Module 3: Improving Education Management Information Systems (EMIS)

Module overview – objectives, topics and learning outcomes

Assessing the state of education in a country demands information about the types and level of differing inputs, resources, governance, operations and outcomes of a country's education system. Measurement of educational outcomes needs to inform the Educational Management Information System (EMIS), in consonance with the dictum that anything that is measured gets done. An EMIS provides systematic, quality data in a well-structured enabling environment that facilitates utilization of the information produced in planning and policy dialogue.

This module has been prepared with a view to helping managers in the education system in familiarizing themselves with the basics of structuring and managing an EMIS. The role of EMIS in monitoring SDG 4 and its targets is especially underpinned. In this module we review the history of EMIS in different country contexts and the challenges of implementing EMIS. We evaluate what makes a good EMIS; how the elements of an EMIS can fit together; and different ways in which EMIS data can be utilized. We review the different types of systems which comprise EMIS and how these can fit together to create a national EMIS. We also review some of the common methodologies used to evaluate an EMIS in a country.

The following topics are covered by this module:

- Understanding EMIS;

- What constitutes an effective EMIS;

- Utilization of EMIS data in education and monitoring SDG 4;

- Improving EMIS through collecting individual data with an integrated School Management Information System;

- Innovations related to data collection with EMIS.

After completing the module, learners will have acquired the following learning outcomes:

- Understanding an enabling environment, the necessary support systems, the production of data and dissemination;

- A better understanding of EMIS data that is utilized in education planning, administration, monitoring and evaluation;

- An understanding that EMIS can report information regarding gender, disability and children in and out of the formal education system;

- Understanding how EMIS caters to the Non-Formal Education (NFE) sector;

- Knowledge about School Management Information Systems (SMIS) and their relation to EMIS;

- Ensuring the tracking of individuals through EMIS, while also guaranteeing their privacy.

1 Understanding the Education Management Information System

The following chapter provides an introduction to EMIS and gives an overview of the direct role EMIS plays in education planning, monitoring, evaluation and administration and how, as a rich source of information, EMIS provides important data for all stakeholders in education. This chapter explores how EMIS can be defined depending on the purpose it has been developed for. This section also reviews the historic development of EMIS.

1.1 What is EMIS and why do we need it?

For any organization, a general management information system is designed to assist managerial and professional workers by processing and disseminating vast amounts of information to managers and administrators organization-wide[1].

The information is selected and presented in a format that is suitable for managerial decision-making and for planning and monitoring of an organization's activities. Management information systems can be used to support education managers to make strategic, tactical and operational decisions.

Administrative management information systems can help provide accurate, comprehensive and timely data collection which can promote more rational and effective education policy-making. This can result in improved decision-making regarding the volume and allocation of public financing; the best way to reach children that are most in need (due to socio-economic circumstances, special needs, etc.); staff recruitment; training and quality; and adherence to standards[2].

A management information system for education may therefore be construed as an integrated technology framework that automates the entire end-to-end management of education and its related information. The primary aim is to collect and analyse the relevant

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[1] Alavi, M., & Leidner, D. (1999). Knowledge management systems: Issues, challenges, and benefits, Communications of the Association for Information Systems, 1(7).

[2] Ishimine K., Tayler C., Bennett J. (2010). Quality and Early Childhood Education and Care: A Policy Initiative for the 21st Century, International Journal of Child Care and Education Policy, November 2010, Volume 4, Issue 2, pp 67–80.
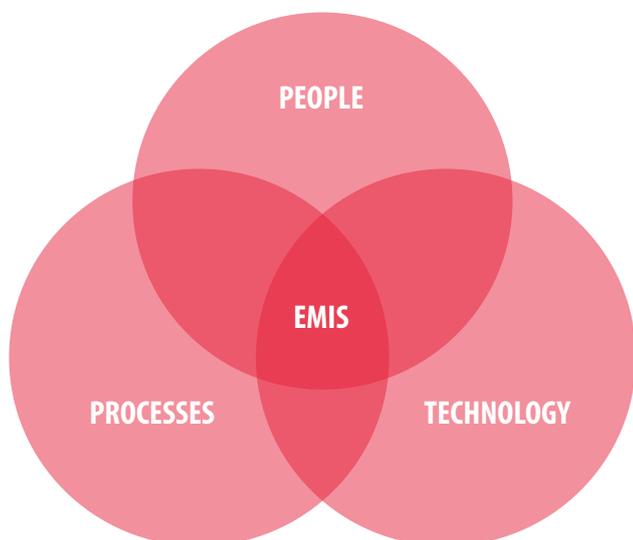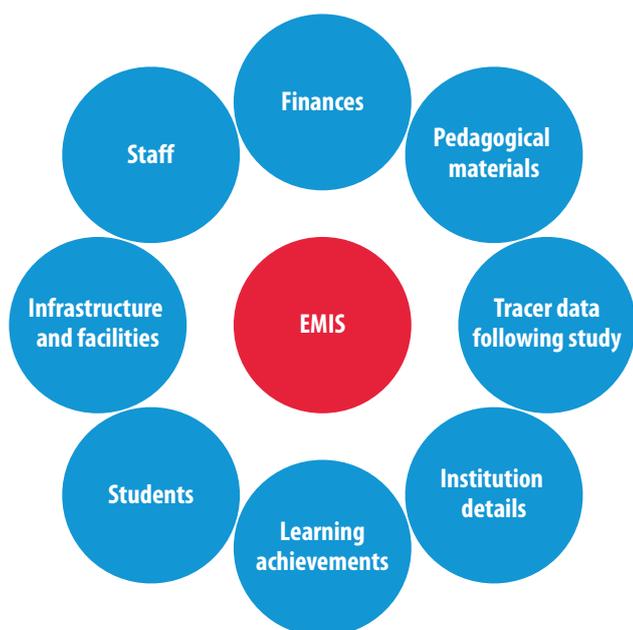
Figure 1: What EMIS Requires

Figure 2: Elements of an EMIS covering all sub-sectors of the education sector

information for better decision-making and to facilitate administration of the education system.

An EMIS can be defined as the ensemble of operational systems and processes – increasingly supported by digital technology – that enables the collection, aggregation, analysis and use of data and information in education, including for management and administration, planning, policy formulation and monitoring and evaluation (M&E). This definition insists on the systemic nature of EMIS – a fact which is often overlooked in efforts to reinforce government information systems[3].

A comprehensive EMIS is defined as not only including **ADMINISTRATIVE AND PUPIL DATA**, but also **FINANCIAL**, **HUMAN RESOURCES** and **LEARNING DATA** as well as data on graduates after the completion of their studies. This information can and should be available, both at the individual and aggregate level, for policy-analysis and formulation, planning, monitoring and management at all levels of an education system[4].

It is a system of people, technology, models, methods, processes, procedures, rules and regulations that function together to provide education leaders, decision-makers and managers at all levels with a comprehensive, integrated set of relevant, reliable, unambiguous and timely data and information to support them in the completion of their responsibilities[5]. It is crucial for tracking changes, ensuring data quality and timely reporting of information and facilitating the utilization of information in decision-making. This very circumstance makes it one of the principal sources of data to monitor education sector plans, as well as SDG 4 commitments.

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[3] UNESCO. (2018). Working Papers on Education Policy Re-Orienting Education Management Information Systems (EMIS) towards inclusive and equitable quality education and lifelong learning, Working Paper 5.

[4] Abdul-Hamid, Husein. (2014). 'What Matters Most for Education Management Information Systems: A Framework Paper.' SABER Working Paper Series No. 7, World Bank, Washington, DC.

[5] UNESCO. (2012), Education Micro Planning Tool Kit, Module 5, Data and Information for Decision-Making and Planning, UNESCO Bangkok.

The type of data entered into the system needs to follow a logic, fixed methodology and have a well-defined purpose. A successful EMIS is credible, operational in planning and policy dialogue, as well as teaching and learning. It produces and monitors education statistics within an education system and has a multifaceted structure, comprising the technological and institutional arrangements for collecting, processing and disseminating data[6].

As the potential users of data, education administrators, managers and staff, such as teachers, are systematically provided with accurate and timely information so that decision-making, planning, project development and other management functions and operations can be carried out effectively.

1.2   The usefulness of EMIS in Education

The main use of EMIS data is – and has been at the national level. It is used little at the district level because little responsibility is typically allocated to this level. Countries primarily use EMIS for national-level planning and budgeting and resource allocation, but not yet as a tool for the management of routine and day-to-day education system activities.

Countries do not usually provide application of EMIS data at the institutional (school) level. However, the application of EMIS data can expand the role of day-to-day management in EMIS, such as recording transactions related to teachers, students and equipment which can contribute to increased transparency, improved administrative management quality – and at the same time, the provision of quality data for M&E.

To be useful, EMIS data should be adapted and made accessible to all levels of decision-making within the education system. UNESCO distinguishes three main levels of data use, which correspond to the tasks of three levels of education administration in most education systems[7]. The higher the level of detail and disaggregation of information to use, the lower the level of decision-making, i.e., closer to the school level.

Across these three levels of decision-making, EMIS creates value in four distinct, but interrelated educational processes:

1.   Management and administration;

2.   Planning;

3.   Policy formulation;

4.   Monitoring and evaluation[8].

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[6] Abdul-Hamid H. (2014). Lessons Learned from World Bank Education Management Information System Operations Portfolio Review, 1998–2014, The World Bank Group, access: http://dx.doi.org/10.1596/978-1-4648-1056-5

[7] UNESCO. (2012). Education Micro Planning Tool Kit, Module 5, Data and Information for Decision-Making and Planning, UNESCO Bangkok.

[8] UNESCO. (2018). Working Papers on Education Policy Re-orienting Education Management Information Systems (EMIS) towards inclusive and equitable quality education and lifelong learning, Working Paper 5.
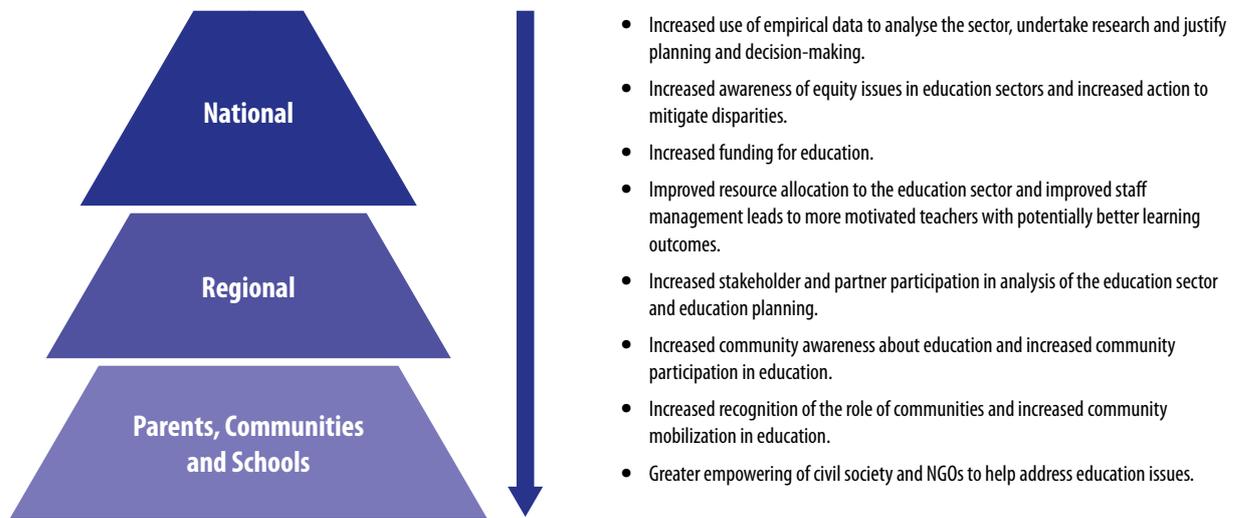
1.3 EMIS and the changing perspectives of different stakeholders

EMIS can contribute towards the changing perspectives of the different stakeholders including government, parliament, the media, the public and communities. With this in mind, the following initiatives are supported:

- **ENCOURAGE ITS USE IN EDUCATION PLANNING, MONITORING, AND OTHER ACTIVITIES:** Making data available in the correct format can help ensure that decision-makers use data to support and justify their actions and institutionalize the use of EMIS data for decision-making.

- **ENCOURAGE INVESTMENT IN THE EDUCATION SECTOR:** Adopting evidence-based management encourages governments to increase investment in the education sector by government, the community and development partners.

- **EMIS DATA CAN HELP PROMOTE EQUALITY AND ENCOURAGE COMMUNITY PARTICIPATION:** The availability of EMIS data helps improve school facilities, staffing and staff morale through improved career management. Good data can also be promoted through the media and used to advocate for community participation in education. Civil society can be empowered through data to conduct policy dialogue with the government and to mobilize community contributions towards education.

- **EMIS DATA CAN HELP INFORM PARENTS AND CHILDREN:** EMIS can help parents and communities be more informed and help them understand if their schools are meeting national standards or not.
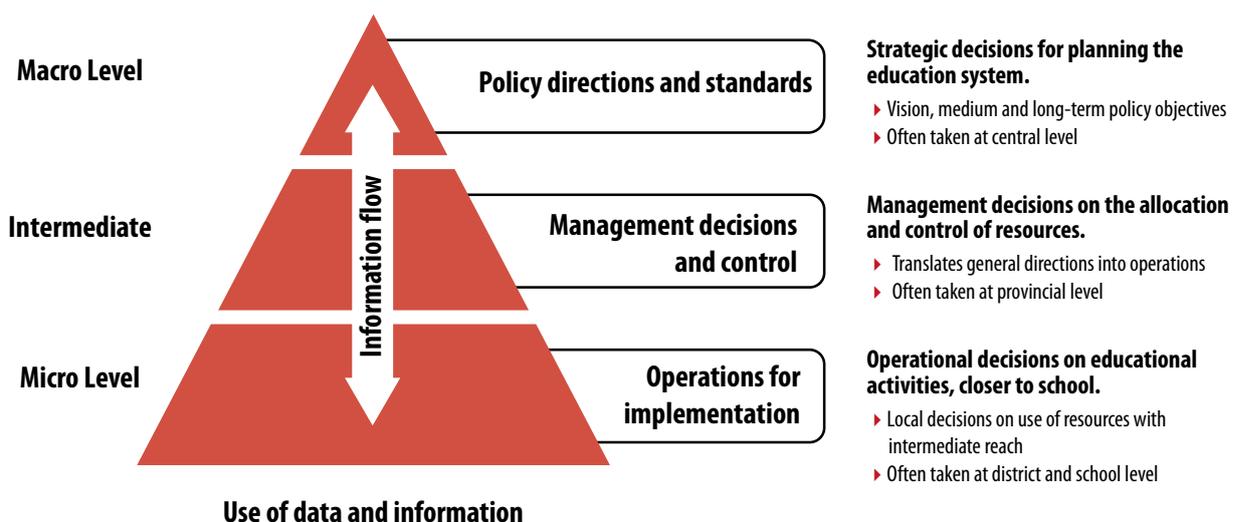
Figure 3 on the next page illustrates the relationship between EMIS data and changing attitudes, from the national level to the community level. This exemplifies how a well-functioning EMIS can spur an environment that is more beneficial to education sector development and specifically better learning outcomes.

Figure 3: Elements of an EMIS covering all sub-sectors of the education sector

- Increased use of empirical data to analyse the sector, undertake research and justify planning and decision-making.
- Increased awareness of equity issues in education sectors and increased action to mitigate disparities.
- Increased funding for education.
- Improved resource allocation to the education sector and improved staff management leads to more motivated teachers with potentially better learning outcomes.
- Increased stakeholder and partner participation in analysis of the education sector and education planning.
- Increased community awareness about education and increased community participation in education.
- Increased recognition of the role of communities and increased community mobilization in education.
- Greater empowering of civil society and NGOs to help address education issues.

Different stakeholders require answers to different questions; a well-functioning EMIS provides data that can respond to the various questions posed by actors across all levels of the education system. The level of detail of data and information decreases as the level of decision-making goes up, where information becomes more aggregated and synthesized, integrating all available data so that assessment of the education system can take place over regions rather than individual schools. Figure 4 illustrates the use of EMIS data by the different levels of decision makers.

Figure 4: Use of EMIS data by level of decision-making

Macro Level — Policy directions and standards

Strategic decisions for planning the education system.
- Vision, medium and long-term policy objectives
- Often taken at central level

Intermediate — Management decisions and control

Management decisions on the allocation and control of resources.
- Translates general directions into operations
- Often taken at provincial level

Micro Level — Operations for implementation

Operational decisions on educational activities, closer to school.
- Local decisions on use of resources with intermediate reach
- Often taken at district and school level

Information flow

Use of data and information

Source: UNESCO. (2012). Education Micro Planning Tool Kit, Module 5, Data and Information for Decision-Making and Planning, UNESCO Bangkok. **Note:** Operational decisions are often accommodated in transactional systems such as Human Resource Information Systems (HRIS), School Management Information Systems (SMIS or SIS) and Financial Management Information Systems (FMIS).

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> **Remember!**
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> The three decision-making levels, which sometimes overlap with each other at the administrative levels, require different types of reports and functions requiring education data in order for education actors to be able to make judgements appropriate to their role in the education system. A good EMIS should be capable of providing information and facilitating functions for each of these levels of operation.

MACRO-LEVEL ADMINISTRATION

- Responsible for strategic decisions concerning the planning of the whole education system.
- Concerns general policy directions.
- Information required are aggregates that are used for setting and monitoring the policy objectives at the national and regional levels.

INTERMEDIATE LEVEL

- Comprises decision-makers who are in charge of **management and control** in the allocation and monitoring of the use of resources.
- Translates general policy directions into more technical, operational decisions.
- Requires more specific data to ensure an efficient and equitable distribution of resources, to detect possible shortcomings and to optimize the use of resources.

MICRO-LEVEL

- Corresponds to operational tasks of defining the use of allocated resources to deliver education services and to translate them into concrete results.
- Concerned with routine activities closer to the school.
- Decisions have local and immediate reach and hence will require more detailed information.

1.4 Understanding the different EMIS types and data

When describing information systems, we often classify them according to the type of data they store, or the functions they manage. For example, a system that manages financial information may be termed a Financial Management Information System (FMIS).

Such a system may be a stand-alone system, or it may be part of an **integrated** (or shared) system. It may be operated on completely different information standards and even through different departments, or ministries. Each system may cover a single sub-sector, such as basic education.

The following table lists and describe the main categories of a system which are typically part of an overarching EMIS. The specific names and terms is very much dependent on the nature of the systems operated under each ministry and department and may therefore vary occasionally.

Table 1: Different Types of Information Systems comprising an EMIS

Type of Data	Module or System Names	Description
Student Records and Information	Student tracking or information System.	Individual student records exist that collect and store information on individual students and update this information during the duration of the student's stay in the school. Background information on students can collect information on deprived students and those that receive financial aid, such as grants, or scholarships. Student tracking systems will also usually contain additional information on the condition of the student, including information such as disability, ethnicity, language at home and even the wealth, or income status of the family. In sophisticated systems, financial allocations to individual students may be tracked such as the award and disbursement of disability allowances, stipends and scholarships.
Student Academic Record keeping	Student tracking or information system. Examinations or assessment system,	These manages information on the academic performance of the students at regular intervals, such as by each semester and the end of the academic year. Depending on the nature of the EMIS system, this information may be available to teachers and even to pupils and parents under secure access.

General Staff Management	Personnel or Human Resource Management Information System	Staff records are often maintained in a Personnel Management Information System (PMIS). The full biodata, academic history and in-service training records of staff may be managed through this system. The PMIS may also manage payroll and other functions such as leave, disciplinary action, promotion and demotion, however the extent to which it does will often depend on the relationship and roles assigned to ministerial bodies such as ministries of finance, home affairs and education and the extent to which each ministry shares information.
Teacher information	Teacher or personnel management information system	This relates to information on teachers, such as, their attitudes, innovations used in teaching and outcomes of teaching-learning in terms of achievements by students. It can also include information relating to the activities a teacher undertakes at the school-level, such as their teaching hours and subjects taught.
Financial Information	Financial Management Information System.	This includes all data on financial transactions within the school such as, grants received, salaries paid, maintenance charges, fees collected, scholarships disbursed, expenditure incurred on welfare measures, such as the school lunch programme and money spent on enhancing school infrastructure. In many ministries, this data will be stored under Financial Management Information Systems (FMIS) which support the automation and integration of public financial management processes, including budget formulation, execution (e.g. commitment control, cash/debt management, treasury operations), accounting and reporting.
Procurement and Asset Data	Asset Management Information System. Procurement System.	Asset data includes the allocation and condition of fixed and variable assets owned by the school. This can be as simple as completing an asset inventory on an annual census form, or it may be a more complex and dedicated system capable of managing and tracking all institution fixed, mobile, hard and soft assets, including documents relating to asset procurement. This system may often be part of a financial system.
Physical facilities	Facilities.	Physical facilities include fixed assets under the school such as the number and condition of classrooms, Water, Sanitation and Hygiene (WASH), playgrounds and other physical facilities. This data may be recorded once annually, or it may be part of a procurement and asset data system, or a greater financial system.
Textbooks and Instructional Material	Textbook Information System.	Textbooks, teachers' guides and other pedagogical materials are often managed through distribution and procurement systems which help determine how many textbooks are required for each subject for each school or institution. As in the case of asset systems, these types of systems may be simple or complex depending on the country context.
Planning and Scheduling	School Academic Planning	This relates to planning of activities for the school each year in terms of actions planned, implementation, spending of earmarked budgets and assessing performance.

1.5   Evolution of EMIS

EMIS has existed in one form or another in many countries for decades and in some cases centuries. Bureaucracies, such as those in the British Empire, India and China, have compiled education statistics on students, teachers and other aspects of education institutions for centuries.

EMIS rarely appears out of a void but rather evolves or is enhanced from an existing statistical system through focused efforts such as those of projects, programmes and government initiatives.

- For example, in Myanmar the government has collected and manually compiled information on teachers, students, finances and other aspects of schools on a monthly basis prior to initiating modern EMIS development programmes to help automate the task of compiling and analysing data.

Increasingly, EMIS are moving away from using data narrowly for counting students and schools. Instead, they use data to drive system-wide innovations, accountability, professionalization and most importantly, quality and learning[9]. This broader use of data also benefits classroom instruction and support in schools.

Figure 5 below shows the evolution of EMIS in countries[10]. The figure highlights the path EMIS has taken from independent annual census collection, through to fully integrated and decentralized government systems. EMIS also becomes increasingly granular with the introduction of web-based individual student tracking systems and human resource management information systems.

Drivers of change

- Changing technologies;
- Increased expectations from education stakeholders, administrators and planners;
- Evolving national and international standards (SDG, equity, disability etc);
- Increased accountability to the public;
- Increased complexity of education systems, for example public, private, Non-Formal (NF), Technical and Vocational Education and Training (TVET) and Higher Education (HE);
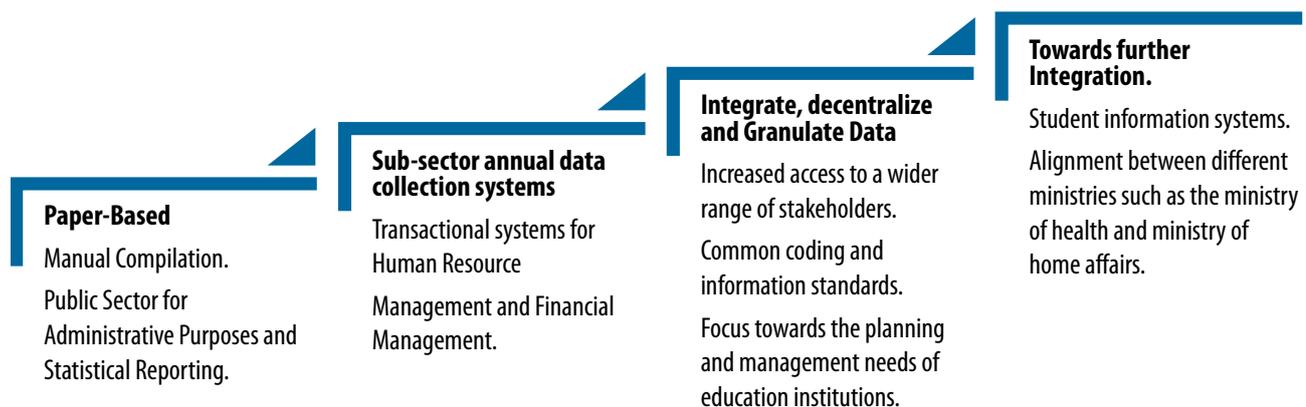- Increased focus on outcomes (learning, wellbeing);

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[9] Abdul-Hamid, H. (2017b). Data for Learning: Building a Smart Education Data System. Directions in Development-Human Development; Washington, DC: World Bank. © World Bank, access: https://openknowledge.worldbank.org/handle/10986/28336 License: CC BY 3.0 IGO.

[10] UNESCO. (2018). Re-orienting Education Management Information Systems (EMIS) towards inclusive and equitable quality education and lifelong learning Subosa M, West M., Document code:ED-2018/WS/11.

- Increased need to engage stakeholders at the school-level, such as parents and teachers.

Countries surveyed reported that these factors have all been instrumental in propelling systems towards increasing granularity of data[11], complexity of systems and towards various forms of integration and decentralization. Experiences of EMIS from a number of countries receive further elaboration in the **Annex.**

Figure 5: General path towards the evolution of EMIS in Surveyed Countries

Paper-Based

Manual Compilation.

Public Sector for Administrative Purposes and Statistical Reporting.

Sub-sector annual data collection systems

Transactional systems for Human Resource

Management and Financial Management.

Integrate, decentralize and Granulate Data

Increased access to a wider range of stakeholders.

Common coding and information standards.

Focus towards the planning and management needs of education institutions.

Towards further Integration.

Student information systems.

Alignment between different ministries such as the ministry of health and ministry of home affairs.

1.6   Challenges of EMIS Development

Even though most countries in the Asia-Pacific region have set up EMIS to collect, store, analyse and disseminate education data as a pillar of their decision-making processes, various challenges exist to monitor progress with SDG 4. Before we discuss how to ensure the development of an effective EMIS, we will look at the common challenges we will encounter so we are better prepared to deal with these challenges when they arise.

i. *Lack of political commitment*

The main limitation relates to lack of recognition on the need to establish an effective EMIS system that focuses on all aspects of collection and dissemination of reliable and quality data to meet the requirements of both good governance and the needs of monitoring all the targets and indicators of SDG 4.

ii. *Qualified personnel*

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[11] Individual student and teacher data.

Hiring highly competent professional staff to work with an EMIS can be an issue because of government service rules. Deciding upon a high pay scale to attract competent professionals does not necessarily result in actually hiring personnel with such a competence due to promotion rules in ministries. Senior positions are too often filled according to seniority of service and not competence.

iii. *Obfuscation in roles and responsibilities*

Data duplication and multiple data producers in the education sector without proper coordination is another challenge. In many countries, there is a lack of clarity in collecting, processing, disseminating and the sharing of data among different data producers.

iv. *Limited data coverage*

Basic education is the only area where almost all Asia-Pacific countries have a decent system to collect data through EMIS. In many countries, higher education, NFE and Early Childhood Education (ECE) are not part of EMIS. The lack of holistic data collection systems in education sub-sectors and challenges in some phases of the data production cycle hampers countries from generating the necessary indicators.

v. *Dearth of disaggregation to measure equity*

EMIS does not include all the needed equity disaggregation required for SDG 4 planning and monitoring. In order to better identify the dimensions of disadvantage in education and measure inclusion, efforts should be made to increase the capacity of EMIS to disaggregate data where relevant by sex, age, location, ethnicity and disabilities.

vi. *No culture of data sharing and cooperation*

Although many types of data and indictors are collected by different departments and ministries, it has been determined they are not shared, or access is barricaded. A culture of data sharing and establishing cooperation among data producers is crucial for effective monitoring of Education 2030 and the world development agenda. Information from national statistical offices and other non-traditional education providers, who might collect data on aspects of education not covered by the traditional education providers, should be taken into consideration to fill the data gaps.

vii. *Lack of resources*

Due to heavy budget constraints, countries may prioritise scarce resource areas such as teacher training and direct allocation to facilities in educational institutions. It may be difficult to find adequate resources to meet the requirements of establishing an effective EMIS, which will not only require the hiring of well-paid professional staff, but also the purchase of expensive digital hardware and software.

viii. *Inefficiency in data collection, processing and dissemination*

The collection, processing and dissemination of data is still very inefficient in many countries. Many countries still use paper-based data collection methods and verification and validation processes and manuals. Many countries are still not able to exploit the benefits of technologies in data management due to a lack of funds, or due to a lack of skills and capacity.

ix. *Lack of capacity in analysis and use of data*

Though data is collected through EMIS, many data is not analysed, or used for planning, management and monitoring – mainly due to a lack of capacity in the staff tasked with proper analysis and the use of data.

x. *Staff turnover*

In many countries, EMIS staff are scarce and their high turnover can negatively impact on institution memory. This means that each time an EMIS staff member leaves, the acquired knowledge and skills also leave with the departing person. An added issue is that a new recruit needs to be trained and this requires a trainer with EMIS knowledge and skills.

2 A good Education Management Information System

In this chapter we will discuss some of the principals behind establishing a good and effective EMIS. Before going into EMIS specific considerations, this section describes the central elements we need to keep in mind when establishing any Management Information System (MIS). We also explore aspects of a strong enabling environment required for an effective EMIS, such as the policy and legislation required for EMIS.

2.1 Preparing a good Management Information System

Every MIS requires an enabling environment as its very basis. This includes political commitment and monitoring at all levels so staff are equipped with the necessary technical capacities. Disaggregated data must flow without any loss to the decision-making levels. Data entry needs to follow logic, fixed and comparable methodology and have a well-defined purpose. For each country context, the existing situation relating to data quality; its architecture relating to collection, analysis, interpretation and dissemination; the availability of adequate resources; and the needed infrastructure needs to be analysed to identify obstacles in paving the ground for establishing and/or improving an MIS.

2.2 Central elements for a good MIS

The central elements for an effective MIS are detailed below:

RELEVANT: The data and information produced by MIS should be relevant for different stakeholders and partners within the country. A broader consultation on the data requirement at various levels and different sub-sectors and aspects of education is needed to ensure that the data generated from MIS is relevant and useful for various stakeholders and for different purposes.

ACCURATE: The data produced should be accurate and reliable to be used for various purposes. The data collection and generation through MIS should follow standard national and international principles, standard methodologies and use standard classification systems. Such methodologies, standards and metadata should be well documented and made accessible to users in a transparent manner.

USEFUL: Information generated from MIS should be useful for taking decisions regarding education development at the different levels. The information should be generated in various formats and structures based on the users' needs.

TIMELY: MIS should be able to produce timely data and information for timely decisions. Time lagged data and information might not be that useful for education planning and management. How timely the MIS can produce data/information should depend on how efficiently it collects, processes, analyses and disseminates the data. Using new technologies in collecting, compiling and processing data can help MIS to produce more timely data.

COMPLETE: The data collected and produced by MIS should be complete. It should cover all the sub-sectors including higher education, NFE and ECE. It should cover all types of institutions such as public, private and community.

ACCESSIBLE: A good MIS should not only collect and disseminate the data on a regular basis, it should also provide stakeholders with access to its data and information. A good MIS should use appropriate technologies to store all historical data and information andprovide appropriate tools and techniques to access them. It should also use securityfeatures to avoid unwanted access to respondents' personal and sensitive data.

SECURE: A good MIS should be secure and protect the rights of individuals whose data is stored within, as well as protect sensitive government data such as financial data. The MIS should be secure from unauthorized access and data corruption and users should have secure access to data relevant to their job functions and research purposes.

GRANULAR: A good MIS will have data on individual students and teachers. This information should be available at the school and administrative levels.

2.3 Data and information flow in EMIS

A good EMIS should have a smooth data and information flow, including sharing and exchanges (both vertical and horizontal cross-section flow) from educational institutes to different levels of education and among various data producers. Education institutes, as the main data sources for EMIS, should have the required data and a full understanding of the process and channel of data submission.

- Similarly, district education offices and provincial education offices should also have clear guidance and responsibilities in making data flow smooth.

- A well-developed data management mechanism is needed with clear roles and responsibilities assigned for the different levels (please refer to the diagram under Streamlining the Organizational Structure).

- There is a need to empower local planners; the system needs to accommodate simple functions which have relevance at the local levels.

- Verification of data should also be undertaken at the local level, therefore, there is a need at the local level to have access to the systems through secure interfaces. For this purpose, web-based deployments are best as high-speed Internet networks are now pervasive in most countries.

Information also flows in accordance with information approval processes. Whatever may be the case, suitable support legislation and policy commitments may be necessary to complete this process. The needed vertical and horizontal information flows may have to be clearly spelled out, assigning responsibilities to the various departments and organizations concerned. A manual of procedures may also be needed to be produced to give effect to this arrangement.

Box 1: Ideal composition of the NEIF

- All the records and information should be stored safely with proper classification, labelling and filing so this can be accessed when needed.

- There should be clear identification of the personnel who have accessed to various information based on information types.

- Data and information can also be entered into computerized storage in the school database to facilitate tracking, updates, search, retrieval and use.

- There should also be clear policy on retrieval, disposal and access to the records to ensure the safety of the data and information.

Figure 6: Flow of information within ministry of education

MoE = Ministry of Education
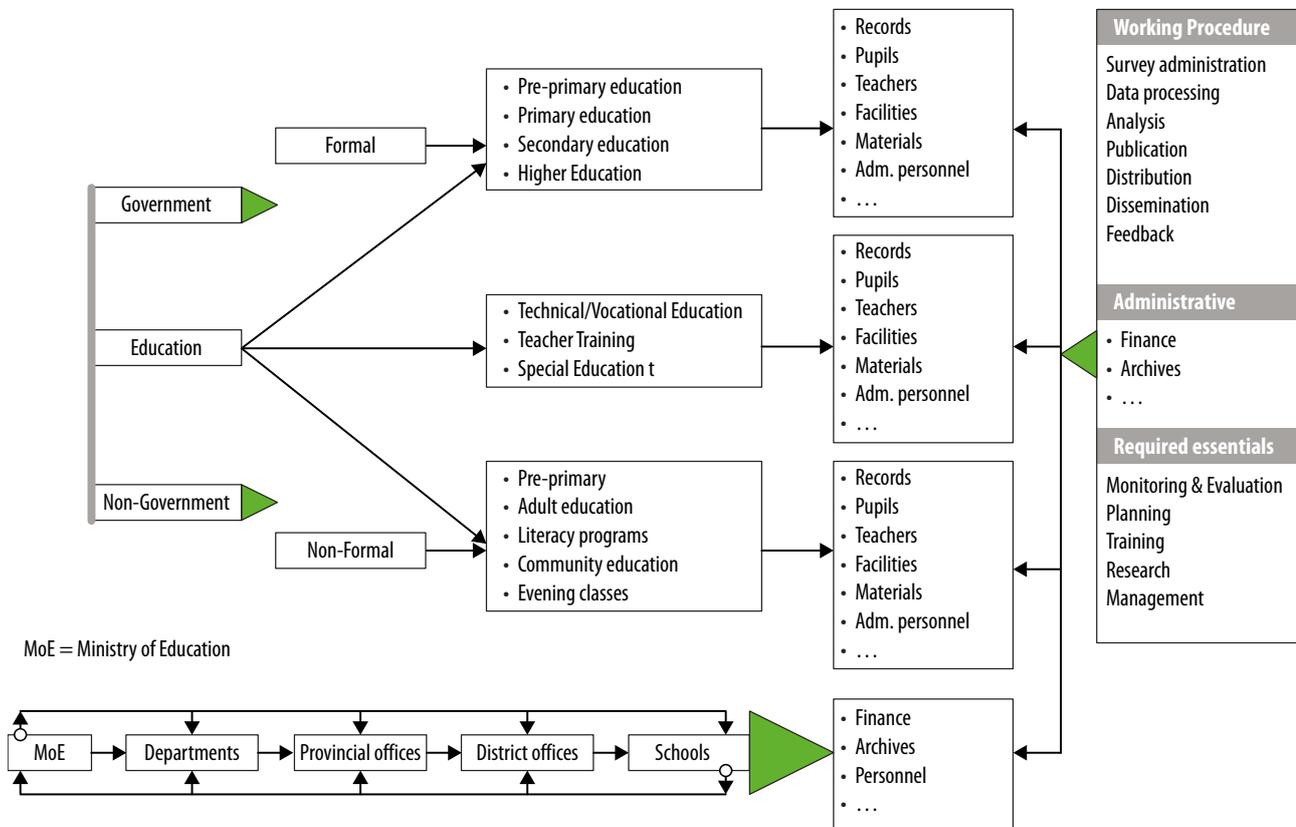
Source: NESIS and UNESCO. (2003). EMIS – A Guide for Young Managers,.

The diagram above indicates that EMIS should address all areas of education and should store detailed information on pupils, teachers, facilities, materials and finances. This information should be available at every level of government and should be comparable between education sectors.

Information systems enable countries to be cost-efficient and effective in their education planning. When institutionalized and guided by a clear policy and strategy, an EMIS helps policy makers manage an education system to produce quality outputs and outcomes. However, many countries have invested resources in building education management information systems, but these systems are often not institutionalized, that is, lack in guiding vision and are not incorporated into strategic planning processes. EMIS are intended to help planners and decision-makers to design and implement policies. However, as we have already noted, most countries do not have clear formulated policies on how to use EMIS data in planning and decision-making.

- The way in which EMIS will be involved in processes for each user and function should be mapped for each module, or component of EMIS. This will help ensure that EMIS systems and data become integral to education management functions and in day-to-day operations.

2.4 Establishing a good EMIS

Establishing a good management information system for education starts with a quality diagnosis of the system's structural elements. This includes a preparatory assessment and evaluation of the data and information, or the absence of such data and information; the institutionalization of legislative policy frameworks; an organizational structure with streamlined clear roles and responsibilities; and a clear plan not only for the initial establishment but also for the continued maintenance of the system.

2.4.1 Assessing and evaluating the quality of an EMIS

An EMIS should be understood as a dynamic, shifting and evolving system that needs to be adjusted when new demands on information are needed. It is now common practice to evaluate EMIS according to established benchmarks and in relation to established best practices. Evaluation can help inform EMIS development plans and inform about reforms needed to help improve systems.

There are several methods for a quality assessment of EMIS, which are routinely conducted by international development partners to help assess the quality of EMIS systems and make recommendations for further development, such as:

> **Remember!**
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> Each methodology relies heavily on the skills of the assessor. A good assessor can help provide information as to how a national EMIS compares with global standards and best practices and it can help ask questions which may be challenging for persons working daily with systems.

- **Light Ed-Data Quality Assessment Framework** (DQAF) developed by the UNESCO Institute of Statistics (UIS).

- EMIS **Systems Approach for Better Education** (SABER) developed by the World Bank.

In general, each of these methods helps evaluate an EMIS along thematic dimensions which are generally aligned to:

- Policy and institutional environment;

- Statistical processes;

- Statistical data output and use;

- Information use.

Light Ed-DQAF

UIS has developed and implement evaluation methodologies that assess the quality of data produced by national statistical systems within the UNESCO domain of competence, including standards and tools for assessing education data quality produced by member states. The DQAF assesses the strengths and weaknesses of the education statistical system by reviewing parameters based on the following eight principals:

1. Policy and legal framework.

2. Adequacy of resources.

3. Relevance.

4. Sound methodology.

5. Accuracy and reliability.

6. Periodicity and timeliness.

7. Consistency.

8. Accessibility and clarity.

UNESCO and UIS are undertaking holistic assessments of education information systems using DQAF. The DQAF is designed to evaluate whole education information systems in relation to national education monitoring frameworks and SDG 4 indicators. The final product of the evaluation should be a National Strategy for the Development of Education Statistics (NSDES) which details recommendations for improvements of all education data sources. Ed-DQAF is based on DQAF methodology and is specific to just administrative systems. Over 140 quality parameters are assessed against the six core DQAF principals. The detailed findings from Ed-DQAF and recommendations can be used to develop strategies for strengthening EMIS in the country.
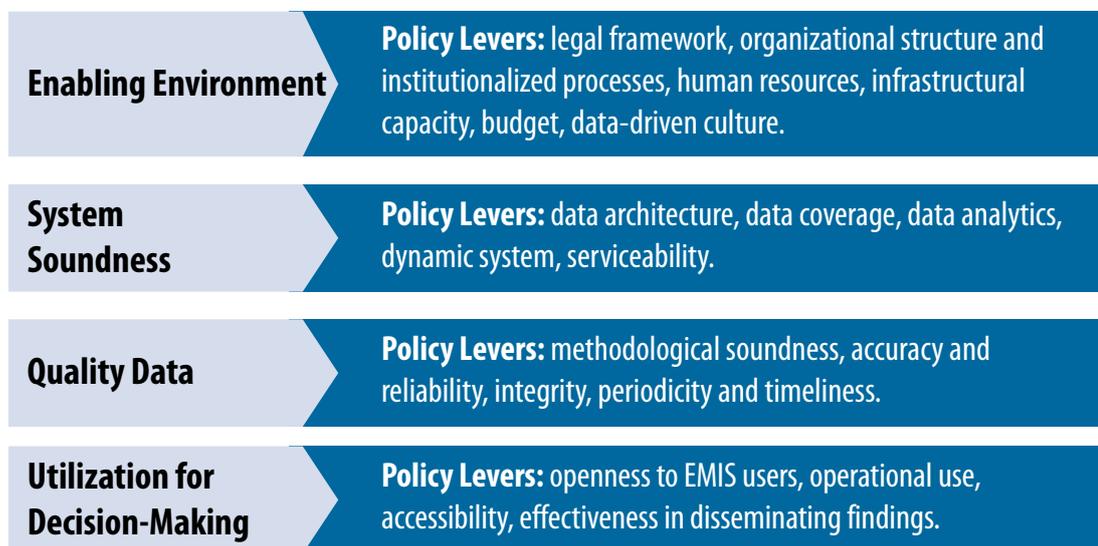
For more information see:

> (i) **Ed-Data Quality Assessment Framework (Ed-DQAF) to Evaluate Administrative Routine Data Systems: Manual for the Conduct of an Evaluation by a National Technical Team**[12]

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[12] Ed-Data Quality Assessment Framework (Ed-DQAF) to Evaluate Administrative Routine Data Systems, access: http://uis.unesco.org/sites/default/files/documents/training-workshop-manual-data-quality-assessment-framework-2017-en_0.pdf

SABER-EMIS

The SABER-EMIS assessment methodology is built on four key policy areas that are essential to EMIS and must be assessed to understand and ultimately strengthen the system. Each policy goal is defined by a set of policy levers (actions that help governments reach the policy goal) and indicators (measuring the extent to which the policy levers are achieved). (Please see the figure below). Policy areas key to the successful implementation of EMIS are shown in Figure 7 below. Each policy goal is defined by a set of policy levers (actions that help governments reach the policy goal) and indicators that measure the extent to which the policy levers are achieved [13].

Figure 7: Policy Goals

Enabling Environment — **Policy Levers:** legal framework, organizational structure and institutionalized processes, human resources, infrastructural capacity, budget, data-driven culture.

System Soundness — **Policy Levers:** data architecture, data coverage, data analytics, dynamic system, serviceability.

Quality Data — **Policy Levers:** methodological soundness, accuracy and reliability, integrity, periodicity and timeliness.

Utilization for Decision-Making — **Policy Levers:** openness to EMIS users, operational use, accessibility, effectiveness in disseminating findings.

Source: Abdul-Hamid, H. (2014). SABER EMIS Framework Paper, World Bank.

Similarly, there are other tools such as the ADEA [14] Evaluation Framework to assess the quality of EMIS.

For more information, see:

(i) **SABER Education Management Information Systems Data Collection Instrument** [15]

[13] For more information on SABER, access: http://saber.worldbank.org/index.cfm

[14] ADEA. (2017). EMIS Norms and Standards and EMIS Norms and Standards Assessment Framework for North Africa, Association for the Development of Education in Africa (ADEA).

[15] SABER Education Management Information Systems Data Collection Instrument, access: http://wbgfiles.worldbank.org/documents/hdn/ed/saber/supporting_doc/Background/EMIS/SABER_EMIS_Questionnaire_092414.pdf

2.4.2 Factors affecting EMIS data quality

Many factors affect the quality of education data. Some of these factors are directly related to an EMIS, such as verification procedures, the data capture forms and tools and staff capacity. Other factors which influence data quality are often more difficult to measure, such as governance, or perceptions on data and attitudes. The following table presents an overview of some of the critical factors that affect data quality as they originate from an EMIS and possible remedies to mitigate these problematic factors.

Table 2: Factors affecting EMIS data quality and possible actions

Factor	Description	Remedies for mitigation
Perception	The perception of education ministry staff regarding the quality of data used can play a critical role in determining the level of attention given to education data. A poor perception of data may impact negatively on the level of investment needed to build and maintain effective information systems.	1. Create feedback loops to allow staff to identify and note poor data. 2. Provide clear information and guidance on the process for improving data quality and accuracy. 3. Provide clear information as to the gradual nature of data improvement through information systems.
Verification	In a study of EMIS projects implemented between 1997 and 2014, it was found that poor data quality and completeness was a widespread problem for EMIS due to a lack of measures adopted to verify the accuracy of data provided by schools.	1. Appoint government officers at each level of the education system (schools, local, regional, and central). 2. Developing automated validation mechanisms for quality assurance purposes to help improve data quality. 3. Provide easy access for supervisors and inspectors to assess the quality of EMIS data when they visit schools. 4. Migrate to granular systems with individual student/teacher data and each individual should have a unique identifier. 5. Incentivize private schools to supply accurate data for reporting.
Systems	Well-designed systems with appropriate validation, coding standards and integrity can reduce the likelihood of poor data.	1. Have systems reviewed by professional agencies. 2. Use proper development standards, such as the ISO 12207:2017, which enforces integrity and coding standards. 3. Develop national coding standards for all entities including schools and individuals such as teachers and students and other

Policy and Legislation	Good quality data should be supported by appropriate legislation and policy. Linking EMIS data to key decision-making can reward individuals who submit timely and accurate EMIS data. An example is in Fiji where submission of all individual student data ensures schools receive timely distribution of grants. Policy in general must be carefully considered, as policy decisions can also influence data in environments where verification of data is weak, such as having per capita funding where there is no verification of student numbers. In such a case, schools may be encouraged to inflate figures[16].	1. Ensure one government agency is responsible for statistical and data standards. 2. Ensure policies or legislation that penalize individuals for submitting false, or misleading data. 3. Ensure data is linked to key decisions, ideally involving funding releases. 4. Review policies for elements which may lead to distortion of data and ensure proper verification mechanisms are in place.
Data Use	Data providers must have motivation and ability to complete and submit data which needs to be aligned with the concepts of the respondent. Also, tools need to be provided with adequate instructions. Data quality is related to the provision of proper training and regular discussion should occur with school staff to help inculcate a culture of data-driven decision-making. This will lead to improved data quality by helping to ensure the producers of the data understand the meaning and relevance of the data.	1. Ensure adequate pre and in-service training is given to school level staff to both submit and to use data. 2. Ensure policies encourage proper use of EMIS data at all levels of government and are linked closely to decision making.

2.4.3 Building a legislative and policy framework

For the purpose of reforming EMIS in preparation for the requirements of monitoring progress towards the achievement of SDG 4, legislative and policy measures may be required to facilitate such a revamping. The aim of doing this would be that the existing legal framework should be supportive of a fully functioning EMIS.

INSTITUTIONALIZATION OF THE SYSTEM: An EMIS is institutionalized as an integral part of the education system and, by extension, the government. The existence of the education system presupposes the need for an EMIS. The legal institutionalization of the EMIS codifies its activities.

RESPONSIBILITY: The responsibility for collecting, processing and disseminating education statistics is clearly assigned to an institution or entity. This responsibility needs to be well defined and well communicated to other agencies.

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[16] Peter W.M., van Nederpelt and Piet J.H. Daas. (2012). 49 Factors that Influence the Quality of Secondary Data Sources, Paper Quality and Risk Management (2012020. Statistics Netherlands.

DYNAMIC FRAMEWORK: The legal framework should be dynamic and elastic so that it can adapt to advancements in technology[17]. This means that the framework is not driven by technology or a particular product and/or tool. The legal framework also needs to be broad enough so that it can be applied to different types of EMIS tools on an ad-hoc basis, such that ICT can be utilized to its fullest potential. The legal framework should also mandate that the EMIS undergoes external and internal reviews.

DATA SUPPLY: The legal framework mandates that schools participate in the EMIS by providing educational data. This data will create the data supply for the EMIS and will be supplemented by data from the broader education community. The legal framework aims to hold schools accountable for supplying data and thus ensuring the sustainability of the EMIS, as well as for increasing school efficiency.

COMPREHENSIVE DATA AND QUALITY DATA: The requirement of comprehensive, quality data is clearly specified in the legal framework for the EMIS. There is an established and known process for monitoring data collection, data processing and data dissemination of education statistics. Different data are comprehensive, meaning that they portray a complete picture of the education system and are of a high quality.

DATA SHARING AND COORDINATION: There is a legal framework allowing adequate data sharing and coordination between the education ministry (or other ministries, depending upon where the EMIS is housed) and agencies and/or institutions that require the data (e.g., universities). The framework mandates that data be shared on a timely basis with other stakeholders.

UTILIZATION: The legal framework emphasizes data-driven decisions for education policy-making.

BUDGET: The education system budget includes a line item for the EMIS budget. The existence of a budget for the EMIS is mandated by the legal framework.

CONFIDENTIALITY: The legal framework guarantees that respondents' private data is kept confidential and used for the sole purpose of statistics. The data should be kept secure and protected from inappropriate access, as well as from unauthorized use and disclosure. This confidentiality is widely understood by EMIS clients and users. Additionally, the framework specifies that data collection, maintenance and dissemination infrastructure be kept secure according to current multilevel security classifications. In addition, the framework is consistent with existing freedom of information laws: 'The very existence of these laws has legal implications for education leaders and managers at all levels,' since they can lead to greater access to education related information[18].

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[17] Bodo, Shaem. (2011). EMIS opportunities and challenges for mobile data collection and dissemination.

[18] Cassidy, Thomas. (2006). 'Education Management Information System (EMIS) Development in Latin America and the Caribbean: Lessons and Challenges.' Work document. Inter-American Development Bank, Washington, DC.

2.4.4 Streamlining the organizational structure

The organizational structure should be designed in a way that it assigns clear roles and responsibilities for obtaining and reporting SDG 4 indicators. An efficient organization is responsible for ensuring equitable distribution of resources based on its assessment of education performance by the different units of programme implementation.

Since statistics are a part of EMIS, the statistical capacity of concerned staff and other staff in the MoE should be reviewed and developed on a regular basis. Countries should be encouraged to assess and develop a plan for streamlining the organizational structure of EMIS. The following figure shows the conceptual framework of EMIS placement in the context of data producer and data user. In order to understand streamlining the organizational structure, Figure 8 provides a comprehensive overview and an explanation of its components are below:

- We notice the EMIS centre is within the ministry of education (the inner circle) giving information services to all users around it.

- Directives, guidelines, demand for information and other administrative information are sent down the administrative channel to schools.

- Reports demand for support and other necessary information flows up from the school through the same channel up to the top decision-making body.

- The top grey arrows show the information that comes from higher body – higher than the education ministry (perhaps the council of ministers, or higher) and responses are sent back to them.

- The three bold rectangles at the lower end of the figure indicate major sources of information that need attention.

Box 2: Quick advice to improve EMIS

- Improve capacities in collecting, processing, storing, analysing and disseminating data in order for decision-makers, managers and educators to base their judgement on timely and reliable data;

- Coordinate the dispersed efforts in acquiring, processing, analysing and disseminating education data and information;

- Rationalize the nature and flow of information necessary for decision-making by reducing and eliminating duplications;

- Link and assemble different existing data and information systems;

- Work towards integrating in one single system the quantitative and qualitative data;

- Adapt data collection and the use and dissemination of information to constantly evolving needs for information;

● At each point of the administrative channel; region, province and districts and schools, they not only receive and pass information accordingly, but also process and use information at each stage. This is due to increasing awareness and appreciation for information and hence leads to better quality information. In all directions, there are arrows pointing inwards and outwards, both in inner circles and outer circles. These signify information exchange and feedback information at all levels of administrative channels and beyond. Hence, users at different stages have to get access to information and feedback information has to be collected, processed and incorporated for future enhancement.

Figure 8: MIS: Producers–Users Conceptual Relationships
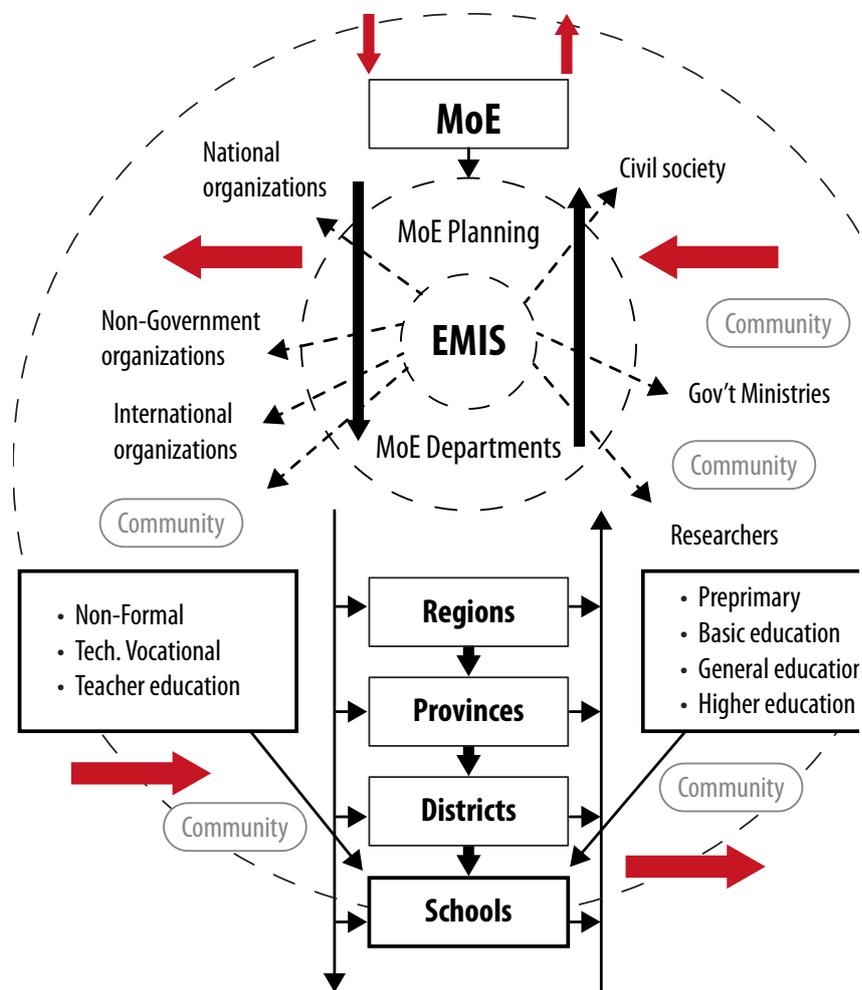
MoE = Ministry of Education
EMIS: Producer – Users Conceptual Relation

Source: NESIS and UNESCO. (2003). EMIS – A Guide for Young Managers,.

2.4.5 Planning EMIS development

Failure to have proper data on the education system will ultimately cost far more than good data systems will cost. In the long run, the unnecessary costs caused by a lack of data to guide expenditure surpasses the cost of improving data quality through EMIS development[19].

However, developing and maintaining effective EMIS systems comes with their own costs. UIS estimated in 2018 that while the average country would have to allocate around USD1.4 million per year to generate the data required by SDG 4, this would be offset by the USD143 million that would be saved by having such data on-hand[20].

An effectively operated EMIS will usually have:

a. A strategy for education data that clearly defines all components, standards, methodologies, required technical assistance and capacity development and all involved stakeholders;

b. A funding strategy that accounts for technical responses, data collection and capacity development;

c. Coordination between national and international education stakeholders.

Taking from these findings, governments have recently been encouraged to develop longer-term development plans for EMIS which also specify operational costs, to incremental changes to their respective systems.

Such plans typically result from the recommendations produced by EMIS evaluations using one of the methodologies noted in this section. EMIS development plans will often articulate where the government envisions its EMIS to be in three-to-five years which is called the '**Target State**'. The **Target State** is a more developed EMIS which will address the shortcomings identified in the evaluation. The plan will then articulate a costed stepwise strategy for achieving the **Target State**.

Plans usually have the following elements:

a. A system development component to improve systems and push them towards the target state.

b. A capacity development component for both users of data and operators of the systems who may be one and the same.

c. An infrastructure component which specifies the hardware, facilities and Internet connectivity required.

d. Increments to operational budgets and other requirements (for example staff skills) which result from improvements to the systems.

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[19] Abdul-Hamid, H. (2014). SABER EMIS Framework Paper, World Bank.

[20] UIS. (2018). The Investment Case for SDG 4 Data Concept Note Technical Cooperation Group on SDG 4–Education 2030 Indicators Dubai, United Arab Emirates, UNESCO Institute for Statistics (UIS).

Such plans help articulate the vision for EMIS, define the costs and identify the path towards the development of EMIS. EMIS strategic development and operational plans can help guide and steer partnerships, particularly where multiple partners and funding sources are evident.

Case Study: Fiji FEMIS/LANA – Example of a developed and effective integrated and decentralized EMIS

The Fiji Ministry of Education developed an integrated system of administration called the Fiji Education Management Information System (FEMIS). FEMIS enables evidence-based policy planning and resource allocation. FEMIS is a web-based application whereby data is almost exclusively managed through schools. FEMIS facilitates the collection and analysis of all routinely used data on the education system. FEMIS includes data on individual students from kindergarten through the basic education system and is being expanded to include higher education and TVET. Data on every student is available through the system including biodata, families, daily attendance, learning outcomes and school grades, subsidy programmes, such as transport allowances and emergency relief and disciplinary action.

The national formative standardized assessment for literacy and numeracy is undertaken on all students in years four, six and eight to the completion of basic education (changed in 2016 to years five and seven). The ministry's examination and assessment unit designs, manages and reports on Literacy And Numeracy Assessment (LANA) data annually. Reports are sent back via FEMIS directly to teachers and head teachers in the same year so that corrective action can be taken to improve learning outcomes. This rich source of data enables the monitoring and evaluation of each individual's student performance throughout their entire academic career.

LANA analysis is used as a diagnostic tool to provide feedback to students, teachers and parents on student learning progress. Almost real time data provides planners and policy-makers with a large amount of data on which to evaluate the success, or failure of education policies. The system provides intervention (at individual, school and national levels) to improve students' learning in literacy and numeracy. For example, if support or subsidy is offered to particular students such as those from low-income houses, the immediate impact on attendance and learning outcomes can be assessed:

- To identify what students have learned;
- To identify students' strengths and weaknesses;
- To provide a way to measure a teacher and/or school's effectiveness;
- To lead to pedagogical improvement;

- To measure specific elements of learning;

- To identify academic weaknesses and strengths so that educators can define a pathway for improvement that takes many forms and requires an assortment of refined strategies and techniques.

The system is fully integrated and can correlate inputs such as financial contributions to individual students, teacher training and qualifications and facilities and supply of pedagogical materials with student attendance and learning outcomes. The system is presently being expanded to include the TVET and HE sub-sectors. Fiji FEMIS/LANA provides a good example of a comprehensive system that is able to track learners and their learning outcomes throughout their career.

Figure 9: High Level Conceptual Diagram of Fiji EMIS
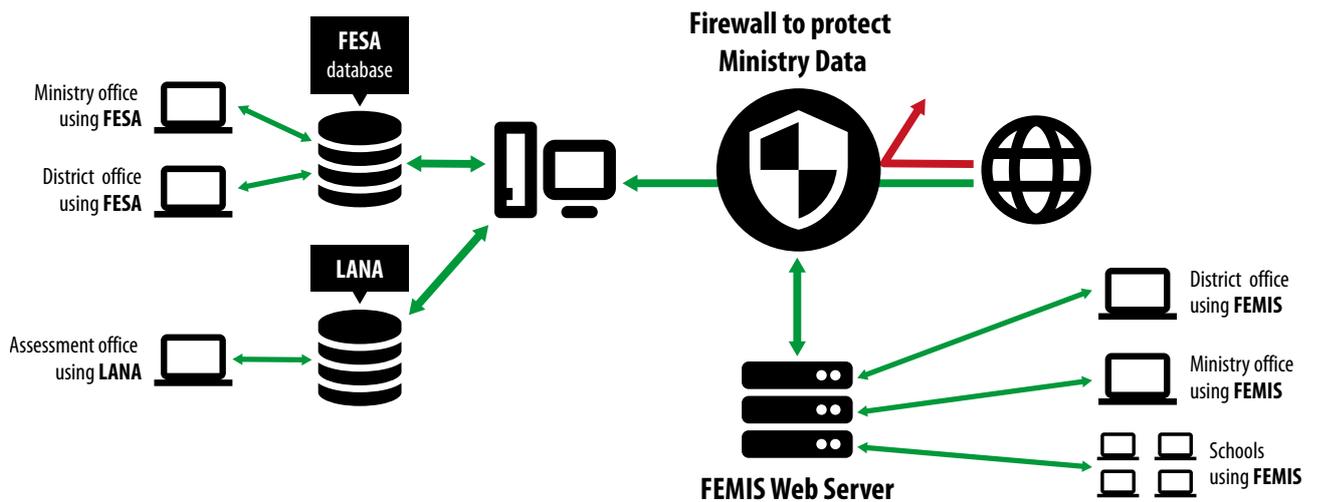
Sources: DFAT. (2017). Analysis of Fiji Learning Literacy and Numeracy Assessment (LANA) results for AQEP-supported Schools 2012-2016, Department for Foreign Affairs and Trade (DFAT),; DFAT. (2017b). FEMIS Analysis of Attendance at Access to Quality Education Programme (AQEP) Supported Schools 2016, Department for Foreign Affairs and Trade (DFAT); World Bank. (2017). SABER Evaluation of Fiji.

3 Monitoring SDG 4 -Education 2030 with EMIS

The three main focus areas for the education sector under the SDGs are measurement of learning outcomes, improved measurement of equity in education and a focus on lifelong and alternative means of learning[21].

The explicit focus on equity in education implies that in addition to reporting national averages, the selected education indicators should also be reported across different sections of the population, such as wealth, religion, gender and ethnicity, among others.

Under an expanded vision of EMIS for lifelong learning, it is important that EMIS manages information on all sub-sectors of education, ranging from ECE, vocational education and NFE. This places an increasing requirement on EMIS to be able to track an individual's progress through the whole education system and emphasizes the need for systems to be able to report on data longitudinally. The resulting design of EMIS is likely to be more complex and more integrated in terms of sub-sector data.

There is also greater recognition that a complex interplay of socio-economic factors influences learning outcomes. This means EMIS must respond to information needs concerning the child and the environment. This means EMIS systems should 'talk' with other government administrative systems to ensure all aspects of child wellbeing are addressed.

These requirements are placing increasing demands on systems to track individual children as they progress through the education system. Systems should enable disaggregation of data to allow for analysis of complex socio-economic factors affecting a child's progress through the education system, or exclusion from it.

[21] Such as NFE and technical and vocational education.

3.1   SDG 4 Indicators obtainable from EMIS

As discussed, monitoring SDG4 needs various data sources including EMIS. EMIS plays a role in monitoring SDG4 at the country level as over 60 per cent of the thematic indicators need to be populated from EMIS. Table 3 provides the list of indicators that can be produced using administrative data sources.

Table 3: Indicators that can be calculated from administrative data sources

4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes		
Completion	4.1.3	Gross intake ratio to the last grade (primary, lower secondary).
Participation	4.1.5	Out-of-school rate (primary, lower secondary, upper secondary).
	4.1.6	Percentage of overage children (primary, lower secondary).
4.2 By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education		
Participation	4.2.2	Participation rate in early childhood care and education in a given period prior to entry into primary education.
	4.2.4	Gross early childhood education enrolment ratio in (a) pre-primary education; and (b) early childhood educational development.
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university		
Participation	4.3.2	Gross enrolment ratio for tertiary education.
	4..3.3	Participation rate in technical-vocational education programmes (15- to 24-year-olds).
	4.3.1	The percentage of people in a given age-range participating in education and training in the last 12 months, by type of programme.
4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous people and children in vulnerable situations		
*Equity cross-target	…	Parity indices (female/male, rural/ urban, bottom/top wealth quintile and others such as disability status and conflict-affected as data become available).
	…	Where possible, other indicators should be presented in relation to their distribution across the study population.

Policy	4.5.2	Percentage of students in primary education whose first or home language is the language of instruction.
	4.5.4	Education expenditure per student by level of education and source.
	4.5.5	Percentage of total aid to education allocated to low-income countries.

4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy

| Provision | 4.6.3 | Participation rate of youth/adults in literacy programmes. |

4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

| Knowledge | 4.7.2 | Percentage of schools that provide life skills-based HIV and sexuality education. |

4.a Build and upgrade education facilities that are child, disability and gender-sensitive and provide safe, non-violent, inclusive and effective learning environments for all

Resources	4.a.1	Percentage of schools with access to basic drinking water, basic sanitation facilities; and basic handwashing facilities.
	4.a.1	Percentage of schools with access to electricity, Internet access for pedagogical purposes and computers for pedagogical purposes.
	4.a.1	Percentage of schools with adapted infrastructure and materials for students with disabilities.
Environment	4.a.2	Percentage of students experiencing bullying, corporal punishment, harassment, violence, sexual discrimination and abuse.
	4.a.3	Number of attacks on students, personnel and institutions.

4.b By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing states and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes in developed countries and other developing countries

| Number | 4.b.2 | Number of higher education scholarships awarded by beneficiary country. |

4.c By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states		
Qualified	4.c.3	Percentage of teachers qualified according to national standards by education level and type of institution.
	4.c.4	Pupil-qualified teacher ratio by education level.
Trained	4.c.1	Percentage of teachers in pre-primary, primary, lower secondary and upper secondary who have received at least the minimum organized and recognized teacher training pre-service and in-service required for teaching at the relevant level in a given country, by type of institution.
	4.c.2	Pupil-trained teacher ratio by education level.
Motivated	4.c.5	Average teacher salary relative to other professions requiring a comparable level of education qualification.
	4.c.6	Teacher attrition rate by education level.
Supported	4.c.7	Percentage of teachers who received in-service training in the last 12 months by type of training.

In most of the countries, all indicators stated in Table 3 can already be produced; for some countries, adjustments in their EMIS are needed. From the monitoring of the EFA indicators to the SDG 4 indicators, some new areas appeared such as teachers' motivation; the support they receive; the school environment and resources; and the language of instruction.

3.2 Critical issues of EMIS data production for SDG 4

Looking at the current situation of EMIS in countries, there are three issues related to EMIS that can be identified as critical for the production of data for monitoring SDG4.

I. **DATA UNAVAILABILITY:** Careful analysis of data availability for the various indicators of SDG4 has revealed most of the data is available to monitor access and participation, such as enrolment ratios, the out-of-school population, percentage of coverage etc. However, data for monitoring TVET, areas such as vocational education, NFE and ECE are missing. Appropriate strategies should be developed to strengthen the system to collect adequate data for TVET, ECE and NFE institutes.

II. **LACK OF DISAGGREGATION:** In many countries EMIS still does not collect data by all the disaggregation suggested by SDG4. A significant level of work is needed to make EMIS collect data at all the levels of disaggregation. Most countries collect

aggregated data from schools. In the process of aggregation, important data on ethnicity, disabilities, language, wealth and other data on characteristics of students and teachers tends to get lost. The school census questionnaire also does not capture a lot of important data on student and teacher characteristics.

III. **DATA INTEGRATION AND EXCHANGES:** Data sharing and integration has to promote the effective collection and processing of administrative data from different data sources. It is important to map out who are the main data providers for the different types of data. There is a lack of coordination among different data producers at the national level. There are also organizational, as well as technical issues in sharing and exchanging data among educational data producers.

3.3 Strengthening Non-formal education data systems to capture literacy and NFE data

SDG 4 is not only about formal education. It is also about creating educational opportunities through NFE to provide learning and training to children, youth and adults – opportunities they would otherwise not get.

NFE can be organized in the form of adult literacy programmes, second chance education programmes, or equivalency education programmes at different levels.

To produce indicators such as: i) The participation rate of youth/adults in literacy programmes; and ii) The percentage of people in a given age-range participating in education and training in the last 12 months, by type of programme, the data producers need data from NFE programmes.

In order to decide how NFE data will be part of EMIS, it is important for us to understand what policy makers would like to know about NFE.

We generally encounter questions like the following, which policy makers would like to find the answers to:

- Who wants to learn? What do they want to learn?
- Where and how are NFE centres and programmes operational?
- Who sponsors them? How are resource inputs sourced?
- Does supply match demand?
- Who actually participates? In which NFE programmes?
- Who completed NFE programmes? Who didn't?
- What have they learned?
- What benefits have they derived?

We can see that these questions require thoughtful and therefore a systematic approach, especially when we consider that various agencies and private sector institutions, as well as NGOs, also provide NFE programmes in various areas and in consequence create data on their own.

The scope of monitoring NFE includes all intentional and organized learning activities (with clearly defined location, target population, teaching-learning contents and methods, schedule and duration) that take place beyond the regular formal educational programmes in schools, universities and other educational institutions.

Figure 10: Illustration of NFE data areas
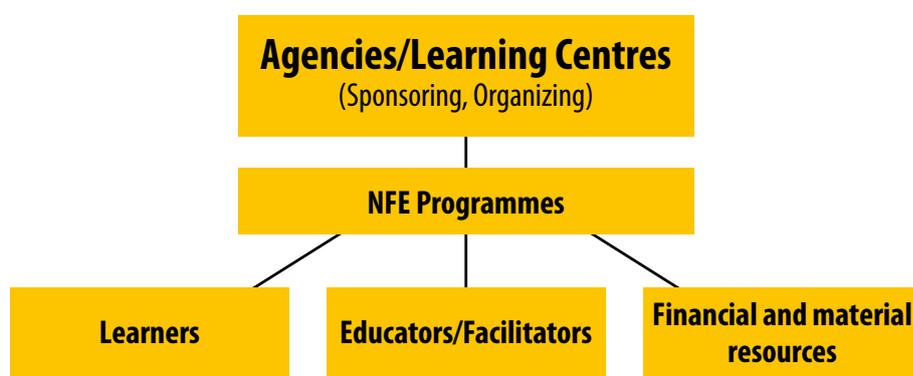
Sources: DFAT. (2017). Analysis of Fiji Learning Literacy and Numeracy Assessment (LANA) results for AQEP-supported Schools 2012-2016, Department for Foreign Affairs and Trade (DFAT),; DFAT. (2017b). FEMIS Analysis of Attendance at Access to Quality Education Programme (AQEP) Supported Schools 2016, Department for Foreign Affairs and Trade (DFAT); World Bank. (2017). SABER Evaluation of Fiji.

Steps towards developing an information management system for NFE

The following are the steps involved in developing an information management system for monitoring NFE activities.

- **STEP 1:** Identify government ministries, departments, agencies, NGOs, communities and private bodies that support and/or organize NFE (Mapping study – Directory of NFE Programmes);

- **STEP 2:** Determine the coverage, scope and outputs of the NFE component of EMIS and development phases (Diagnostic study/report on NFE);

- **STEP 3:** Develop an appropriate model for the NFE component of EMIS (Pilot phase);

- **STEP 4:** Expansion of the suitable model;

- **STEP 5:** Continuously upgrading the NFE component of EMIS and operations to meet changing needs.

The following figure outlines the monitoring structure of NFE programmes in Cambodia.

We can see that data and information flows over local communal managers, to the district offices, where the NFE data is processed for verification and then handed to the provincial education offices where it is consolidated in provincial level databases.

The Department of NFE in Cambodia compiles the national database from provincial level data before reporting it to donors, education departments and NGOs where applicable.

Figure 11: NFE-MIS structure in Cambodia
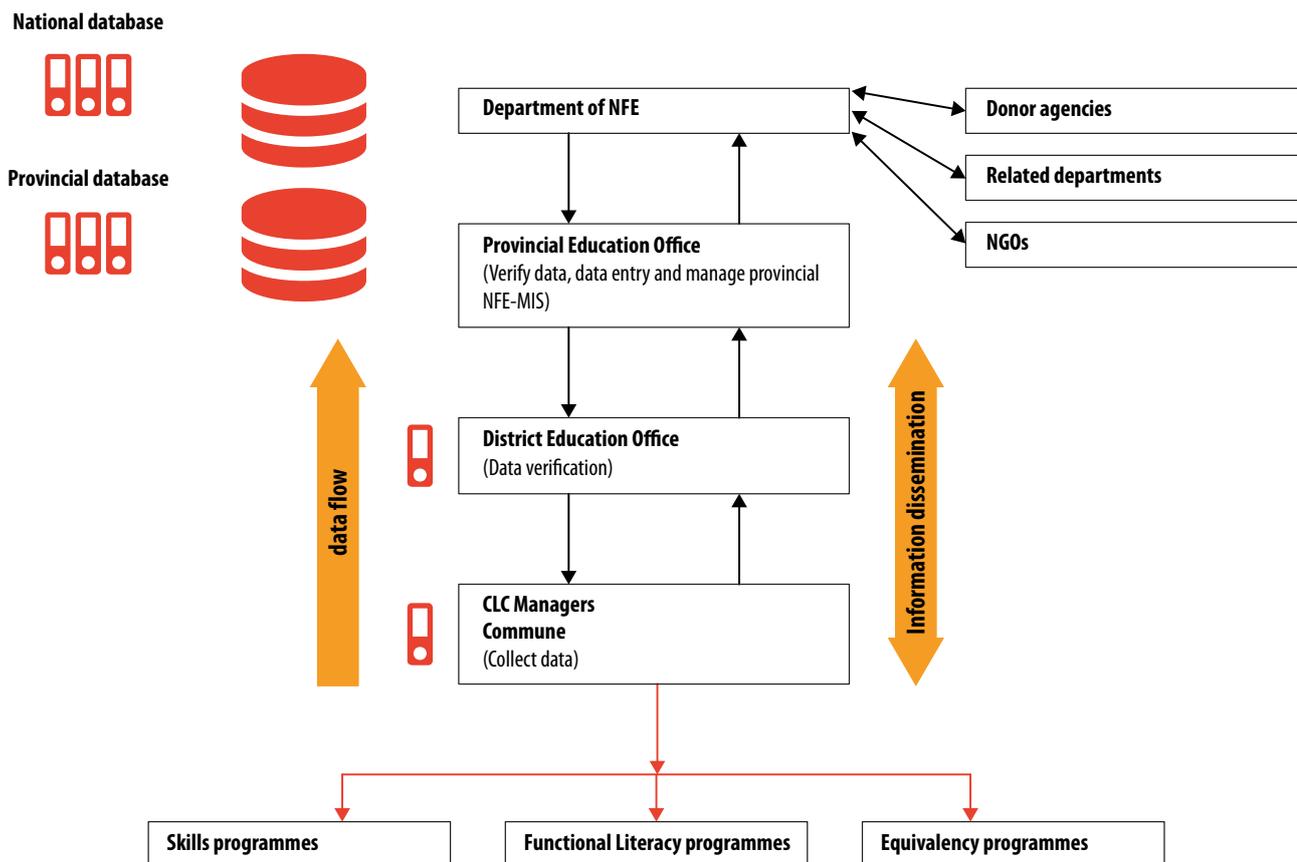
Source: Author

For more information on developing an NFE-specific EMIS, see:

(i) **NFE-MIS Handbook: Developing a Sub National Non Formal Education Management Information system**[22]

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[22] NFE-MIS Handbook: Developing a Sub National Non Formal Education Management Information system, access: http://unesdoc.unesco.org/images/0014/001457/145791e.pdf

3.4 Capturing out-of-school children with EMIS

Out-of-school-children (OOSC) are those not enrolled in schools. They often belong to socially marginalized groups, such as ethnic minority groups, children excluded because of gender barriers and children living in extreme poverty. It is of critical importance to note that all of these children have the right to an education and they are currently being deprived of this fundamental right.

The main challenges to OOSC data availability

1. A lack of adequate tools and methodologies to identify OOSC in order to measure the scope and describe the complexity of exclusion and disparities and to assess the reasons for exclusion and to inform policy and planning . National governments may not cover all schools, such as private schools, that are not managed by the education ministry.

2. Many children are 'invisible' to administrative data systems, such as street children and migrant children. OOSC have three main levels of visibility (see figure below). These levels create methodological challenges for capturing OOSC. A range of data sources must be used, including administrative records, household surveys and other means such as surveys of street children.

Figure 12: Visible, semi-visible and invisible OOSC
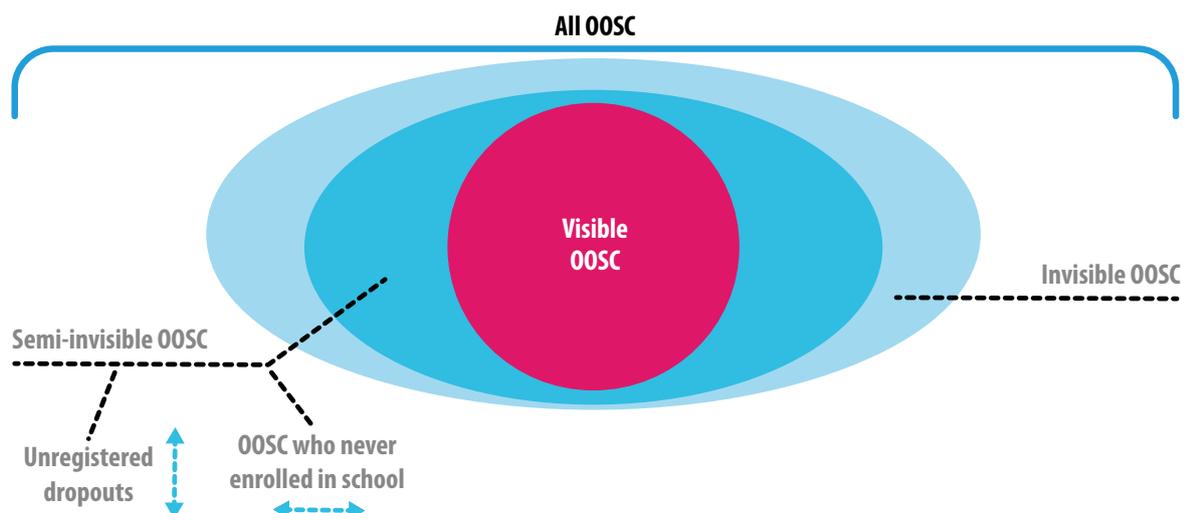
Source: UNICEF and UIS. (2016.) Monitoring Education Participation, Framework for Monitoring Children and Adolescents who are Out-of -School or at Risk of Dropping Out, Volume 1, UNICEF and UIS.

Please note: The size of the ovals in this figure is for illustration purposes only and it does not represent the actual number of children in each group, in any particular country. In reality, the actual size of each area would vary from country-to-country.

Box 3: Types of out-of-school children

Visible OOSC: Visible OOSC are can be identified using the ministry of education database, or EMIS. Visible OOSC typically are school leavers (dropouts), as they have come into contact with the schooling system and are thus recorded. In the previous figure they are represented by the red oval.

Semi-invisible OOSC: These are OOSC who currently cannot be identified using EMIS but could be made visible through improved vertical or horizontal information flows. In the previous figure they are represented by the dark blue oval. They consist of the following two groups:

Unregistered dropouts: Children who dropped out but were never recorded as such in EMIS because schools, or educational institutions, did not record, or report the dropouts. These OOSC could be identified using improved vertical information flows from schools and educational institutions to the national level.

OOSC who never enrolled in school: Children who never enrolled but for whom information can be collected through national citizen registries. Records on children can be linked through a unique ID, such as a birth certificate number, to identify those who are not recorded in the ministry of education database but are recorded in other databases, such as civil or local registries, whether electronic or paper-based. Compulsory school-age children who are not enrolled in school, but exist in other databases or registers, may be out-of-school

Invisible OOSC: These are children who are not visible in any government administrative data, or records from schools, or education institutions. They are thus completely invisible in terms of their absence from electronic databases, or registers. They generally represent the most vulnerable and disadvantaged children. In the previous figure, above, they are represented by the light-blue oval.

Visible children at risk of dropping out: Children attending school but at risk of dropping out who are identified as such within schools and the data is also monitored at the national or sub-national levels.

Invisible children at risk of dropping out: Children attending school but at risk of dropping out who are either not identified as such within schools, or are identified but not included within school-level data monitored at national, or sub-national levels.

Strengthen EMIS to monitor OOSC

Administrative data, as in the case of EMIS data, has its limitations. Enrolment records include only those children in school; but not direct information on those out-of-school.

An EMIS can, however, provide an early warning system on children at risk of dropping out. The most effective means of ensuring OOSC are effectively tracked is through individual child tracking by means of a national identifier, or the citizen registry to populate the EMIS database with registered children who should be in school at a certain level, according to their age and time of enrolment.

In order to strengthen EMIS to monitor children at risk of dropping out, EMIS can build upon the following information:

3. Information on enrolment by single year of age.

4. Absenteeism data with distinction between excused and unexcused reasons for absenteeism.

5. Data on children who have never been to school.

6. Distinction between different reasons for the drop out.

For more information on statistical methods to capture the various types of OOSC, see:

> ⓘ **Global Out-of-School Children Initiative – Operational Manual**[23]

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[23] Global Out-of-School Children Initiative – Operational Manual, access: https://unesdoc.unesco.org/ark:/48223/pf0000247531

Case Study: Case study: Including invisible children in Malaysia's Sabah region [24]

The issue of children without access to basic education is a major cause of concern in Malaysia. Displacement and the undocumented status of children are among the major barriers to securing access to quality education for many young children worldwide. In the context of Sabah, 'invisible children' are categorised as: (1) Stateless children; (2) Dependent children of foreign workers; (3) Children of foreigners staying illegally in Sabah; (4) Children born from mixed marriages; (5) Children born from traditional and not legally registered marriages; (6) Children born soon after marriage; (7) Children borne by single mothers; (8) Children from indigenous groups. Due to their absence, or omission from any official government databases, such as EMIS, these children officially do not exist; no provision is or could be made for their education, health, safety and welfare. With an indication of an estimated 50,000 children in Sabah being stateless and thus without access to health and education services, a study on the issues was commissioned on undocumented children living in Sabah.

The study referenced information on alternative means of access to education with a focus on children not enrolled in the formal education system, specifically those side-lined or excluded due to factors such as age, gender, ethnicity or geographical location. The study also focused on those children receiving an alternative curriculum which emphasizes more on non-traditional, or contextualized subjects either within, or in parallel with the formal education system for a specific duration with learners of different ages.

The Sabah study addressed the gap in data through conducting fieldwork in refugee, stateless and undocumented communities to obtain data in the absence of any concrete or official records on the children, parents and households in these 'invisible' enclaves. Data was procured from alternative learning centres sited in communities or plantations.

The study has helped inform the Malaysian government about the extent of invisible children throughout the Sabah region. The government has since taken concrete steps to ensure invisible children are identified and included in the national EMIS and that institutions practicing alternative forms of education are also monitored through EMIS.

Source: Taken from the Sabah OOSC study commissioned by UNICEF and the Government of Malaysia between 2016 and 2018.

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[24] The Sabah Study into Out of School Children is unpublished owing to the sensitive nature of the material in the Malaysian national context. Findings from the study are noted in: UNESCO (2017) Situation Analysis of Out-of-School Children in Nine Southeast Asian Countries, United Nations Educational, Scientific and Cultural Organization (UNESCO)

3.5   Disability and EMIS

A lack of reliable data is consistently one of the major weaknesses in providing evidence to governments for the need to increase their educational provision for children with disabilities. The intent is to promote the participation of persons with disabilities in all aspects of life. Tracking persons with a disability nationally can help ensure these people have access to the assistance they need in all sectors, not just education. Measuring disability also entails understanding which institutions are disability-friendly; for what types of disability; and if staff have disability training.

Four main purposes can be attributed to tracking children with disability through an EMIS:

1. Provision of services for children with disabilities, including the development of programmes and policies for service provision and the evaluation of these programmes and services.

2. To monitor the level of functioning in the population.

3. To assess equalization of opportunities.

4. To track, help and address individual children with disabilities.

There are also some issues to consider when addressing disability with EMIS:

- **SKEWED RESULTS:** Measuring disability can vary between sources/methods and can produce skewed results[25][26]. The training of enumerators and the unwillingness of parents to admit to having a child with disabilities, due to social stigma, are important factors to overcome.

- **POCKETS OF CHILDREN WITH DISABILITIES:** It is important not to rely on national averages to portray the situation, as there may be geographical pockets of increased numbers of children with disabilities. This situation could include hearing problems caused by rubella outbreaks during pregnancy, or visual impairments due to a measles epidemic in areas where access to vaccinations is restricted.

- **OOSC CHILDREN WITH DISABILITIES:** Many children with disabilities may not be in school and are difficult to locate. These children pertain to the invisible population of OOSC.

- **INADEQUATE TOOLS:** Many school questionnaires do not ask adequate questions concerning children with disabilities, or about support facilities or teachers for children with disabilities. For example it is important to identify whether teacher support and facilities are available for children with disabilities attending school.

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[25] Mont, Daniel. (2007). Measuring Disability Prevalence, World Bank, Washington DC.

[26] Singal, N. (2007). Conceptualising Disability and Education in the South: Challenges for research. RECOUP Working Paper 10, Research Consortium on Educational Outcomes and Poverty, University of Cambridge.

What Data on disability should an EMIS contain?

Successful implementation of Article 24 of the CRPD (Convention on the Rights of Persons with Disabilities) requires high-quality data which is useful for developing policies and then monitoring and evaluating their implementation. These data fall into several categories:

1. **IDENTIFICATION OF CHILDREN WITH DISABILITIES:** According to Article 1 of the CRPD, these include 'those who have long-term physical, mental, intellectual, or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.'

2. **PHYSICAL AND MATERIAL BARRIERS TO LEARNING:** These barriers include not only physical access to school buildings, but also the use of furniture, equipment, learning materials and communication support (e.g., Braille and audio books, etc.) for delivering information.

3. **HUMAN RESOURCES AND SERVICES:** These include the training of teachers, their access to support services to assist their teaching and support services designed to assist students. These services include speech, physical and occupational therapy, or the presence of classroom aids.

4. **MEASURES OF STUDENT SUCCESS:** These include standard educational outcome measures used in monitoring.

Classifying and tracking every child with a disability

UNICEF has developed a technical guide for the inclusion of disability in EMIS. The guide provides details on how to include questions on disability in EMIS, with example tables for data capture. It should be noted that the tables presented on the next page only allow for very limited analysis of disability data. In order to properly record children with disabilities, it is important to have:

a. Individual records of all children with a disability in the database so they can be properly identified, registered and tracked for services.

b. A proper and robust methodology for identifying and classifying children with disabilities. This can either be by registered physicians, or by using a robust methodology such as the Washington Methodology (For more information on integrating disability see Module 6)[27].

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[27] Access: http://www.washingtongroup-disability.com/methodology-and-research/

Figure 13: Sample EMIS form for children with disabilities by grade level

Compared with children of the same age, how many children enrolled in school have difficulties in the following areas (a child can be counted in more than one area)?:														
	Vision		Hearing		Gross Motor (e.g., walking or climbing steps)		Fine Motor (e.g., writing or fastening clothes)		Intellectual		Communication (understanding and being understood by others)		Behaviour and socialization	
	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty	Some difficulty	A lot of difficulty
Boys														
Girls														
TOTAL														

How many children enrolled in school have difficulties in the following number of areas, as recorded above?								
	1 area	2 areas	3 areas	4 areas	5 areas	6 areas	All 7 areas	**TOTAL**
Boys								
Girls								
TOTAL								

Source: UNICEF. (2014). Education Management Information Systems and Children with Disabilities. Webinar 6 - Companion Technical Booklet, **access:** http://www.inclusive-education.org/sites/default/files/uploads/booklets/IE_Webinar_Booklet_6.pdf

For more information on generating data on disability, see:

(i) **UNICEF's Education Management Information Systems and Children with Disabilities**[28]

(i) **UNESCAP and WHO Training manual on disability statistics**[29]

[28] UNICEF. (2014). Education Management Information Systems and Children with Disabilities. Webinar 6 - Companion Technical Booklet, access: http://www.inclusive-education.org/sites/default/files/uploads/booklets/IE_Webinar_Booklet_6.pdf

[29] UN ESCAP. (2009). Training Manual on Disability Statistics. Access: https://www.unescap.org/resources/training-manual-disability-statistics

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Remember!

Mainstreaming the topic of gender equality goes beyond just allowing both boys and girls access to school. Gender equality is as important a subject to learn as other more conventional disciplines such as history or geography.

Box 4: Gender parity in education

Gender parity is reached when there is equal representation and participation of both male and female learners in education. It is a useful indicator, but on its own does not measure gender equality. Gender parity can be calculated for any data or indicator. For example, the net enrolment rate can have gender parity calculated. A value of higher than one indicates more girls than boys, a figure of less than one indicates more boys than girls.

3.6 Gender and EMIS

An effective EMIS should be able to monitor gender issues equally well so it informs policy-making, planning and implementation of programmes aimed at the gender mainstreaming of education. All data produced through EMIS should be able to be gender disaggregated and should be reported as such.

EMIS should help promote gender equality by ensuring all data is gender disaggregated and analyses highlighted gender issues in which one gender may have improved access, performance, participation, or another quality over the other. This accounts for both genders and this ensures that female and male learners are treated equally, have equal access to learning opportunities and benefit from education equally.

GENDER-BASED STEREOTYPES: These are generalized traits and qualities attributed to specific ethnic, national, cultural, or racial groups that are then expected to exhibit these traits, regardless of their individual inclinations and qualities. Gender stereotypes are often mobilized to justify the exploitation, disadvantage and discrimination of specific groups such as women, minorities and people with disabilities.

- **GENDER-SENSITIVE:** Acknowledging that differences and inequalities between women and men require attention, a gender-sensitive policy incorporates and translates actions into programmes, strategies and activities in order to improve gender relations and reduce gender inequalities.

- **GENDER-RESPONSIVE:** This refers to articulate policies and initiatives that address the different needs, aspirations, capacities and contributions of women and men. This is the translation of awareness into change in perception and desired actions that ensure equality and equity, which is often achieved through gender mainstreaming. Gender-responsive policies respond to the needs, requests and requirements articulated by men and women for policies that benefit one, or both genders.

A proper understanding of the above concepts will help countries develop indicators to monitor gender mainstreaming according to the individual country contexts.

3.7 Good practices in data collection

Listed below are some issues which can help improve data collection. For further information, consider looking into the provided references on the source material.

1. The right education data: Data must have meaning to those at each level of government. If the right data is not captured, then EMIS may be neglected[30].

2. Data that would fill in gaps: In the USA, the Elementary and Secondary Education Act (ESEA) (1965 and again in 2002) legislation was reauthorized as the No Child Left Behind Act (NCLB). Both policies prioritize and incentivize – through funding – the utilization of data and integrated data systems. While ESEA was more compliance-focused, NCLB is part of a new wave of legislation that promotes the use of data in decision making and more innovative uses such as state longitudinal data systems, which track student data over time and into the workforce.

3. Data that would trigger decision making: Based on data from yearly school censuses, researchers found that classes taught by female teachers had one more girl for every 10 boys than the same classes taught by male teachers. This finding, in conjunction with evidence from other sources, could guide education policy formulation in Senegal with an eye to further promoting gender equality in the education system[31].

4. Data on 'ghost students': Another example is the issue of 'ghost students' which occurs in different contexts and leads to wastage in an education budget. The 'ghost student' problem is not unique to developing countries. In the U.S. state of Arizona, where education funding is allocated on a per student basis, it has been estimated that eliminating ghost students would save US$125 million per year in the state education budget[32].

5. Data on inequities: Data can highlight differences between specific groups and allow decision- makers to design policies that ensure equity (e.g., equitable division of resources, gender equity, etc.). The data collection tools should be developed to get disaggregated data as much as possible.

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[30] Bernbaum, Marcia, and Kurt Moses. (2011). 'A Guide to Education Project Design, Evaluation, and Implementation Based on Experiences from EQUIP2 Projects in Malawi, Uganda, and Zambia.' USAID (EQUIP2) and FHI 360, Washington, DC.

[31] Makwati G., Audinos B., Lairez T. (2003). The role of Statistics in Improving the Quality of Basic Education in Sub-Saharan Africa, ADEA Biennial Meeting, Grande Baie, Mauritius.

[32] Butcher, Jonathan. 2012. 'Ghost Busters: How to Save $125 Million a Year in Arizona's Education Budget.' Policy Report 246 (May). Goldwater Institute, Phoenix, Arizona.

Box 5: Target 4.5 - Eliminate all discrimination in education

> By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous people and children in vulnerable situations.
>
> Indicator: Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous people and conflict-affected, as data becomes available) for all education indicators on this list that can be disaggregated.
>
> This requires all other indicators relying on people – students and teachers – to be reported in a disaggregated format to identify disparities in access and participation. For many countries this has proven to be a challenge. One way to help address this is to employ granular systems which track individual teachers and students and provide background data related to outcome data on both.

For general and further information on making an EMIS more inclusive and equitable for lifelong learning, see:

> **Re-orienting Education Management Information Systems (EMIS) towards inclusive and equitable quality education and lifelong learning**[33]

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[33] Re-orienting Education Management Information Systems (EMIS) towards inclusive and equitable quality education and lifelong learning, access: https://millenniumedu.files.wordpress.com/2018/04/unesco-emis-policy-paper-2018.pdf

4 Strengthening EMIS for SDG 4 with School Management Information Systems

One trend in the development of EMIS in recent years has been the advent of Internet-deployed national institution systems such as a School Management Information System (SMIS) and university information systems and associated student tracking, or student information systems.

As much of the SDG 4-Education 2030 Agenda is concerned with tracking individuals – as in students and teachers – developing and integrating an SMIS as part of EMIS is indispensable. In fact, SMIS fulfils a dual purpose in Education, as illustrated in Figure 14. Therefore, the following chapter will introduce the management information system for schools.

Figure 14: Illustration of the dual purposes of an SMIS system
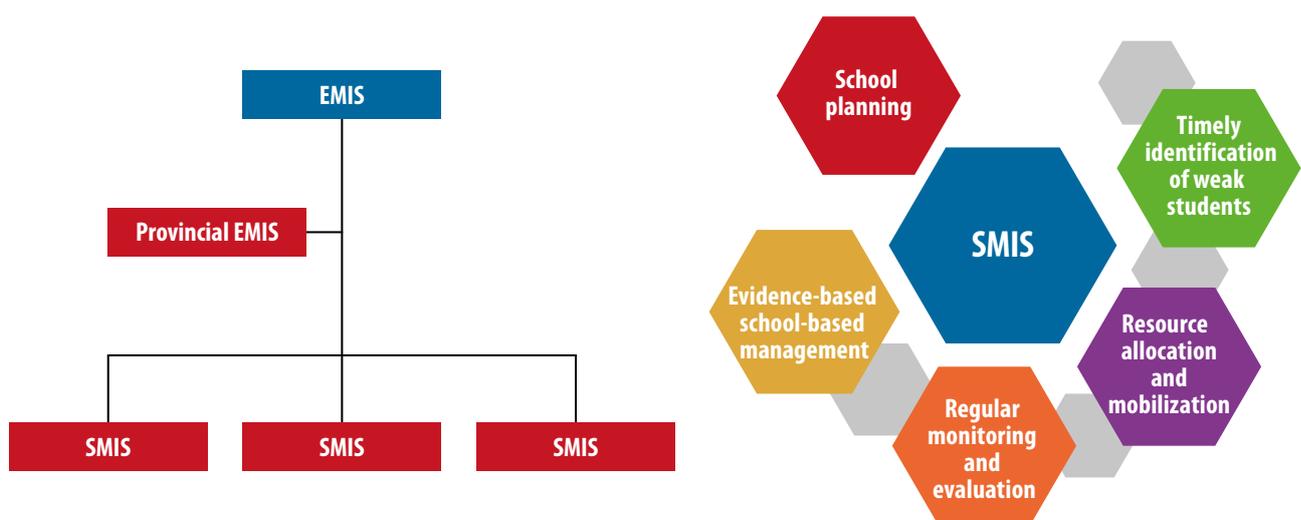
A strong and effective SMIS will help schools to collect and compile the required data for effective planning and management of the school.

Such a system allows schools to identify the issues and challenges affecting them; it helps

to design effective strategies regarding teaching learning design; it identifies students who need support to achieve the desired academic achievements; and it helps formulate strategies, together with parents and the community, to reduce the risk of children dropping out of school.

It is very important that an SMIS meets information needs at school and at the local level, so that the data/information produced is meaningful and useful to the school.

However, authorities at higher levels, such as at district, provincial and national levels also expect some data and information from schools for their district/provincial and national education monitoring. Therefore, the SMIS should also include the data and information required at the higher levels.

4.1 What is a School Management Information System?

SMIS is a management information system designed to match the structure, management task, instructional processes and special needs of the school[34]. Thus, SMIS will include data on schools, students and their background, teachers and their teaching subjects, attendance rate, participation, school resources, finance etc. An SMIS will almost always contain a STUDENT INFORMATION SYSTEM (SIS), too.

SIS is a student management system, school administration software, or a student administration system. It is a management information system for education establishments to manage student data. SIS provide capabilities for registering students in courses; documenting grading, transcripts, results of student tests and other assessment scores; building student schedules; tracking student attendance; and managing many other student-related data needs in school.

The primary objectives of an SMIS

a. Generate the required data and information for school planning and management.

b. Facilitate operation of the school by managing financial, student, teacher and other information.

c. Enable electronic storage and retrieval of school records.

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[34] Telem, M. (1999). A case of the impact of school administration computerization on the department head's role. Journal of Research on Computing in Education, 31(4), 385-401. Access: https://outshinesolutions.com/development/school-management-software.html

4.1.1 Advantages of SMIS

When we look at the documented advantages of an SMIS, we can understand quickly why SMIS has gained much attention. This includes the following reasons:

- To manage a school or learning centre and to provide a better interaction between teachers, students and parents[35].

- To permit users access to relevant school information.

- To enable teachers to exchange their experiences in a systematic way, to work in teams and to determine the needs of students[36].

- To facilitate EMIS data being accessible to administrators and planners. This can be part of national and provincial EMIS data entered in SMIS. It can be made accessible automatically by a district/provincial SMIS and the central EMIS.

- To assist the producers of school statistical information to improve timeliness, accuracy and completeness of education information[37].

- To produce information for school leaders, managers and stakeholders to take necessary decisions about school improvement, school planning and improving teaching practices[38].

- To enable a country to undertake full tracking of individual pupils and ensure a national registry of each student's academic record and performance aligned with background data such as the student's biodata and socio-economic factors.

- To facilitate more effective operation of the school and reduce workloads[39].

- To enrich an ICT culture in schools, better accessibility to information and more efficient administration[40].

- To provide documented evidence that future school managers can use to continuously improve the management of the school.

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[35] Telem, M.; Buvitski, T. (1995).The potential impact of information technology on the high school principal: a preliminary exploration, Journal of Research on Computing in Education, 27 (3). 281-297.

[36] Gurr, D. (2000) How Information and Communication Technology is changing the Work of Principals. International Congress of School Effectiveness and Improvement, Hong Kong; Pegler, G. (1992). Perspectives for school information systems. Australian Journal of Educational Technology, 8(2), 161-171, access: http://www.ascilite.org.au/ajet/ajet8/pegler.html

[37] EU (2010) Supporting the Dialogue between the Users and Producers of Statistics with a special focus on social statistics in the Southern & Eastern Mediterranean Countries, European Union.

[38] Ibid.; Telem, M. (1991). A knowledge base for information technology in educational administration. Journal of Research on Computing in Education, 23 (4), 594-611.

[39] Condie, R., Munro, B., Seagraves, L., & Kenesson, S. (2007). The impact of ICT in schools – a landscape review. Coventry: Becta. Access: http://webarchive.nationalarchives.gov.uk/20101102103654/publications.becta.org.uk/download.cfm?resID=28221; Cunningham, M., Kerr, K., McEune, R., Smith, P., & Harris, S. (2004). Laptops for teachers: An evaluation of the first year of the initiative. ICT in Schools Research and Evaluation, 19. Coventry/London: Becta/DfES. Access: http://www.becta.org.uk/page_documents/research/lft_evaluation.pdf; Granville, S., Russell, K., & Bell, J. (2005). Evaluation of the Masterclass Initiative. Edinburgh: Scottish Executive. Access: http://www.scotland.gov.uk/Publications/2005/12/13133428/34291

[40] Zain, M. Z., Atan, H., & Idrus, R. M. (2004). The impact of information and communication technology (ICT) on the management practices of Malaysian Smart Schools. International Journal of Educational Development, 24 (2), 201–211.

4.1.2 Challenges of SMIS

Despite the advantages, like every system, there are challenges that need consideration. These include:

- Low capacity within national EMIS units to manage complex and large education data collections.

- Low capacity of schools to operate, or access SMIS when Internet connectivity is insufficient, requiring individual data to be collected through an annual school census[41].

- Ensuring protection of confidential information on individual students and teachers to prevent misuse of personal data.

- Aligning the systems with the needs of decision makers at the school level.

- Time constraints, higher administrative costs, negative acceptance/support from untrained staff, abuse of ICT facilities and problems related to the imposed rigid procedural requirements.

4.2 The process of SMIS

SMIS should be established through a participatory process to include stakeholders from all levels, including the parents and the local community so that the school management and teachers will take ownership of the system and use it properly[42].

The SMIS should be able respond to the data required for the school to make timely and effective decisions about school management. Therefore, data collection and recording in an effective SMIS would carefully look into the data requirements at the school and local levels. Such a decision on what needs to be collected and recorded can be made through thorough discussions with teachers, students and other stakeholders reviewing the national and provincial/district education policies, school policies and vision and decision-making processes at the school level.

The SMIS has to involve various school staff to systematically collect and record data and information about different aspects of the school's operations. They use specific, pre-designed school record forms and follow procedures that are defined by school regulations and requirements. Different staff can be responsible for different school records and procedures in recording, storing, updating and retrieving information.

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[41] In this case, schools upload their SMIS data annually (two to three times a year as agreed). Once the SMIS data is uploaded, it becomes accessible to a district/provincial and central EMIS for compilation, processing and analysing district, provincial and national education statistics.

[42] Fulmer, C. (1995). Maximizing the potential of information technology for management: Strategies for interfacing the technical core of education. In B. Barta, M. Telem, and Y. Gev (Eds.), Information Technology in Educational Management (pp. 1–8). London: Chapman and Hall.

A good SMIS is characterized by organized classification and filing of the school records in a way that makes it easy to search, access, retrieve and use the recorded data and information[43]. Records about the same topic, or issue are grouped and arranged in a logical order, such as by alphabetical order, chronological order, or sorted by other criteria. For example, individual student records can be classified and filed by grade, class or subject. Teacher records can be sorted according to years of service and school facilities by type of facilities, etc.

Computers can help to manage school records by storing information in a way that allows for rapid sorting, searching and retrieval of data. Besides reducing the use and handling of papers, an additional advantage of a computerized system is that it can help to analyse the recorded data and quickly generate various summary statistics, performance indicators, tables and graphs and even detailed school management information such as lists of students and teachers who were absent on a specific day, or a list of equipment needing repair, etc. Computers can also be used to archive inactive school records in an electronic form such as on CD-ROMs, DVDs, Sold State Disks (SSDs), or other forms of backup media, for efficient storage and retrieval.

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[43] Information and Records Management Society. (2012). Records Management Toolkit for School, access: http://www.thomasmills.suffolk.sch.uk/files/Retention%20of%20Records.pdf

4.3 What does SMIS collect and record?

Based on a review of school management practices in many countries, school data collection and recording can be focused on the following eight aspects[44] (Chifwepa, V,n.d.):

1. Students – Personal and family characteristics, previous educational experience, current grade, attendance, academic performance, behaviour, achievements/ faults, outcomes (e.g. promotion to next grade, repeating grade, drop-out, transfer, or graduation).

2. Teachers – Personal characteristics, past education, qualification, pre-service and in-service teacher training received, years of service, employment status, subject specialization, class/subject taught, teaching load, special skills, attendance, performance, behaviour, achievements/faults.

3. Finance – School budget and income by source, expenditure by type, financial balance.

4. Physical facilities – Quantity and conditions of school buildings, classrooms, furniture, equipment and other physical facilities; maintenance, repairs and new construction; rate of utilization.

5. Teaching/learning materials – Quantity and conditions by type of material, new acquisitions, rate of utilization.

6. Learning achievement and outcomes – Results of tests, examinations and assessments (regarding academic, behavioural and other student attributes).

7. Extra-curricular and co-curricular activities – Type of activities, schedules, staff involved, number of participants, results, impact.

8. School and community interactions – School management board meetings, parent-teacher association activities, school-and-community activities.

Box 6: Creation of unique IDs to track students and teachers

Gender parity is reached when there is equal representation and participation of both male and female learners in education. It is a useful indicator, but on its own does not measure gender equality. Gender parity can be calculated for any data or indicator. For example, the net enrolment rate can have gender parity calculated. A value of higher than one indicates more girls than boys, a figure of less than one indicates more boys than girls.

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[44] Chifwepa,V. neSiS module on Managing Records at School Level, access: http://www.adeanet.org/adeaPortal/adea/downloadcenter/neSiS/e-records-021065.pdf

Case Study: SMIS in Nepal using the Flash Report System

Under EMIS, Nepal has been using its flash report system to monitor and manage its school sector since 2004. The Flash Report System was designed specifically for 'just-on-time' delivery of tailor-made reports produced for planning at the local to central levels, resource management, support to schools, M&E and targeted priority users. The system serves three major functions: i) National policy formulation; ii) Performance review; and iii) Donors' investment decision-making. Subsequently, it has been facilitating targeted interventions, such as per capita funds, incentive grants and scholarships.

The system includes school records management and district data entry; Resource Centre (RC) data collection and local application; ministry national database management, early planning and resource management, monitoring and evaluation; and national and district policy analysis and reporting.

The system proved to be crucial for policy development and the management of resources. However, accuracy and reliability issues of the data were observed due to a lack of capacity at the school level to keep good records of all the information needed.

The Department of Education upgraded the Flash Reporting System to an electronic EMIS system by developing the individual school's EMIS (IEMIS). The IEMIS captures the original individual records of students, teachers, infrastructure, exams and other school activities to analyse the data immediately at the school-level and use the data for their own management, planning and resource generation. The outcome of the IEMIS in Nepal has been a culture of evidence-based decision-making at the school level.

Data collected in IEMIS

- Individual student's detailed records by age, sex, cast/ethnicity, grade, exam achievements etc. by tracking their history over the year;

- Individual teacher's records by age, sex, ethnicity, training, qualification, subject, grades, salary, subject teaching by grade and others by tracking their history over the year;

- Students learning achievements by tracking their history over the year;

- School facilities (building, WASH, library, playground, health etc.);

- Others (child clubs, audits – both financial and social, local contributions etc.);

- School Management Committee (SMC) and Parent Teachers Association (PTA) and their composition and functions.

The data reporting process

Each school applies a simple spreadsheet software and processes user-friendly summary tables and reports. Schools upload these spreadsheet-based reports into the web-portal, where they are reviewed at the local, provincial and central levels, as well as by other stakeholders who can further utilize the data (confidentiality protection applies). The data is obtained more efficiently, with greater reliability and timeliness compared to school questionnaire surveys

4.4   Tools to collect data for SMIS

Different types of tools should be developed and used for the SMIS. Such tools should be developed objectively and should respond to information needed for the school and authorities at the district, provincial and national levels.

For school managers, administrative staff and teachers to better plan, organize, conduct, monitor and evaluate their daily school activities, additional school records may be created and used such as detailed financial ledgers, records of presence of school staff, records of use of school facilities and teaching-learning materials, school meals and scholarships, etc.

Separate school records can be created and updated about extra-curricular and co-curricular activities organized, village education committee meetings, school management board meetings, PTA activities and other school-and-community activities, after each such activity has taken place. Those additional records that are found to be most useful can become regular components of the school's SMIS.

Based on good practices in school management and the need to monitor progress towards education progress, the following tools can help capture and manage data in SMIS:

1. Student's record card.
2. Class attendance sheet.
3. Textbook record sheet.
4. Student's performance summary.
5. Teacher's record.
6. Teacher's performance evaluation report.
7. Inventory of physical facilities.
8. Inventory of furniture/equipment.
9. Inventory of teaching/learning resource materials.
10. Financial summary.

4.4.1 Types of school records, tools and reports

The SMIS can include four major forms to generate information at the school level:

1. **Records of individual persons** (e.g. students, teachers or school staff), or of physical items (e.g. classrooms, furniture, equipment, teaching/learning materials, ledger of financial transactions).
2. **Summary lists** (e.g. of students, teachers, equipment).
3. **Tally sheets** to count the number of persons, school facilities or occurrences.
4. **Summary tables**.

Table 4 on the next page describes the examples of different types of school records, together with their purpose, contents and presentation, use and storage and access to information. The example forms are provided and can be adapted to suit the needs of individual countries and school systems.

Table 4: Examples of school records

Tools	Purpose	Contents and presentation	Use of the tool
Student Record Card	To record and manage information about individual students, including personal and family details. To track and manage the students, to help teachers manage their classes and to identify students who need counselling, or extra teaching.	Information on the personal and family characteristics of each student. Additional information about individual students' academic performance, examination results, participation in school activities, behaviour etc. School meals, scholarship, free uniform, transportation, boarding and/or other incentives.	Each record is used for one school year at the time of new enrolment and continues to be updated during the school year when there are changes. If a student transfers, or drops out, other information should be recorded properly.
Class attendance sheet	To record the presence and absence of individual students. To monitor the regularity and patterns of students attending class and to generate lists of students with frequent absence from class so that action can be taken by the school and teachers.	A daily, or monthly class attendance sheet contains essentially a list of names of students enrolled in a specific class, together with corresponding cells for each day of the month to record the presence and absence of individual students.	Teachers use these sheets to record the presence, or absence of each student on each school day. School managers are responsible for defining the methods and the rules for recording class. Class teachers and school managers use the completed class attendance sheets to count the number of days each student was absent and to calculate average student attendance rates.
Textbook record sheet	To monitor whether all the students in a class have all the textbooks required for all subjects.	Lists the names of all the students in each class in a school and records the number of copies each student possesses of textbooks required for each subject.	Teachers use these sheets to verify and record, in each class, whether every student has the textbook(s) required for the respective grade and subject. Teachers can then determine reasons why and help these students to acquire the missing textbook(s). Data should be updated during each school term to monitor any loss or damage to textbooks.

Student performance summary	Monitors the academic and behavioural performance of students.	Records the scores obtained by individual students in a class in different subject examinations, or assessments. This summary may also include the observations teachers make about each individual student's behaviour.	The teacher who is in charge of each class creates a student performance summary by recording each student's score by subject for each term/year. Both class and subject teachers use such student performance summaries to monitor and compare their students' performance, and to identify students with learning problems who need remedial support.
Teacher record card	To record each teacher's personal, educational and employment characteristics and information about the teacher's role and responsibilities at the school.	Includes information about the personal and academic details of teachers in a school and particulars about their previous work experience and current responsibilities, pre-service and in-service teacher training.	Teacher records are created when a new teacher joins a school. They are used by school managers and education administrators at district/provincial levels and/or the MoE to manage the assignments, working conditions, transfers, promotions, in-service training, discipline etc.
Teacher performance evaluation report	To improve teaching and learning at a school. A teacher performance evaluation can be organized on a periodic basis for each teacher, and the results can be summarised in individual reports.	A teacher performance evaluation report presents the results of an evaluation of a teacher's aptitude and actions in various aspects of teaching and learning activities such as using teaching learning techniques, communicating with students and other stakeholders, implementing school and national policies etc.	Each teacher's performance should be evaluated at least once a year, towards the end of the school year. The evaluator(s) score each teacher's performance according to each attribute and then record the scores in an evaluation report. However, such scores should be provided in consultation with individual teachers. The reports should be stored for use in managing the employment and career development of the teacher.

Inventories of school facilities	To record the number of buildings, classrooms, furniture, equipment and other physical facilities. To monitor and assess the conditions of facilities to determine maintenance work, repairs, replacements and new construction/acquisitions.	Contains summary tables of the quantity of different school facilities and information about their condition and use. Additional data about the materials used for the building, roof and/or floor, lighting, ventilation and noise level may be recorded.	Inventories of school facilities should be created when the school first opens and be updated whenever changes occur such as new construction, or acquisitions, damages or destruction by the staff responsible. Before the start of each school year, the school management must update these inventories.
Inventory of teaching/learning materials	Enable the school to ensure that all students have the necessary learning materials including textbooks and to replenish teaching/learning materials that are, or will be, in short supply.	It consists of summary tables of the quantity of various materials available at the school, such as teaching aids, textbooks, supplementary reading and learning materials and sports, music, arts, etc. Additional information about new acquisitions, distribution to students and frequency of use, damage and disposal can be included.	During the school year, these inventories are continuously updated based on new acquisitions, distributions, damage and disposal. The school management uses the inventory to monitor the quantity, distribution and/or use of various teaching and learning materials so as to identify shortages and gaps
Financial summary	To produce monthly, term and yearly financial summaries of school income and expenditure to report information about a school's financial position to higher levels of the education administration, funding agencies, local government and community stakeholders.	Information about the flow of a school's financial resources, both into the school (income or revenue) and out of the school (expenditure). One side of such financial summaries shows the school's revenue, categorized by source of funding. The other side records the school's expenditure by type.	The responsible officer should prepare financial summaries on a monthly, term and/or yearly basis, using the detailed data recorded in the school ledger. The school manager and the school management board use the financial summaries to monitor, verify and control the financial position of the school. The summaries may also be incorporated into school reports to inform local stakeholders about the school's financial position.

Source: UNESCO Bangkok. (2011). Systematic Monitoring of Education for All, Training Modules for Asia Pacific. Access: http://uis.unesco.org/sites/default/files/documents/systematic-monitoring-of-education-for-all-training-modules-for-asia-pacific-en.pdf

5 Data innovation and EMIS

Rounding up this module on EMIS, the final chapter looks at some of the current data trends. The introduction of the trends is by no means considered essential for establishing a good and functioning EMIS. However, these are topics that should be on every one's radar as the future will likely see innovative developments that might influence how we monitor education.

5.1 The data revolution

The data revolution refers to 'an explosion in the volume of data, the speed with which data is/are produced, the number of producers of data, the dissemination of data and the range of things on which there is data, coming from new technologies such as mobile phones and the Internet of Things, and from other sources, such as qualitative data, citizen-generated data and perceptions data[45].' The data revolution includes the following innovations:

- **The integration of new data with traditional data** to produce high-quality information that is more detailed, timely and relevant for many purposes and users, especially to foster and monitor sustainable development[46].

- **Data collection during service delivery** which allows for a link to be created between the provision of services and the collection and procession of data for decision making[47]. For example, education service providers can actively record data about student and teacher attendance through smartphones, thus providing opportunities to follow up more easily with the students who drop-out and target interventions to reduce drop-out rates[48].

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[45] UN. (2014). Report on data gaps A world that counts: mobilising the data revolution for sustainable development, The United Nations Secretary-General's Independent Expert Advisory Group on a Data Revolution for Sustainable Development, access: http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf

[46] Ibid.

[47] Sachs, J. (2015). Data for Development, access: https://www.project-syndicate.org/commentary/sustainable-development-data-by-jeffrey-d-sachs-2015-05?barrier=accesspaylog

[48] Ibid.

- **Data which tracks a child's detailed learning outcomes**. If sufficient information can be gathered and analysed concerning pedagogical methods and learning outcomes, then links to student outcomes can be established and better understood[49].

- **Citizen-sourced data**. Mobile phones can be used to collect administrative data by adding citizen-sourced data, for example, the use of citizen-sourced data to measure the quality of public services[50].

- **Data on individual learners**. The administrative data has to move from school-level data to include records on individual learners. This will facilitate better data-driven decision-making and research and better understanding of each child's learning needs. Ultimately, teachers will be in a better position to understand and help individual children to learn and progress. There is also potentially a need to support governments and ministries in integrating varied data sets such as costs, exams and assessments, poverty and qualifications to produce a comprehensive picture of school performance[51].

These innovations can help increase the usefulness of data and help make it more useful, open and transparent for education policy and planning.

The data revolution raises two major concerns:

- **PRIVACY RIGHTS OF THE INDIVIDUAL**. There is the need to safeguard fundamental rights such as those of minorities and the privacy of individuals. This is especially important as increasing amounts of data are passively collected from people's 'digital footprints', or from sensor-enabled algorithms. As more of such data becomes available, the risk of such data being misused also increases, with people being susceptible to being harmed in both material and non-material ways[52].

- **TOO MUCH INFORMATION**. More information is not always beneficial. Information overload is a concern for many organizations and has been for some time and this is increasingly exacerbated by the rapid advances made in information and communication technology[53]. For example, the amount of data being collected about learners is growing significantly, especially as student

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[49] Hudson, P., English, L., Dawes, L., King, D., & Baker, S. (2015). Exploring Links between Pedagogical Knowledge Practices and Student Outcomes in STEM Education for Primary Schools. Australian Journal of Teacher Education, 40(6). Retrieved from: http://ro.ecu.edu.au/ajte/vol40/iss6/8

[50] Ethan M, Ash H., Gretchen R. (2010). Unpacking Twaweza's Theory of Social Change: Citizen Agency, Information, Accountability, and Basic Services (2010). Twaweza Initiative. 1, Retrieved from: https://scholarworks.umass.edu/cie_twaweza/1

[51] Crouch L., DeStefano J. (2017). Doing Reform Differently: Combining Rigor and Practicality in Implementation and Evaluation of System Reforms, RTI International, Working Paper, February 2017, No. 2017-01.

[52] UN. (2014). Report on data gaps A world that counts: mobilising the data revolution for sustainable development, The United Nations Secretary-General's Independent Expert Advisory Group on a Data Revolution for Sustainable Development, access: http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf

[53] Ibid.

work moves into digital mediums where everything from examination scores are recorded, to individual keystrokes, response times, changed answers, pages read and information about a myriad of other inputs. In many countries, the challenge today is coming to a clear understanding about **what data is worth tracking and tabulating and how this data will complement other information in a meaningful data set.**

5.1.1   Why is EMIS data sensitive?

A central challenge facing the international effort to re-orient EMIS to SDG 4 relates to privacy concerns. While large, long and interconnected data sets are excellent for educational research, questions regarding; **who owns this information** are endless. Countries have started building regulatory frameworks that seek to safeguard sensitive digital information about individuals.

This work is unfolding with increased urgency as data sets grow deeper and wider and breaches of this information become routine. Hackers have proven capable of gaining access to highly confidential information as was illustrated in 2017 when the national identification numbers, birth dates and home addresses of up to 143 million people were stolen from Equifax, a data analytics and technology company that serves as a clearing house for credit history.

Educational data is especially sensitive because it can be used to influence hiring decisions and may have repercussions in other social realms. As an example, knowledge that a particular person failed a third grade mathematics class might look insignificant at first glance, but if, say, big data analytics powered by artificial intelligence show that problems in early-grade maths strongly correlate with poor professional performance and perhaps even increased instances of divorce, or substance abuse, this information, if widely known or accessible, could be highly damaging.

Box 7: Data privacy concerns shutting down data collection

Numerous countries and municipalities have faced legal challenges and a political backlash when attempting to expand and integrate EMIS. For example, in 2014, inBloom, an NGO that offered a data warehouse solution designed to help public schools and teachers in New York integrate educational data to improve day-to-day teaching, was abandoned after two years of operation and over USD100 million in investments. The parent and civil society groups that championed the shutdown claimed that the system did not have adequate parental notification, or consent controls and shared highly sensitive information about children in ways that could be abused.

For more information, see: Economist Magazine. (2014). Big data and education: Withered inBloom. Retrieved from https://www.economist.com/blogs/schumpeter/2014/04/bigdata-and-education

EMIS data involves our children and thus the stakes are high and thus regulations to protect privacy are important. For example, in Europe the General Data Protection Regulation (GDPR) has enforced data privacy laws when enforcement began in May 2018. Although GDPR is not unique to education, it is expected to cover the collection and use of EMIS data. GDPR requires, among other stipulations:

- Consent of subjects for data processing, anonymization of collected data, public notifications of data breaches, and safe handling of data transfer across borders.

Creating Privacy Regulatory Frameworks

Some countries have seen the rise of principles and regulatory frameworks to guide privacy concerns connected to the collection and use of educational data.

Countries will need to carefully consider the privacy implications as they move to align EMIS with SDG 4. SDG 4 itself says nothing about data protection as it relates to education. Solutions are not just regulatory but extend to technology itself.

Block-chain solutions are often cited as a possible technological 'fix' for privacy and security concerns surrounding learning credentials and other educational records[54]. This technology, because of the immutability of entries and absence of a centralized information warehouse, carries a potential to put individuals in greater control of their educational data.

Box 8: Data Privacy through regulation and assistance

The United States Department of Education established a Privacy Technical Assistance Center (PTAC) which aims to function as a one-stop resource for education stakeholders to learn about data privacy, confidentiality, legal issues and security practices related to student-level longitudinal data systems and other uses of student data.

PTAC resources are tailored to help educational institutions ensure compliance with the Family Educational Rights and Privacy Act, a federal law that protects the privacy of student education records. The private sector, sensitive to legal and societal considerations surrounding the protection of children, has also created various guidelines, frameworks and protocols. The most visible of these is probably the Student Privacy Pledge which has been signed by over 300 companies including international corporations such as Google and Facebook.

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[54] Keevy, J. and Chakroun, B. (2018). Digitisation of Credentials: Implications for the Recognition of Learning. Manuscript in preparation.

5.2   Big data

New technologies allow schools, colleges and universities to analyse absolutely everything that happens. From student behaviour, testing results, career development of students, to educational needs based on societal demands.
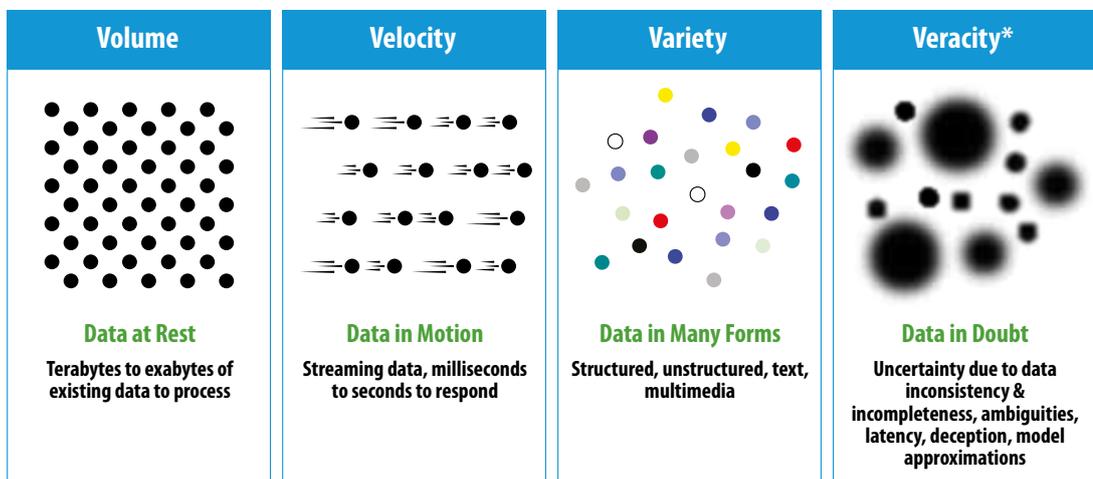
As discussed already, these types of data are collected through EMIS. However, big data allows for innovative ways of using data in the educational field that will revolutionize the way students learn and teachers teach.

What is big data?

BIG DATA REFERS TO EXTREMELY LARGE DATA SETS THAT DEFY TRADITIONAL DATA-PROCESSING APPLICATIONS. But what exactly are 'extremely large' or 'traditional data-processing applications'? Big data is often defined in terms of volume, velocity, and variety[55]. In the education context, this refers to the 'numbers of student observations, the frequency of observations and the number of types of observations, respectively[56].'

The following figure illustrates the four dimensions of big data.

Figure 15: The Four Dimensions of Big Data

Volume	Velocity	Variety	Veracity*
Data at Rest	**Data in Motion**	**Data in Many Forms**	**Data in Doubt**
Terabytes to exabytes of existing data to process	Streaming data, milliseconds to seconds to respond	Structured, unstructured, text, multimedia	Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations

Source: Lukoianova, L. and Ruben, V. (2013). Veracity Roadmap: Is Big Data Objective, Truthful and Credible? Access: https://www.researchgate.net/publication/260178341_Veracity_Roadmap_Is_Big_Data_Objective_Truthful_and_Credible

In the educational context, big data is about administrative data and teaching- and learning process-related data. Learning process data are 'big' data because they are:

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[55] Laney, D. (2001). 3D Data Management: Controlling Data Volume, Velocity, and Variety. Stamford, CT: META Group.

[56] Ho, A. (2017). Advancing Educational Research and Student Privacy in the 'Big Data' Era. Washington, DC: National Academy of Education

- **TALL:** Include many participants;
- **WIDE:** Include a large number of variables about any one individual;
- **FINE:** Include multiple fine-grained observations taken across small-time intervals;
- **DEEP:** Theoretically coded in a meaningful way.

For example, data related to a learning process relates to data collected in online assessments and courses (for example, Mass Open Online Courses (MOOCs)).

The benefits of big data for educational research often arises when data sets are combined and merged. For example, learning outcomes data combined with administrative data, such as demographics and test scores, can provide insights into how to address educational inequities in faster feedback cycles[57].

Applications of big data in education

If anything, big data should improve student results. Currently, the answers to assignments and exams are the only measurements on the performance of students.

- Many schools, especially in developed countries, are using learning software that generate data with which it is possible to mine and find evidence of how well students are learning.

- Large data sets, including information related to attendance patterns and academic performance of students, are also analysed to predict which students may be expected to drop out of school or become disengaged otherwise.

- It is possible to monitor every action of the students, such as, how long they take to answer a question; which sources they use; which questions they skipped; what the relation is to other questions answered; which tips work best for which student, etc. Answers to most questions can be checked instantly and automatically to give instant feedback to students.

Appropriate interventions are then designed and implemented to improve student results and perhaps reduce drop-out rates. Big data can give insights in to how each student learns at an individualized level – as each student learns differently and the way a student learns affects her/his test scores.

For more information, see:

> (i) **School Management Information Systems: Challenges to Educational Decision Making in the Big Data Era**[58]

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[57] Perry, J. & Klopfer, E. (2014). UbiqBio: Adoptions and Outcomes of Mobile Biology Games in the Ecology of School. Computers in the Schools, Vol. 31, pp. 43-64.

[58] School Management Information Systems: Challenges to Educational Decision Making in the Big Data Era, access: https://www.academia.edu/38700223/school_management_information_systems_challenges_to_educational_decision-_making_in_the_big_data_era

5.3 Changes in technology and adapting EMIS

Changes in technology have enabled cost affordable opportunities to deploy EMIS and ensure it is accessible to a wider audience. These include the deployment of EMIS via the Internet and access to stakeholders at the school level, such as teachers and even students, via mobile devices is now feasible and cost-effective in many countries.

Accessing EMIS via mobile devices

The proliferation of mobile devices, combined with exponential uptake of highspeed internet, offers new and affordable possibilities for deployment of EMIS systems, as well as enabling a broader audience to access and engage with EMIS systems directly.

By enabling access to EMIS functions through mobile devices via the Internet, a much wider audience can be reached cost-effectively. However, there are also limitations which must be acknowledged and these include limited screen sizes and data entry facilities such as a keyboard, as well as the high cost of mobile Internet in some countries.

- An example of this approach is in Punjab India where teachers are required to log their attendance via mobile devices which also records their coordinates at the time of logging attendance. This has significantly helped to reduce teacher absenteeism[59].

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[59] This fact was reported in interviews with the Punjab Ministry of Education, Director Planning in 2014.

6   Annex

EMIS experiences in selected countries

The experiences of developing and using EMIS in selected countries is diverse. The following annex captures the experiences of each country selected for this study. The specific focus of each example is derived from the country presentations conducted at the UNESCO/GPE conference conducted in April 2018.

CAMBODIA

The Ministry of Education, Youth, and Sport (MoEYS) launched EMIS in 1995. The system was initially piloted in 10 provinces and in 1996 it was rolled out to all 24 provinces. Since then, the EMIS Office under the Department of Planning has benefited from substantial international technical support. The responsibility of the EMIS office is to provide comprehensive data to technical departments within MoEYS and other related ministries to inform the development of the education sector. In recent years, MoEYS has undertaken substantial efforts to reform and improve its EMIS, particularly moving towards decentralized planning.

At present, MoEYS and the Ministry of Labour (MoL) (for TVET) oversees a large number of disparate information and data systems which together provide information on the education system throughout Cambodia. The systems are collectively referred to as Cambodia's Education Management Information System. However, they are not formally recognised as a coherent system.

The Department of EMIS located in MoEYS has received support from UNICEF, the Asian Development Bank (ADB) and more recently, from the education Capacity Development Partnership Fund (CDPF) funded by the Swedish International Development Cooperation Agency (SIDA) and the EU. EMIS was verified twice in 2006 by international consultants and in 2007 by an expert from the National University of Educational Planning and Administration, India. Over the past 16 years, data has been collected regularly and education statistics and indicators published annually for use in education sector performance reviews. In 2014, the EMIS unit was upgraded from a unit to a department and is now formally known as the Department of EMIS (DEMIS). EMIS development is guided by the five-year National EMIS Strategic and Development Plan which was first approved in 2014 for 2014-2018 and has recently been updated for the years 2017 to 2021.

MoEYS, with support from UNICEF, is working to develop the capacity of the Department of EMIS under the Directorate General for Planning and Policy within MoEYS, at national and sub-national levels for the management, use and development of EMIS. The project

focuses on developing a system to collect data regarding children's enrolment and learning outcomes in education institutions under relevant line ministries.

The project also includes:

- Implementation of a medium-term operational plan for the development of EMIS;

- Expansion of the newly integrated web-based system to include school-level indicators, as well as other cross-cutting education indicators;

- Training so EMIS staff can develop the capacity of MoEYS officials at sub-national levels.

Cambodia hopes that as its systems mature further, the country should move away from the collection of aggregate data on facilities, students and teachers and migrate to data on individual persons and facilities through systems such as Human Resource Management Information Systems (HRMIS), Student Tracking Systems and School Information Systems (SIS). Cambodia hopes that such developments will ensure that more accurate and timely data is available at all levels of the education system.

MALDIVES

MEMIS was launched nationally on July 16, 2017 by CSF with support from UNICEF under the Open EMIS initiative. MEMIS was initiated in response to the changing context and needs of the education system in the Maldives and as a means of achieving better education outcomes by taking advantage of the latest information technology. With the aim of supporting and optimizing the implementation of Open EMIS, as well as full capacity transfer, CSF has been working with the MoE of Maldives since project inception and collaborating with local education professionals, including principals, teachers, and administrative staff. Partner support of EMIS in the Maldives has focused on the building of a robust and reliable MEMIS and the strengthening of national capacities in the provision of reliable information for the planning, monitoring and evaluation of education systems.

MEMIS has developed modules for:

- Data capture on institutions, students, staff;

- Computation of standards-based education indicators in compliance with internationally recommended methodology;

- Consolidated data warehouse of all education data in the country;

- Advanced methods for data reporting, data visualization and dissemination to all stakeholders, including ministry planners, principals, teachers, parents and students.

MEMIS integrates these features into national MoE's management processes to ensure that education data are put to appropriate use in decision support at all levels of the education system.

The Maldives developed its EMIS using Open EMIS, because it's potential of being an open software and the possibility to customize modules to meet specific needs.

Challenges in developing EMIS include the training of local EMIS administrators, limited Internet for data collection purposes, lack of national capacity in computer programming/coding and dependency towards the Community Systems Foundation (CSF) in managing Open EMIS, particularly for software development and configuration.

Good practices that were identified throughout the process include:

- Implementation of EMIS should be an iterative process (piloted in 20 schools);

- Creation of a technical team on EMIS within MoE and 40 units at the school level;

- Capacity development activities and training – several training opportunities offered at national and school levels;

- Introduction of a mobile application Open EMIS Classroom to allow teachers to collect data at the classroom level from their smartphones, addressing the issue of the lack of Internet on remote islands.

Moving forward, the Maldives will seek to raise MoE capacity in computer programming in order to overcome dependency from international technical agencies.

In addition, the Maldives will be extending the use of MEMIS data beyond education management and administration into: (i) Education planning and policy formulation; (ii) Monitoring and evaluation; and (iii) Integrating MEMIS with other government information systems.

The development of EMIS contributed to strengthening the Maldives' education system and it has significantly improved learning achievement in the tenth grade (five or more 'O' Level examination passes) by 28 per cent in four years.

The presentation also touched on the importance of using data for management/leadership and cited an example of which a 30 per cent reduction in school absenteeism was witnessed within the first month of EMIS implementation.

MYANMAR

The Government of Myanmar considers EMIS reinforcement as a critical reform requirement for its education sector. Myanmar intends to use EMIS data to improve: (a) Access and quality of education services; (b) Efficiency of resource management in educational institutions; and (c) ICT planning and the professional competencies of education administrators. To ensure the attainment of these objectives, the ministry has developed a Five-year EMIS Strategic Plan and has solicited the technical support of UNESCO through a partnership with UNESCO's Capacity Development for Education Programme (CapED). CapED-UNESCO's implementation strategy emphasizes the following elements:

- Building competencies of MoE staff;

- Improving access to education data through a unified education portal;

- Improving data quality;

- Enforcing data-driven school planning.

In September 2015, MOE established the EMIS Implementation Unit (EIU). This compromised of members from the Union Minister's Office and the Department of Human Resources and Educational Planning (DHREP) and it was supported by focal points from all eight MoE departments – to manage the development and day-to-day operations of Myanmar's EMIS, with support from UNESCO's technical experts.

The unified EMIS software system will house all education data from different sectors within the education system, containing data as granular as well as individual school data, as well as data from TVET institutions and NFE platforms. Myanmar's EMIS Strategic Plan can be considered a promising framework since it is holistic and systemic. CapED-UNESCO and Myanmar's MoE shall be addressing not only the technological aspects of EMIS, but also the material, financial, human and institutional aspects of the system.

The web-based EMIS system consists of five 'software program modules':

- Basic education (BE), which is currently in the field-testing stage;
- Human resources (HR), which is currently in the field-testing stage;
- Higher education/TVET module (HE/TVET), which is under the development stage by a local software company;
- NFE module, which is under the development stage by a local software company;
- Financial Asset Procurement module (FAP), which is under the development stage by a local software company.

Since the formation of the EIU, MoE and UNESCO have been working closely through discussions, capacity building workshops and on-the-job training to enhance the knowledge base of EIU members in preparation for the roll-out of the National EMIS Programme. Myanmar has faced some challenges in piloting the web-based EMIS system, particularly challenges in achieving:

- Adequate Internet access and speed (although an off-line version has been developed to help those in townships);
- Sufficient computer and human resources;
- Strong data checking and verification processes;
- Proper communication strategy for EMIS and coordination among all stakeholders.

In terms of implementation, Myanmar has identified the key challenges that they are likely to experience and ways to mitigate the challenges, including:

- Regular update of all information and data;
- Technical capacity to be built for the long run sustainability of web-based system implementation;
- Modernize, advance, and update ICT technology and hardware.

PAKISTAN

National and Provincial EMIS were established in Pakistan in 1990s through financial assistance from the UN with functions of collection and consolidation of education data, establishing a national repository of education data through the National EMIS Database as the standard setting agency and to establish linkages and develop the capacity of provinces/regions. NEMIS computes and disseminates key education indicators, especially SDG-4 indicators and also provides data to national and international agencies, such as the Economic Survey of Pakistan, UIS, etc.

In order to fulfil the responsibility of national education data repository with ownership and involvement of provincial EMISs, NEMIS has established technical and coordination committees. Technical committees comprise of technical members of provincial/regional EMISs which consolidate/finalize the EMIS database and EFA/MDGs/SDGs indicators on an annual basis. The coordination committee comprises of provincial/regional EMIS coordinators who approve the National EMIS database consolidated by the technical committee.

Provincial/regional EMISs function under the respective education departments and conduct data collection of the respective province/region through the annual school census. Data is collected by the district EMIS and transmitted to provincial/regional EMIS. The data collection mechanism, EMIS, individual and institutional capacities and infrastructure availability varies across provinces/regions. Data analysis is carried out at different levels, as per the requirements of decision-makers, however, district EMIS cells lack this capacity. NEMIS publishes its reports, namely the Pakistan Education Statistics, the Pakistan Education Atlas and District Education Profiles on annual basis to meet the data needs of education stakeholders.

Some issues and challenges related to NEMIS include:

- Lack of data standards and harmonization on education indicators across the provinces and data gaps in respect of SDG-4 indicators. The country does not have proper standards for data at the national level. Data is not harmonized across the provinces and the data collection mechanism (and infrastructure) varies across provinces and regions. For example, some provinces/regions do not collect data from private schools, NFE, technical and vocational, tertiary education and financial data.

- Delays in collection, processing and reporting of data due to limited capacity of some of the provinces/regions. There is also a lack of coordination among various stakeholders managing education data.

- Pakistan currently places low priority on the allocation of resources to EMIS, thereby limited utilization of data/statistics for policy and decision-making at provincial and national levels.

- Furthermore, there is a lack of coordination among various stakeholders managing education data and as a result, there is limited comparability of data, which poses problems for interpreting the data.

NEMIS has taken many initiatives to overcome the challenges that includes advocacy and sensitization seminars on SDG-4; the establishment of non-formal EMIS, capacity building on the use of data for policy and planning; websites showing institution-level data; a GIS-based education atlas for cross-comparison among districts; and a real-time data regime (bio-metric attendance system for teachers in three provinces).

NEMIS is working on a mid-term plan to align its data collating and consolidation mechanism as per new global priorities in the most effective and efficient way possible. Dimensions of this plan relates to strengthening EMIS to full data requirements of SDG-4, development of data norms and standards from data collection up to dissemination, improved coordination among education data stakeholders and more active partnerships and capacity building of provincial/regional EMIS in data production, analysis, reporting and use are some of the activities.

The country is placing emphasis on capacity building on the use of data for policy and planning at the regional and national level. To improve knowledge on issues regarding SDG-4, Pakistan has been hosting advocacy and sensitization seminars on a systemic basis at the regional level.

Pakistan has also trained over a thousand educators to establish a non-formal EMIS process. In addition, the country plans on introducing a GIS-based education atlas for cross-comparison among districts. Another initiative is the development of a strategy for this process and this will involve collaboration with various education stakeholders.

Ideally, Pakistan's future strategy on EMIS will focus on:

- Strengthening EMIS to fulfil data requirements of SDG-4;

- Development of data norms and standards, from data collection to dissemination;

- Improving coordination among education data stakeholders and encourage more active partnerships;

- Capacity building of provincial/regional EMIS in data production, analysis, reporting, and use.

UZBEKISTAN

The Ministry of Pre-school Education was established in 2017 by the country's president and this aims to expand equitable access to a quality pre-school education for at least 50 per cent of children in the next five years.

The Republic of Uzbekistan received financing from the Global Partnership for Education (GPE) toward the cost of the 'Improving Pre-Primary and General Secondary Education Project', which is being implemented under supervision of the World Bank, with UNICEF as the coordinating agency.

In 2017, UNICEF supported Uzbekistan in the development of a robust EMIS for monitoring pre-school education development. In addition, UNICEF has been providing support in developing a new law on pre-school education, early learning development standards, a competency-based curriculum, alternative and innovative models for expanding pre-

school education, the development of public-private partnership models and financing mechanisms.

The ministry is currently partnering with UNICEF in developing a curriculum and it will soon have a project to improve the quality of pre-school education in the country with 50 million USD International Development Association (IDA) World Bank[60] and 10 million Global Partnership for Education (GPE) support[61]. EMIS in pre-school education is an important component for Uzbekistan because it provides: (1) Evidence-based planning of expansion and quality improvement in the country; and (2) Monitoring of results and subsequent decision making.

The current data collection system in pre-school education is not sufficient. The issues presently existing in data collection include:

- Time taken to collect, compile and the submission of data;

- No meaningful analysis possible due to the nature of data collected;

- Duplication of efforts (reporting same or similar data multiple times);

- Different data requirements for different agencies.

The challenges faced with developing EMIS include developing an indicator framework, which comprises education quality, health and safety, equity of access. Additionally, Uzbekistan has the challenge of tracking individual children level data, collecting data via a single online system and improving data quality.

For the implementation stage, Uzbekistan is using Open EMIS and has been able to define their indicator framework, installed and configured their system and has conducted two training events so far, held in January and April 2018.

Uzbekistan has set out plans for their EMIS in three phases:

- Short-term: Implementation across all pre-schools and first data collection process;

- Medium-term: Get all relevant data and indicators reflected in the EMIS; produce analytical reports; ensure relevant stakeholders at all levels are comfortable with the use of EMIS and EMIS data;

- Long-term: A self-sufficient and self-sustaining (including system support) system; EMIS adapted for general and higher education; integration with other systems (e.g. Ministry of Justice, State Tax Committee, etc.); systematically used for evidence-informed decision making.

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[60] International Development Association (IDA) World Bank, access: http://ida.worldbank.org/
[61] Global Partnership for Education, access: https://www.globalpartnership.org/