REVIEW OF EDUCATION MANAGEMENT INFORMATION SYSTEMS (EMIS) THAT TRACK INDIVIDUAL STUDENT DATA

SUMMARY REPORT

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for every child

MINISTRY OF EDUCATION MALAYSIA

GOVERNMENT OF MONGOLIA
MINSTRY OF EDUCATION, CULTURE, SCIENCE AND SPORTS

Foreword

All 28 countries in the East Asia and Pacific region have signed and ratified the Convention on the Rights of the Child (CRC), providing a promise to all children to their fundamental right to quality education and learning. Today, more children than ever before are enrolled in school worldwide and in the East Asia and Pacific region.

The Sustainable Development Goal 4 on Education **(SDG 4)** aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", with the core principle of 'leaving no one behind'. However, a staggering **35 million** children and adolescents from pre-primary to secondary levels in East Asia and Pacific are still out of school, being denied their right to learn. This figure is from before the **COVID-19 crisis**. Moreover, **one in three** students who remain in school do not obtain minimum basic skills in reading and mathematics at lower secondary level. These children need to be equipped with necessary knowledge, skills and competencies to thrive in the 21st century's knowledge-based society and the 4th Industrial Revolution.

A transformation in our education systems is urgently needed. Doing 'more of the same' is evidently not enough. We need to better understand the challenges that most vulnerable children and adolescents face in their daily lives. We must know who they are, where they are, what they can and cannot do, and how we can support each of them effectively.

It is in this context that we present this new Regional Report – **Review of Education Management Information Systems (EMIS) that Track Individual Student Data** – which highlights major gaps in education policy and data. More specifically, the report examines the extent to which and how various data on individual students are collected, analyzed and utilized in our region. Three countries (Malaysia, Mongolia and Timor-Leste) voluntarily participated in the research. In return, we offer key recommendations for these three countries, and all the other countries that care about education and learning of all children and adolescents, to improve evidence-based decision-making and informed targeted investment.

UNICEF will continue to do its best to make the Convention on the Rights of the Child a reality; and will work hard until the day that all children and adolescents, without exception, see the future as a promising and exciting adventure. We hope you enjoy this Report and join us in the journey towards the common dream of 'Quality Education and Learning for All'.

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Definitions

Administrative data: Administrative data are data collected as part of the routine provision of a service. In the context of EMIS, this includes all school and student data, including student management data, student learning data, school finance data etc.

EMIS: An education management information system (EMIS) is a system that manages education information. In different contexts, this system may be referred to by a different name. An EMIS can manage a wide range of data, including: student information (demographics, enrollment, discipline and other functional elements); instructional/learning information (assessment and achievement data, teacher evaluations, curriculum effectiveness data and other elements related to progression through school); longitudinal data; and business intelligence (financial and human resource data, strategic metrics, etc.).

Local: This refers to all the administrative subdivisions that fall under the sub-national level. For example, municipalities, counties, districts and communes.

Metadata: A set of data that describes and gives information about other data.

National: This refers to the whole country. In the survey, the national level refers to legislation mandated by the central government.

Sub-national: This refers to administrative levels that fall below the national level. For example: the country of Mongolia is divided into 21 provinces (Mongolian: аймаг, aimag) and the capital (нийслэл, niislel) Ulaanbaatar. Secondary subdivisions outside Ulaanbaatar are called 'sums'. In 2006, Mongolia had 331 sums. Sums are further subdivided into 'bags'. Malaysia is a federation comprising 13 states (Negeri) and three federal territories (Wilayah Persekutuan). Each state is further divided into districts, which are then divided into 'mukim'.

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Acronyms

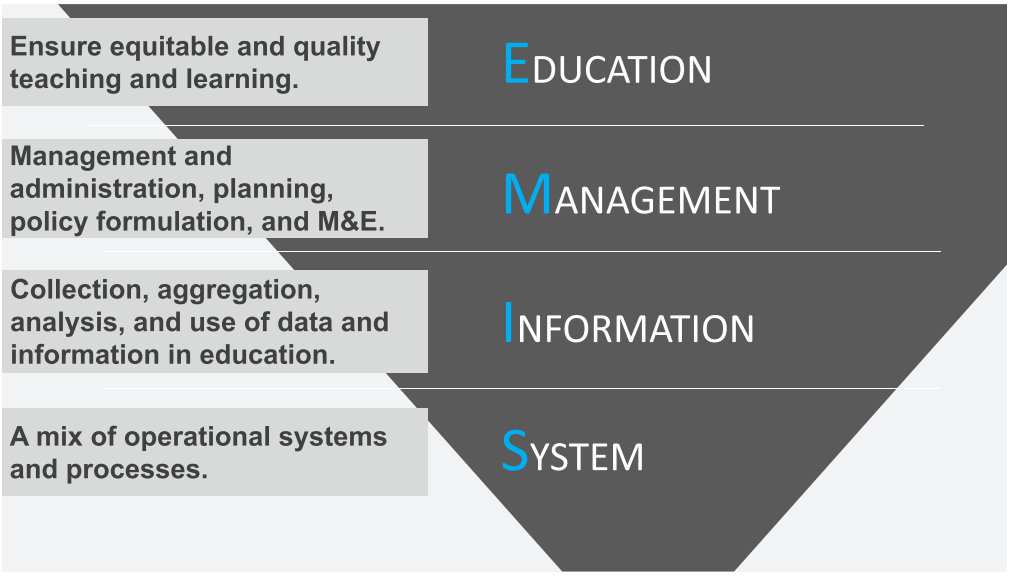
DQAF	Data Quality Assessment Framework
EAPRO	East Asia and Pacific Regional Office for UNICEF
EMIS	Education management information system(s)
MoE	Ministry of Education
NGO	Non-governmental organization
OOSC	Out-of-school children
SABER	Systems Approach for Better Education Results
SDG	Sustainable Development Goal
TVET	Technical and vocational education and training
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

Background

This Review has examined policy and data gaps in relation to education management information systems (EMIS), and the extent to which data are analyzed and utilized for decision-making in three countries (Malaysia, Mongolia and Timor-Leste), and with reference to other global studies and examples. The three countries reviewed provided significant social, economic and geographic diversity regarding investigating responses to questions concerning EMIS. The EMIS operating in the three countries were significantly different as a result of choices made during their implementation.

Participation in the Review was voluntary and based on a commitment to improving EMIS. The Review examined all facets and components necessary to fully capitalize on the potential of EMIS as a facilitator of data-driven decision-making. The Review had a particular focus on systems with individualized student data and tracking.

Figure 1 EMIS conceptual diagram



For this Review, EMIS has been defined as a mix 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.

The Review was initially to be undertaken on EMIS that capture individual student data. However, each of the three country EMIS reviewed for this report employ system(s) that also track individual students. Therefore, the Review is more properly focused on EMIS that track individual students.

The Review has been conducted using a qualitative approach. Twenty-one Review questions, focusing on EMIS that track individual students at school level, have been organized around two main areas (see table 1):

- **Policy and data gaps,** which covers: plans to strengthen EMIS; coverage of national plans and Sustainable Development Goal (SDG) indicators; coverage of equity and out-of-school children (OOSC); quality, quality assurance and data privacy; interaction with other data systems, management and position in data architecture; and resourcing and budgeting.
- **Data analysis and utilization,** which covers: accessibility; processes of interpretation, analysis and use; use for operations and monitoring, reporting and planning; operation in relation to various systems; use for equitable resource distribution; and other requirements for improvements.

Table 1: List of 21 Review Questions

#	Review Question
1.0	***Strategic Area: Policy & Data Gaps***
1.01	Does the country have a strategic plan to strengthen the EMIS?
1.02	Does the EMIS collect and analyze data that is necessary and sufficient to monitor and develop the national education policy framework and sector plan?
1.03	Does the EMIS collect and analyze data required for SDG targets and indicators monitoring?
1.04	To what extent does the EMIS capture data and information in ways that allow for equity analysis, such as enrolment/ attendance of children with disabilities, children from ethnic minority communities, and children from poor households?
1.05	How, if at all, does the EMIS address issues around out-of-school children (incl. children at risk of dropping out)?
1.06	What are the various aspects of the quality of EMIS?
1.07	What are the quality assurance processes in place and how effective are they?
1.08	How does the EMIS protect data privacy of students and teachers?
1.09	How does the EMIS interact, if at all, with other administrative data systems (e.g., health, social welfare, civil registry, labour)?
1.10	How is the EMIS managed and where is it situated in the data architecture or statistical systems of the country?
1.11	Are there sufficient resources (human and financial) available for the EMIS?
1.12	Is there annual budget allocation to improve the EMIS?
1.13	Do parents and teachers have access to EMIS data and does it result in improved pedagogical outcomes?
1.14	What were the key drivers, process, challenges and costs for transition from aggregate data systems to individual child systems?
2.0	***Strategic Area: Data Analysis & Utilization***
2.01	To what extent are the EMIS data accessible to intended ministries and the public?
2.02	How are the EMIS data interpreted, analyzed, presented and consumed for decision making and policy implementation?
2.03	How are the EMIS data used to improve/influence implementation of sub-national education plans at district and school levels?
2.04	How does the EMIS facilitate daily transactions for operational requirements?
2.05	How does the EMIS operate with various systems and functions, e.g., Student Tracking (student's movement, transition, transfer, etc.), real-time monitoring (attendance, academic progress, etc.), early warning (dropout prevention, learning improvement, etc.), automated reporting with data visualization, feedback loop (e.g., school report card)?
2.06	How is the EMIS used, if at all, to help ensure equitable distribution and allocation of resources (e.g., school grants, teachers)?
2.07	What are some key requirements and issues to consider in order to ensure better collection, analysis and utilization of the EMIS data?

The Review's conclusion was phrased to address five overarching questions developed during a workshop at which preliminary findings were disseminated.

The advent of national Student Tracking systems globally is a relatively recent innovation. In the East Asia and Pacific region, countries have started migrating to individual Student Tracking systems in the last decade. National tracking commenced in Timor-Leste in 2012, in Mongolia in 2013 and in Malaysia in 2009, although Malaysia had individual student data in schools prior to 2009. In some cases, such as Malaysia, only students in the public general education sector are presently tracked, and data on the private sector are stored as aggregate data. Complete coverage of national tracking of all students in all sub-sectors was not evident in any of the reviewed countries. Other countries in the region outside this study are also migrating to Student Tracking systems. Small Island Nations that have commenced Student Tracking include Fiji, beginning in 2012 for general education and presently expanding to include technical and vocational education and training (TVET) and higher education. Other countries including Lao PDR and Cambodia, have plans to commence Student Tracking.

The move towards individual Student Tracking is likely motivated by a range of factors. Expectations concerning the capability of EMIS changed significantly over the past decade, in line with progress in technology and in response to the increased monitoring expectations of governments and development partners, particularly the need to monitor performance and achievement.[1] During the past decade, EMIS has increasingly incorporated resource management systems, including human resource information systems and performance evaluation systems, such as Student Tracking and examination systems. These data are used to contextualize learning outcomes and provide information on school quality and performance, which can then be related to learning outcomes. These data are essential to ensure issues impacting learning outcomes can be properly addressed. The proliferation of Internet access via 3G has also enabled ministries to deploy increasingly granular systems directly to schools, such as student and teacher management systems.

Student Tracking may also be motivated by increased emphasis on ensuring all children are able to benefit from opportunities to learn. Both international communities and national governments have driven a change for greater emphasis on **equity** and **equality,** whereby the needs of marginalized and disadvantaged groups are clearly addressed in education planning. SDG 4 emphasizes the need to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", and SDG Target 4.5 particularly stresses the need to "ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations". This requires that all data needs to be **disaggregated** by gender, location, wealth quintile and other factors, such as disability status, ethno-linguistic groups and conflict-affected groups. Thus, EMIS must increasingly be capable of storing data on individuals in order to be able to disaggregate by a wide range of socio-economic factors.

This report summarizes the findings of the Review of EMIS in Malaysia, Mongolia and Timor-Leste, to provide a basis for the key recommendations presented at the end.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1 UNESCO (2015), *EMIS and ICT supported Planning October 2015 UNESCO Bangkok Office*, http://www.unescobkk.org/fileadmin/user_upload/ict/ict-newsletter/ictnl-oct15.pdf


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Methodology

The Review was conducted over four working months in 2019 and under the guidance and management of the United Nations Children's Fund (UNICEF) East Asia and Pacific Regional Office (EAPRO), as well as through the Malaysian, Mongolian and Timor-Leste UNICEF Country Offices. Primary and secondary data sources were used. The focus of the Review was qualitative, consisting of comprehensive literature reviews, technical examination of EMIS and interviews with key stakeholders using standardized research tools. The research tools and methods for key informant interviews were informed by: the set of 21 research questions; methodology and tools commonly used in EMIS evaluations such as the World Bank Systems Approach for Better Education Results (SABER)-EMIS[2] ; and the United Nations Educational, Scientific and Cultural Organization (UNESCO) Data Quality Assessment Framework (DQAF).[3]

Respondents were from ministries, national non-governmental organizations (NGOs) and international NGOs associated with education data, and included staff at all levels of the education system, including national and sub-national (state and district) levels, and schools, universities, TVET colleges and non-formal institutions.

Governments and partners were involved in the Review during all phases and in approval of the final report. This has helped ensure government and partner ownership of the findings and recommendations, which will hopefully lead to their eventual inclusion in national education policies and sector plans.

2 The SABER-EMIS methodology utilizes a structured evaluation process to provide education systems analyses, assessments, diagnosis, and opportunities for dialogue. At global level, it improves the education systems knowledge base and uses this information to implement effective reform. http://saber.worldbank.org/index.cfm?indx=8&pd=2&sub=4, accessed 27 March 2019. However, this Review was not envisaged as a detailed SABER evaluation and was not designed to address all of the same issues.

3 Developed to implement evaluation methodologies that assess the quality of data produced by national statistical systems using such standards and tools for assessing education data quality produced by member states. http://dqaf.uis.unesco.org/index.php?title=The_DQAF_Manual, accessed 27 March 2019.

Key Findings

This Review highlights the benefits, enabling factors and challenges of implementing national Student Tracking systems in the education sector. Here, we provide a synthesis of the main findings and conclusions, responding to the five overarching questions formulated by synthesizing the 21 research questions related to the review of EMIS, and specifically to Student Tracking.[4] The country Reviews for Malaysia, Mongolia and Timor-Leste produced separate country reports, each including main findings, conclusions and recommendations.

1) How did the deployment of EMIS in the three countries vary to enable Student Tracking, and were there sufficient resources?

The three countries reviewed provided significant social, economic and geographic diversity, giving a basis on which to investigate responses to questions concerning EMIS. The three systems reviewed used different architectural and system arrangements to deploy Student Tracking systems.

Timor-Leste presented an example of a highly centralized EMIS, whereby data were entered, cleaned and reported through a national EMIS department. Data were published in aggregate format and available on request in other departments and at municipal level. Mongolia's EMIS, by contrast, was centralized and integrated, but most of the data management occurred at school level. The system was designed and implemented in accordance with a strategic plan[5] developed in 2012, to facilitate the information needs of the actors at each level of government, down to school level. Malaysia presented an example of an EMIS where development of data capture systems had historically occurred based on departmental-, state-, district- or institution-perceived data or system needs. This resulted in a vast number of applications and a core set of systems in which data were often duplicated and interoperability was limited. This placed a heavy burden of data management on actors at school level, as they had to acquire expertise in an array of applications and ensure data were entered and current in each. The Ministry of Education (MoE) is now working to consolidate the systems and to integrate them in a common database, and where possible to enable interoperability.

In Mongolia and Malaysia, individual student data were managed directly in the system through schools. Robust processes existed to ensure student data were managed properly. These included processes for enrolment of students, transfer between schools, dropout and other events, such as student repetition. Electronic management of student records at school level occurred through EMIS, which largely replaced physical records and allowed for a greater amount of information on each pupil to be managed, such as attendance and grade scores. This was not the case in Timor-Leste, where the centralized management of student data limited the frequency at which student data could be updated to once a year, and which prohibited detailed information about, for example, monitoring student attendance.

The structure, cohesion and deployment of the different EMIS impacted the resources required to develop and maintain them. Mongolia reported that adhering to a strategic plan for the development and operation of the EMIS assisted in ensuring adequate resources for the operation and development of the overall EMIS, including not only data capture, but also processing, analysis and utilization processes. Mongolia was the only country that had a clear and projected budget allocated to the development of the EMIS for the general and higher education sub-sectors. Mongolia also noted that the plan helped mobilize and channel resources in which partnerships were involved, and helped all parties identify the longer-term operational requirements of the EMIS. Malaysia was expending considerable resources trying to ensure alignment and

4 These questions were synthesised after review of the responses to the Review questions and further discussion at a presentation conducted by UNICEF EAPRO in August 2019.

5 Ministry of Education (2011), *Five year strategic plan for Education Management Information Systems in Mongolia* (Asian Development Bank (ADB)/Government of Mongolia: Mongolia, Shoobridge J., 2011).

interoperability of disparate systems operating through different departments. Malaysia has recently developed a sector-wide information and communication technology ICT transformational plan, but funding is determined annually, which risks underfunding. Timor-Leste lacked adequate resources and had no plan for operation or development of the EMIS, and the system had remained static since 2012.

2) What were the main drivers, challenges and opportunities in the migration towards Student Tracking?

The process of shifting from aggregate student data to individual student data was not rigorously documented by any of the three countries, and a significant amount of institutional knowledge was lost. It should also be noted that the path of migration towards Student Tracking was not a focus of this Review and therefore information on this subject is limited.[6]

Timor-Leste commenced national tracking in 2012. Malaysia began electronic student record-keeping in schools in 2003 but did not move to a national web-based system until around 2009. Mongolia developed a vision for Student Tracking in 2012 and implemented national Student Tracking in 2013.

Enabling factors varied between the countries reviewed. In Timor-Leste, evidence suggests that the main driver was development partner influence prompted through a World Bank intervention.[7] Malaysia developed national Student Tracking to help monitor exam results and to provide schools with greater capacity for electronic record-keeping by consolidating the individual school databases of student records into a national system to track all students. Mongolia had a clear record of decisions and objectives, as documented in their EMIS strategic plan (2011–2015). In Mongolia, linking EMIS to the Civil Registration System helped identify all children and facilitated transition to individual student data.

The countries reviewed reported that the main drivers of transition to individual Student Tracking were the need to record and understand the learning outcomes of individual students and to help ensure that the education system became more accountable and efficient. It was generally reported that individual pupil data produced more accurate data at the national and sub-national levels.

The countries noted challenges in migrating towards Student Tracking. These included the challenge of institutionalizing a unique student identifier for Student Tracking in Malaysia. This process took time and required changes to national policy and the processes employed at school level. Mongolia and Malaysia both reported challenges in developing capacity at school and sub-national level. In Mongolia, capacity was developed according to its implementation plan. In Malaysia, capacity was not developed uniformly but through departments implementing different systems and applications for specific purposes over a longer period of time. The 2015 initiative to consolidate these disparate systems as part of a central data repository was intended to simplify the environment for the future. Timor-Leste reported challenges presented by limited resources in the EMIS department, and difficulties in decentralization owing to limited capacity to engage the web-based system at municipal and school level; there the EMIS remained highly centralized.

The evidence indicates that countries wishing to pursue individual Student Tracking would benefit from a clear strategy and plan for implementation that takes into account the capacity development needs at each level of government. All actors should be informed of the benefits of moving to individual student data, and the strategy should ensure the EMIS is developed to facilitate processes at school level. Linking to a national citizen registry can assist in populating the EMIS and in ensuring a unique identifier for all students. National policy should reflect the need for individual Student Tracking, but this was not identified as a predominant enabler. Institutionalizing the correct processes at school level is also important. In environments where school capacity to connect to the Internet may be low, Student Tracking can also be facilitated by schools first managing student data electronically offline at school level. In the case of Malaysia, this helped lay the foundation for migration to the national system.

6 Only Review Question 1.14 concerned transition to Student Tracking: "What were the key drivers, process, challenges and costs for transition from aggregate data systems to individual child systems?".

7 World Bank funding ceased in 2013 and development of the system ceased in the same year.

3) What were the key issues countries faced in maintaining individual Student Tracking, such as data quality, privacy and coverage, and how these can be addressed?

Ensuring full data coverage was an issue in all countries. In Malaysia, only students in the public general education sector were tracked, and data on the private sector were stored as aggregate data. Timor-Leste only tracked students in the general education sub-sector. None of the countries had national Student Tracking systems in the TVET sub-sector. None of the countries could track students between sub-sectors, such as between general and higher education. Mongolia was planning to ensure systems in all sub-sectors shared data so that students could be tracked between sub-sectors. This would enable a complete national academic record to be available for any citizen.

Countries noted that individual student records provide an auditable and transparent national data record, which helps improve data quality. A robust coding system for students and a strong process of validating data at school level, such as via birth registration certificates and other documents, was also seen as important to helping ensure data quality. In Mongolia and Malaysia, individual student data could also be verified through other government systems, such as the civil service registry of citizens, through the use of robust coding systems. In Malaysia, sharing information with other government systems[8] also helped to enhance the data stored on each pupil by including data on each student's health and welfare. The benefits of doing this include improved quality of data and capacity to share information to support improved delivery and monitoring of government services. To help achieve this, Malaysia developed several high-level government information technology strategies that promote the sharing of information between government agencies. This approach facilitates the triangulation and verification of data between government systems.

8 Including: the health management information system located in the Ministry of Health; the Malaysia Central Government Data Exchange located in the Malaysian Administrative Modernisation and Management Planning Unit of the Prime Minister's Department; the Royal Malaysia Police Public Sector Open Data located in the Central Criminal Intelligence Unit; MyIdentity located in the National Registration Department; and the Human resource management information system(s) located in the Public Service Department.

Staff at all levels of government were required to check data as part of their job functions and this role was included in the job descriptions of teachers, principals and district- and state-level staff. In Mongolia and Malaysia, direct access to the data in accordance with job roles helped ensure verification was undertaken. In these countries, data quality was a criterion in staff evaluations and data verification was included in in-service training for staff at all levels. Mongolia and Malaysia also noted that systems that engaged users at school level resulted in better quality as they ensured that users checked data on a continuous basis.

Maintaining the currency of data was also an issue. Mongolia and Malaysia noted that maintaining the quality and accuracy of individual student data required having robust processes and procedures for recording transfer, dropout, repetition, promotion and changes to student records for attendance, exam results and other data.[9] They noted it was also important to monitor the currency of data.

The countries reviewed also used error eradication systems that flagged data that did not match or was not consistent.[10] It was also noted that many other factors play a key role in data robustness and quality, including: the robustness and structure of the data capture tools; the strength of the database design; and response rates. However, these were not identified as primary factors in the countries reviewed.

Having national systems containing data on individuals raised issues concerning the rights of individuals to the privacy of their personal data. Malaysia and Mongolia had robust legislation and policies to protect the rights of individuals. This provided a framework for the use and distribution of data concerning individuals. The policy in both countries stipulated that data on individuals could only be used anonymously[11] or in aggregate form by those not having specific permission. Permission was granted through authorized access to individual data compliant with job descriptions and responsibilities. This was not the case in Timor-Leste, which at the time of the Review lacked legislation or policy, and relied instead on 'common sense', which meant the judgement of the individuals responsible for the data. All countries applied physical and virtual security, such as firewalls and passwords, to their databases. The efficiency of such measures was not evaluated but data breaches had not occurred. Privacy concerns did exist in all countries. For example, in Mongolia contractors working on the database did not have to sign confidentiality agreements.

4) To what extent was Student Tracking being utilized for education planning, administration and operation, and how were countries capitalizing on individual student data and ensuring the data were used effectively?

EMIS data were used extensively at national level in all countries reviewed to monitor sector plans and national education policy frameworks. However, Malaysia and Timor-Leste did not ensure data were available for sector monitoring at sub-national level. Mongolia's EMIS enabled districts and schools to visualize progress in key performance indicators by providing online dashboards and reports for these levels. **Countries used EMIS data to report against most SDG indicators when requested by international organizations.** The countries highlighted that they were reviewing the structure of individual child records to enable the addition of variables required to analyze education data by parameters such as wealth, inequality and disability. The countries reviewed reported challenges in reporting on the SDGs, including: a) defining 'non-formal education' and ensuring it is properly captured through the EMIS; b) ensuring the disaggregation of all indicators by disability and wealth; and c) localizing difficult indicators, such as SDG 4.7.1 relating to global citizenship and sustainable development, which are classified as Tier III.[12] Mongolia and Malaysia demonstrated

9 In the case of Timor-Leste, information was only updated once a year and all data were maintained at the national Department of EMIS. Student movements occurring during the year were not accounted for until the following year.
10 Including the use of statistical procedures to identify missing or possibly erroneous data.
11 With identifying attributes removed.
12 SDG indicators in Tier III means that no internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.

significant capacity to undertake equity analysis in accordance with the requirements of SDG 4.5.1. They attributed this to the capacity of their systems to report on a large number of parameters relating to individual children.

EMIS data use at sub-national level varied between countries. All countries noted the importance of empowering districts and schools to undertake planning and monitoring. In Timor-Leste, planning was highly centralized and this correlated with detailed statistical data generally only being available at national level. By comparison, in Malaysia, planning had been decentralized and hence, at sub-national level, the systems and applications comprising EMIS were used to generate and monitor sub-national and national plans, and to provide empirical evidence for the implementation of education, resourcing and monitoring in schools. The countries also noted that it was important to ensure the EMIS provided information in an appropriate format for use in sub-national and school planning. For example, Mongolia employed data visualization through an electronic form of school report card, using EMIS data to enable schools to better understand their progress against national objectives. The extent to which EMIS data were used in schools depended on the capacity of the schools to use data. In Mongolia and Malaysia, in-service training included training on how to use the EMIS to facilitate job functions.

The countries reviewed also used Student Tracking systems to track children who were both in and out of school, and to address issues such as dropout. In Mongolia, where all citizens were registered through a national citizen registry, the EMIS could accurately calculate participation and exclusion rates. In Malaysia and Mongolia, the EMIS also helped identify children at risk of dropping out by measuring factors such as attendance, academic performance, distance from school and family income. Malaysia demonstrated a sophisticated system that produced early warning of children at risk of dropping out so that preventative action could be taken for individual students. Challenges concerning accurate reporting of OOSC in the three countries reviewed included: a) ensuring data is available on 'invisible children', who are those not included in any administrative systems (Malaysia, Timor-Leste); b) ensuring full data coverage through the EMIS (all countries); c) tracking children between education sub-sectors, such as between basic education and TVET (all countries); d) comparing EMIS data to household survey data to verify EMIS data and data on other government systems (all countries); and e) linking EMIS data to other government systems that can provide additional data concerning the likelihood of children dropping out of school, such as household income and health information (Timor-Leste).

Mongolia and Malaysia engaged teachers through the EMIS and were piloting parental access to some EMIS data. In Malaysia, teachers received early warning notices regarding possible dropout risks, and could facilitate responses to issues, such as enabling counselling, through the system. Mongolia was in the process of piloting a parent–teacher portal through its Education Sector Information System, which is the national EMIS for general education. The portal was comprehensive and enabled parents to check their children's attendance, exam dates, homework, marks, curriculum, schedules, textbook allocation information, disciplinary information, school information, and information on activities, and to communicate with teachers and other parents via a web portal and mobile application.

Challenges in implementing these types of systems were identified. Both Malaysia and Mongolia noted the need to consult actors at school level when developing EMIS for teachers and parents. They also noted that systems that interacted with actors at school level required strong capacity development and advocacy at school and community level, and also required good Internet and powerful servers, which can increase the cost of deploying EMIS. Mongolia and Malaysia also noted that this kind of EMIS should be designed to engage teachers and parents in meaningful ways that can directly impact the pedagogical outcomes of individual children.

The countries reviewed demonstrated multiple methods for interpreting, analyzing and presenting data for consumption. At strategic level, being the level concerned with high-level decision making and policy implementation, data were generally presented in the form of headline indicators (Malaysia and Mongolia). In such cases, empirical data were usually presented graphically, in the form of a dashboard that could be queried or filtered to enable more precise representation of data, such as for a specific area or region. Information intended for the public was generally made available through brochures, infographics and media publications (all countries). Administrators and planners were also provided with routine reports for specific purposes (Mongolia and Malaysia), and could request specific reports through the relevant EMIS department (all countries). At operational level, functions and reports were provided through EMIS to facilitate transactions, such as student enrolment, transfer and staff management (Mongolia and Malaysia).

Mongolia and Malaysia, where EMIS were accessible at school level, used EMIS extensively for transactional purposes. The main areas of transaction reported concerned student and teacher data. However, financial data relating to students and teachers were also managed via regular transactions, for example, the financial data for student stipends and scholarships being processed in the EMIS as allocation, disbursement and remittance of funds occurred for each student. The types of functions that were facilitated included: teachers' appointment to class; teacher training; timetable organization; support to children with disabilities and children from ethnic minority communities; support to children from poor households and poor herders; textbook distribution; classroom allocation; student intake, promotion, transition and dropout; student grade and examination recording; and attendance monitoring.

Countries also noted drivers of change towards transactional systems. These included ensuring the capacity for transactional systems to add value to processes at school level, such as assessing individual student dropout risk in order to enable timely preventative interventions. They also noted that transactional systems should reduce paperwork over time. However, challenges were also reported, including: ensuring staff in schools had the capacity to use the systems for daily transactions; ensuring systems did not impose an undue burden on operators; and ensuring that they help eliminate duplication.

Government policy also plays a significant role in encouraging the use of information at all levels of government. In Malaysia and Mongolia, many functions relating to planning and resource management were decentralized to sub-national and school levels. The MoE in each country had issued numerous policy statements indicating that EMIS must be used to justify a decision or facilitate a process. This ensured that EMIS became an integral part of many processes, which in turn helped ensure data currency and quality.

5) What were the main benefits experienced by countries employing Student Tracking and what were the opportunities for further benefits?

The evidence from this Review indicates that there were substantial benefits for the countries that employed individual Student Tracking systems.

The countries reviewed demonstrated that Student Tracking can provide superior statistical data for the generation of national education statistics. The capacity to combine any variables that are part of student records in the analysis of data provides much greater statistical capacity compared to systems storing aggregate student data. Data in systems where all students are uniquely identified are also likely to be of much greater validity, and are more easily verifiable. However, in the countries reviewed, the quality of data were still dependent on ensuring proper processes were in place, and in many cases there were issues of coverage that needed to be addressed.

Mongolia and Malaysia demonstrated that Student Tracking systems can, if properly deployed with appropriate reporting, functions and staff capacity, enable interventions to be targeted towards individual children. Both countries demonstrated that a complete repository of information on individual students can facilitate better student monitoring and enable interventions that can positively affect pedagogical outcomes and address other issues relating to the wellbeing of a student. They both provided many examples of student data systems being used to track student movement and to provide early dropout or performance warnings, which enabled intervention.

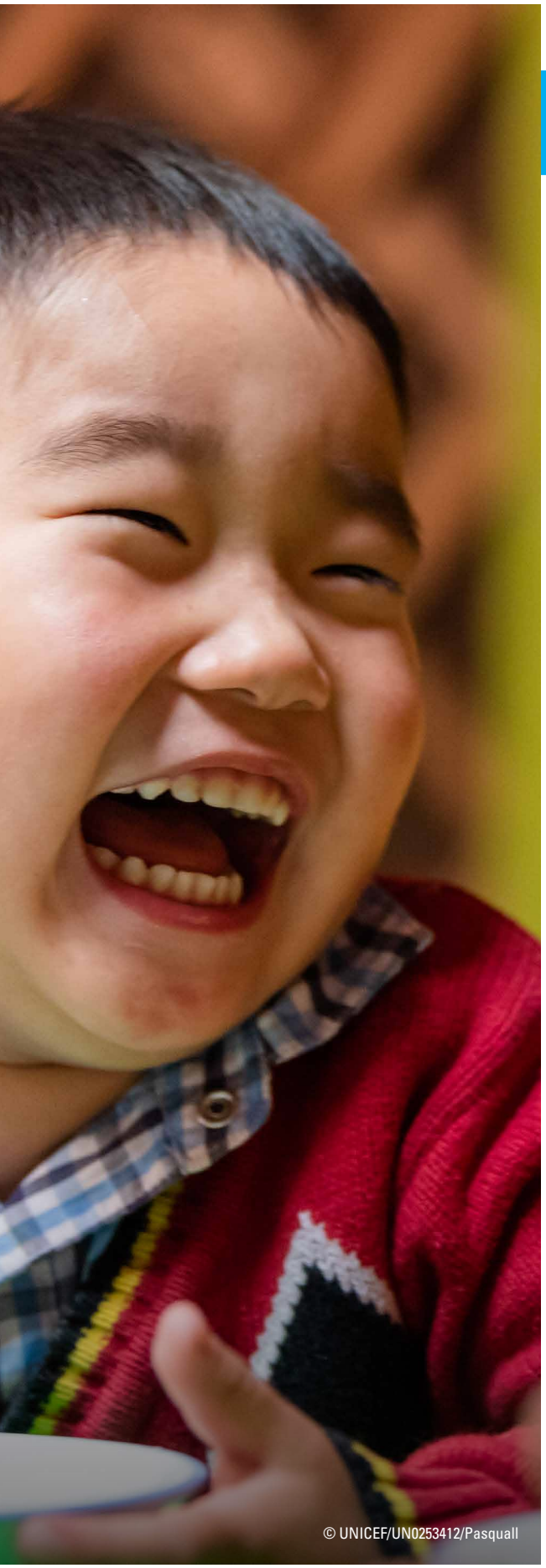
There is enormous scope to increasingly tailor education to the needs of individual children using Student Tracking systems. However, there are also limitations concerning the amount of data that can be captured on individuals.

More data does not necessarily mean increased capacity to positively affect the education system. Malaysia's complex array of systems placed substantial strain on actors at school level and indicated the pitfalls of developing systems without constraints and a holistic vision.

There is also potential to use Student Tracking to engage parents and facilitate communication between parents, students and teachers. This was being piloted in Mongolia and Malaysia, but it is too early to definitively state what is required to achieve this and whether it is feasible on a large scale in these countries.

There is also some evidence to suggest that Student Tracking systems in government environments that have high levels of interoperability between sector information systems, such as those in health, education and social welfare, can provide a more holistic picture of the wellbeing of each individual child, and can help determine whether a child is participating in mandated and essential services. Malaysia expressed a desire to achieve this goal and is presently working to consolidate government systems to enable this vision.

Timor-Leste also highlighted some constraints of Student Tracking. **In environments where individual pupil data are underutilized, considerable resources can be expended for limited gain.** The potential for utilization of individual Student Tracking systems was greatest when data management took place in schools and the system helped facilitate processes and data needs at school level.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Conclusions

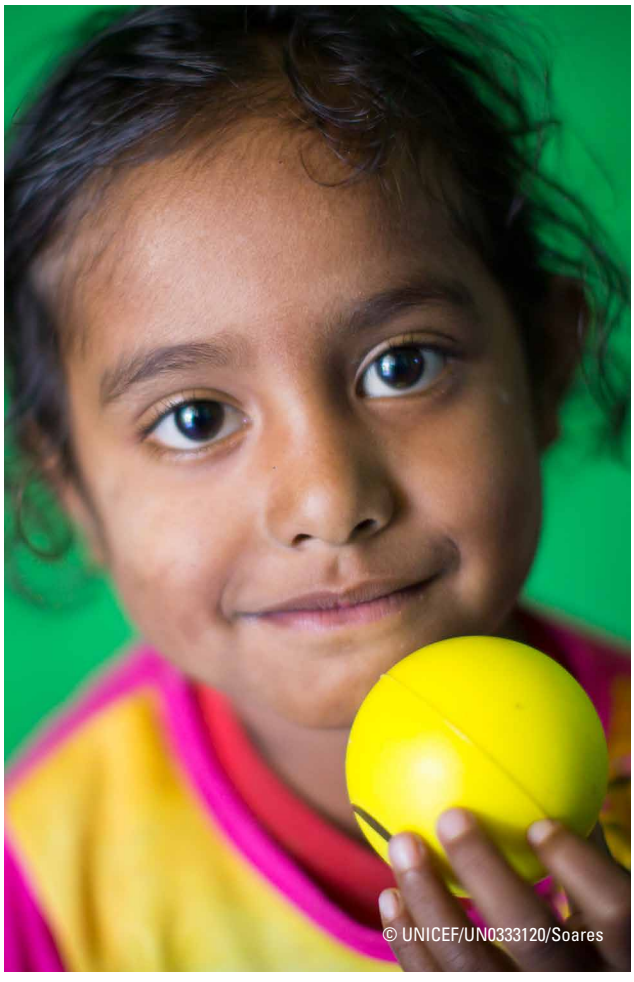
This Review has highlighted the importance of quality disaggregated data on education for SDG reporting and national monitoring and systems improvement purposes, and has helped identify ways in which EMIS can be strengthened to promote equitable quality education and learning in the region. The findings generated in this Review have led to recommendations for improving EMIS and their use by the governments and partners in the countries reviewed, but also – importantly – they have led to recommendations to UNICEF EAPRO and other development partners, such as UNESCO/Institute for Statistics (UIS), about how to better support EMIS and EMIS data utilization across the region.

Implementing EMIS using Student Tracking has many **benefits,** including:

1. **Providing superior data for the generation of national education statistics:** The capacity to combine any variables that are a part of student records in the analysis of data provides much greater statistical capacity than systems storing aggregate student data.
2. **Enabling interventions to be targeted towards individual children:** Individual Student Tracking, if properly deployed with appropriate reporting, functions and staff capacity, can facilitate better monitoring of students and can enable interventions that can positively affect pedagogical outcomes and address other issues relating to the wellbeing of a student.
3. **Engaging parents and facilitating communication between parents, students and teachers.** However, it is too early to definitively state what is required to achieve this and whether it is feasible on a large scale in the countries reviewed.
4. **Providing a more holistic picture of the wellbeing of each individual child:** In government environments with high levels of interoperability between sector information systems, information on health, education and social welfare can be shared to help create a more complete picture of an individual child's wellbeing and participation in essential government services.

Implementing EMIS using Student Tracking also introduces challenges, some of which are applicable to any EMIS, but made greater with the requirement of Student Tracking. These include:

1. **Ensuring full data coverage** (ensuring individual child data encompass all children and all sub-sectors of education): The countries reviewed highlighted difficulties with ensuring full child coverage between sub-sectors, such as vocational, higher and basic education. Populating databases from national registries of citizens helped to generate full coverage. However, to ensure full data coverage, EMIS must be aligned between sub-sectors, and they must be aligned for public and private schools. A lack of data on 'invisible children' (those not included in government systems) was an issue for all countries reviewed.
2. **Access to EMIS at sub-national and institutional levels** (ensuring adequate resources at sub-national and institutional level in terms of hardware, software, connectivity and human resources): Timor-Leste provided an example where the Student Tracking system was centralized and individual child data were not available to those at sub-national and institutional level, owing to a lack of adequate resources, such as computers, Internet and staff capacity. As a result, individual child data were underutilized compared to countries such as Mongolia and Malaysia, which made the EMIS available at sub-national and institutional levels.
3. **Use of EMIS data at sub-national and institutional levels:** Ensuring EMIS and EMIS data use at sub-national and institutional levels remains a challenge for countries such as Timor-Leste, while overall information use is a general challenge at national level, across the researched countries. EMIS must be aligned with administrative, planning and monitoring needs, and people undertaking these functions should have direct access to the EMIS. This increases the likelihood that EMIS data will be used.
4. **Data privacy:** As countries progress towards government systems that track individuals, maintaining the rights of individuals to the privacy of their personal data is a leading concern. The rights of individuals must be protected through legislation, policy, EMIS design, confidentiality agreements, physical security and virtual security. Countries often address some of these issues but usually fail to address all of them.
5. **Interoperability, integration, data rationalization and system alignment:** Aligning EMIS development between departments and separate ministries was a challenge for some of the countries reviewed. Malaysia had a fragmented system within the MoE but had established connectivity with other ministries. In contrast, Mongolia had an integrated EMIS but little connectivity to other ministry databases.
6. **Quality of data on individual students:** Ensuring the existence of quality and up-to-date data on individual students can be challenging and requires robust processes facilitated by connectivity to other government systems. The countries reviewed struggled to ensure accurate data in areas such as disability, parental education and income status.
7. **Limited resources:** Ensuring adequate resources to further develop EMIS was challenging for two of the countries reviewed. Deploying Student Tracking systems often required capacity development at school level, which was expensive.



Recommendations

Recommendations relating to the Review methodology

The recommendations set out below relate specifically to the methodology of this Review, and are applicable to UNICEF and other international and national development partners[13] interested in supporting EMIS development in general, or with a specific focus on enabling national systems for Student Tracking.

1. **Review the methodology used in this Review to inform other EMIS evaluation methodologies:** The methodology applied in this Review was designed to be understood by actors at all levels of education, and by those who consume EMIS data or rely on the systems to undertake job functions. Responses to interviews and general feedback from the workshops conducted in each country indicated that this approach was easily relatable and helped a diverse range of participants to respond and provide feedback. There may be some benefit in applying this approach jointly with other EMIS evaluation methodologies, such as SABER and DQAF, to help non-technical staff engage in the process of identifying areas for improvement.
2. **Rationalize questions and group them as sub-questions:** There is scope to rationalize some of the questions. For example, Question 1.01 deals with strategic planning, 1.11 with resources for EMIS and 1.12 with budget. There are inter-related issues in each question and there is scope to unpack and rationalize questions to enable more focused responses concerning quality and provision of resources. Another example is provided by Questions 1.04 and 2.06, which both deal with equity. There is also scope to cluster questions under overarching themes, as in the conclusion of this report. This helps to reduce the complexity of the findings and to synthesize the conclusions through a simplified thematic approach. The overarching questions also align more easily with both SABER and DQAF methodologies and so will be more familiar to EMIS practitioners.

13 International development partners are agencies (including: UNICEF; the UNESCO Institute for Statistics; UNESCO; the Department of Foreign Affairs and Trade, Australian Government; and the World Bank) supporting EMIS development at global level. National development partners may include NGOs, commercial partners and others active at national level supporting EMIS development within countries.

3. **Ensure adequate time and resources for a full review:** EMIS are becoming increasingly complex in countries that are moving to Student Tracking, as evidenced by Malaysia, where the EMIS is highly fragmented at national and sub-national level. EMIS also encompass all sub-sectors of education. The countries reviewed were enthusiastic about participating in highly comprehensive and detailed reviews, but such reviews may take longer than the time allocated to each country in this Review.

Recommendations concerning further work that may result from this Review

Further work following on from this Review may include:

4. **Transition recommendations to a strategic plan:** The main product of the country studies was a situation analysis that was given focus through specific research questions. Recommendations were generated in a planning format but not in a strategic plan format. Countries expressed an interest in dedicated EMIS strategic plans that could help guide development for a five-year period.
5. **Provide further technical support to the reviewed countries:** The countries reviewed noted the need for further technical inputs specific to each country context. The recommendations were also captured in each country report resulting from this Review. There is scope for UNICEF and other development partners in each country reviewed to fund further technical assistance to help them improve their EMIS.
6. **Study the transition from aggregate EMIS to EMIS that track individual children:** It would be beneficial to further study the transition from aggregate to individual data systems. In the countries reviewed, this process was not well documented and levels of institutional knowledge were low. A study of the transition process could help confirm the factors that contributed to a successful transition, and identify further factors that could ensure success. Such a study should focus on the different aspects of transition, such as capacity requirements and development in schools and sub-national offices, and the impact of policy and legislation. The study should also help identify key drivers for transition, such as government commitment, opportunities to leverage technology, resources and resource mobilization. It should also help identify challenges and barriers, and strategies for overcoming those that are typically encountered.
7. **Study the specific design features, processes and functions supported through Student Tracking systems that are most useful in impacting pedagogical outcomes and school planning:** Student Tracking has the potential to facilitate positive interventions for the individual student. However, which design features, processes and functions are more likely to provide the greatest impact is poorly understood. A study into this topic could help countries to better deploy Student Tracking systems to positively engage actors at school level.
8. **Study the capacity of countries to utilize individual data to provide a more holistic picture of the wellbeing of each individual (child), and to help improve service delivery support between sectors:** Government systems that contain individual (child) data can be effective in enabling different areas of service delivery to support each other, such as cooperation between health centres and schools. If government systems are interoperable down to the individual level, unique perspectives can be gained on the wellbeing of individuals and their participation in essential government services. Such systems can help place citizens, and importantly children, at the centre of government systems, and can help identify individual children who may have issues or may not be participating in all essential services. Such gains must be balanced against concerns about privacy. A study into the capacity of countries to utilize individual data would help provide perspective on this and could lead to the development of guidelines to assist countries to migrate government systems towards individual data.
9. **Disseminate and promote the main findings of the Review:** UNICEF can play a lead role in disseminating and promoting the findings of this Review, which can assist other countries to mobilize resources and support for a transition to Student Tracking systems. EAPRO can do this through regional forums and through the wide network of Country Office programmes.

Recommendations concerning international support to EMIS

International development partners can also play a role in assisting countries to migrate towards Student Tracking systems. These recommendations can also be implemented at country level but they will be more effective for a greater number of countries if they are applied at international level.

At international level:

10. **Develop and promote guidelines for EMIS using Student Tracking:** Develop guidelines for the development of individual Student Tracking systems, which should include methods and guidelines to track 'invisible children', i.e., children who are not included in administrative systems. Guidelines may be developed based on reviews of best practice using country examples. Guidelines should highlight the capacity for Student Tracking systems to be used to facilitate the management of education at operational and transactional level.
11. **Revise SDG 4 metadata:** SDG 4 metadata refer to means of verification for many indicators, via EMIS that capture aggregate data or via household surveys. There is scope to revise SDG 4 metadata to include methodologies for reporting against SDG 4 indicators using Student Tracking systems, and for guidelines to be developed. Data structures and data elements for tracking individual students can be included as examples.
12. **Develop methodologies for using individual child data to improve pedagogical outcomes:** Methodologies should be developed to help countries utilize Student Tracking systems to improve the pedagogical outcomes of children. Examples include methodologies for implementing early warning systems to prevent child dropout and truancy, and for monitoring preventative interventions. Information on learning outcomes should be presented to teachers in ways that help them to identify interventions that can: positively affect student pedagogical outcomes; address other issues relating to the wellbeing of a student; and lead to improved classroom delivery targeting individual children. Country case studies can highlight best practice.
13. **Develop and disseminate standards and guidelines for the protection of individual child data:** As individual citizen tracking systems become more prominent, international standards for the protection of data relating to individuals should be developed and promoted. Standards should include guidelines for developing legislation, confidentiality and data-sharing, and virtual and physical security to protect individual data.

Recommendations for EMIS improvement at country level

The following recommendations are synthesized from this Review, and are applicable both to the reviewed countries and those wishing to further develop their EMIS, enhance their use of information and migrate towards Student Tracking systems.

14. **Migrate to Student Tracking systems:** This Review highlights the substantial benefits that can be derived from individual Student Tracking, including improved capacity to target interventions towards individual children. Systems that capture data on all individual children and their participation in education across all sub-sectors (public and private), have greater capacity to use EMIS to report statistically. This report concludes that countries should progress towards individual Student Tracking systems. However, transition to Student Tracking also requires changes to processes, such as student transfer and institutionalization of unique identifiers for students, and it requires capacity development at school and sub-national level. It also requires a strong vision and is best facilitated by a strategic development plan. Development partners can assist individual countries to migrate their EMIS towards individual Student Tracking by providing technical and capacity development support at country level. This will also require strong capacity development and advocacy at national level. Development partners are well placed to provide advice and capacity development opportunities for government staff at national level.
15. **Coordinate EMIS to establish an interoperable and, where feasible, integrated, rationalized vision for tracking all children nationally through all sectors.** All countries reviewed had data gaps in their Student Tracking systems, such as in relation to TVET or private school children. Student Tracking

is most effective if all students in the country are tracked through all sectors. This enables a complete academic record of every citizen and can enable more accurate tracking of dropouts and OOSC.

16. **Ensure Student Tracking data are accessible and used at sub-national and institutional level:** EMIS should present data relevant to education sector plans at national and sub-national (district and state) level and at institution (school) level. Data should be presented in graphical and tabular forms to help enhance understanding, and presentation should align with planning and monitoring needs. Actors at sub-national and institution level should be empowered to use EMIS data for planning and should be monitored in regard to their data use. EMIS must complement decentralization of planning and financial responsibilities. As EMIS increasingly become integrated into processes and data management at schools, in-service training programmes for teachers should be adapted to include references to EMIS. Staff at all levels require continuous training in the use of EMIS and data for education management, planning and monitoring. EMIS that track individual children have great capacity to assist actors at school level to ensure positive outcomes at individual student level. It is important that such systems are accessible and usable by actors within the school and that the correct functions and reports are available to them to help ensure positive pedagogical outcomes.

17. **Make EMIS data on individual children accessible to parents and students:** EMIS should be developed to enable parents and students to access child data and to facilitate communication between parents and teachers. Such systems can help parents to become involved in their child's education, monitor their child's progress and communicate with the teacher on any issues that arise.

18. **Assist governments to ensure resources are available to achieve a strategic vision regarding child tracking.** Governments may be reluctant to apply resources for the development of information systems as this has traditionally not been a core strength of ministries of education. This Review highlights resourcing deficits in the reviewed countries. The development of EMIS requires the coordination of human capacity development and system development, changing processes and methods, and infrastructure and connectivity. The complex technical interplay of different factors can result in high levels of complexity that are poorly understood by many actors in education. There was also evidence from the countries reviewed that developing a strategic vision and plan for EMIS helped to focus EMIS development and to channel resources towards EMIS development. Development partners can assist governments to not only develop a strategic vision and plan to help migrate towards Student Tracking, but also to help focus and align national EMIS in general.

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