Each student must have a unique identifier, without duplicates.

**2. Have a unique record of students.** The unique record of students is the repository of all the students' personal, academic (digital reports), socio-educational, behavioral and health information as well as their certificates, records of passes, exams, attendance, promotion to the following year and repetition of a year.

**3. Systematize day-to-day management of students and their learning.** Efficient management of students and learning is carried out using a unique nominal record. This includes the management of scholarships, food and transportation at the student level, as well as the enrolment of students for each school year. The IT system used to support management of students must permit automatic allocation of students to schools in accordance with the jurisdiction's regulation as well as the issue of grades, certificates and diplomas. Bogotá, for example, has an online enrolment process offering three options of school for new students. The District makes the final allocation at the central level.



## Process 5: Management of digital content for student learning and teacher training

Digital content comprises all online teaching resources. Efficient management of digital content is based on curricular demands and guarantees access regardless of the user's geographic location and whether the user is a teacher or student. A high-impact SIGED must provide support and monitoring of teachers' professional development plans and the syllabus of schools as regards:

**1. Digital resources.** A SIGED must monitor and systematize the generation, analysis, evaluation, approval by qualified personnel, classification and subsequent publication of all digital resources. Digital resources must be stored in a central repository where they are classified by educational level, modality, type of resource and area.

**2. Digital management of learning.** Virtual (asynchronous and/or synchronous) tutoring schemes, learning platforms (such as adaptive mathematics, reading and language platforms and virtual laboratories) and LMS platforms must be integrated into the SIGED. Uruguay, for example, has a wide range of learning platforms, digital content and repositories (CREA, PAM, Matific, Open Resources Network, Digital Library, DOMO, Apps, Logros) under the CEIBAL plan.

## Process 6: Tools for strategic management

Tools for strategic management are all the indicators that are generated from day-to-day management of the different levels of the educational system. These indicators, in turn, serve as an input for the system's management. In this field, a high-impact SIGED must:

**1. Consolidate and provide key indicators for the different management processes.** The SIGED must produce management and learning indicators such as: individual and aggregate pedagogical indicators, records of educational performance, teaching positions, sick and administrative leave, payment of remunerations, teacher-student ratios, occupation of school buildings, total investment per school vs. academic performance, investment in





assistance (transportation, food, scholarships) and number of hours and teaching positions allocated in relation to the number of students.<sup>36</sup> The SIGED must permit the generation and visualization of these indicators for all levels of management of the educational system, including both the public and private sectors, as well as disaggregation by, for example, age, gender or race.

## Diagnostic methodology

A diagnostic instrument consisting of 119 closed-ended questions about management processes and structural conditions is used to measure the level of development of information and management systems.<sup>37</sup> Each question relates to a sub-process or functionality that a high-impact SIGED should perform. The answer, affirmative or negative, is accompanied by a brief description of how the sub-process works and permits its classification in one of four levels: latent, incipient, emerging or established. A sub-process is classified as:

- I )** Latent, if it does not comply with the characteristics defined for a high-impact SIGED;
- II )** Incipient, if its coverage according to the definition is partial and it is not geared to efficient management;
- III )** Emerging, if its coverage according to the definition is partial and it is geared to efficient management; or
- IV )** Established, if its coverage according to the definition reaches over 80% and it is geared to efficient management.

After classifying all the sub-processes, a simple average is calculated in order to classify each process or structural condition. Finally, a weighted average of the classification of each process or structural condition is calculated in order to classify the SIGED as a whole.<sup>38</sup> The weighting of processes and structural conditions is determined exclusively by their importance in the context of a SIGED, with greater weight given to those processes of greater importance in terms of their contribution to achieving a high-impact SIGED (Table 1).

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36 Business intelligence (BI) is one of the useful tools for generating and presenting indicators.

37 The Annex presents the SIGED diagnostic tool.

38 Each sub-process is assigned a score: 1 for latent, 2 for incipient, 3 for emerging and 4 for established. In the case of processes, the simple average is rounded to the nearest second decimal point and the process is classified as follows: 1.00-1.74 = latent, 1.75-2.49 = incipient, 2.50-3.24 = emerging and 3.25-4.00 = established. Once the weighted average has been calculated, this same process is then used to classify the SIGED as a whole.

**Table 1.** Weighting of processes and structural conditions

PROCESSES EVALUATED USING THE METHODOLOGY	WEIGHTING
Management of physical infrastructure and equipment	1
Management of schools	1
Management of human and financial/budgetary resources	1,5
Management of students and learning	1,5
Management of digital content for teacher training and students' learning	0,5
Tools for strategic management	1
Technological infrastructure	1,5
Governance and institutional framework	1,5

Source: Compiled by authors.

In this way, a SIGED can be classified in one of the four development levels (Figure 7).

**Figure 7.** Levels of classification of SIGEDs

Source: Compiled by authors.



A high-impact SIGED is achieved when the processes analyzed have a sequence of steps that can be repeated and are deterministic or, in other words, always produce the same values/information for the same set of inputs.<sup>39</sup> It is understood that an established SIGED can still be improved but has a good level of integration. Therefore, when this report refers to an integrated high-impact SIGED, this means that it is an established SIGED with a high score for all its processes and sub-processes.

Information is gathered in a field visit during which discussions, guided by an instrument, take place with the users and managers of each of the SIGED's processes and structural conditions. A specialized SIGED consultant is responsible for leading the discussions and comparing the different users' management model in order to form a complete picture of how each sub-process really operates.

As a key part of the field visit, at least one school operating with the SIGED is visited for each case study. The project team meets with its director and, in some cases, also teachers and administrative personnel. The aim of this visit is to capture the user experience at the level of the school as the primary management unit of the educational model.

The information gathered is consolidated into a diagnosis in which strengths and challenges are identified according to the classification of each process. Based on this diagnosis, a plan is proposed to strengthen the SIGED and bring it up to the Established level. This plan is accompanied by costing at two levels: investment in capital and current expenses. In addition, a proposal is drawn up for change management during implementation of the improvements. Finally, as far as possible, the possible benefits of the most important improvements are estimated in general terms in order to obtain a cost-benefit analysis of a high-impact SIGED.

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<sup>39</sup> For example, in practical terms, the sub-process for managing students' online enrolment is effective (is properly geared) if, in each year during the month for enrolment, all the students' families can carry out the process autonomously (have the knowledge to do so), the support system operates in a stable manner and validates the data entered, security standards for IT management of the data are met and the process is completed within the time envisaged.



## 5. Conclusion

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There is evidence of the benefits of improving the management of educational systems. However, although there are signs of ample room for improvement in the management models and processes currently used in LAC, there is a lack of consolidated and systematized information about their state of development. This study will help close this important information gap, identifying areas for improvement and offering a roadmap for the region's Education and Finance Ministries.

To this end, once the case studies have been completed, best practices and the lessons learned will be systematized, focusing on the key management processes and their interoperability. Each chapter or section of the systematization will address one of the management processes or structural conditions. An exchange of experiences would follow, enabling countries to learn at firsthand how the elements of the educational system are managed by their peers.

In addition, the possibility of conducting a quantitative study will be considered as a means of examining whether a correlation exists between the level of development of the different educational management processes and the learning performance of the countries and provinces analyzed, using the results of the SIGED and the new ERCE 2019 regional study. In more advanced systems, where SIGEDs have been in operation for at least two or three years, there is sufficient data to analyze in depth the trends of the main variables of internal efficiency of educational systems and to attempt to identify changes in the outcome variables before and after reforms are implemented.



# 6.

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# 7 ■ Annex: SIGED Diagnostic Tool

## 1. Management of physical infrastructure and equipment

LEVEL	LATENT	INCIPIENT	EMERGENT	ESTABLISHED
<b>1.1 How many and which systems/modules exist within this process? How do they operate?</b>				
<b>1.2 Do you apply the unique school building identification model?</b>				
	There is no unique identifier for each element	Not all elements have a unique identifier	A unique identifier for each element exists, but there are duplications or other data quality issues	A unique identifier for each element exists and there are no duplications
<b>1.3 Do you keep a unique record of buildings in digital format for use in the day-to-day management of schools?</b>				
	There is no unique record	There is a partial unique record, or several records, scattered in digital format	A complete unique record in digital format exists but it is not used for the day-to-day management of schools	A complete and updated unique record in digital format exists and it is used in the day-to-day management of schools
<b>1.4 Do you record the georeferenced data of school buildings?</b>				
	There is no georeferenced information on school buildings	There is a partial digital record of the georeferenced data of the buildings, although it is outdated	A complete digital record of the georeferenced data of buildings exists, although it is outdated	There is a complete and updated digital record of the georeferenced data of the buildings



#### 1.5 Do you record the schools that function by shift in each building?

There is no record of the schools operating in each building

There is a partial digital record of the schools that operate in each building (with updated information of up to 50% of the schools)

There is a significant digital record of the schools that operate in each building (between 51% and 80 % of the schools with updated information)

There is a complete and updated digital record of the schools that operate in each building (more than 80%)

#### 1.6 Do you record the state of conservation of buildings in SIGED?

There is no information on infrastructure's state of conservation

Partial information is available on the infrastructure's state of conservation

A digital record of the infrastructure's state of conservation exists, even if it is not complete or updated

A systematic and periodic digital record of the infrastructure's state of conservation is kept. The record is complete and updated

#### 1.7 Do you record information about basic services (electricity, water, gas, telephone, Internet, etc.)?

There is no information on the basic services of each school

Partial information is available on the basic services of each school

A digital record of access to basic services exists, even if it is incomplete or outdated

A systematic and periodic digital record of access to basic services is kept. The record is complete and updated

#### 1.8 Do you keep a precise record of the classrooms that operate in each school?

There is no information of the classrooms that operate in each school

There is a partial digital registry of the classrooms that operate in each school, although it is outdated

There is a complete digital record of the classrooms that operate in each school, although it is outdated

There is a complete and updated digital record of the classrooms that operate in each school

#### 1.9 Does SIGED have the necessary and timely information to assess the match between supply of physical infrastructure and demand for educational services?

The SIGED does not have the necessary information to measure the relationship between physical infrastructure supply and demand (# of schools, population density, characterization of the population)

The SIGED has part of the information necessary to measure the relationship between physical infrastructure supply and demand (# of schools, population density, characterization of the population), even if it is outdated

The SIGED has the necessary information to measure the relationship between physical infrastructure supply and demand (# of schools, population density, characterization of the population), even if it is outdated

The SIGED has necessary and timely information to measure the relationship between the supply of physical infrastructure and the demand for educational services



1.10 Do you record and update inventory information about movable goods: desks, chairs, blackboards, cafeteria equipment?

There is no inventory record

There is a digital inventory record, but it is not updated or complete

There is an updated and complete digital inventory record, but it is isolated from (not integrated to) the unique building record

There is an updated and complete digital inventory record (available for all schools) integrated into the unique building record

1.11 Do you record and update inventory information about specialized teaching equipment (e.g. physics, chemistry, biology and computer laboratories, etc.)?

There is no inventory record

There is a digital inventory record, but it is not updated or complete

There is an updated and complete digital inventory record, but it is isolated from (not integrated to) the unique building record

There is an updated and complete digital inventory record (available for all schools) integrated into the unique building record

1.12 Through SIGED, do you implement a procedure for managing demand for urgent building maintenance?

There are no procedures for schools to implement in the case of building emergencies

There is a procedure for building emergencies, but it does not cover all schools

There is a procedure for building emergencies used by all schools, but digital tracking is not possible (e.g. it is managed in paper)

There is a procedure for building emergencies used by all schools, and it is incorporated into the respective SIGED records

1.13 Through SIGED, is there a procedure for scheduled building maintenance, with inspection routes and scheduled repairs?

No procedures for scheduled maintenance of buildings are in place, including inspection routes and scheduled repairs

There is a procedure for scheduled maintenance of buildings, with scheduled inspection and repair routes, but it does not cover all school

A process for scheduled maintenance of buildings exists and is used by all schools, but it is not possible to digitally monitor each stage of the process (i.e. it is managed in paper)

There is a procedure for scheduled maintenance of buildings used by all schools, which is incorporated into the respective record in the SIGED



1.14 In the building records, do you digitally record the different interventions in school infrastructure (with date, project implemented, investment, contractor)?

There is no record of infrastructure interventions (e.g. repairs and renovations)

A partial digital record of infrastructure interventions exists (e.g. repairs and renovations)

There is a complete digital record of infrastructure interventions (e.g. repairs and renovations), even if it is outdated or with low quality

There is a complete and updated digital record of infrastructure interventions (e.g. repairs and renovations)

1.15 Do you have precise real-time information about the data managed in the unique record of buildings, with access rights and privileges for the different actors in the educational system (principal, supervisor, level director, administrative areas, political management level)?

The relevant actors have no access to information from the unique physical infrastructure record

Relevant actors have access to some information (e.g. reports) from the physical infrastructure record

Relevant actors have access to impartial or outdated information from the physical infrastructure record

The relevant actors have timely access to the physical infrastructure record, with the different actors having their respective access controls

## 2. Management of schools

LEVEL

LATENT

INCIPIENT

EMERGENT

ESTABLISHED

2.1 How many and which systems/modules exist within this process? How do they operate?

2.2 Do you implement a management system that relies on the use of a unique school identification code?

There is no unique identifier for each school

Not all schools have a unique identifier, or it is not used for management purposes

A unique identifier for each school exists, but there are duplications or other data quality problems and/or it is not used for management purposes

There is a unique identifier for each school, and it is used for management purposes



**2.3 Do all management and information systems (i.e. Ministry or sub-national Secretariat) use the unique school identification code?**

The unique identifier code is not used in all management and information systems

Some systems use the unique school identification code

Several systems have their own unique identification code for each school and there is a clear relation between the (different) codes used in each system for management purposes

There is a unique identifier for each school, and it is used in all management and information systems

**2.4 Do you implement integral management based on the unique record of schools which contains all the data about each school?**

There is no unique record

There is a partial unique record or several scattered records in digital format

There is a complete unique record in digital format, but it is not used for the daily management of schools

There is a complete and updated unique record in digital format and it is used for the daily management of schools

**2.5 Does the system implement and manage study plans and the structure of teaching positions and reflect their changing dynamics, linking them to the different sections or groups of students?**

There is no record of the study plans

There is a partial digital record of the study plans

There is a digital record of the study plan, but it is not used for the daily management of schools

There is a complete and updated digital record that is used in the daily management of schools

**2.6 Based on the allocation of the educational offer for each school, do you record the scheduling of each subject/teaching position, with the allocation of teachers and students?**

There is no record of the scheduling, with the allocation of teachers to sections and students

There is a partial digital record of the scheduling, with allocation of teachers to sections and students

There is a complete digital record of the scheduling, with the allocation of teachers to sections and students, but it is not used for the daily management of the school

There is a complete and updated digital record of the scheduling, with the allocation of teachers to sections and students, and is used in the daily management of the school

**2.7 Do you manage educational offer in schools in a centralized way, systematizing the evolutive history of the structure of teaching positions, study plans and the educational services that are provided and eventually withdrawn?**

There is no centralized record of the study plans or the corresponding educational offer of each school

There is a centralized digital record of the study plans and a partial record of the educational offer provided in each school

There is a complete digital record of the study plans and each school's offer, but it is not updated or used in schools' management

There is a complete and up-to-date digital record of the study plans and the educational offer associated to each school, with school information being used for school management



2.8 Does SIGED have digitalized information for managing the grouping of students in shifts (morning, evening, weekend, etc.) and sections, the criteria for categorization of schools and regulation about the minimum space required per student per classroom?

There is no record of the parameters for shifts, sections, categories of schools or classroom dimensions

There is a partial digital record of the parameters for shifts, divisions, categorization of schools and classroom dimensions

There is a complete and updated digital record of the parameters for shifts, divisions, categorization of schools and classrooms dimensions, but it is not used for daily management of schools

There is a complete and updated digital record of the parameters for shifts, divisions, categorization of schools and classroom dimensions, and it is used for management purposes

2.9 Do you record which school operates in each building?

There is no record of the schools that operate in each building

There is a partial digital record of the schools operating in each building

There is a complete digital record of all the schools that operate in each building, even if it is not updated or with low quality

There is a complete and updated digital record of all the schools that operate in each building

2.10 Do you precisely identify school use of the building by shifts?

There is no record that identifies school use by shifts and by building

There is a partial digital record that identifies school use by shifts and by building

There is a complete digital record that identifies school use by shifts and by building, even if it is outdated or with low quality

There is a complete and updated digital record that identifies school use by shifts and by building

2.11 Is the management of monthly transfers for expenditures managed by schools systematized?

There is no record of funds transfers for school expenditures

There is a partial digital record of funds transfers for school expenditures

There is a complete digital record of funds transfer for school expenditures integrated into the school record, even if it is outdated or with low quality

There is a complete digital record, updated and systematized, for the management of funds transfers for school expenditures integrated into the school record



2.12 Through SIGED, do you manage a fund for immediate assistance (FIA) for school emergencies?

There is no digital process for the management of a fund for immediate assistance for school emergencies

There is a partially digitized management process for a fund for immediate assistance for school emergencies

There is a digitized management process for a fund for immediate assistance for school emergencies, although it is not implemented in the whole system

There is a systematized and digitalized management process for a fund for immediate assistance for school emergencies that is used throughout the system

2.13 Do you record and update information related to the educational material a school receives from the provincial or national government such as school materials, textbooks, teaching materials (pencils, exercise books, etc.) and school uniforms?

There is no record of the educational material schools receive from the provincial/regional/national directorates (e.g. school supplies, textbooks, teaching materials, school uniforms)

There is a partial digital record of the educational material schools receive from the provincial/regional/national directorates (e.g. school supplies, textbooks, teaching materials, school uniforms)

There is a complete digital record of the educational material schools receive from the provincial/regional/national directorates (e.g. school supplies, textbooks, teaching materials, school uniforms), even if it is outdated or with low quality

There is a complete and updated digital record of materials that schools receive from provincial/regional/national directorates (e.g. school supplies, textbooks, teaching materials, school uniforms)

2.14 Does the system provide real-time information about the data managed in the Unique Record of Schools, with access rights and privileges for the different actors in the educational system (principal, supervisor, level director, administrative areas, political management level)?

Relevant actors have no access to information provided by the unique record of schools

Only some relevant actors have access to complete or partial information provided by the unique record of schools

Most of the relevant actors have access to most of the information provided by the unique record of schools, although it is impartial or outdated

Practically all the relevant actors have real-time access to relevant information provided by the unique record of schools, with the corresponding access rights by management levels



### 3. Management of human and financial/budgetary resources

LEVEL	LATENT	INCIPIENT	EMERGENT	ESTABLISHED
<b>3.1 How many and which systems/modules exist within this process? How do they operate?</b>				
<b>3.2 Do you use a unique model of identification for teaching positions in the educational system and are they included into the budget?</b>				
	There is no unique identifier for each teaching position	Not all teaching positions have a unique identifier or unique budget line	A unique identifier/budget line for each teaching position exists, but there are duplications or other data quality issues	A unique identifier/single budget line for each teaching position exists, there are no duplications, and a systematized process for the creation of new teaching positions is in place
<b>3.3 Do you use a model of unique identification of persons in the educational system and their relationship with the budget?</b>				
	There is no unique identifier for each hired person	Not all hired people have a unique identifier or unique budget line budget	A unique identifier/single budget line for each hired person exists, but there are duplications or other data quality issues	A unique identifier/single budget line for each hired person exists, and there are no duplications
<b>3.4 Do you have a unique human resource record in digital format to use in the daily management of these resources that includes the following data?</b>				
	<ul style="list-style-type: none"> <li>• Complete personal and family data</li> <li>• Dependents</li> <li>• Contact information</li> <li>• Employment data such as number of hours required by the position, subject/position taught and type of appointment (class teacher, temporary, replacement, hired)</li> <li>• Special additional assignments (relief teaching, secondments, etc.), highlighting the function performed and the number of hours involved</li> <li>• Medical history and workplace health care received</li> <li>• Special bonuses, embargos, memberships</li> <li>• Details of salary payments history</li> <li>• Professional background information for automatic scoring/rating in competitive processes to fill vacancies (qualifications, training, extra-jurisdictional employment history)</li> </ul>			
	A unique record does not exist	There is a partial unique record or several scattered records in digital format	A complete digital unique record exists, but it is not used for the daily management of human resources	A complete and updated digital unique record exists and it is used for the daily management of human resources





### 3.5 Do you have systematized budget administration processes through which to allocate and identify budget by school?

There is no systematized process for the administration of schools' budget allocation

A partially systematized process for the administration of schools' budget allocation exists

A systematized process for the administration of the schools' budget allocation exists, although it does not run throughout the entire educational system

A systematized process for the administration of schools' budget allocation exists, and it is used throughout the educational system

### 3.6 Do you estimate a school's teaching and non-teaching positions based strictly on demand in the form of enrolled students?

There is no relationship between the number of positions (teaching and non-teaching) and demand (students enrolled)

The demand (students enrolled) is one of the factors that defines the number of positions (teaching and non-teaching)

The number of positions (teaching and non-teaching) is based solely on demand (students enrolled), although not all the system operates using this model

The number of positions (teaching and non-teaching) is based solely on demand (students enrolled) and the entire system operates using this model

### 3.7 Is management of sick and personal leave systematized?

There is no record or systematized process for the administration of medical and administrative leaves

There is a partial digital record or a partially systematized process for the administration of medical and administrative leaves

There is a complete digital record or a systematized process for the administration of medical and administrative leaves, even though it is outdated or does not work efficiently

There is a complete updated digital record or an efficient systematized process for the administration of medical and administrative leaves

### 3.8 Do you automatically record and validate the hiring of human resources?

There is no mechanism for the record and automatic validation of human resources' hiring

The record and validation of human resources' hiring is partially automated

The record and validation of human resources' hiring is automated, although it is outdated or with low quality

The record and validation of human resources' hiring is completely automated

### 3.9 Does the unique personnel record contain training and employment history?

There is no model for teacher classification based on the unique personnel record

The unique personnel record is used for the classification of teachers, although it is not a standardized process carried out for all teachers

There is a teacher classification model based on the unique personnel record, even if it does not have complete or updated data for all teachers

There is a teacher classification model based on the unique personnel record that has complete and updated information



3.10 Is salary payment based on the information held in the personnel records and the budget module? Are these the only inputs?

There is no record of salary payment or it does not have any relation with the unique personnel record nor the corresponding budgetary line

Salary payment is partially recorded using the unique personnel identifier

Salary payment is recorded using the unique personnel identifier, even if the corresponding budget line is not recorded

A complete digital record of salary payment is made using the unique personnel identifier and the corresponding budget line is identified

3.11 Can teachers consult their own record on Internet, with due security restrictions?

It is not possible to access the unique personnel record

It is possible to access the unique personnel record, but there is no web portal designed for these purposes

There is an internet portal where it is possible to consult some information of the unique personnel record, with the appropriate access/security restrictions for the different relevant actors

There is an internet portal where it is possible to consult all the information on the unique personnel record with the appropriate access / security restrictions for the different relevant actors

3.12 Do you keep a regular (at least, semiannual) electronic online record to assess school environment, including teachers' level of satisfaction?

There is no record on teachers' level of satisfaction

There is a partial record of teachers' level of satisfaction

There is an electronic record of teacher's level of satisfaction

There is an electronic model for consultation and periodic recording of teachers' level of satisfaction

3.13 Do you record and manage the results of external teacher assessments, whether regional or national?

There is no external assessment, or there is no record of external teacher assessments

There is a partial digital record of external teacher assessments

There is a complete digital record of external teacher assessments, although it is not used for teacher management purposes

There is a complete digital record of external teacher assessments and it is used for personnel management purposes



3.14 Do you provide precise real-time information about all the data in the personnel record such as totals of filled and vacant positions, hierarchies of replacement by type of function, agents' current and historical service records, medical history and absenteeism, with access rights and privileges for the educational system's managers (principal, supervisor, level director, administrative areas, political management level)?

The relevant actors have no access to information from the personnel record

Relevant actors have access to some information (e.g. reports) from the personnel record

Relevant actors have frequent access to information from the personnel record, although it is partial or outdated

Relevant actors have real-time access to the personnel record, with the respective access control for the different actors

## 4. Management of students and learning

LEVEL

LATENT

INCIPIENT

EMERGENT

ESTABLISHED

4.1 How many and which systems/modules exist within this process? How do they operate?

4.2 Do you use the unique School-Study Plan-Section-Student model to identify the school, study plan, and section corresponding to each student?

There is no unique identifier for the courses each student takes and the corresponding section/school

Not all students have a unique identifier of the study plan and the corresponding section/school

There is a unique identifier for each student's study plan and the corresponding section/school, but the information is not updated

There is a unique identifier for each student that allows to identify the school, study plan, and section to which the student belongs to, and the information is updated

4.3 Do you use the unique School-Study Plan-Section-Student model to manage the creation and elimination of teaching positions in accordance with demand?

There is no systematized process to determine the creation or elimination of sections based on demand

There is no systematized process to determine the creation or elimination of sections based on demand, although at least some of the necessary elements for it to develop are recorded

There is a systematized process that determines the creation or elimination of sections based on demand, but it is not used for management purposes

There is a systematized process that determines the creation or elimination of sections based on demand and it is used for management purposes



4.4 Do you keep a unique record of students in digital format to use in day-to-day management, including the following data?

- Student's personal data:
  - ID number
  - Gender
  - Date of birth
- Home address
- Contact details
- Family member details:
  - Personal data
  - Civil status
  - Level of education
  - Occupation
- Student's legal tutor
- School record:
  - Record of courses taken by the student in the educational system
  - Grades completed
  - Grades repeated
  - Change of section
  - Dropout
  - Change of school
  - Graduation
  - Certificates
  - Grades
  - Absenteeism
  - Integration projects
  - Previous subjects
  - Registration with examination boards
  - Learning support assistance
- Resources obtained from the system:
  - Scholarships
  - Loans
  - Social assistance
  - Feeding programs
  - Transport
- Special needs
- Socio-educational assessment
- Conduct
- Reprimands/punishments
- Medical card with vaccinations
- Over-age
- Records of school climate:
  - Cases of bullying
  - Safety inside the school
  - Students' level of satisfaction
  - Parents' level of satisfaction

There is no unique record

There is a partial unique record, or several records scattered in digital format

There is a complete unique record in digital format, but it is not used in the daily management of students

There is a complete and updated unique record in digital format and it is used in the daily management of students

4.5 Do you use the information on students found in the unique student record to generate information requested periodically by other public or international bodies?

The unique student record does not have all the necessary information to satisfy the demand for information

The unique student record partially satisfies the demand for information

The unique student record satisfies the demand for information, but there is no mechanism to send it periodically

The unique student record satisfies the demand for information and there is a mechanism to send it periodically



4.6 Do you use the information on students found in the unique record to issue study certificates, registry of passes and exams, and to process new information about years completed or repeated through the system?

There is no system in place to issue study certificates, registry of passes, exams, and to process new information

Necessary elements to issue study certificates, registry of passes, exams, and to process new information, are registered, although not effectively implemented

The system is used to issue study certificates, registry of passes, exams and to process new information, although its coverage is partial

The system is used to issue study certificates, registry of passes, exams and to process new information for the vast majority of students

4.7 Do you monitor students using individual digital reports, including the following basic data?

4.7.1 a. Attendance/absence and late arrivals

No record is kept

A partial record or several scattered records are registered in digital format

A complete record in digital format is registered, even if it is outdated or with low quality

A complete and updated record in digital format exists

4.7.2 b. Grades

No record is kept

A partial record or several scattered records are registered in digital format

A complete record in digital format is registered, even if it is outdated or with low quality

A complete and updated record in digital format exists

4.7.3 c. Conduct

No record is kept

A partial record or several scattered records are registered in digital format

A complete record in digital format is registered, even if it is outdated or with low quality

A complete and updated record in digital format exists

4.7.4 d. Years completed/repeated

No record is kept

A partial record or several scattered records are registered in digital format

A complete record in digital format is registered, even if it is outdated or with low quality

A complete and updated record in digital format exists



#### 4.8 Are individual student reports in digital format?

There are no individual student reports in digital format

At least part of individual student reports is in digital format

All individual student reports are in digital format, although outdated or with low quality (e.g., cases initially registered on paper and digitized afterwards)

Most individual student reports are in digital format and updated

#### 4.9 Do you keep systematized records related to school environment, such as cases of student harassment, safety within the school, level of student satisfaction, and level of parent satisfaction?

There is no record on school environment (e.g., cases of student harassment, safety within the school, level of student satisfaction and level of parental satisfaction)

There is a partial record or systematization of the school environment registration process (e.g., cases of student harassment, safety within the school, level of student satisfaction and level of parental satisfaction)

There is a systematized and complete registration process of the school environment (e.g., cases of student harassment, safety within the school, level of student satisfaction and level of parental satisfaction), even though it is outdated or with low quality

There is a systematized, complete and updated registration process of the school environment (e.g., cases of student harassment, safety within the school, level of student satisfaction and level of parental satisfaction)

#### 4.10 Do you use a module to issue graduation certificates and diplomas, with their corresponding record in a central system?

There is no centralized process for issuing and registering degrees, certificates and diplomas

There is a partially systematized centralized process, and/or a partial record of the issuance of degrees, certificates and diplomas

There is a centralized systematized process, and/or record of the issuance of degrees, certificates and diplomas, although it is outdated or with low levels of quality

There is a centralized systematized process, and an updated digital record of the issuance of degrees, certificates and diplomas

#### 4.11 Do you manage the results of external student assessments, whether regional, state or national, and use this information as feedback for educational practices and policies?

There is no external student assessment or no record of external student assessments

There is a partial digital record of external student assessments

There is a complete digital record of external student assessments, although results are not used for management purposes

There is a complete digital record of external student assessment, and results are used for management purposes

#### 4.12 Do you have an online process to record and manage enrolment?

There is no systematized process or digital record of student enrolment

There is no systematized process, but information is digitized afterwards

There is a systematized process and/or a digital record of student enrolment, even though it is outdated or with low quality

There is a systematized process and an updated online record of student enrolment



4.13 Does SIGED have all the necessary information for the systematized allocation of students to schools in accordance with local legislation?

There is no information in the system for the systematized allocation of students to schools, in accordance with national/subnational legislation

There is information, partial or scattered, for the systematized allocation of students to schools, in accordance with national/subnational legislation

There is complete information for the systematized allocation of students to schools, in accordance with national/subnational legislation, but it is not used for management purposes

There is complete information and a systematized allocation of students to schools is made in accordance with national/subnational legislation

4.14 Do you have a systematized process to manage school meals by student?

There is no systematized process or digital record of school meals at the student level

There is a partially systematized process and/or partial digital record of school meals at the student level

There is a systematized process and/or digital record of school meals at the student level, even if it is outdated or with low quality

There is a systematized management process and an updated digital record of school meals at the student level

4.15 Do you have a systematized process to manage school transportation by student?

There is no systematized process or digital record of school transportation at the student level

There is a partially systematized process and/or partial digital record of school transportation at the student level

There is a systematized process and/or digital record of school transportation at the student level, even if it is outdated or with low quality

There is a systematized management process and an updated digital record of school transportation at the student level

4.16 Do you have a process to manage scholarships by student?

There is no systematized process or a digital record of scholarships at the student level

There is a partially systematized process and/or a partial digital record of scholarships at the student level

There is a systematized process and/or a digital register of scholarships at the student level, even if it is outdated or with low quality

There is a systematized management process and an updated digital record of scholarships at the student level

4.17 Do you provide parents and legal tutors with online information from the updated student records?

Parents and guardians have no access to the unique student record

Parents and guardians have access to some information from the unique student record

There is an internet portal where parents can consult some information on the unique student record with appropriate access/security restrictions, even if it is impartial or outdated

There is an internet portal for parents and guardians to consult updated information on the unique student record with appropriate access/security restrictions



4.18 Do you provide students with updated online information about the corresponding unique record? Do you have a web portal for students which provides online information about the data contained in the student record?

Students do not have access to the unique student record

Students have access to some information found in the unique student record

There is an internet portal where students can consult some information on the unique student record with appropriate access/security restrictions, even if it is impartial or outdated

There is an internet portal for parents and guardians to consult updated information on the unique student record with appropriate access/security restrictions

4.19 Do you provide precise real-time information on the data found in the unique student record, with access rights and privileges for the educational system's managers (Principal, Supervisor, Level Director, administrative areas, political management level)?

Relevant actors have no access to information coming from personnel records

Relevant actors have access to some information (e.g. reports) from personnel records

Relevant actors have access to information from personnel records, although these are impartial or outdated

Relevant actors have real-time access to personnel records, with the appropriate access/security restrictions

## 5. Management of digital content for teacher training and students' learning

LEVEL

LATENT

INCIPIENT

EMERGENT

ESTABLISHED

5.1 How many and which systems/modules exist within this process? How do they operate?

5.2 Do you implement an annual professional development plan for teachers, based on new curricular demands and students' learning challenges, which guarantees access regardless of where the teacher is based?

There is no professional development plan for teachers

There is a limited professional development plan for teachers, or it is not based on the school curriculum

There is a professional development plan for teachers based on curricular needs, but it is limited to certain geographical areas (e.g. large urban centers) and/or based on demand

There is a professional development plan for teachers based on curricular needs and it covers/reaches all teachers regardless of their geographical dispersion





5.3 Does your educational system implement digital support and monitoring tools for teacher's professional development, taking into account its different dimensions?

- a. Organizational
- b. Pedagogical
- c. Territorial scope
- d. Integration with the Unique Personnel Record
- e. Follow-up information
- f. Technology

There is no digital tool to support or monitor teacher training

There is a digital tool to support or monitor teacher training, although it is barely used

There is a digital tool to support or monitor teacher training, although it is not implemented throughout the system

There is a digital tool to support or monitor teacher training, implemented throughout the sector

5.4 Do teachers have access to digital content for their professional development and is this content incorporated in Learning Management System (LMS) tools?

Teachers do not have access to digital content for their professional development

Teachers have access to some type of digital content for their professional development

Teachers have access to digital content for their professional development, even though it is not implemented throughout the system

Teachers have access to digital content for their professional development and these contents are integrated in an LMS

5.5 Do you use tools to support and monitor students' learning and skill development such as the following?

5.5.1 a. Learning platforms (mathematics, reading, languages, virtual laboratories)

No learning platform is implemented to support or monitor students' learning

There is a learning platform to support or monitor students' learning, although its use is low

There is a learning platform to support or monitor students' learning, although it is not implemented throughout the education system

There is a learning platform to support or monitor student training implemented throughout the education system

5.5.2 b. Assessment platforms

No evaluation platform is implemented to support or monitor students' learning

There is an evaluation platform to support or monitor students' learning, although its use is low

There is an evaluation platform to support or monitor students' learning, although it is not implemented throughout the education system

There is an evaluation platform to support or monitor students' learning, implemented throughout the education system



## 5.5.3 c. Remote education

No remote education platform is implemented to support or monitor students' learning

There is a remote education platform to support or monitor students' learning, although its use is low

There is a remote education platform to support or monitor students' learning, although it is not implemented throughout the education system

There is a remote education platform to support or monitor students' learning, implemented throughout the education system

## 5.5.4 d. Learning Management System

No LMS is implemented to support or monitor students' learning

There is an LMS to support or monitor students' learning, although its use is low

There is an LMS to support or monitor students' learning, although it is not implemented throughout the education system

There is an LMS to support or monitor students' learning implemented throughout the education system

## 5.6 Do you use a transversal virtual tutoring scheme (asynchronous and/or synchronous teaching), used as a measure to support specific subjects within students' curricula in the case that learning difficulties are detected (according to pedagogical indicators)?

There is no virtual tutoring

There are some initiatives or scattered efforts to implement virtual tutoring that are not integrated into the LMS

There is a model of virtual tutorials integrated into LMS although coverage is partial (e.g. due to connection limitations)

There is an established model of virtual tutoring

## 5.7 Do you have an area that defines guidelines and uses technologies to generate and use digital resources to develop students' learning and skills?

There is no area responsible for defining guidelines and generating digital content

There is an area that defines guidelines and generates digital content, even if it is not fully responsible or undergoes only incipient efforts

There is an area responsible for defining guidelines and generating digital content, even if it is not fully operational

There is an area responsible for defining guidelines and generating digital content that is fully operational

## 5.8 Do you train teachers how to generate and use digital content for the development of students' learning and skills?

There is no type of teacher training on generating/using digital content

There are some initiatives or dispersed teacher training efforts on generating/using digital content

There is a model in place for teacher training on generating/using digital content, although its coverage is partial

There is a systematic and complete model of teacher training on generating /using digital content



5.9 Do you encourage schools to generate digital resources for the development of student learning and skills?

There is no promotion/support for generating/using digital content

There are some initiatives or dispersed efforts for promotion/support to generate/use digital content

There is a promotion/support model to generate/use digital content, although its coverage is partial

A systematic and complete promotion/support model is in place to generate/use digital content

5.10 Do you foster the publication of innovative pedagogical experiences in schools that involve digital pedagogical resources used in the development of students' learning and skills?

There is no promotion/support for the publication of innovative pedagogical experiences used in schools

Some initiative or scattered advocacy efforts exist for the publication of innovative pedagogical experiences used in schools

A promotion/support model for the publication of innovative pedagogical experiences used in schools is in place, although its coverage is partial

A systematic and complete promotion/support model for the publication of innovative pedagogical experiences used in schools is in place

5.11 Have you acquired repositories of digital resources to support curricular training from specialized suppliers? Do you use these resources?

There are no specialized digital resources to support curricular training

There are some specialized digital resources to support curricular training, even if these are incomplete or outdated

There are some packages of specialized digital resources to support curricular training, although these are not used throughout the education system

There are packages of specialized digital resources to support curricular training, that are daily used

5.12 Do you have an established process to manage digital content that provides virtual follow-up for generation, analysis, use, evaluation and subsequent publication of the content?

There is no process for the management of digital content (generation, analysis of resources, use of content, evaluation and publication)

There is no process for the management of digital content (generation, analysis of resources, use of content, evaluation and publication) but some of these functionalities are carried out with ad-hoc tools

There is a process for the management of digital content (generation, analysis of resources, use of content, evaluation and publication), although they only have limited functionalities enabled

There is a process for the management of digital content (generation, analysis of resources, use of content, evaluation and publication) in practice



5.13 Do you have a centralized repository, with a powerful search engine and classification of the digital resources by educational level, mode of use, type of resource and area?

There is no repository of digital content

There is a repository of digital content, even if it is incomplete or outdated

There is a central repository of complete and updated digital content

There is a central repository of complete and updated digital content that allows the classification by educational level, modality, type of resource, and area

5.14 Do you provide information about teachers' digital training and the incorporation of this information into the corresponding unique record?

No information is provided on the information about teacher's digital training or the impact of this information on the corresponding unique record

Some type of aggregate information of the digital training background of teachers and the impact of this information on the corresponding unique record is provided

Information is provided for several disaggregation levels of the digital training background of teachers and the impact of this information on the corresponding unique record, although impartial or outdated

Complete and updated information is provided for several disaggregation levels of the digital training background of teachers and the impact of this information in the corresponding unique record

5.15 Do you provide information about students' digital training and the incorporation of this information into the corresponding unique record?

No background information is provided about the students' digital training and the impact of this information on the corresponding unique record

Some type of aggregate background information on the students' digital training is provided as well as the impact of this information on the corresponding unique record

Background information is provided for different disaggregation levels of the student's digital training and the impact of this information in the corresponding unique record, although impartial or outdated

Complete and updated background information is provided for different levels of disaggregation of student digital training and the impact of this information on the corresponding unique record



## 6. Tools for strategic management

LEVEL	LATENT	INCIPIENT	EMERGENT	ESTABLISHED
<b>6.1 How many and which systems/modules exist within this process? How do they operate?</b>				
6.2 Do you use business intelligence (BI) tools to provide online information through dashboards?				
	There is no BI tool	There is some kind of BI tool (e.g. for the construction of dashboards), even partially used	There is a BI model (e.g. for the production of dashboards), although it is not well established	A BI model is implemented for the management of the education system
6.3 Do you generate dashboards with updated and consolidated information on management indicators?				
6.3.1 a. Assessment of teacher performance				
	No information about it is generated	Some type of related indicator is generated	Some dashboard that includes this indicator is generated, although the process is not automated	There is an automated process for the periodic generation of a dashboard that includes this indicator
6.3.2 b. Positions (filled, vacant, etc.)				
	No information about it is generated	Some type of related indicator is generated	Some dashboard that includes this indicator is generated, although the process is not automated	There is an automated process for the periodic generation of a dashboard that includes this indicator
6.3.3 c. Sick and personal leave				
	No information about it is generated	Some type of related indicator is generated	Some dashboard that includes this indicator is generated, although the process is not automated	There is an automated process for the periodic generation of a dashboard that includes this indicator
6.3.4 d. Replacements with double and simple expenditure				
	No information about it is generated	Some type of related indicator is generated	Some dashboard that includes this indicator is generated, although the process is not automated	There is an automated process for the periodic generation of a dashboard that includes this indicator



## 6.3.5 e. Expenditure on salaries

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

## 6.3.6 f. Teacher-student ratios

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

## 6.3.7 g. Occupation of school buildings

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

## 6.3.8 h. Total investment by school vs. academic results

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

## 6.3.9 i. Investment in social assistance (transport, meals, scholarships)

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

## 6.4 Do you generate dashboards with updated and consolidated information about student performance and profile?

## 6.4.1 a. Progress in school (repetition/completion of years, dropout, over-age, others)

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator



6.4.2 b. Results in standardized sub-national, national, international and regional assessments

No information about it is generated

Generan algún tipo de indicador relacionado

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

6.4.3 c. Academic results

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

6.4.4 d. Learning context: school climate or welfare

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

6.4.5 e. Other skills such as citizen, digital (ICILS) or socio-emotional skills

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

6.4.6 f. Indicators from sources external to the educational system

No information about it is generated

Some type of related indicator is generated

Some dashboard that includes this indicator is generated, although the process is not automated

There is an automated process for the periodic generation of a dashboard that includes this indicator

6.5 Does the system calculate some synthetic indicator of the quality of education at the school level?

No synthetic indicator of educational quality at school level is calculated

Some synthetic indicator of educational quality is calculated at the school level, even if its coverage is partial

Synthetic indicators of educational quality are calculated at the school level, although they are outdated

Synthetic indicators of educational quality are calculated at the school level and complete and updated information is available



6.6 Is it feasible to generate/visualize indicators of students' individual performance or their combined performance for different levels through the system? Is it feasible to perform comparison at the level of section, school, supervision circuit, region or administrative headquarters and over time?

The system does not allow to change the indicator's visualization level

The system allows changing the indicator's visualization level for some predetermined views

The system allows changing the indicator's visualization level, but with limited functionalities (partial coverage)

The system allows changing the indicators' visualization level and making comparisons between levels over time

6.7 Do you consolidate information only for state schools or do you also include information about the private sector?

Only public schools' information is consolidated

Information from public and subsidized/concession schools is consolidated

Information from the whole education system is consolidated, including private sector and subsidized/concession schools, but with partial coverage

Information from the entire education system, including private and subsidized/concession schools, is consolidated with full coverage

6.8 Do you have the human resources to design, produce and analyze dashboards and communicate their results?

There are no human resources to design, produce, analyze and communicate the dashboards

There are some human resources to design, produce, analyze and disseminate the dashboards, although it is not part of their responsibilities

There are human resources to design, produce, analyze and disseminate the dashboards, although they are not specialized

There are specialized human resources to design, produce, analyze and disseminate the dashboards

6.9 Are the dashboards available actually used in decision-making and school management?

The boards that are generated are not used for management purposes

To some extent the dashboards that are generated are used for management purposes

The dashboards that are generated are used for management purposes, but not for all levels of decision making

The dashboards that are generated are used for management purposes at all levels of decision making

6.10 Have some dashboards been implemented?

There are no dashboards implemented

There is some kind of dashboard implemented

Dashboards are implemented, but information is incomplete or outdated

There are updated and complete dashboards implemented (covering the whole educational system)





#### 6.11 Do you use appropriate tools for the timely detection of learning challenges or dropout risks?

There is no tool (e.g. software) for the timely detection of learning challenges or dropout risks

There are some tools (e.g. software) to detect timely learning challenges or dropout risks, although the tools' main functionality is not automatically generating indicators based on large volumes of data

There are some tools (e.g. software) to estimate indicators whose main function is automatically generating indicators based on large volumes of data, although not working efficiently to meet information demands

There are some tools (e.g. software) to estimate the indicators whose main function is automatically generating indicators based on large volumes of data, which efficiently satisfies the demand for information

#### 6.12 Have executive management levels (ministries, regional offices, schools, teachers) received training in interpreting dashboards?

The executive levels are not able to analyze and interpret the indicators. They are not prepared to elaborate their own dashboards from cubes of information

Some executive levels have received some type of training to analyze and interpret indicators

Some executive levels have received training and build new dashboards based on their management needs

All executive levels have received training and build their own dashboards according to their management needs

#### 6.13 Can SIGED users create their own dashboards?

The SIGED is not enabled for users to create their own dashboards

The SIGED has limited functionality for users to generate their own control panels

The SIGED is enabled for users to create their own dashboards, but this functionality is only enabled for some levels of management

The SIGED is enabled for users to create their own dashboards

#### 6.14 Is the data available in the dashboards adequately updated in terms of time and form?

The information on the dashboards is completely outdated (it does not show the latest information available in the SIGED)

Information on dashboards is barely updated (less than 50% of the cases show the latest information available in the SIGED)

Information on dashboards is dynamically updated and between 50% and 80% of the cases shows the latest information available in the SIGED

Information on dashboards is dynamically updated and shows the latest information available in the SIGED (of 80% or more)



6.15 Do you use other qualitative measurement tools to guide and make decisions based on the management objectives established?

There is no qualitative information used to guide and make decisions based on established objectives

Some kind of qualitative measurement information is generated to guide and make decisions based on established objectives

There are qualitative measurement tools to guide and make decisions based on established objectives, although it does not generate complete or periodic information

There are qualitative measurement tools that generate complete and periodic information to guide and make decisions based on established objectives

6.16 Do the tools in place allow for the interpretation of the performance of the different management processes, programs and projects at each level of SIGED (school, supervisors, regional directors, level directors, etc.), identifying deviations or variations with respect to the goals?

The tools do not allow for the interpretation of the performance of the processes, programs and projects

The tools allow to make some interpretation of the performance of the processes, programs and projects

The tools allow to interpret the performance of the processes, programs and projects, although it is not broken down for the different levels of decision making

The tools allow to interpret the performance of the processes, programs and projects for the different levels of decision making

6.17 Is information about the performance of the educational system made available to civil society (parents, communities, oversight institutions)?

No information is provided to civil society

Some aggregated information is provided on the performance of the education system to civil society

Information on the performance of the education system is provided to civil society at different levels of disaggregation, although impartial or outdated

Complete and updated information on the performance of the education system is provided to civil society at different levels of disaggregation

## 7. Technological infrastructure

LEVEL

LATENT

INCIPIENT

EMERGENT

ESTABLISHED

7.1 Do schools have the connectivity to make use of administrative and pedagogical management systems?

The levels of connectivity coverage (internet or alternative network) for school management is very low (only 25% or less of the institutions have connectivity)

The levels of connectivity coverage (internet or alternative network) for school management is low (between 25% and 50% of the institutions have connectivity)

The levels of connectivity coverage (internet or alternative network) for school management is medium (between 50% and 75% of institutions have connectivity)

The levels of connectivity coverage (internet or alternative network) for school management is high (more than 75% of the institutions have connectivity)



7.2 Is connectivity sufficient to meet the demand from administrative and pedagogical areas, either at the central or district level?

The levels of connectivity (internet or alternative network) for administrative and pedagogical management is very low (only 25% or less of the administrative and pedagogical areas have connectivity)

The levels of connectivity (internet or alternative network) for administrative and pedagogical management is low (between 25% and 50% of the administrative and pedagogical areas have connectivity)

The levels of connectivity (internet or alternative network) for administrative and pedagogical management is medium (between 50% and 75% of the administrative and pedagogical areas have connectivity)

The levels of connectivity (internet or alternative network) for administrative and pedagogical management is high (more than 75% of administrative and pedagogical areas have connectivity)

7.3 Do you have technological infrastructure (software and hardware) for the processes handled by Educational Information and Management Systems (SIGED) that cater to demand, with redundancy in the production environment?

There is some kind of technological infrastructure

There is technological infrastructure for the SIGED, although it does not fully cover the key management processes

There is technological infrastructure that covers all the key management processes, even if it is not fully operational

There is technological infrastructure that fully covers all the key management processes and that responds to the operational demand of the sector

7.4 Do you implement a development, a testing, and a production environment, with adequate infrastructure?

None of the environment are implemented

There are some of the environments at least partially implemented

The three environments are implemented, even if only partially

The three environments are fully implemented with technological infrastructure that meets the basic requirements

7.5 Do you use an adequate procedure for the protection and recovery of information?

There is no procedure for the protection and recovery of the SIGED information

There is some kind of procedure for the protection and recovery of the SIGED information, even if it is not efficient or completely reliable

There is a procedure for the protection and recovery of the SIGED information, even if it is not fully operational

There is a fully operational procedure that efficiently and reliably protects and restores the SIGED information

7.6 Do you implement automatic auditing processes for sensitive data that can be modified by the system's users?

There is no mechanism for auditing sensitive data that can be modified by the system's users

There is some mechanism for auditing sensitive data that can be modified by the system's users, even if its coverage is partial (only some data is audited)

There is an automatic auditing mechanism for sensitive data that can be modified by the system's users that covers all SIGED information, even if it is not fully operational (e.g., periodic audits are not carried out)

There is an automatic audit mechanism for sensitive data that can be modified by the system's users, covering all the SIGED information fully operational SIGED



7.7 Do you have updated technical documentation about the information systems in use?

There is no technical documentation of the information systems

There is some technical documentation of the information systems, even if it is incomplete or outdated

There is complete technical documentation of information systems, although it is outdated

There is complete and updated technical documentation of the information systems

7.8 Do you have operating manuals (standardized work methodology)?

There is no methodology on the system's operation

There is some standardized methodology on the system's operation, even if it is not documented (the process takes place, but there is no documentation about it)

There is a documented methodology on the systems' operation, even if it is incomplete or outdated

There is a complete and updated documented methodology on the systems' operation

7.9 Do you have adequate development architecture and tools?

The architecture and technological tools (e.g. database management software, development language, server) do not respond to the needs of the SIGED

The architecture and technological tools (e.g. database management software, development language, server) respond to the needs of the SIGED, even if only partially or with incompatibility problems

The architecture and technological tools (e.g. database management software, development language, server) respond to the needs of the SIGED, even if only partially

The architecture and technological tools (e.g. database management software, development language, server) respond to the needs of the SIGED in an integral way

7.10 Do you apply "protection of identity" management mechanisms, understood as the set of authentication and online access technologies designed to offer users robust and easy-to-use security, in order to identify accesses to digital services and applications?

There is no identity protection mechanism

There are some scattered efforts of identity protection and authenticity for system users

There is an established mechanism of identity protection and authenticity for system users, even if it does not work efficiently

There is an established mechanism of identity protection and authenticity for users of the system that works efficiently

7.11 Do you apply cybersecurity management that includes: (a) availability of data; (b) integrity and authenticity; and (c) confidentiality?

There is cybersecurity management

There are some scattered efforts of cybersecurity

There is a formal cybersecurity mechanism, although it is not fully operational

There is a formal cybersecurity mechanism that is fully operational



#### 7.12 Do you have a maintenance and technological support policy for the SIGED?

There is no maintenance or technological support policy for the SIGED

There are certain unscheduled maintenance and technological support activities for the SIGED

There is a schedule for maintenance and periodic support of the SIGED

There is a maintenance and technological support policy/mechanism for the SIGED

#### 7.13 Does the technology area provide updated digital information about the projects' progress?

The relevant actors have no access to information from the technology area on the projects' progress levels

The relevant actors have access to some information (e.g. reports) from the technology area on the projects' progress levels

Relevant stakeholders have frequent access to information from the technology area on the projects' progress levels, although impartial or outdated

The relevant actors have real-time access to information on the projects' progress levels, with the respective access controls for the different actors

#### 7.14 Are the different systems integrated at the data level?

The data of the different systems are not integrated

There is some level of integration of systems at the data level

Some systems are fully integrated at the data level

All systems are integrated at the data level

#### 7.15 Are the systems that have been implemented compatible and interoperable?

There is no compatibility or interoperability between the different systems

There is some level of compatibility or interoperability between different systems

Some systems are fully compatible or interoperable

All systems are fully compatible or interoperable

#### 7.16 Is the SIGED integrated or does it interoperate with external systems (belonging to other government agencies in the same jurisdiction, national bodies for decentralized systems, the private sector or civil society)?

There is no integration or interoperability between the SIGED and other key external systems (other public entities within the same jurisdiction, national entities for decentralized systems, private sector or civil society)

There is some level of integration or interoperability between the SIGED and other key external systems (other public entities within the same jurisdiction, national entities for decentralized systems, private sector or civil society)

Some SIGED modules are fully integrated or interoperable with other key external systems (other public entities within the same jurisdiction, national entities for decentralized systems, private sector or civil society)

The SIGED is fully integrated or interoperable with other key external systems (other public entities within the same jurisdiction, national entities for decentralized systems, private sector or civil society)



## 8. Governance and institutional framework

LEVEL	LATENT	INCIPIENT	EMERGENT	ESTABLISHED
8.1 Are there established norms (laws, decrees, resolutions, provisions, manuals) that regulate key management processes and the systems that support these processes?				
	There is no legal regulation (laws, decrees, resolutions, provisions, manuals) that define and establish the responsibilities of SIGED	There are some legal regulations (laws, decrees, resolutions, provisions, manuals) that define some key processes or establish some responsibilities of the SIGED	There are some legal regulations (laws, decrees, resolutions, provisions, manuals) that define and establish the responsibilities of SIGED, even if they are outdated	There are updated and in force legal regulations (laws, decrees, resolutions, provisions, manuals) that define and establish the responsibilities of SIGED
8.2 Is there effective compliance with the norms indicated in the previous answer?				
	There is no relationship between the legal regulations and the operation of the SIGED	Some processes comply with some aspects of the legal regulations	Some processes comply with all legal regulations	The SIGED operates by following all legal regulations
8.3 Are there norms to protect the privacy of the information held by SIGED and guarantee its ethical use?				
	There are no regulations that protect the privacy of the information contained in the SIGED, or that regulate the use of this information to guarantee its ethical use	There are regulations that protect the privacy of the information contained in the SIGED, and that regulate the use of this information to guarantee its ethical use, but they are not implemented	There are regulations that protect the privacy of the information contained in the SIGED, and that regulate the use of this information to guarantee its ethical use, but these are partially implemented	There are implemented regulations that protect the privacy of the information contained in the SIGED that regulate the use of these to guarantee an ethical use
8.4 Do you have and apply norms to regulate the disclosure of information from SIGED related to education system results?				
	There are no norms that regulate the dissemination of information from SIGED related to education system results	There are norms that regulate the dissemination of information from the SIGED related to education system results, but they are not implemented	There are norms that regulate the dissemination of information from the SIGED related to education system results, but these are partially implemented	There are norms and regulations that are implemented to regulate the dissemination of information from the SIGED related to education system results



8.5 Is there a clear strategic vision for the implementation or development of the education management and information system (unique identifiers, virtualization of processes, modernization of systems, integrated approach, etc.)?

There is no strategic vision for the development of the SIGED

There is a strategic vision for the development of SIGED, even if it is not documented

There is a partially documented strategic vision for the development of SIGED

There is a documented strategic vision for the development of SIGED (e.g. they have an annual or multi-year strategic plan)

8.6 Does SIGED have a strategic plan approved and backed by the educational system's top authorities?

There is no comprehensive strategic plan

There is a limited project in terms of coverage (e.g. less than 50% of processes and subprocesses)

There is a project with coverage reaching between 50% and 80% of the processes and subprocesses, with short, medium, and long-term goals

There is an adequate project with high coverage (more than 80% of the processes and subprocesses), with short, medium and long-term goals (e.g. an annual or multi-year operating plan)

8.7 Do you have the necessary human resources to improve SIGED in the short, medium and long term?

There are barely enough human resources for the operation of the SIGED

There are human resources for the improvement of certain functionalities of the SIGED

There are human resources for significantly improving the SIGED functionalities or adding new functionalities

There are human resources for continuously improving the SIGED functionalities or adding new functionalities, depending on the goals and objectives of the project

8.8 Do you have the necessary financial resources to improve SIGED in the short, medium and long term?

There are barely enough financial resources for the operation of SIGED

There are financial resources for the improvement of certain SIGED functionalities

There are financial resources for significantly improving the SIGED functionalities or adding new functionalities

There are financial resources for continuously improving the SIGED functionalities or adding new functionalities, depending on the goals and objectives of the project

8.9 Do you have a change management plan for SIGED?

There is no change management plan

The change management plan is limited in terms of coverage (less than 50% of the processes and subprocesses)

There is a change management plan with significant coverage (between 50% and 80% of processes and subprocesses)

There is a change management plan with high coverage (more than 80% of processes and subprocesses)

