Data and education transformation

A maturity model

Microsoft

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Glossary of key terms

Data
Facts, figures or statistics collected together for reference or analysis in education. Data involves personal information, such as a student's age, gender, race, ethnicity, and place of residence. Data also includes enrollment information such as the school a student attends, the student's grade level, and attendance record. Data on academic information is comprised of a student's test scores, grades, and fulfilled academic requirements. Other data collected can be related to the student's parents, such as household income, parents' level of educational attainment, and household expenditures for their child's education.

Analytics
The measurement, collection and reporting of data to develop statistical models and analysis for the purposes of understanding and optimizing education. Data is harnessed to provide actionable intelligence for students, teachers, and administrators.

Data Privacy
The safe harbor of information that can identify an individual student: academic records, enrollment information, or personal information such as age or gender.

Standards
The documentation and agreements of common data guidelines. Standards help to draw comparisons among indicators of educational success and identify areas in need of improvement.

Executive summary

The comparative analysis and review of current policies on national performance measures show that countries are making different decisions when assessing student, school, and system performance. Policy decisions are directly reflected in differences between examination parameters such as frequency, subject matter, the participation of an entire class/grade or just a sample, and analysis of the data. National policies on data analysis are still evolving. Debates on the role of student data are moving forward as some countries move into sophisticated use of educational analytics and others begin to complete full implementation of their systems for assessing student performance. Some countries reassess their experience to date, and yet others only consider the possibility of introducing national standards. This report considers countries at four different levels of "maturity" in their use of education analytics—Entry Level, Emerging, Advanced, and Transformative. We highlight key aspects of data collection, reporting, and analysis, and examine ways in which countries can learn from each other's experience. However, the impact of analyzing data related to the performance of students and schools and on the overall quality of a nation's educational system, as well as the cost effectiveness of such analysis remain areas for which further research is needed. In every case in which data are is collected, analytics can be used to make improvements to student learning, but it is up to the individual country to decide how to overcome obstacles (such as privacy laws) and apply the political wherewithal and budgets to effect positive change.

Introduction
Data analytics in education
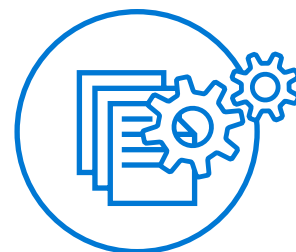
The knowledge economy is prompting countries to improve their competitive advantage by investing in education. At the national level, this means policymakers are increasingly relying on the analysis of student data to inform their decision-making. From Nigeria to Germany, nations are realizing the importance of employing data for evidence-based education planning. Data are collected to help countries gauge the status of their education systems and identify gaps in schooling. Analytics are also used to provide trend analysis and comparisons between different regions within a country. Digital tools provide detailed, real-time information to help educators make informed decisions about student performance. Data analytics now has the power to revolutionize education by translating national-level policies into classroom practice. The collection, reporting and analyzing of data seeks to help countries meet targets outlined by the United Nations' Millennium Development Goals.

Recommendations

01   Entry level countries

At the early stage of data collection the following steps may be helpful to increase efficiency:

- Develop a central shared data center to streamline data access and reliability
- Establish a quality assurance body to coordinate databases and ensure data quality
- Create standards for data collection and reporting to better utilize the data

02   Emerging countries

The following steps will support nations to improve upon their existing data analytics:

- Develop privacy policies and practices to protect students and staff
- Transition data storage to cloud-based systems for easier access and reliable storage
- Incorporate data findings into policy or legislative discussions
- Implement real-time data collection technology to create timely reporting

03   Advanced countries

These nations could improve on their advanced systems through the following:

- Continue to develop comprehensive privacy policies
- Continue to develop reporting and incorporation of data into education legislation and policy on the national and local level

04   Transformative countries

Countries at the most mature level can support continued development in education analytics by:
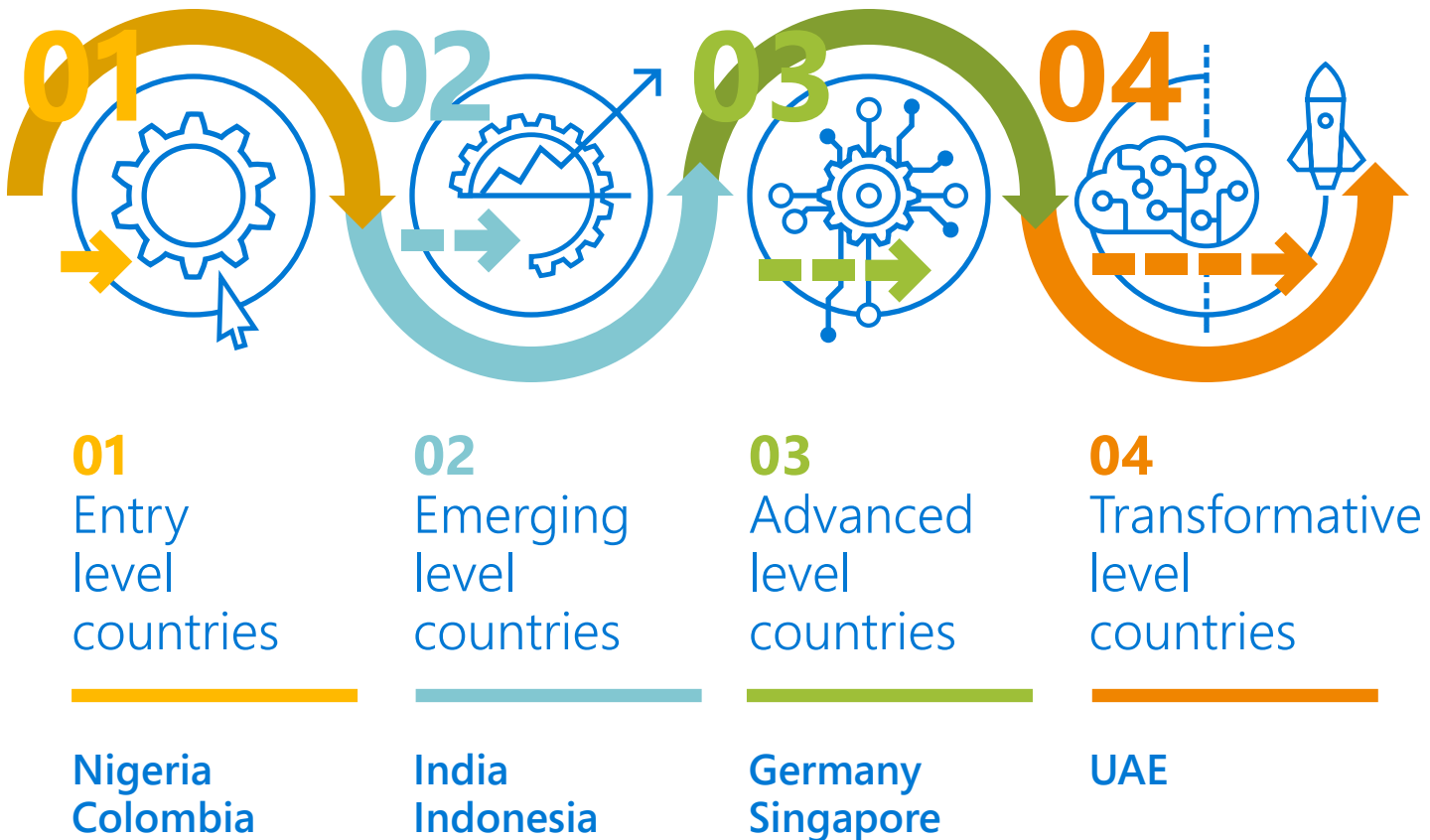
- Sharing their data models, templates, and learning with others
- Advocating with technology vendors for data access and transparency
- Leading with education data standards organizations for accessible inclusive standards

Educational analytics maturity model

This overview of global educational analytics has revealed three stages of analytical evolution. The first stage is "Entry Level" in which nations are collecting data using limited technology and standards. In this first stage, data are not collected annually nor used to inform policy. The second stage, "Emerging Level," is characterized by frequent and comprehensive data that is used to create specific reporting and inform policy. This stage includes digital collection and storage without privacy policies in place. The third stage, "Advanced Level," conducts real-time data collection used to inform policy. These countries typically use cloud-based collection and storage technologies under national privacy provisions. The fourth stage is "Transformative Level" at which data come from a wide range of sources including telemetry, and analysis is supported by AI and cognitive services.

Six countries (Nigeria, Colombia, India, Indonesia, Germany, Singapore) were chosen to represent the stages of educational analytics. Some were selected due to an abundance of public information. While the summaries of the analytics focus on the national level, at times local or regional analytics are much more in depth. However, to demonstrate the stages of development this report focuses on data usage at the national level. The stages of educational analytics are displayed on the next page.

Educational analytics maturity model

01
01
Entry level countries

Nigeria
Colombia

02
02
Emerging level countries

India
Indonesia

03
03
Advanced level countries

Germany
Singapore

04
04
Transformative level countries

UAE

Data metrics and country levels

	ENTRY	EMERGING	ADVANCED	TRANSFORMATIVE
Amount of data collected	Basic data	Comprehensive student data	Comprehensive student, staff, finance data	Holistic quantitative and qualitative student, staff, finance data, including IoT
Data collection cycle	1+ year	< 1 year	Real-time human-entered	Real-time human-entered and telemetry
Policy guidance and reporting	Limited application of data to guide policy	More targeted reporting to guide policy	Data-driven policies and standards	Adaptive organisational culture informed by data
Application of data	Underdeveloped	More advanced application	Implementing advanced analytics	Applying cognitive services and AI
Technology/ data standards	Basic technology, including analog; local or limited education data standard	Digital data storage; recognized education data standard partially applied	Cloud-based data storage; alignment to recognized education data standard	Networked intelligent cloud storage; integration of multiple or extended education data standards
Data privacy and security	None	Limited privacy framework	Comprehensive privacy	Privacy balanced with transparency
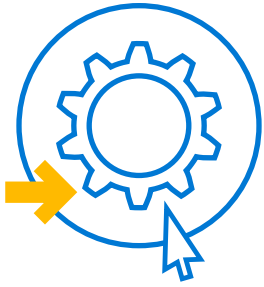
01 Entry

Countries at the entry level of collecting and using data

Countries at the entry level are collecting and using data with limited technology and standards. In this first stage, most data are collected every one to five years. Data analysis is underdeveloped and therefore rarely used to inform policy.

Nigeria

National education system

The education system consists of basic, post-basic, and tertiary education. Basic education is comprised of pre-primary education for children 0 to 5 years of age, primary education for children 6 to 11 years of age, and junior secondary education for children between the ages of 12 and 14. Post-basic education is comprised of senior secondary education for children ages 15 to 17. Tertiary education consists of universities, polytechnics, technical colleges, colleges of education and other institutions. Education is a shared responsibility of federal, state and local governments.[1]

National policy and priorities

The National Policy on Education emphasizes the provision of nine years of free and compulsory basic education as well as the importance of technical and vocational education. The Federal Ministry of Education is responsible for driving education policy and for collecting data for educational planning. Policymakers emphasize the need for for more reliable information to enhance the decision-making process. To improve evidence-based planning, the Federal Ministry of Education and the National Population Commission conduct the National Education Data Survey. The country-wide household survey assesses the status of education in Nigeria to help inform policy and ensure that the education system is responsive to the needs of society.[2]

1 Nigeria DHS EdData Survey 2010: *Education Data for Decision-making*. Rep. Abuja: National Population Commission, 2011. Print.
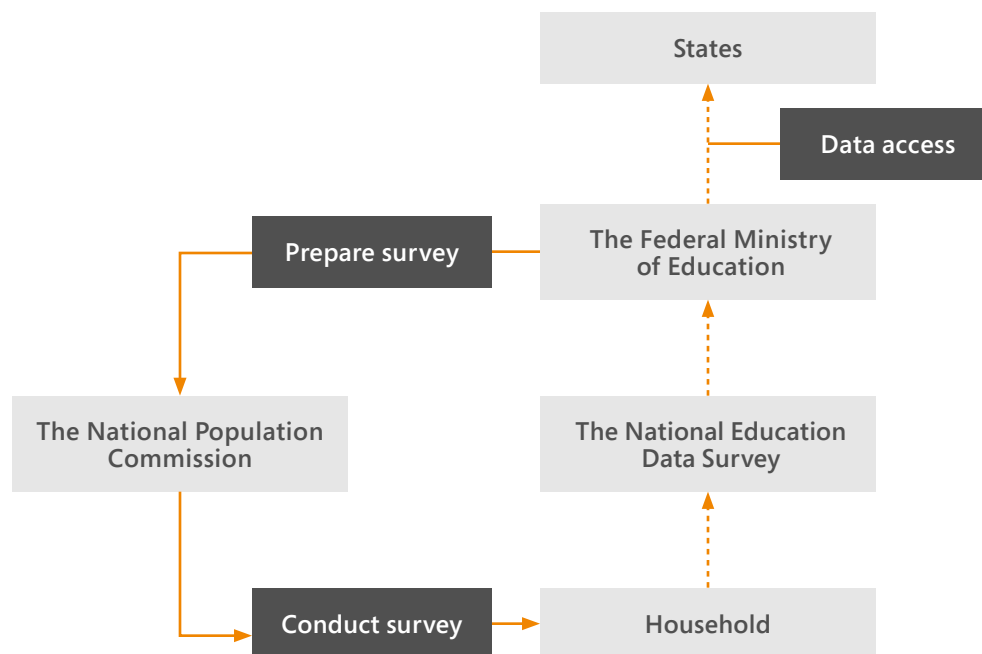2 Ibid.

Data collection and reporting

The National Education Data Survey was first conducted in 2004, and again in 2010 and 2015. About 32,000 households with school-aged children are surveyed throughout the country. Survey results are reported by gender and residence, economic quintiles and class level. Survey results are also available by the state-level.[3] In the latest survey, data was collected on tablets using computer assisted interview techniques. Data are stored in the Nigerian Education Management Information System (NEMIS), a database managed by the federal government. The main objectives for the National Education Data Survey are to:[4]

- Provide data on the schooling status of children of basic education age and reasons for school attendance or drop out.
- Quantify household expenditures on schooling.
- Measure parents' attitudes toward schooling to provide an understanding of their willingness to send their children to school, such as the quality of schooling.
- Measure how frequently students are absent and reasons for missing school to help determine possible approaches to boosting the attendance rate.
- Provide data for trend and state analysis.
- Serve as a reference point for national, state and local education authorities.

Data flow | Nigeria

States

Data access

Prepare survey

The Federal Ministry of Education

The National Population Commission

The National Education Data Survey

Conduct survey

Household

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3   2015 Nigeria Education Data Survey (NEDS). Rep. Abuja: National Population Commission, 2015. Print.
4   Nigeria DHS EdData Survey (2010)

Data privacy

Nigeria has no privacy or personal information laws. The Proposed Data Protection Bill 2010 is intended to protect against unauthorized processing or use of personal data and information without prior consent from the data subject (the individual whose data are being collected). The proposed legislation requires data controllers (individuals or entities treating the data) to keep personal data safe and to process data in accordance with the law.[5]

Challenges and opportunities

Nigeria's challenges concern NEMIS, the federal software system that stores and manages education data. Many of the problems are similar to those faced by other countries, such as a lack of capacity, limited commitment or political will from stakeholders, and difficulties with collecting survey data. As a result, there have been few attempts to develop or implement education policies based on accurate data.[6] NEMIS struggles with delays in retrieving, entering and reporting data. The system also lacks operational guidelines to support the state level education management information systems (EMIS). There is no feedback to states, local government education authorities or schools. NEMIS also struggles with incomplete and poor data quality due to weaknesses in training, field procedures and data entry procedures.[7]

There is an opportunity for greater coordination between NEMIS and the state-level EMIS. Many of the problems with NEMIS, such as incomplete and poor data quality or lack of feedback, need to be tackled at the state level. The Federal Ministry of Education is working towards improving NEMIS. In February 2016, Minister of Education Mallam Adamu Adamu announced that NEMIS would be hosted on the Internet for real-time online data entry and processing. Adamu expressed confidence that education data at the basic and secondary levels would be more timely, accurate and accessible.[8]

Colombia

National education system

The Colombian education system begins with Early Childhood Education and Care (ECEC) services for children 3 to 5 years of age. ECEC consists of pre-primary, pre-kindergarten (pre-jardín), kindergarten (jardín), and a compulsory transitional year. Basic education is comprised of primary education (Grades 1 to 5), and lower secondary education (Grades 6 to 9). Upper secondary education is for students 15 to 16 years of age (Grades 10 to 11). Students are enrolled in either general academic programs or in programs offering vocational education and training (VET). The Higher Teaching School is a third option for students who aspire to be preschool or primary school teachers. The school consists of two years of secondary-level education and two additional years of post-secondary education. Upon completion of upper secondary education students receive a certification of completion and must pass a national exam.[9]

5   Aliyu, Abubakar Sanni. "THE NIGERIA DATA PROTECTION BILL: APPRAISAL, ISSUES, AND CHALLENGES." *Innovative Issues and Approaches in Social Sciences* 9.1 (2016): 48-59. Web.

6   The World Bank (2006), *Education Management Information System: A Short Case Study of Nigeria*, Cambridge Education, Washington.

7   ESSPIN (2009), *Approach to supporting EMIS – Position Paper*, Cambridge Education, Nigeria.

8   "World Bank to Support Nigeria's Annual School Census." *The Nigerian Tribune*, February 25, 3016. http://tribuneonlineng.com/world-bank-to-support-nigeria%E2%80%99s-annual-school-census

9   OECD (2016), *Education in Colombia*, Reviews of National Policies for Education, OECD Publishing, Paris.

National policy and priorities

The National Development Plan 2014-2018 outlines education as one of three major policy priorities. Policy priorities for education include rolling out full-day of schooling, increasing access to both early childhood education and upper secondary education and improving education in rural areas. For example, the plan continues support for the government's Zero to Forever strategy aimed at enrolling 2 million 3 to 5 year-olds, including children in extreme poverty, in ECEC by 2018. Plans include transforming the Zero to Forever strategy into legislation that would establish ECEC as the first stage of the education system. Another ECEC policy priority is the development of an information system and quality index to collect information on children and their progress. The government has so far established a policy framework and technical benchmarks, including educational environment.[10]

Data collection and reporting

Colombia is working towards improving data collection and management to bolster evidence-based policy making. The Ministry of National Education oversees a complex information system with several databases collecting information across educational levels. Databases include the Early Childhood Information System, the Enrollment Information System and the National Primary and Secondary Information System. The databases hold information that comes from the Survey on the Quality of Life (ECV), the Integrated Survey on Households (GEHI), Population Projections, The System of Identification of Social Program Beneficiaries (SISBEN) and the Colombian Institute for the Evaluation of Education (ICEFS).[11] For example, the Survey on the Quality of Life aims to better determine the socioeconomic conditions of Colombian households. Data are collected about every three to five years and include education information on literacy, school attendance, highest educational level attended and last grade passed for students aged five and over.

Data flow | Colombia

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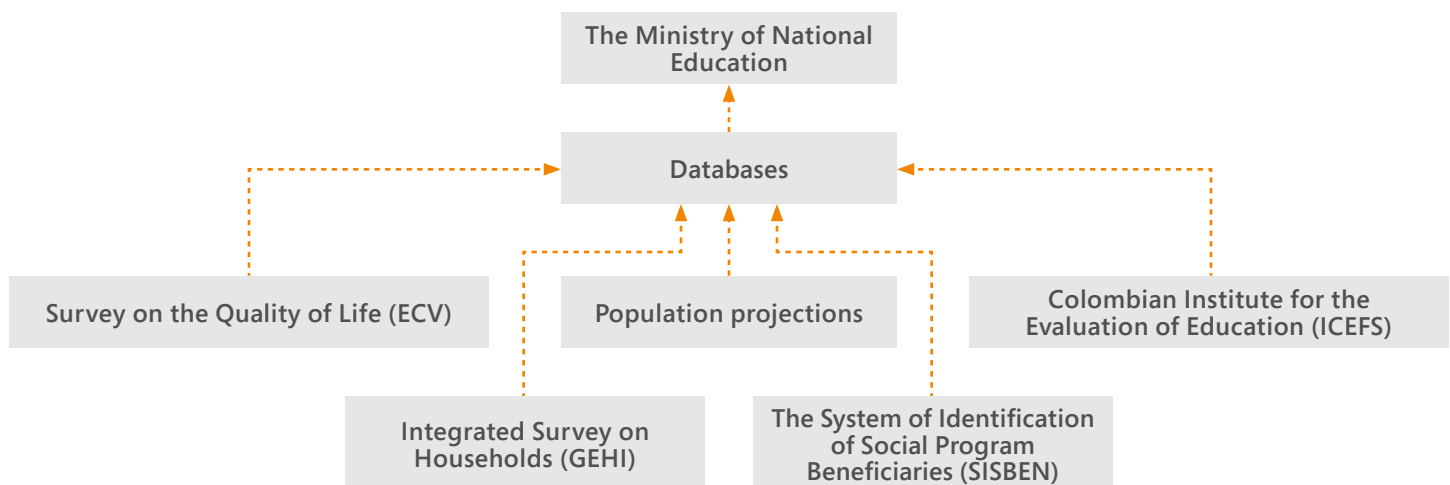
10 Ibid.
11 Ibid.

Data privacy

Law 1581 of 2012 regulates personal data, which is defined as any information that directly or indirectly relates to a living individual. The law applies to any data registered in databases that are used by both public and private entities. Under the law, data controllers (individuals or entities treating the data) must abide by certain stipulations. For example, they must inform data subjects (individuals whose data are being collected) of the purpose of the data collection and of their rights. Data subjects have the right to access their data, request to be informed on how their data is being used, and to update any data that is incorrect or incomplete. The law also specifies additional rules for the treatment of sensitive personal data, such as ethnicity, race, political views or religious convictions. Exemptions to the law include data used for personal or domestic use and data related to the country's national security or defense.[12]

Challenges and opportunities

There are three main challenges to Colombia's information system. The first challenge is the lack of database integration. A majority of databases operate independently of each other and have their own indicators and objectives. Access is challenging because there are few tools to link the databases to obtain relevant education data. The lack of integration affects the ability to track trends across education levels, and the ability to assess performance so that data is used to inform the policymaking process. The second challenge is poor data quality, caused by a weak capacity for data collection and use, and the absence of an independent national body responsible for quality assurance. This was evident in 2012 when the Ministry of National Education conducted an audit of the education system to verify school enrollment. The audit revealed that over 300,000 students who were said to be enrolled were actually "ghost" students. The third challenge is the absence of disaggregate information that could be used for policymaking. For example, data on schools does not include equity variables that could help policymakers identify factors influencing the performance of disadvantaged schools or regions.[13]

Although Colombia's information system is strong, it is underutilized and can be better exploited for policymaking purposes. The country can establish a shared framework of standards, indicators and methods of data reporting to be applied to all institutions. Colombia would also benefit from establishing quality assurance bodies that can coordinate the country's many databases and develop standards to ensure data quality.

12 Adarve, Luz Helena, Juanita Acosta, and Juan Pablo Martinez. "Data Protection in Colombia: Overview." *Practical Law*. Thomson Reuters. Web. 28 Apr. 2016. <http://us.practicallaw.com/2-619-4326>.
13 OECD (2016).
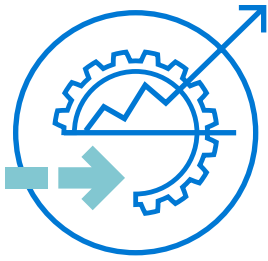
02 Emerging

Countries at the emerging level of collecting and using data

Countries at the emerging level of collecting and using data are characterized by frequent and comprehensive data that is used to create specific reporting and to inform policy. This stage includes digital collection and storage, but lacks privacy policies to protect student data.

India

National education system

India uses a common structure of education known as the 10+2+3 system, which is now widely used throughout the country.[14] Students are provided with 10 years of compulsory education and 5 years of college education.

Compulsory education is comprised of 5 years of primary education and 3 years of upper primary, followed by 2 years of high school.[15] The National Council for Educational Research and Training (NCERT) prepares a National Curriculum Framework that is followed by each State Council for Educational Research and Training (SCERT). The states have considerable freedom in implementing the education system, which has led to a wide discrepancy in the literacy rates of different states.[16] Between 2013 and 2014, India had more than 790,640 primary schools serving 130 million students (total gross enrollment ratio was 99.3), and more than 634,925 upper primary schools and secondary schools with nearly 296 million students.[17]

National policy and priorities

States plan and administer elementary education, therefore state-level education departments are responsible for the collection, collation, tabulation, analysis and transmission of educational data.[18] One national aim in education is to remove social prejudices by promoting equality between castes and genders.[19] As of the time of writing, data collection functions as a reporting system rather than a tool to assist policymaking.[20]

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14   "National Policy on Education." *Minister of Human Resource Development*. Web. 24 May 2016. <http://www.ncert.nic.in/oth_anoun/npe86.pdf>.

15   Ibid.

16   "The Education System in India - GNU Project - Free Software Foundation." *The Education System in India - GNU Project - Free Software Foundation*. Web. 24 May 2016. <http://www.gnu.org/education/edu-system-india.en.html>.

17   "Educational Statistics at A Glance." *Government of India Ministry of Human Resource Development Bureau of Planning, Monitoring & Statistics.* 2014. Web. <http://mhrd.gov.in/sites/upload_files/mhrd/files/statistics/eag2014.pdf>.

18   Tilak, Jandhyala B. G., P. R. Panchamukhi, and K. Biswal. "STATISTICS ON EDUCATION." Reports & Studies. 2015. Web. 24 May 2016. <http://www.dise.in/Downloads/Reports&Studies/Tilak_educational_statistics-2015.pdf>.

19   "National Policy on Education." *Minister of Human Resource Development*. Web. 24 May 2016. <http://www.ncert.nic.in/oth_anoun/npe86.pdf>.

20   Indian Educational Statistics.

Data collection and reporting

The entire data collection and reporting process is seen more as a formality rather than an empirical data analysis.[21] With the help of NCERT, states aggregate data for the All India Educational Survey through manual compilation, a process that leads to considerable delays and possible data loss.[22]

In 2001 India began implementing the District Information System for Education (DISE). By 2005-2006, DISE 2001 had been successfully implemented in 604 districts across 35 states. Apart from removing the constraints of manual data handling, DISE 2001 also increases data accessibility at the national and state level. The software also enables the comparison of aggregated data from different states, which was a feature that had never before existed.[23] The collection for core data is still done manually at the level of institutions and villages with the annual deadline of September 30th. The district-level professionals were assisted in the establishment of Educational Management Information System (EMIS) units, and trained in data collection, computerization and analysis using DISE. This has greatly improved transparency and sharing among user agencies, further reducing data manipulation at various levels. DISE 2001 creates standardization in education variables and, at the same time, allows for the bi-directional flow of data. National, state, and district-level users can access and develop statistics with secondary education variables, and reporting can be done within 8 to 12 weeks of data collection. The NCERT conducts a survey every 3 to 4 years to verify and monitor the quality of data. See figure below.

Data flow | India

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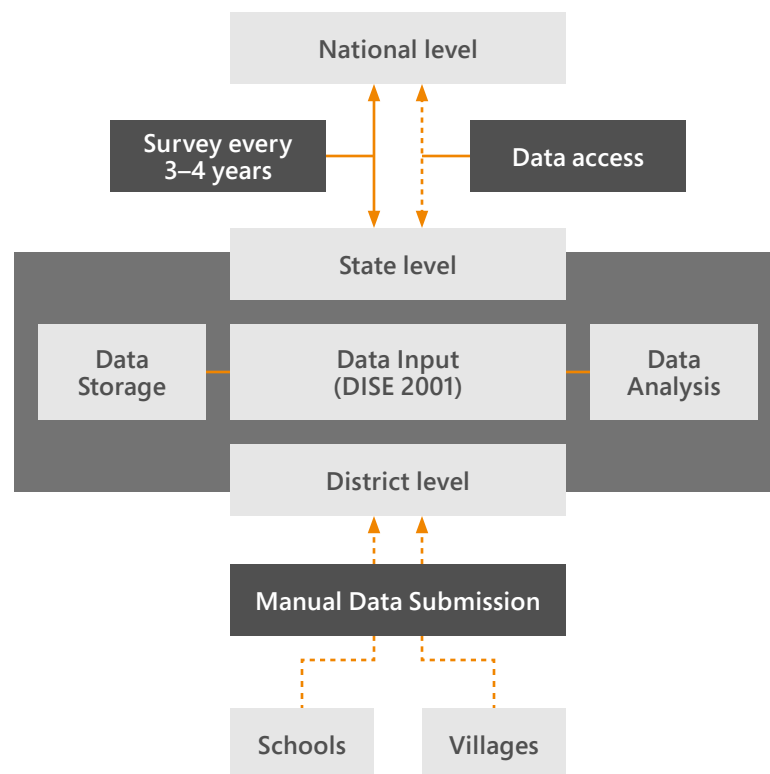
21   Ibid.
22   Ibid.
23   Ibid.

Data analysis

As of today, DISE is used as a district report card. It will ultimately be developed as a country report card once access to DISE 2001 is available to all states (no timeline has been set). DISE 2001 can be a data source for some of the performance matrixes, such as: age grade matrix by caste, gender and class; vital information on access (villages without schools, school size); indicators of internal efficiency like repetition and dropout rates. DISE 2001 is not currently used as a major reference for policymaking, although future possibilities are being explored.[24]

Data privacy

There are no standard guidelines to protect data. Indeed, data are still being transferred through the open internet. There are no established guidelines on data privacy or risk assessment. Data handlers are also unaware of risk mitigation best practices.

Challenges and opportunities

Although there are significantly fewer challenges than before DISE 2001 was implemented, there is still a time gap between data collection and reporting. Current data collection does not include a large segment of private schools, both recognized and unrecognized. Even in rural areas, there are students who are enrolled in fee-based private schools, thus reducing the overall quality of data collected.[25] There are also difficulties with usability, accompanied by limited technical support and training. A basic requirement of computer usage and a basic knowledge of computer-based information systems must be established at the school and state levels.

Indonesia

National education system

The Indonesian Constitution Nomor 20 Tahun 2003 regarding the National Education System in Indonesia ratified compulsory primary education and extended the 9-year program to include early education for children ages 0 to 8.[26] Every Indonesian citizen from ages 7 to 15 has the opportunity to enroll in the program. Indonesia has the world's fourth largest education system, comprising around 55 million students and 3.35 million teachers.[27] There are approximately 196,169 schools in Indonesia; 148,272 primary schools, 35,488 junior secondary schools and 12,409 high schools.[28] Three separate ministries oversee the education system in Indonesia: The Ministry of Education oversees state primary, junior and secondary schools; the Religious Affairs Ministry has control of Madrassas or Islamic schools; and the Ministry of Research and Technology is responsible for universities and polytechnic schools.

24   Ibid.
25   Kingdon, Geeta Gandhi. "Private and Public Schooling: The Indian Experience." University of Oxford, 05 Oct. 2005. Web. <http://www.ksg.harvard.edu/pepg/PDF/eve
26   "UNDANG-UNDANG REPUBLIK INDONESIA NOMOR 20 TAHUN 2003 …" Indonesia Ministry of Education and Culture, 2003. Web. 18 May 2016. <http://kemenag.go.id/file/dokumen/UU2003.pdf>.
27   "Badan Pusat Statistik." *Badan Pusat Statistik*. Web. 18 May 2016. <https://www.bps.go.id/Subjek/view/id/28#subjekViewTab3|accordiondaftar-subjek1>.
28   Ibid.

National policy and priorities

Indonesia is launching the universalization of Senior Secondary Education, with a goal to achieve 97% enrollment by 2020. To achieve this goal, Indonesia has created an online national database system to track education- related data accurately. The program, DAPODIK PAUD-DIKMAS, consists of data centralization for courses and curriculum, a teacher database, formal and non-formal education offices, early education for children aged 3 to 6, and job and skills training programs for anyone over the age of 15. The federal government, along with some non-governmental organizations, have set the United Nations' Sustainable Development Goals (SDG) on their agenda with a priority of SDG 4 and 5.
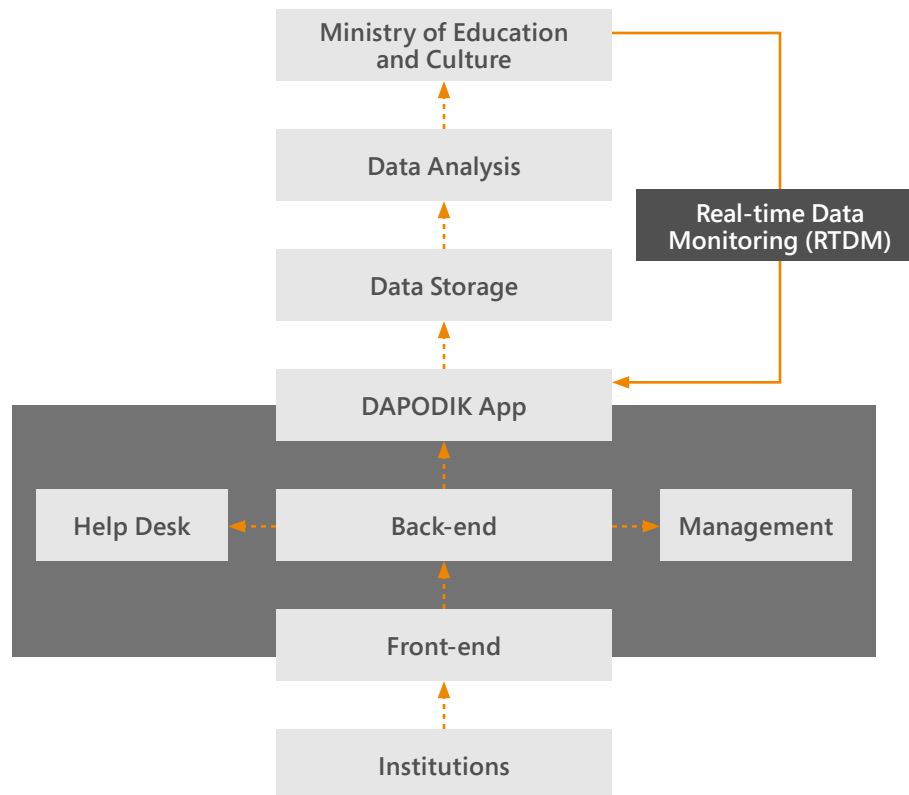
Data collection and reporting

The data collection initiative was created in 2006 by the Center for Educational Statistics (CES). However, the education data variables collected were not inter-correlated. A school location could exist even if it did not include the information of teachers and students and vice versa. As a result, many duplicate education variables overlapped and could not be verified or assessed. With the 2011 Ministry of Education Initiative No. 2 on Activities in Education Data Management, Indonesia aims to streamline the education variables collected, develop an integrated application between agencies, construct a data collection mechanism, socialize the program and develop a monitoring and evaluation strategy. The DAPODIK PAUD-DIKMAS application is a centralized and unified effort to collect educational data under the supervision of the Ministry of Education and Culture. The initial phase of the program began in 2015 and is expected to be in full operation by 2019. The data collection will include not only the compulsory basic education program, but also the Early Childhood Education and Development (ECED), Community Learning Centers, Group Learning, Community Reading Gardens (CRG), some private schools, and other government-sponsored education institutions.[29]

Two new departments were established to manage data collection and analysis within the Ministry of Education and Culture: Management of DAPODIK and HelpDesk Management. The management of DAPODIK is for officials at the city, district, province and ministry levels to monitor data development, improve data profiles and data analysis. HelpDesk Management is responsible for day-to-day operations to respond to complaints, questions, and problems encountered by the DAPODIK unit in field or city/district/province education offices. It was established to mitigate problems from growing at the ministry level. The new sub-departments are also responsible for creating detailed planning of infrastructure, equipment, and human resource training. They are accountable for providing training workshops and manuals to local institutions on the use of a front-end application for data entry. The following four data variables (identities) are collected by the application: institutions, teachers and staff, students, and the substance of education. The application is expected to provide real-time data monitoring (RTDM). The public can also access the data warehouse to monitor the portal site, data collection and statistics to help verify the information provided by schools in their neighborhood.[30]

29 "ROADMAP PENGEMBANGAN SISTEM DAPODIKMEN TAHUN 2014 - 2019." *Direktorat Jenderal Pendidikan Menengah*. Indonesia Ministry of Education and Culture, Nov. 2014. Web. 18 May 2016. <http://dapo.dikmen.kemdikbud.go.id/portal/web/docs/Roadmap_Dapodikmen.pdf>.
30 Ibid.

Data flow | Indonesia

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                    Ministry of Education
                        and Culture ──────────────────┐
                            ↑                          │
                            ┊                          │
                       Data Analysis                  │
                            ↑                 ┌────────────────────┐
                            ┊                 │  Real-time Data     │
                                              │  Monitoring (RTDM)  │
                       Data Storage           └────────────────────┘
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                       DAPODIK App  ←──────────────────┘
   ┌──────────────────────────────────────────────────┐
   │  Help Desk  ←┄┄  Back-end  ┄┄→  Management        │
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                       Institutions
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Data analysis

DAPODIK officials can conduct data analysis with a multitude of approaches using the four data identities collected. The principles of 'single source of data' analysis are:

- **Relational analysis:** all four identities are related and supplementary.
- **Longitudinal analysis:** all identities can be easily traced back to their unique identification number.
- **Transactional analysis:** data can be integrated into an institutional search engine for various purposes, ranging from moving education units, planning the national exam, scholarship purposes and incentives for educators, to a welfare program, student assessment reports, student graduation rates, etc.
- **Real-time analysis:** the latest data development can be monitored in real time.[31]

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31   Ibid.

Data privacy

There are no data privacy laws or protections in Indonesia. However, the Ministry of Communications and Information recently drafted a Data Protection Law to regulate information considered sensitive personal data. The definition of personal information in the draft legislation is similar to the term "Personal Identifiable Information" (PII) defined by the European Union.[32] The bill is currently under review.

Challenges

Indonesia has yet to develop an advanced analytics tool to customize individual student assessment as found in other OECD countries. One of the challenges Indonesia faces is the rampant corruption in the education system. Thus, the government has to consider corruption risk mitigation in order to fully rely on the data. There are also some regions in Indonesia that still do not have access to a reliable internet connection. Data synchronization from those regions has to be done offline, which can create a time lag in the data entry.[33]

32   Lukiantono, Daru, and Wiku Adininto. "Indonesia: Upcoming Data Privacy Law and Regulation." *Managing Intellectual Property*. 24 Feb. 2016. Web. 18 May 2016. <http://www.managingip.com/Article/3532480/Indonesia-Upcoming-Data-Privacy-Law-and-Regulation.html>.

33   "About Dapodikmen Application." Indonesia Ministry of Education and Culture. Web. 18 May 2016. <http://dapo.dikmen.kemdikbud.go.id/portal/web/laman/tentang>.
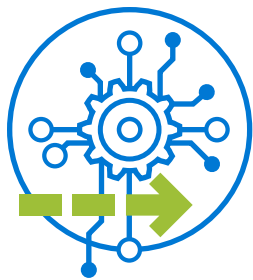
03 Advanced

Countries at the advanced level of collecting and using data

Countries at the advanced stage of collecting and using data conduct real-time data collection that is used to inform policy. These countries typically use cloud-based collection and storage technologies under national privacy provisions.

Germany

National education system

The educational system in Germany provides free public education but Germany has little federal control and uniformity. General education policy is set by the Federal Ministry of Education and Research (BMBF), and there is a national conference of state education ministers (KMK) that serves to coordinate educational practices at the national level. Education is the responsibility of each of the 16 German states (Bundesländer), and each has its own Ministry of Education which sets its own education program and standards. Until recently, by the age of 10 most students in Germany had been put on one of three educational tracks for secondary schooling. Until the year 2000, any efforts to reform the tracking system were largely unsuccessful.[34]

National policy and priorities

The mediocre 2000 results of the first Program for International Student Assessment (PISA) shook Germany to the core. Germans, who were proud of their educational system, suddenly had to realize that a large percentage of students had failed basic reading comprehension tests. In addition, the country received the unwanted accolade of having the most unequal education performance among the 43 countries PISA examined. Newspapers proclaimed an "education catastrophe".[35] Since then, Germany has, for the first time, introduced nationwide curriculum that set the standards for the knowledge and capabilities students are expected to possess at the end of each level of education. Besides testing for central comparisons between the Länder (states), comparative tests based on educational standards began in each Länd from 2009.[36] The latest results show much improvement.

34 "The German School System: From Kita to Uni". The German Way. Undated Web. Accessed 5/12/16. http://www.german-way.com/history-and-culture/education/the-german-school-system/

35 *Experts: Germany Needs to Step up School Reforms.* Deutsche Welle. April 12, 2006. Web. http://www.dw.com/en/experts-germany-needs-to-step-upschool-reforms/a-2259935

36 OECD. "National Education Policy Outlook – Germany". 2014. Accessed 5/2/16. http://www.oecd.org/edu/EDUCATION%20POLICY%20OUTLOOK%20GERMANY_EN.pdf

National data collection policies and actions

Germany faces challenges to support disadvantaged and migrant students and to continue reducing the impact of socio-economic background on student outcomes while raising academic performance. Recent policy responses include:

- Improving equity and boosting participation and success of students from disadvantaged backgrounds (especially immigrants).
- Supporting school improvement through sustainable gains in teacher training, including career entry and further learning.
- Developing the use of educational standards.
- Transferring some responsibility from the Ministry of Education to local schools.

National objectives of data collection

A new set of common educational standards were defined by the German Institute for Educational Progress (IQB) and adopted in 2004 by the KMK.[37] The Institute developed math, reading, writing, and foreign-language tests, and a Research Data Center (FDZ) was created. This was a widespread, large-scale intervention program where the ministries of all states collaborated with researchers and educators.[38] In 2006, the KMK adopted a comprehensive strategy for educational monitoring including three interconnected areas:

- International comparative studies of student achievement.
- Central review of achievement of educational standards (the basis for comparison between Länder).
- Länder comparisons of efficiency of individual schools' joint education reporting.[39]

Data collection and reporting

The national test content reflects both the curriculum of the appropriate Länd for the subjects and school years concerned. The 2016 National Assessment for International Comparison was taken by 30,000 4th graders from more than 1,500 randomly chosen schools in randomly chosen classes in the subjects of German and mathematics. The competency exams are supplemented by a student questionnaire, with questions about the class itself as well as personal information. In addition, school principals, selected teachers, and the parents of the children involved are surveyed in writing. The National Assessment is commissioned by the Federal Ministry of Education and State Ministers of Education in conjunction with the IQB.[40] The test itself is performed by external test managers who are trained by the DPC for this task. The coding and data processing of student responses is performed by the DPC. The evaluation of the data and determination of student competency falls under the jurisdiction of the IQB.[41] For privacy reasons, it is not possible to draw any conclusions about the performance of individual schools, classes or students from the published results.[42]

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37 "Germany to Introduce Federal School Standards". DW. 5/12/03. Web. Accessed 5/3/16. http://www.dw.com/en/germany-to-introduce-federal-schoolstandards/a-1050915

38 Knigge, Michel. "Research Data Center at the German Institute for Educational Progress (IQB)". 2009. Web. Accessed 5/17/16. http://www.iza.org/en/webcontent/events/redcubeseminar_description?sem_id=1684
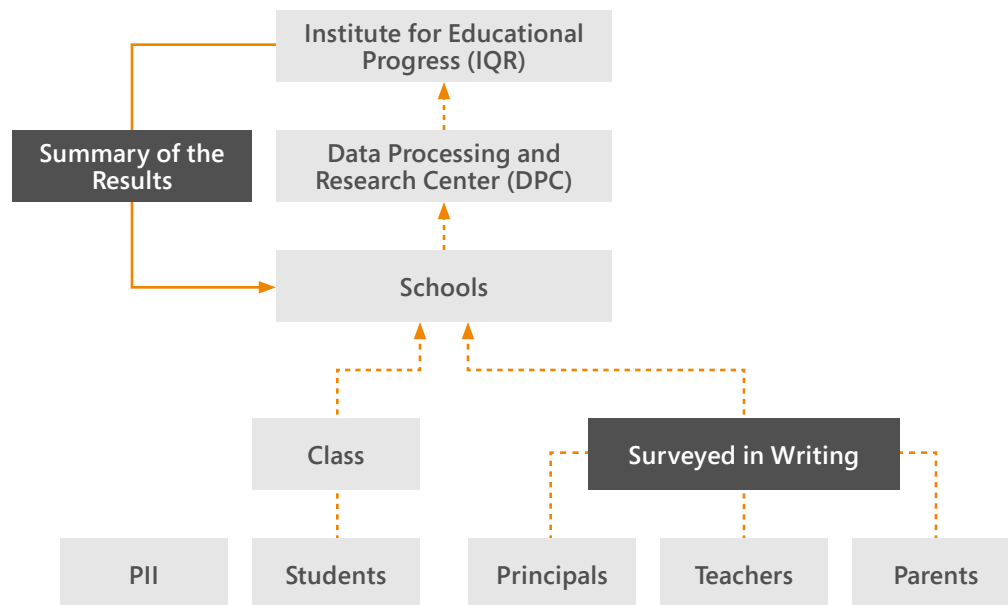
39 Eurydice. "National Testing of Pupils in Europe: Objectives, Organisation and Use of Results". Education, Audiovisual and Culture Executive Agency (EACEA). 2009. Web. Accessed 5/5/16. http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/109en.pdf

40 "Overview: Overall Strategy for Educational Monitoring". Institut zur Qualitatsentwicklung im Bildungswesen. 11/6/2015. Web. Accessed 5/12/16. https://www.kmk.org/themen/qualitaetssicherung-in-schulen/bildungsmonitoring.html

41 "National Assessment Study 2016". Institut zur Qualitatsentwicklung im Bildungswesen. 2016. Web. Accessed 5/15/16. https://www.iqb.hu-berlin.de/laendervergleich/LV2016

42 "National Assessment Studies". Institut zur Qualitatsentwicklung im Bildungswesen. 2015. Web. Accessed 5/15/16. https://www.iqb.hu-berlin.de/laendervergleich

Data flow | Germany

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Application of the data

The findings of 2000, which exposed how far socioeconomic background was tied to educational opportunity and performance, concluded that tracking children at the age of 10 didn't work and appeared to be perpetuating inequality. Several measures were taken to relax the system including delaying the age when children are assigned to different secondary schools, combining Realschulen (for intermediary students) with Hauptschule (for the less academic), and introducing more comprehensive schools. These measures have broken down the segregation between children set on academic paths and those on a vocational path, allowing them more flexibility in their learning and taken away a lot of stigma.[43] The tracking system was a big part of the problem in Germany and the data showed that tracking held back the most disadvantaged students, so the focus on the weaker students increased in response to the new standards.[44]

How data are being used to inform policy

The focus of the national test is on providing school-based support to monitor and target the most disadvantaged students, which has allowed it to improve performance and test-score gains, especially among low-achieving and minority students.[45] Both federal and state education ministries got behind programs that help these disadvantaged students, including increasing the proportion of schools that are full day and adding government-funded early- childhood education programs.[46]

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43 Young, Holly. "What can we learn from the great German school turnaround?" The Guardian. November, 2105. http://www.theguardian.com/teacher-network/2015/nov/25/what-can-we-learn-from-the-great-german-school-turnaround

44 "Are Grouping and Selecting Students for Different Schools Related to Students' Motivation to Learn?" PISA in Focus. 2014. Web. Accessed. 5/2/16. http://www.oecd.org/pisa/pisaproducts/pisainfocus/pisa-in-focus-n39-(eng)-final.pdf

45 OECD. "2012 PISA Results – Germany". Key Findings. Country Note. 2013. Web. Accessed 5/4/16. https://www.oecd.org/germany/PISA-2012-results-germany.pdf

46 Ibid.

National assessment studies

National assessment studies are carried out every five years at the primary level and every three years at secondary level (where they alternate between German/English/French and mathematics/science).

Data privacy

In Germany, data protection is primarily regulated by the Federal Data Protection Act (Bundesdatenschutzgesetz) (BDSG), which implements the Directive 95/46/EC on data protection (Data Protection Directive). There are also state data protection laws providing legal requirements for data processing carried out by state-level public authorities or public bodies. Apart from the general data protection laws there are sector-specific regulations at both state and federal level that provide data protection requirements.[47] Data privacy regulations in the European Union are among the strictest in the world and among EU member states, Germany has one of the strongest policies. Germany does not even provide schools with aggregated results when tests have a significant impact on the school career of pupils. Before 2008, there were such restrictive regulations that even aggregate data was nearly impossible to access. Now one can apply for access to educational data from the FDZ under strict rules.

Singapore
National education system

The education system in Singapore is decentralized, consisting of 360 primary schools in total. Singapore offers a minimum of 12 years of free public education: 6 years of primary education followed by 4 years of secondary, and 2 years of junior college. Primary education provides 4 years of foundational stages in which students follow common curriculum focused on English, mother tongue language, and mathematics.[48]

Over the past 40 years, Singapore's education system has transformed from one of a developing nation to that of an OECD member. In 1997 the Ministry of Education issued a new vision for national education: "Thinking Schools, Learning Nation." Prime Minister Goh Chok Tong promoted the belief that a nation's wealth depends on the capacity of its people to learn. This vision translated into a school system that valued creative thinking, passion for lifelong learning and nationalistic commitment to the youth.[49]

Under the "Thinking Schools" initiative the structure of the education system changed. The management of schools decentralized to create geographic clusters to allow for more regional autonomy. Each school sets its own goals and conducts annual assessments of the programs. Every six years the Ministry of Education conducts an external review of the schools.[50]

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47 "Data Protection in Germany: Overview". *Practical Law.* December 2015.
48 "Strong Performers and Successful Reformers in Education; Lessons from PISA." OECD, 2011. Web.
49   OECD (2011).
50   Har, Yeap Ban. "Singapore's Experience with Learning Assessment." Nanyang Technological University, Singapore.

The Ministry of Education sets annual goals for schools and staff. Teachers are assessed annually based on 16 different competencies, including their interactions with students and the greater community. Students are incentivized through government grants for high academic performance.[51] Singapore ranked the highest in the 2012 PISA assessment of problem solving.[52]

National policy and priorities

Singapore is renowned for its unified focus and mission towards education. Throughout the society, inside and outside the education sector, a clear focus on implementation and evaluation of the education system is valued.[53] The "Thinking Schools" initiative was launched to promote schools to become continuously focused on self-improvement and implementers of solutions. Through decentralizing assessments and standards, the "Thinking Schools" initiative has empowered teachers and administrators to constantly improve their schools.[54]

A strong relationship exists between the Ministry of Education, the National Institute of Education (a teacher training institute) and the schools. The Ministry of Education focuses on policy development, and the National Institute of Education conducts research and training that is used to help inform the ministry's policies.[55]

The ministry conducts monthly meetings with superintendents, principals and teachers to examine current teaching practices and assessment tools. These meetings are also used to hear from the teachers and principals about the effectiveness of educational policies.[56]

Data collection and reporting

National examinations are conducted at three phases of the education of a student: Primary 6, Secondary 4, and Junior College 2 (12th year). Historically the national examination was a replica of the British national tests. However, in 2004 the Ministry of Education set up the Singapore Examination and Assessment Board to develop and oversee the national exams. The tests were shifted towards problem-solving and other higher-ordered competencies, replacing rote memorization.[57]

Traditional examinations are accompanied by alternative methods of assessment such as authentic assessments, coursework assessments, and school-based assessments. These other assessments are used to create a broader understanding of the students' performing and learning beyond the snapshot results from the tests.[58] The national examinations still hold great value in Singapore. Access to higher education and employment are linked to student performance on national exams. The schools are also assessed by student performance.[59]

51 "Singapore System and School Organization." Center for International Education Benchmarking. Web
52 Results from PISA 2012 Problem Solving. OECD, 2014. Web.
53 OECD (2011).
54 "Building a National Education System for the 21st Century: The Singapore Experience." Building Blocks of Education. Toronto, Canada. 2010.
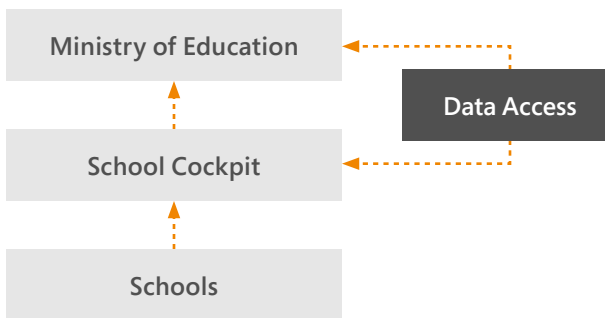55 OECD (2011).
56 OECD (2011).
57 Har, Yeap Ban. "Singapore's Experience with Learning Assessment." Nanyang Technological University, Singapore.
58 Ibid.
59 Ibid.

Data flow | Singapore

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Data analysis

Singapore has been collecting education data in databases since the 1980s. In 2001, the Ministry of Education developed a web-based program called the School Cockpit System to give students and teachers access to national examination scores. Each school has access to their students' information to help inform the development of, and adjustments to, the curriculum.[60]

The Ministry of Education uses the databases to research and analyze data to inform policy. "For example, data on home language trends collected from parents of Grade 1 students have been used to inform major reviews on the teaching and learning of mother tongue languages (MTLs). The growing trend of a rising proportion of students coming from predominantly English-speaking households provided the impetus for us to further customize teaching methods, to make the MTLs more accessible for those who might have very limited exposure to the language prior to entry into Grade 1."[61]

Another example of the use of the School Cockpit program is the Learning Support Program (LSP). The LSP identifies grade 1 and 2 students entering into school with limited oral and literacy skills. The School Cockpit program assesses the child's skill upon entry, informing teachers of the needs of the child. The student's improvement is tracked through the year. The improvement results are then used by the Ministry to assess the effectiveness of the LSP program. The School Cockpit program tracks the student throughout their education to better inform schools and the Ministry on student performance.[62]

Data privacy

The Personal Data Protection Commission is mandated in Singapore to oversee the privacy laws. This commissioner has issued specific guidelines for schools outlining the requirements for accuracy and consent. The guidelines go on to require schools to explain the reasoning and use for the data collections.[63]
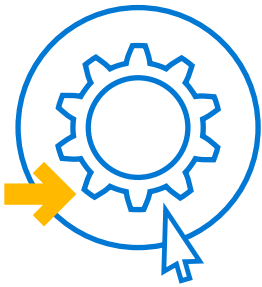
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60   "Building a National Education System for the 21st Century: The Singapore Experience." Building Blocks of Education. Toronto, Canada. 2010.
61   Ibid.
62   Ibid.
63   "Advisory Guideline for Education Sector." Sept. 2014. Web.

Recommendations

01 Entry
Entry level countries

Entry level countries can benefit from developing a central shared data center that allows for accurate and timely reporting to all stakeholders. The establishment of a quality assurance agency can help coordinate a country's various databases. And finally, countries can create standards for data collection and reporting to ensure quality information.
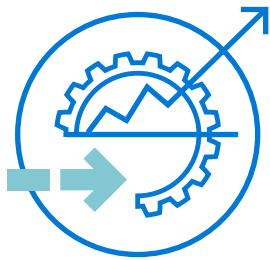
02 Emerging
Emerging countries

Emerging level countries may develop stronger privacy policies and practices to protect their students and communities. In addition, transitioning data collection to digital systems using cloud technologies can streamline collection and reporting. Finally, emerging countries should focus legislation around data driven initiatives to best utilize educational analytics.
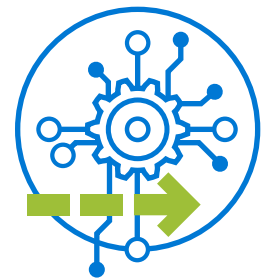
03 Advanced
Advanced countries

Advanced level countries should continue to develop and adapt privacy laws to ensure protections for communities. Countries can develop innovative ways to expand access and reporting to more stakeholders to better inform policies and procedures.
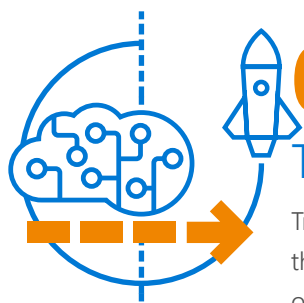
04 Transformative
Transformative countries

Transformative level countries have opportunities to advance learning outcomes beyond their borders through leadership and advocacy. By sharing their data models, templates, and learnings, they enable others to progress. By advocating with technology vendors for data access and transparency, they open doors to locked data and enhance understanding of the learning experience. By advocating with education data standards organizations for accessible inclusive standards, they enhance the ability of researchers to compare outcomes across countries.

Ideal level

The following graphic represents an ideal data flow that includes comprehensive data privacy procedures and transparency. Data can be accessed at all times and monitored in real-time. Data entry begins at the school and institutional levels with additional surveys from students and parents. Data are automatically compiled into different segments for various customizable reports, which are accessible through the Ministry of Education. Schools can access institution-specific data that can help with their policymaking. Simultaneously, students and parents have access to individualized student performance reports. Aggregated data that are free of Personally Identifiable Information (PII) are shared with the public as part of transparency and data privacy policies.

Since there is no one-size-fits-all solution, the model is used as a reference only and should be modified as needed.
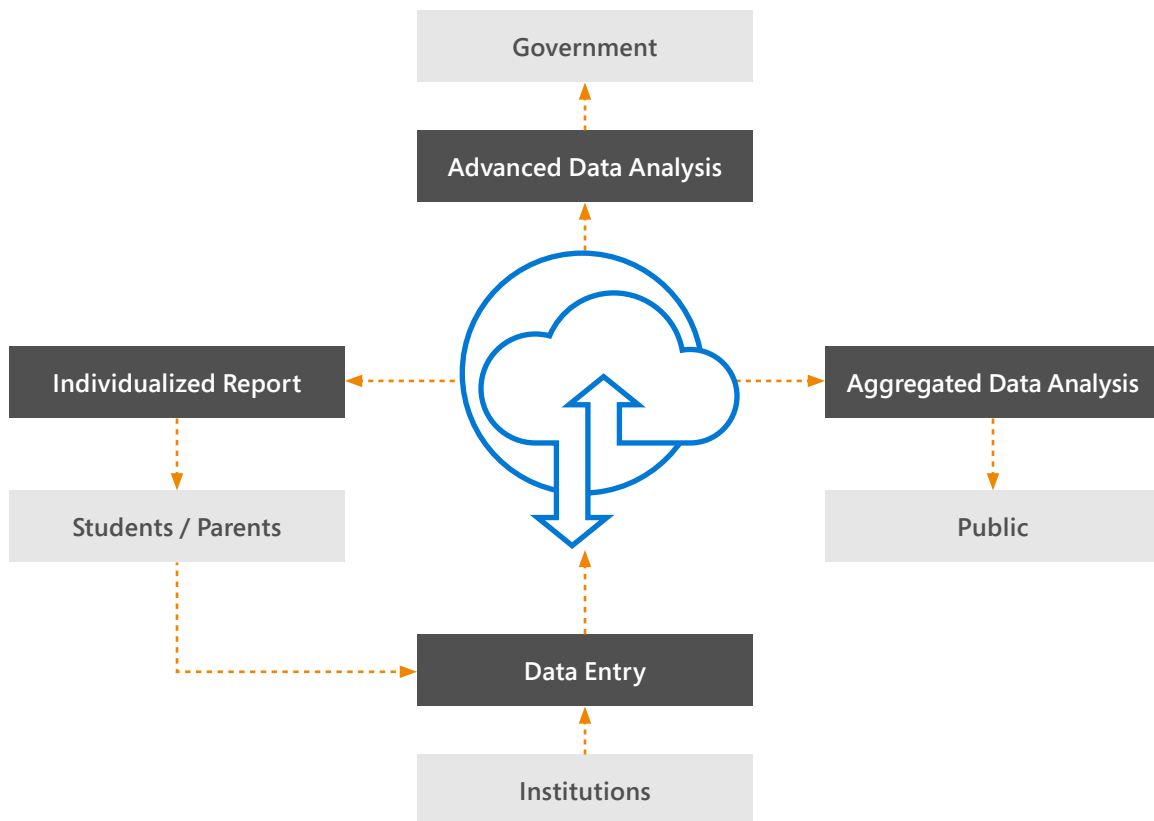
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