Connecting every school in Indonesia: A bespoke implementation framework





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In Partnership with:





Acknowledgements

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The report was prepared by the ITU Regional Office for Asia and the Pacific and was written by Cahya Ratih in her capacity as an ITU expert.

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Foreword



I am delighted to present this bespoke implementation framework report which focuses on how to connect every school in Indonesia.

Since 1989, the International Telecommunication Union (ITU) has been working, through the Telecommunication Development Bureau (BDT), to strengthen technical assistance to lower- and middle-income countries to close the digital divide and drive digital transformation.

Despite the increasing importance of technology in our daily lives, there are still 2.7 billion people offline. Those left unconnected are disproportionally located in least developed countries, in rural or

remote areas, or belonging to marginalized groups of society. The power of information and communication technologies, particularly in relation to the opportunities that can be opened up through digital learning, can drive economic prosperity, generate jobs, and advance national digital skills as well as promoting gender equality and encouraging diversity.

With our partners, we are trying to understand how universal connectivity can be achieved, in particular school connectivity, and how we can improve digital skills in low- and middle-income countries to close the digital divide and drive digital transformation. We are focusing on regulatory analysis, capacity development, tools and frameworks to explore innovative sustainable financing and technology development models.

As part of this work, and building of related assessment of the policy landscape in Indonesia, this framework sets out the requirements for school connectivity, such as the policy and regulatory environment, infrastructure, sustainable financing, data and mapping, as well as the multiplier components that help optimize the utilization of school connectivity, such as digital literacy and digital skills. Efforts to expand broadband connectivity to ensure that it is meaningful and universally accessible will ultimately enhance the opportunities available to those currently excluded, as well as improving the wealth of information and educational opportunities available to the next generation. It will open the door to an almost unlimited store of online learning content and educational resources, regardless of a child's location and will significantly contribute to developing that child's full potential.

I recommend this report to national regulators and decision-makers as they work to implement the policies, regulations, technologies, and financing required to ensure that school broadband connectivity is truly universal, safe, sustainable, and equitable to all.

18 Alelong

Dr Cosmas Luckyson Zavazava Director, Telecommunication Development Bureau (BDT) International Telecommunication union (ITU)

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Abbreviations

ASEAN	Association of Southeast Asian Nations
ΒΑΚΤΙ	Indonesia Telecommunication and Information Accessibility Agency
BOS	School operational assistance (bantuan operasional sekolah)
Coronavirus disease	COVID-19
BTS	Base transceiver station
Edtech	Education technology
EIU	Economist Intelligence Unit
FCDO	United Kingdom Foreign, Commonwealth & Development Office
GDP	Gross domestic product
GNI	Gross national income
ISCED	International Standard Classification of Education
ICT	Information and communication technology
ITU	International Telecommunication Union
Pusdatin	Ministry of Education, Culture, Research and Technology Data and Information Centre
UNESCO	United Nations Educational, Social and Cultural Organization
UNICEF	United Nations Children's Fund
USF	Universal service fund
VSAT	Very small aperture terminal

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Executive summary

The unprecedented situation brought on by the coronavirus (COVID-19) pandemic has forced many sectors in Indonesia to transform and deliver their public services using ICTs. While the government has leveraged its school connectivity programme, started before the pandemic, in response to the tremendous need for connectivity for home-based teaching and learning, the system was caught unprepared. As this proposal explains, digital learning fell short owing to limited connectivity, the shortage of devices, the lack of digital literacy and skills, unfamiliarity with edtech, and the scarcity of digitized education materials. These shortcomings, associated with the country's geographical situation, urban-rural gaps and socio-economic as well as technological disparities, posed unique challenges in Indonesia. In the face of those challenges, a framework is proposed here to help assess needs and resources related to school connectivity holistically.

The proposal comprises a set of interconnected components (see Figure 7). The outer components are requirements that must be met to enable school connectivity, i.e. policy environment, infrastructure and devices, sustainable financing for connectivity and digital data governance. The inner components are multipliers that help optimize the use of school connectivity, i.e. digital literacy and skills, edtech and school-community partnership.

The proposal ends with a summary of issues meriting further consideration and is expected to initiate further discussion of how to implement school connectivity in Indonesia.

1 Introduction

Indonesia is the fourth most populous country in the world, with a population of over 270 million (70 per cent of whom are of working age) made up of more than 300 ethnic groups (UN Indonesia, 2022). It is an archipelagic country of 17 000 islands; 70 per cent of the territory is ocean. Indonesia's moderately rapid economic growth over the past 50 years slowed significantly (-2.1 per cent) since the COVID-19 pandemic in 2020, but it rebounded to 3.7 per cent and is expected to reach 5 per cent in 2022 (Asian Development Bank, 2022). In 2019, approximately 196.7 million people (73.7 per cent of the population) were connected to the Internet (APJII, 2020).

Despite the growth, economic disparities persist between provinces. Most economic activity is concentrated on the islands of Java, Bali and Sumatra. This has a bearing on the potential market for telecommunication providers; for reasons of economic viability, they are more willing to provide services in areas with a certain population density. A closer look reveals that even in Jawa Barat, the most populated province, there are 300 connectivity blank spots.

Optimizing the effective use of digital technology is one of the strategies underpinning the fiveyear National Medium-term Development Plan (2020-2024), which focuses on the revitalization, modernization and transformation of industry, agriculture, services and other sectors. The Digital Indonesia Roadmap 2021-2024 covers implementation of digital transformation in 10 sectors. The Ministry of Communication and Information Technology is accelerating the digital transformation by providing infrastructure, encouraging the adoption of technology, enhancing digital talent and issuing supporting regulations. BAKTI is cooperating with cellular operators and local governments to deploy 4G base transceiver stations in 12 548 villages, i.e. the 15 per cent of villages that are not yet connected, most of which are in the *daerah terdepan, terluar, tertinggal* (frontier, outermost and least developed), or "3T", areas.

Digital transformation in education is promoted through the implementation of various learning models, the aim being to enhance the quality of and access to the opportunity to learn, in line with the constitutional provision that all citizens have the right to education. In this regard, the government has mandated 20 per cent of the State budget for education. Under the *Merdeka Belajar* (Freedom to Learn) and *Sekolah Penggerak* (Transformative Schools) schemes, connectivity is being accelerated, and digital literacy and skills are being enhanced. The transformative schools in particular are selected based on the capability of the school principal in terms of his/her vision, planning and implementation management and learning development strategies on the one hand, and the readiness of city/district government to provide the enabling policies, local budget, and the commitment towards implementation on the other. Additionally both schemes are to be determined by the central and local government partnerships and by means of tapping into the optimization of edtech.

1.1 Pandemic-induced acceleration of school connectivity

Indonesia's geographical situation, urban-rural gaps, socio-economic characteristics and technological disparities pose unique challenges. Under the National Medium-term Development Plan 2020-2024, connectivity and digitalization are seen as a means of overcoming those challenges, hand in hand with alternative education schemes such as the open junior high school (SMP Terbuka) concept, particularly in 3T areas. In the Open Junior High Schools concept, junior high school aged children who could not attend the regular schools due to economical and/or geographical barriers, could have flexibility in their learning time and place. Under management of regular schools, several learning groups are formed to facilitate student tutorials. Self-directed learning is being promoted and for those who have access to a device and connectivity will benefit through greater access to the learning resources and information. The existing digital divide was exacerbated by the unprecedented COVID-19 pandemic, which caught the system unprepared. The pandemic forced many sectors, including education, to transform and deliver services using ICTs.

Levels of digital learning were already low due to limited connectivity, a shortage of devices, lack of digital literacy and skills, unfamiliarity with edtech and the scarcity of digitized educational materials. Approximately 97 per cent of Indonesian schools have engaged in distance learning in Indonesia since March 2020 (MoEC, 2020), but 67 per cent of teachers have found it difficult to operate digital devices and online learning platforms (Yarrow, Eema, & Rythia, 2020).

Meanwhile, at home, parents are pushed to purchase connectivity and to provide or share devices. Needless to say, underprivileged children and those who live in 3T areas suffer the most from poor or lack of connectivity (UNICEF, 2020) The World Bank estimates that the closure of schools until June 2021 led to a learning loss of 0.4 to 0.9 years, based on the Learning Adjusted Years of Schooling (Yarrow, Eema, & Rythia, 2020).



Figure 1: Effect of school closures during the pandemic on learning

Source: https://documents1.worldbank.org/curated/en/184651597383628008/pdf/Main-Report.pdf

In the broader context, ITU and the FCDO are working together to help promote more effective regulation, greater investment and innovative models for school connectivity in underserved communities and for broader digital inclusion. Their project targets several countries, including Indonesia, where they are helping the government to (a) assess the regulatory and policy landscape and framework; (b) map school connectivity, particularly in underserved communities; (c) establish an environment that is more conducive to sustainable financing for digital inclusion; and (d) advance digital skills. It is closely associated with the ITU/UNICEF-led global Giga initiative to connect all schools to the Internet in order to ensure that young people have access to information, opportunity and choice.

As part of these efforts, various aspects of Indonesian school connectivity in underserved communities are currently being assessed. This proposal focuses on the more technical and operational aspects; it complements another report focusing on the policy and regulatory landscape, consideration of a number of sustainable financing models put forward for school connectivity by Giga and the Boston Consulting Group and the development of school connectivity interactive infrastructure maps. Taken together, the outputs of these assessments are expected to stimulate the conversation among stakeholders about accelerating school connectivity in Indonesia.

Data for this proposal were compiled from a systematic review of the literature and a context analysis, supported by accumulated insights gathered from discussion and presentation of the draft reports at public events and during meetings such as the ITU Asia and the Pacific Regional Dialogue on Digital Transformation and the International Symposium on Open, Distance and E-learning organized by the Pusdatin, which were both held in Indonesia in December 2021, as well as the ITU-SEAMEO Regional Policy Dialogue on Schools Connectivity and Digital Transformation in Post Pandemic Context, held virtually in June 2022.

1.2 Indonesia and digital transformation

Indonesia is the largest economy in South-east Asia, with annual growth rates of between 5 and 6 per cent for the past 20 years. While the COVID-19 pandemic led to a drop in economic growth in 2020 to -2.1 per cent, by the third quarter of 2021 growth had rebounded to 3.7 per cent (Asian Development Bank, 2022).

Digital technology is a key factor of national progress and growth. Digital transformation is a priority under the National Medium-term Development Plan 2020-2024. The aim is to boost economic growth by strengthening human resources and competitiveness on the global market as the country relies less and less on extractive commodities to drive growth. The digital transformation, which includes school connectivity, is poised to accelerate economic growth and contribute up to 20 per cent to GDP (Burhan, 2021).

At the start of 2022, many Indonesians had access to the Internet (73.7 per cent), an increase of 2.1 million (+1.0 per cent) since 2021 (Kemp, 2022). As of 2020, all but 2 per cent of Indonesia's population is covered by a mobile network, and 96 per cent benefit from a 3G or 4G connection; 78 per cent of the population have Internet access at home and generally use mobile phones to access it.

Indonesia ranks 66 out of 120 countries in the four categories of the EIU Inclusive Internet Index 2021: availability, affordability, relevance and readiness. It ranks in the top half in terms of availability and relevance, both of which improved compared to the previous year, but in the bottom half in terms of affordability and readiness, its particular weaknesses being the competitive environment and rates of digital literacy (Inclusive Internet Index, 2022).

The Network Readiness Index is another means of showing the impact of ICT in Indonesia. Based on 2021 data for all four pillars (see Figure 2), Indonesia ranks 66 out of the 130 economies listed. Its main strength compared to other upper-middle-income economies relates to technology (rank 48), access to which is promoted by the Government of Indonesia. The greatest scope for improvement, meanwhile, lies in People and Impact.

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Network Readiness Index	Rank (out of 130) 66	Score 50.37	NRI 100 80
Pillar/sub-pillar	Rank	Score	60
A. Technology pillar	48	50.07	
1st sub-pillar: Access	39	77.75	Impact 20 Techno
2nd sub-pillar: Content	75	33.61	
3rd sub-pillar: Future Technologies	46	38.85	
B. People pillar	79	44.69	
1st sub-pillar: Individuals	55	64.49	
2nd sub-pillar: Businesses	119	22.75	
3rd sub-pillar: Governments	53	46.83	
C. Governance pillar	68	55.02	
1st sub-pillar: Trust	65	45.63	
2nd sub-pillar: Regulation	77	61.28	V
3rd sub-pillar: Inclusion	77	58.15	Governance People
D. Impact pillar	79	51.70	
1st sub-pillar: Economy	57	39.70	0.1.1.
2nd sub-pillar: Quality of Life	72	64.09	
3rd sub-pillar: SDG Contribution	96	51.30	Upper-middle-income group

Figure 2: Network Readiness Index, Indonesia, 2021

Source: <u>https://networkreadinessindex.org/</u>

In 2020, Statistics Indonesia released the ICT Development Index, which is based on the ITU standard of three sub-indices: access and infrastructure, utilization and skills. Owing to the enforcement of pandemic-related measures, there has been positive growth in all the sub-indices, with the most significant increment being the wider user of ICT (10.10 per cent growth).

In order to promote the development of equitable access to connectivity and support digitalization in the economic, social and governance sectors, the government made ICT infrastructure development an explicit strategic priority under the National Mid-term Development Plan 2020-2024. To support this digital transformation, it projected spending in the amount of IDR 435 200 billion (IDR 7 200 billion from the State budget and IDR 428 000 billion from the corporate sector). See Table 1 for detailed information on government support for infrastructure development. In that regard, the government launched a package of five comprehensive digital transformation acceleration policies, from upstream to downstream and covering accelerated expansion of IT infrastructure; adoption and exploration of new technologies; human resource development; accelerated completion of national primary legislation; and closer international cooperation in various fields. The Ministry of Communication and Information Technology has launched the Digital Indonesia Roadmap 2021-2024 to accelerate digital transformation, including by providing infrastructure for Internet access, encouraging the adoption of technology, enhancing digital talent and drawing up enabling regulations for a digital community. As the country enters the post-Covid-19 period, digital infrastructure readiness will kick-start the recovery, with results that are expected to surpass pre-pandemic productivity levels. During its presidency of the G20 in 2022, for instance, Indonesia will place digital transformation centre stage to improve economic values in various sectors. Under the theme "Recover Together, Recover Stronger", digital transformation is poised to encourage digitization in various sectors (Elena, 2021).

			Targets				
	Cumulative targets	2020	2021	2022	2023	2024	Total
	Construction of BTS/ last-mile (non-com- mercial village)	5 052	5 052	5 052	5 052	5 052	5 052 villages
	SATRIA satel- lite capacity (Gbit/s)	Construc- tion	Construc- tion	Construc- tion	150	150	150 Gbit/s
Target and funding	Percentage of sub-districts covered by optical fibre	36.42	37.15	42.85	50	60.6	60
	National data centre oper- ation	M/I: 30% LG: 30%	M/I: 50% LG: 50%	M/I: 80% LG: 80%	M/I: 100% LG: 100%	M/I: 100% LG: 100%	M/I: 100% LG: 100%
	Digital broadcasting infrastructure system	44 locations for transmis- sion units	50 locations for transmis- sion units	60 locations for transmis- sion units	74 loca- tions for trans- mission units	55 loca- tions for trans- mission units	238 locations for trans- mission units
Executor	Ministry of Communication and Information Technology, Ministry of Health, Ministry of Education, Culture, Research and Technology, Ministry of Industry, Ministry of Home Affairs, Ministry of State Apparatus Empowerment, BSSN, BPPT, business entities						
	Broadband mobile network coverage expansion (BTS/last mile): Ministry of Communication and Information Technology, BUMN, private						
Droigethigh	SATRIA satellite network: Ministry of Communication and Information Technology, Ministry of Education, Culture, Research and Technology, Ministry of Health, Ministry of Defence/police, Ministry of Home Affairs						
lights	Broadband fixed network coverage expanded to sub-districts: Ministry of Communication and Information Technology, BUMN, private						
	SPBE infrastruc	ture: Ministry c	of Communicat	tion and Inform	nation Techr	nology, BS	SN, BPPT
	Digital public broadcasting infrastructure: Ministry of Communication and Information Technology, LPP TVRI						

Table 1: ICT infrastructure to support digital transformation

Source: National Mid-term Development Plan 2020-2024

Abbreviations

M/I: ministries/(public) institutions LG: local governments SPBE: e-governance system (hardware and software) BUMN: State-owned enterprises BPPT: technology application review agency LPP TVRI: national TV station BSSN: national cyber and crypto agency Greater access is not necessarily evenly spread in the education sector. In terms of user behaviour, those aged 16 to 64 connect to the Internet for at least eight hours every day. More than 60 per cent are social media users who watch online videos (>98 per cent), including vlogs, and listen to music streaming services (>80 per cent), including online radio stations. Some (>60 per cent) use social media for work purposes. More than 85 per cent say they use the Internet to access YouTube, WhatsApp, Instagram and Facebook. They are also familiar with the online platforms that now provide various services (grocery and other shopping, payments, daily needs, business, news and entertainment).

School connectivity is characterized by the prevailing disparity in Internet penetration and poor bandwidth. Most rural villages across eastern Indonesia suffer from poor or no connectivity. Most of the population there, including students, have never been exposed to digital technology in their daily lives. Figures 3 and 4 depict the digital development situation in Indonesia.



Figure 3: Digital development in Indonesia

Source: ITU Digital Development Dashboard



Figure 4: Digital development in Indonesia

Household access to the Internet, for instance, stands at 78 per cent in cities, 51 per cent in rural areas, 93 per cent in the capital region and 49 per cent in the easternmost provinces (Central Bureau of Statistics, 2018). Low supply and demand in rural areas and in the easternmost provinces is attributable to the challenging geographical conditions and low population density, which result in high capital expenditures for connectivity infrastructure and low penetration rates overall.

1.3 Local autonomy and school connectivity

Historically, Indonesia's centralized education system has managed to provide access to primary education for all children. It is also credited with having contributed to nation building by unifying the nation and instilling in its citizens a single political ideology, a common language and a shared national identity. Local Government Law No. 23 of 2014 establishes the composition, duties and responsibilities of local governments, giving them broad local autonomy within the system so as to empower local stakeholders and communities.

As a result of the decentralization that followed the major economic crisis of 2000, Indonesia continues to struggle with the insufficient capacity of local governments (Nasution, 2016). The situation is further complicated by the sheer number of schools, students and teachers, and there is room to improve management and coordination. 53.6 million students attended more than 221 000 schools and universities, staffed by 3.3 million teachers in 2021 (see Table 2).

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Source: ITU Digital Development Dashboard

Level of education	Number of institutions	Number of students	Number of teachers
Primary schools (<i>sekolah dasar</i>) ISCED 1 - ages 7 to 12	148 743 (88.11% public schools)	24 848 613	1 653 619
Junior high schools (sekolah menengah pertama) ISCED 2 - ages 13 to 15	40 597 (58.30% public schools)	10 090 484	710 659
Senior high schools (<i>sekolah</i> <i>menengah atas</i>) ISCED 3 - ages 16-18	13 865 (49.76% public schools)	5 017 314	338 810
Vocational high schools (sekolah menengah kejuruan) ISCED 3 - ages 16-19	14 078 (25.78% public schools)	5 258 607	335 986
Higher education ISCED 4 - 8	4 593 (6.73% public institu- tions)	8 483 213 (2 163 682 new entrants)	312 890

Table 2: Education by levels and number of students in Indonesia

Source: K12 Education Statistic, higher education statistic

Currently, the role of the national government (Ministry of Education, Culture, Research and Technology) for primary and secondary (K-12) education is limited to drawing up educational standards, the national curriculum and the accreditation system; training and recruiting teachers; and authorizing foreign schools. District/city governments are responsible for the management of primary education (K1-9), provincial governments for that of secondary education (K10-12).

The provision of infrastructure for school connectivity remains challenging. More than 6 000 schools (3 per cent) are still unconnected to the power grid and more than 40 000 (close to 19 per cent, most of them primary schools) have yet to be connected to the Internet (see Table 3).

,		5.1.	
Level of education	Without electricity	Without Internet connection	Without sufficient devices*
Primary schools	5 268	31 834	125 900
Junior high schools	936	6 377	8 783
Senior high schools	224	1 346	1 456
Vocational high schools	328	1 374	NA

Table 3: Summary of connectivity and device gaps based on level of education

Source: National Education Platform data, 3 April 2021, as presented by the head of Pusdatin

* Source: CNN, 2021

1.4 The need for an implementing framework

At least three major sectors need to be involved in addressing connectivity gaps: the digital/ telecommunication sector under the Ministry of Communication and Information Technology, the education sector under the Ministry of Education, Culture, Research and Technology, and, given the local autonomy paradigm in Indonesia, the local government sector under the Ministry of Home Affairs.

The challenges are complex and have been lent an element of urgency by the ongoing pandemic response and recovery. As yet, there exists no agreed framework for implementing the measures needed to address connectivity gaps, and thus no tool to understand and group processes into a classification or to map how more inclusive connectivity can be more rapidly accomplished. The establishment of such a framework could include an appreciation of how the constitutional, legislative, regulatory and institutional arrangements, processes and systems that underpin the governance of connectivity relate to one another. It could also help assess the needs and resources related to school connectivity holistically.

The framework proposed below is derived from the ICT Vision for Indonesia (Satriya, 2020), which lists key enablers: (a) ICT policies and regulations, (b) ICT infrastructure, (c) the ICT ecosystem, (d) security, (e) human resources and (f) digital governance (see Figure 5).



Figure 5: ICT Vision for Indonesia

Source: Indonesia ICT Vision, presented by the Deputy Assistant of Telematics and Utilities, Coordinating Ministry for Economic Affairs, during the focus group discussions of the National ICT Council in January 2020

Such a framework would be in line with the broadband ecosystem framework (see Figure 6) introduced by the Telecom Regulatory Authority of India (TRAI) in 2016, whereby broadband is an ecosystem of interdependent components that work together efficiently. When the components are in place, connectivity is more effectively available and, as more people use it, generates greater value or benefits.

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Source: Telecom Regulatory Authority of India

2 Proposal for an implementation framework

In line with the ICT Vision for Indonesia, connecting all schools to the Internet helps prepare human resources for the digital transformation in a rapidly changing world. The framework proposed below embodies a vision, a philosophy, values, plans and needs for promoting effective regulation, greater investment and innovative models for broader digital inclusion in Indonesia. It promotes a cohesive environment; provides a unifying vision enabling stakeholders to understand the purpose and directions; gives a bird's eye view of all elements and how they are interrelated; and eases collaboration among stakeholders.

Figure 7 shows the proposed framework as consisting of interconnected components. The outer components are requirements for school connectivity: an enabling policy and regulatory environment, infrastructure and devices, sustainable financing and data and mapping. The inner components are multiplier components that help optimize the utilization of school connectivity: digital literacy and digital skills, the use of edtech and school-community partnerships (the synergistic relationship between connectivity in schools and the nearby or surrounding communities).



Figure 7: Proposed framework for school connectivity

Source: ITU

2.1 Policy environment

The policy environment should be conducive to school connectivity. Greater policy harmonization could accelerate the process further.

Indonesia has laws and regulations as a regulatory foundation to encourage greater connectivity in schools as described in Table 4.

Table 4: Indonesia laws and regulations

No	Law/Regulations	Description
1	Law No. 36, Year 1999 on Telecommunications	This law describes the aim of telecommunications is to promote the unity and integrity of the nation, enhance the welfare and prosperity of the people in a fair and equitable manner, support economic life and government activities, and improve relations between nations. It also emphasizes that the telecommunication sector operates under State control to improve the provision of telecommunication networks and services through effec- tive policies and regulations, supervision and control
2	Law No. 20 of 2003 on National Education System	This law establishes a legal framework for the sector's goals, policies and plans that includes provisions concerning the expansion, equity, improved quality, and relevance of education. The Law also opens access to education at all levels and in all forms - formal, non-formal and informal - to all citizens. It provides that basic education is compulsory and free of cost for all citizens aged 7 to 15.
3	Government Regulation No. 46 of 2021, on Post, Telecommunications and Broadcasting on Post, Telecommunications and Broadcasting	The regulation aims to support digital transformation by accelerating the expansion of access to and improve- ment of digital infrastructure and the provision of Internet services; accelerating the expansion and improvement of services; preparing a digital transformation roadmap in strategic sectors; accelerating the integration of national data centres; preparing digital talent; and drawing up regulations related to funding and financing.
4	Government Regulation No. 17 of 2010 lays out the education management and administration system	It provides for the Ministry of Education, Culture, Research and Technology to develop and implement an ICT-based national education information system, which is to be inte- grated with other ministry/ institutional/ local government information systems. The system is intended to give access to learning resources and administrative information to schools of all levels and types. It also covers distance education that aims to extend equitable access and improve the quality and relevance of education. The educational services are provided in
		the form of tutorials, practices and assessments in an integrated manner enhanced by ICT. These ICT-based services are to be combined with face-to-face learning in a hybrid approach.

The School Digitization Programme was launched as one means of fulfilling the third programme priority under the National Medium-term Development Plan 2020-2024, namely building Indonesia from the periphery by strengthening regions and villages within the framework of a unitary State, in order to prepare schools for the Fourth Industrial Revolution. This is to be achieved by equipping people with the digital skills to facilitate the teaching and learning process and accelerate access to educational services in disadvantaged areas.

Recently, as part of its Strategic Plan 2020-2024, the Ministry of Education, Culture, Research and Technology introduced an umbrella scheme, *Merdeka Belajar*, or Freedom to Learn, that considers students as the centre of the learning process and teachers as facilitators promoting the students' potential. Under this scheme, the education ecosystem, teachers, teaching methods, the curriculum and assessment systems are to be transformed into a more enjoyable learning environment that promotes parent and stakeholder participation in school management. One of the key requirements is the leveraging of connectivity and digital technology, including the use of multimedia devices, collaborative work, information exchange and critical thinking.

To supplement the nationwide gradual implementation of the Freedom to Learn scheme, the Ministry of Education, Culture, Research and Technology also launched the *Sekolah Penggerak* or Transformative Schools based on Ministerial Decision No. 1177/M/2021. Transformative Schools will self-transform by enhancing the quality of learning and then share their experiences with nearby schools. Transformative schools are also required to use ICT-based platforms (i.e. teacher platform, school resources management platform, school profile and educational report), which all require connectivity.

Specifically, to support student learning during the pandemic, the Secretary General of the Ministry of Education, Culture, Research and Technology issued the regulation No. 17 of 2021 for the arrangements of Internet connectivity subsidy. The targeted beneficiaries are 35.6 and 26.8 million students and teachers in 2020 and 2021, respectively. They must be registered on the National Education Data (Dapodik) platform and their mobile phones validated by a national committee.

In line with current policy and strategies, as stated in the National Mid-term Development Plan 2020-2024, the government will endeavour to meet ICT infrastructure requirements and support optimal use of ICT for digital transformation. Universal service fund (USF) activities will focus on Internet access in 3T areas by building base transceiver stations and providing multifunctional satellite services; in other areas, the government will simplify licensing for infrastructure development and support the development of passive shared infrastructure among providers. In order to support the optimized use of ICT, the government will also expand ICT use in various sectors that enhance economic sector productivity.

In the educational sector, users (students, teachers, educational staff, parents) should acquire the digital competencies and skills needed to make effective use of edtech platforms. Government policies play a crucial role here, incorporating ICT skills into the curriculum, providing teacher training on ICT use in teaching and learning, and promoting the development of qualified local educational content and appropriate applications. Figure 8 is a schematic presentation of the Internet as a general-purpose technology that has potential multiplier effects, the value of which increases as more people are connected.



Figure 8: Telecommunication network components

Source: ITU, The Last-mile Internet Connectivity Solutions Guide: Sustainable Connectivity Options for Unconnected Sites (Geneva, 2020)

The principal agencies working on school connectivity are the Ministry of Communication and Information Technology, the Ministry of Education, Culture, Research and Technology, the Ministry of Religious Affairs and the Ministry of Home Affairs.

Through BAKTI, the Ministry of Communication and Information Technology develops connectivity infrastructure in both the ground and space segments. BAKTI is working with cellular operators and local governments to deploy 4G base transceiver stations in the 12 548 villages (15 per cent) that remain unconnected, 73 per cent of which are in 3T areas eligible for USF funding allocated to connect government offices and public services, including schools.

The Ministry of Communication and Information Technology is also developing the multifunction SATRIA satellite system, which, using high throughput satellite technology, is expected to cover blank spots in 3T areas by 2023. The system will have a throughput capacity of 150 billion bits per second (Gbit/s), three times the capacity of the nine telecommunication satellites that Indonesia currently uses to boost connectivity in the country; it will provide a free Internet connection to 150 000 public facilities, including 93 000 schools, local government offices and health facilities, with a target speed of 1 Mbit/s, as stipulated almost a decade ago in the National Broadband Plan 2014-2019 (Presidential Regulation No. 96 of 2014). This most likely needs to be upgraded, as it is well below even the recommended minimum speed of 10 Mbit/s for meaningful connectivity in schools (Giga, 2021).

The main policy of the Ministry of Education, Culture, Research and Technology is to improve access to good-quality and relevant education, and to enhance education governance. To this end, it is promoting digitalization in schools, both those directly under its management and the more than 80 000 madrasah (Islamic schools) run by the Ministry of Religious Affairs (Kemenag, 2020).

The Transformative Schools scheme (see Figure 9) requires that schools have access to electricity, Internet connectivity and devices; to teachers qualified to use ICT; to the support of and partnerships between national and local governments; and to edtech/digital literacy and skills (Kemendikbud, 2021). By working with local government, educational facilities will effectively be able to act as transformative schools, starting with planning and the provision of facilities through to enhanced teaching and a digitalized learning process. The target is to have 40 000 transformative schools in 514 districts in 34 provinces by 2024. The schools are intended to help nearby schools, including with access to school connectivity and digitalization.





Source: 5 Intervensi Program Sekolah Penggerak Yang Saling Terkait - PGDIKDAS 2020 (kemdikbud.go.id)

In support of the school digital transformation policy, the Ministry of Home Affairs has invited local governments to develop standard operating procedures based on norms, standards, procedures and criteria established by the Ministry of Education, Culture, Research and Technology, and to identify supportive local policies and initiatives. In addition, the central and local governments have agreed not to rotate principals, teachers and educational staff between public schools, to the extent possible, and for at least the four-year duration of the Sekolah Penggerak scheme (Kemendikbud, 2021), and to integrate the schools' financial management into the local financial management system (Kemendikbud, 2021). Among local agencies playing an important role in school connectivity is the *Dinas Komunikasi dan Informasi/Diskominfo* (Local Communication and Information Office).

The Ministry of Villages, Development of Disadvantaged Regions and Transmigration authorizes the Village Funds to be used to procure, develop, operate and maintain village ICT facilities and infrastructure. This includes various activities to build the capacity to use ICT and develop digital content, as agreed among villagers.

The Strategic Plan for the Accelerated Development of Disadvantaged Regions 2020-2024 (see map in Figure 10) is a government effort to more rapidly reduce the disparities between regions and thereby ensure equitable and fair national development based on Government Regulation No. 78 of 2014. Regions are designated as disadvantaged based on several indicators and, if so designated, receive assistance/facilitation for three years to develop strategic sectors (economic, industries, tourism), infrastructure and facilities, including with regard to ICT, improved governance, the business ecosystem, value-added local products, promotion and partnerships, and human resources and institutions. Twenty ministries, local governments and

industries collaborated in 120 target districts between 2015 and 2019. Based on the village development index released by the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration, almost half of them "graduated" while 62 other districts remained on the list of targets for 2020-2024, as stated in Government Regulation No. 63 of 2020 concerning the designation of disadvantages districts 2020-2024. Specifically for education, the Ministry of Villages, Development of Disadvantaged Regions and Transmigration collaborates with the Ministry of Education, Culture, Research and Technology on support for the development of educational facilities and infrastructure, transformative schools, teacher training, vocational training and enhanced teaching and learning. However, schools whose localities have been taken off the target list may still be unable to afford connectivity. For example, SMAN 1 Tabukan Utara in Kalimantan Selatan received BAKTI connectivity support between 2017 and 2020 but currently cannot access proper connectivity (Riana, 2021).

Figure 10: Map of underdeveloped regions based on the Strategic Plan for the Accelerated Development of Disadvantaged Regions 2020-2024



Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of ITU and of the Secretariat of the ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

Source: Center for Policy Research, Ministry of Education, Culture, Research and Technology

In brief, policy harmonization among ministries, with the Ministry of Education, Culture, Research and Technology at the forefront and the local educational offices on the ground, could facilitate better identification and mapping of school connectivity, align roles and funding, and optimize interlinkages for accelerating connectivity.

2.2 Infrastructure and devices

It will take considerable investment to ensure the availability and accessibility of infrastructure and devices Connectivity infrastructure includes the network hardware and software needed to enable network connectivity, communication, operation and management of schools and education-related processes. Wire, fibre-optic coaxial and wireless connections serve as pathways for communication and services between users, processes, applications, services and external networks/the Internet. The hardware consists of specialized equipment, such as switches, routers, modems and codecs, that links computer or video hardware to modems or two-way conferencing equipment. The term also refers to the physical equipment that sends, receives, stores or processes digital data, such as servers, personal computers, tablets, mobile devices and other user interface equipment. In order to address connectivity gaps, the government has constructed 4G-ready infrastructure in almost 8 000 villages through a blended financing scheme drawing on the USF, the State budget and non-tax State revenues. In partnership with cellular providers such as Telkomsel and XL Axiata, the Ministry of Communication and Information Technology identifies and constructs 4G base transceiver station infrastructure while the operators handle service provision and network maintenance. They thus benefit from the value of increased connectivity for local production, online distribution or new tourist destinations (Bakti Kominfo, 2019). The 4G infrastructure is being deployed mainly because of the affordability and simplicity of the installation process compared to fixed broadband (on the supply side) and of mobile user penetration rates (on the demand side – more than 90 per cent of the total population). The connectivity acceleration programme targets villages that are not yet connected, i.e. 15 per cent, or 12 548 villages. Of these, 73 per cent are situated in the 3T areas and the remaining 27 per cent in blank spots in connected areas. BAKTI is building 4 200 base transceiver stations in the 3T areas, while cellular operators are building those in non-3T areas.

In addition to 4G base transceiver stations, other equipment and services deployed include the following:

- a VSAT system, obtained thanks to USF funding, to provide connectivity in 3T areas (Adam, 2020), for instance at 13 sites, including an elementary school and health and public facilities, in Tana Tidung District in North Kalimantan Province in 2019 (Tanatidung, 2019); and a VSAT system and digital libraries for 12 schools in Nusa Tenggara Timur Province, obtained thanks to funding from the Astra Michael D. Ruslim Educational Foundation (Fiska, 2021);
- the Palapa Ring, which provides a network to all districts/cities using the Marine Cable Communication System and Optical Fibre Communication System in a public-private effort; in 2021, BAKTI provided 11 649 public Internet access points, including 4 600 in schools (Renuki, 2021) in collaboration with the private sector (APJII, 2020);
- multifunctional satellites (SATRIA), under a public-private partnership with USF funding (Bakti Kominfo, 2018), using high throughput satellite technology (the Ka-band satellite with a capacity of 150 Gbit/s is expected to connect 150 000 public service points and all 3T areas at the end of 2023);
- 5G services, which became available in selected areas (e.g. greater Jakarta) in 2021 as an implementation roadmap was being rolled out to establish the ecosystem of devices that support 5G services (5G, which is still at the experimental stage has delivered a better mobile experience in terms of upload and download speeds, video streaming, and playing multiplayer mobile games (Khatri, 2022). In the future the use of mixed reality applications across all areas of the education spectrum is expected to create more opportunities for students to learn faster, more reliably and smoothly, and in a more engaging way, however, 5G providers have yet to optimize their services due to the limited infrastructure and spectrum availability.
- The government is switching off analogue broadcasting and plans to auction the 700MHz spectrum currently being used for analogue services at the end of 2022 (Kompas, 2022); the analogue switch-off, the migration of analogue broadcasts to digital TV, is scheduled to be completed by the end of 2022. This has the potential to vastly improve both the quantity and the quality of the edtech materials available on TV, and to enable more schools to take advantage of this mode of connectivity.

Resource-sharing schemes involve, for instance, local governments allowing the national government to use local land to construct infrastructure assets, instead of having to purchase it, as private sector players do (Kristo, 2019). A base transceiver station set up at the centre of the village can be leveraged to provide connectivity to public facilities, including schools and government offices.

Local level infrastructure coordination has featured good practices. The province of Yogyakarta, located in the central part of Java Island, initiated a 380-km fibre-optic installation to reach all blank spots (Husna, 2020). The provincial government, acknowledging the strategic role played by schools, designated 77 out of 118 senior and vocational high schools as connectivity nodes. Costs were reduced by installing fibre-optic cables in alleys instead of thoroughfares. Local governments assembled the various national programmes of the Ministry of Tourism, Ministry of Cooperatives and Small and Medium Enterprises, and Ministry of Villages, Development of Disadvantaged Regions and Transmigration into holistic community-based broadband planning, adoption and deployment schemes. Meanwhile, computer labs received support from local banks and computer stores that extended them favourable credit terms School authorities have been invited to be part of the pool of stakeholders engaged in joint planning to achieve economies of scale, deliver better services and build more robust community technology infrastructure.

In terms of devices, the Ministry of Education, Culture, Research and Technology strives to overcome the poor availability of appropriate digital devices by providing laptops, LCD projectors and Internet modems to schools in remote areas that do not have them (Anjani, 2021). The provision of ICT devices was a priority for disbursement of physical special allocation funds (Dana Alokasi Khusus/DAK Fisik) directly to schools in 2021 (Arradian, 2021) and 2022 (Kemdikbud, 2021). Under this scheme, the Ministry procured 242 565 locally produced laptops for 15 656 schools at a cost of IDR 3 700 billion to the government budget (IDR 1 300 billion from Ministry funds and IDR 2 400 billion from local government special allocation funds). Additional purchases included wireless routers, LCD projectors, Type-C connectors to HDMI/ VGA, headsets, printers and scanners.

The procurement of ICT devices for school connectivity has not been trouble free. In a case in point, the Ministry of Education, Culture, Research and Technology issued a guideline to purchase laptops with ChromeOS and a minimum 32-GB hard drive. While it is true that such laptops have advantages, they also pose many more challenges on the ground. The Chromebook comes with restrictions in terms of productivity software and its internal storage system has to be synchronized with cloud storage, which requires connectivity and considerable special competencies. It may therefore not be the most effective device for learning, especially in remote areas.

In its Strategic Plan 2020-2024, the Ministry of Education, Culture, Research and Technology sets the targets for increased access to devices (see Table 5). Mapping the schools' actual needs for infrastructure and devices will require a careful assessment of bandwidth requirements and device specifications. The scheme may be complemented by the "Bring Your Own Device (BYOD)" approach. As an example, due to limited facilities the SMK Telekomunikasi Tunas Harapan (vocational high school) encourages students to bring their own devices to school, especially those in ICT-related studies. The ownership of devices enhances the skills development and promotes student's self-directed learning.

Level	Percentage ICT use in schools		
	2020	2024	
Primary schools	62.5	72.5	
Junior high schools	62.5	72.5	
Senior high schools	73.84	83.11	
Special education schools	9.6	26.69	

Table 5: National targets for ICT use in schools

Source: Strategic Plan 2020-2024, Ministry of Education, Culture, Research and Technology

2.3 Sustainable financing

Different business models are required according to the connectivity situation of each school and region.

Providing connectivity and network access cost-effectively, and equitably remains a hurdle. Indonesia has the cheapest mobile connectivity among ASEAN countries, and the cost of fixed broadband per megabit/month is also below the ASEAN average (Global Broadband Pricing League Table 2022, 2022) but still higher than in Singapore, Thailand, Viet Nam and Malaysia. The cost of connectivity remains beyond the reach of impoverished and rural populations. While the price of a 1.5-GB mobile broadband data package was 1.3 per cent of GNI per capita in 2020, the fixed broadband cost was 10.9 per cent of GNI per 5 GB, which is much higher than the 2 per cent recommended by ITU Broadband Commission for Sustainable Development, 2021.¹

Internet tariffs have fallen and remain affordable, especially for the mobile broadband category, as providers face stagnating revenue growth. To keep the market healthy and dependable, operators have recommended the accelerated consolidation of operators, infrastructure sharing, collaboration between network operators and over-the-top providers, and lower user charges for network operation and deployment (regulatory fees) (Jatmiko, 2021). The government endorsed the consolidation of operators through the Ministry of Communication and Information Technology Regulation No. 7 of 2022, approving the merger of PT Indosat Tbk and PT Hutchison 3 Indonesia as of 4 January 2022.

As far as the national budget is concerned, since 2009 a minimum of 20 per cent has been allocated to education. In 2022, this translated into IDR 542 800 billion for education reform, including expenditure for infrastructure development, educational technology, the connectivity subsidy and school operational assistance (BOS - bantuan operasional sekolah).

In 2021, the education budget allocated an explicit amount for school digitalization, made up as follows:

- 34 per cent for national government spending, i.e. allocation to the Ministry of Education, Culture, Research and Technology to support the Freedom to Learn scheme, transfer to the Ministry of Religious Affairs, and the rest to other ministries;
- 54 per cent to local government for salaries; BOS, educational facilities and infrastructure development; education digitalization and incentives for local government development; and special allocations for certain provinces such as Papua, West Papua and Aceh, to

¹ <u>https://www.broadbandcommission.org/advocacy-targets/2-affordability/</u>

develop educational facilities and infrastructure such as ICT, in order to enhance access to, and increase the effectiveness of, educational services;

• 12 per cent for investment in higher education and research endowment.

In the medium term, the Ministry of Education, Culture, Research and Technology is mapping the requirements for ICT products amounting to almost IDR 17 500 billion over five years (2020-2024), to support digitalization at all levels under the "sharing and caring" concept of schools and their nearby communities (see Table 6).

Based on the Giga report by Boston Consulting Group (Giga, 2021), the extreme regional differences that exist between islands in Indonesia leads to large discrepancies in school connectivity. It is recommended to adapt funding solutions to each region (Giga, 2021).

Number of schools	Required ICT products	Required budget (IDR)
204 090	162 265	2 945 109 750 000
149 243	121 036	12 257 226 000 000
41 229	7 838	811 233 000 000
13 965	1 258	130 203 000 000
14 403	2 832	293 112 000 000
2 229	762	51 172 684 000
10 241 446	6 308 160	652 878 000 000 16 560 000 000
435 846	302 458	17 427 494 434 000
	Number of schools 204 090 149 243 41 229 13 965 14 403 2 229 10 241 446	Number of schools Required ICT products 204 090 162 265 149 243 121 036 41 229 7 838 13 965 1 258 144 403 2 832 2229 762 10 241 6 308 445 160

Table 6: ICT products: requirements 2020-2024

Source: National Strategic Planning MoECRT 2020-2024

For the **well-developed islands of Java and Sumatra**, which have a high population density and are generally easier to connect or have already been connected, suitable funding methods are described below.

a) Education-sector support

The government allocates 20 per cent of its national budget for education, which is already more than neighbouring countries. In response to the COVID-19 pandemic, the government allocated IDR 7 000 billion in subsidies to connect students and teachers (Kemdikbud, 2021). The Ministry of Education, Culture, Research and Technology released another IDR 2 600 billion for the three months March to May 2021; this was subsequently extended to the second half of 2021. The scheme ultimately reached 60 per cent of students in need of such support.

The BOS finances the non-wage operational expenditures of schools. Since 2005, it has been disbursed as block grants to schools across the country on a per-student basis, so as to provide quality education to students of all income levels, particularly those from poor families, in primary and junior high school. Given that each education setting has unique needs, the Ministry of Education, Culture, Research and Technology introduced the flexible BOS, to allow schools to plan expenditures more independently.

What used to be a per-student amount is now a range of amounts per student, adapted to the socio-economic level of each region as determined by the standard construction cost index and the student index. There is an opportunity to integrate connectivity costs (operation and maintenance) into the BOS - both the one transferred directly from the central budget as well as those allocated by local provincial/district budgets - in order to ensure a sustainable pandemic recovery through adequate, uninterrupted and meaningful school connectivity.

b) Opportunities in upcoming 5G spectrum auction

Upcoming spectrum auctions could provide new possibilities for school connectivity in urban areas, for example by stipulating that winning bids must connect a certain number of schools in certain regions.

c) Build-operate-transfer by BAKTI

BAKTI has been focusing on providing large-scale backbone infrastructure in 3T regions, leaving the backhaul and last-mile requirements to operators and end users. In order to ensure that schools in areas that have graduated out of the 3T classification are not still deprived of connectivity, the USF could be reframed into a "sharing and caring for community benefit" scheme, whereby the government and operators jointly provide end-to-end access and services to the community. Instead of asking for monetary refunds for the use of the Palapa Ring, BAKTI could ask operators to expand their service areas and to provide school connectivity.

d) Coverage as a service - Revenue sharing

The three main stakeholders in this respect are major players such as Internet service providers and mobile operators; minor players such as small and local Internet service providers; and schools. The major players bear the cost of opening the network and, in return, receive revenues from the local players connected to it. Local players receive revenues from connecting end-point network users to the major players, and also need to share the revenues with the major players. Schools and communities, as network end users, pay the subscription fee to local players in return for the connectivity they provide.

Funding models for less developed villages and islands

For less developed villages and islands with poorer connectivity for the general population and school connectivity levels, there are a number of suitable funding models.

a) Education-sector support

As previously mentioned, the government has already allocated sizable funding for education in special regions in order to meet the requirements that are appropriate to local characteristics and situations as contained in the Regulation of the Ministry of Education, Culture, Research and Technology No 23, 2020 concerning guidelines for the designation of special regions. Subsequently, schools in close to 9 500 villages that are designated as special regions based on the decision of Ministry of Education, Culture, Research, and Technology No 160/P/2021,

are eligible for extra support. This includes the decision to consider schools that have only few students entitled for BOS equivalent to a minimum number of 60 students and provision of more travel expenses for teachers who teach in such schools. Notwithstanding, such BOS still could not cover the cost of connectivity without additional support from local government and communities.

b) USF financing

This is a mechanism by which the government obliges industry stakeholders – usually as a condition for obtaining a licence for telecommunication operations – to set aside subsidies and fees in order to promote access to telecommunication services in hard-to-reach regions or to underserved groups or populations, despite the potential absence of an immediate or compelling commercial incentive to do so. Managed by BAKTI under the Ministry of Communication and Information Technology, the USF is an integral part of school connectivity funding *the Regulated advertising model*.

Regulated advertising could be designed, on a case-by-case basis, to provide the funding required for school connectivity. The advertising could be promoted by e-commerce applications for local community production centres, discussion groups and website-building services for local trades and social groups, digital promotion for local stores, tourism hotspots, etc. The advertising model can be used to ensure sustainable revenue streams for schools.

c) Community contribution

Local ownership by the community could lead to affordable, high-quality connectivity. The goal of community networks is to set up affordable, quality connectivity. The local community could set up and maintain the network, creating job opportunities and providing new opportunities for connectivity for individuals, schools and businesses.

d) Government co-investment alongside service providers

The financing model whereby the government invests alongside Internet service providers is especially relevant to school connectivity in most rural areas. For example, in some cases BAKTI is responsible for providing the base transceiver station infrastructure, and the service providers for providing the service using that station. Another example is the Ministry of Villages, Development of Disadvantaged Regions and Transmigration Village Funds, which village councils use to establish a network connection and provide public Wi-Fi access.

2.4 Data and mapping

Improved education information management, within the realm of the Indonesia One Data Policy, is needed for better mapping and as a basis for robust strategies.

The first step towards school connectivity solutions is to map their data as a basis of further policies and strategies. As in the case of the Giga initiative, mapping is often the first activity undertaken and serves to identify the schools' geographical locations with a view to assessing network and infrastructure needs, potential demand and financial viability, technological options and their constraints, and the possibilities for extending connectivity for the shared benefit of communities.

The Ministry of Education, Culture, Research and Technology is integrating all education data sources and management to ensure that accurate and reliable basic education data are accessible as a baseline for the development of further strategies in response to various educational challenges. The integrated data could help pinpoint issues such as affordability of education, availability of and accessibility to education facilities and infrastructure, including connectivity, and the level of teacher competencies and student outputs.

The database contains basic education data on each school's institutional profile and curriculum, students, teachers and educational staff, other education-related data (and facilities and infrastructure). The nationwide, integrated and geo-referenced data-collection system is the main source for education data, which are continuously updated online with a view to the publication of educational statistics. The Ministry of Religious Affairs, for its part, maintains an education management information system on the madrasas, or religious schools.

The Statistics Indonesia population census 2020 included data on non-residential buildings such as schools and Islamic boarding schools. The buildings were recorded using a geo-tagging process that combines pictures and coordinate measurements so as to incorporate latitude and longitude into websites, images, videos and smartphone transmissions. Statistics Indonesia also collects more specific data, such as the proportion of schools with facilities such as water, toilets, computers and electricity.

More recently, in response to pandemic-related school closures, Statistics Indonesia overlaid 2020 national economic and social statistics, on the one hand, with 2019 village potential statistics, to map out the provinces' readiness to embark on digital learning. Indices were developed for household readiness on the demand side and the availability of village digital learning support facilities on the supply side. The findings confirmed that Indonesia's western provinces are far more ready than their eastern counterparts to transition to digital learning.

ITU, working in collaboration with the FCDO Digital Access Programme, has used publicly accessible data to develop an interim interactive map. The map indicates the total number of schools, the percentage of schools located in 4G areas, the percentage of schools located within 10 km of transport network nodes, the estimated cost of connecting to fibre-optic lines, the additional capital expenditures needed to supply solar power, and the average capital expenditure per student, including electricity. The map helps advance policy discussion and stimulates the exploration of opportunities for infrastructure investment, possible innovative solutions and public-private partnerships. Figure 11 shows the interim interactive maps of school geolocations country-wide overlaid with telecommunication infrastructure data. Further analysis could help unconnected schools identify technology options and calculate investment requirements. The project also zoomed in on one province, West Kalimantan (also depicted in Figure 11).



Figure 11: Interactive maps of school connectivity (provisional)

Indonesia



West Kalimantan Province

Note: The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of ITU and of the Secretariat of the ITU concerning the legal status of the country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

Source: ITU Telecommunication Development Bureau presentation on mapping school connectivity, November 2021

In the broader context, Pusdatin has launched the One Education Big Data policy, which entails data integration, improved data input, verification and validation of both internal and external data sources. As the national authority on education data, the Ministry of Education, Culture, Research and Technology has the power and responsibility to integrate relevant data from other ministries and agencies, including master data on citizenship and civil registration from the Ministry of Home Affairs, data on religious education agencies from the Ministry of Religious Affairs, data on education-related ICT infrastructure and network coverage from the Ministry of Villages, Development of Disadvantaged Regions and Transmigration, and other relevant data from Statistics Indonesia, State civil services, the Ministry of Finance and other ministries/ public institutions.

The way of collecting, storing, analysing, updating, displaying, and destroying the educational data complies with the personal data protection law no 27, 2022. This latest personal data protection law provides standardization of the national arrangements in term of general principles of data protection as well as legal and uniform terms of personal data processing. This law is also expected to provide boundaries and governance for any personal data processing for people in Indonesia and Indonesians living abroad. Research (https://aptika.kominfo.go .id/wp-content/uploads/2019/11/Strategi-Implementasi-PDP-Litbang-Kominfo.pdf) shows that personal data protection issues are being considered, however there are still challenges in the implementation level such as the awareness and competency of electronic system operators to provide data security when processing personal data.

The new data system will be housed on the One National Education Platform, which will comprise three integrated platforms:

- a school resources management system consisting of a school procurement information system and a school planning and budgeting platform;
- the Freedom to Teach platform (Merdeka Mengajar) dedicated to teachers' profiles and achievements;
- an educational report platform that serves as a reference concerning the quality of education at various levels to help identify issues and strategies for the improvement of quality of education.

Each student, teacher and educational member of staff will access the platforms via a unique One Educational Account e-mail address at belajar.id. Together, the data systems will support current transformational efforts, including Freedom to Learn, Freedom Campuses and School Digitalization, to boost digital talents and fulfil Indonesia's vision of becoming a digital economy (Muslim, Arnoldus, & Emanuel, 2021). This suite of digital tools will be available in real time, and each and every school will thus inevitably be connected. This formidable task is being undertaken under Presidential Regulation No. 39 (2019), on the Indonesia One Data Policy, which aims to enhance public data management to promote accessibility, reliability and accountability based on data standards, metadata, data interoperability and the use of a master reference (Data.go.id, n.d.).

Implementation of the Indonesia One Data Policy is ultimately intended to achieve integrated planning, implementation, evaluation and control of national development. It will include a national platform containing accurate, current, integrated and easily accessible data collected in line with the principle of accountability (Putera, Manik, Rianto, Sari, & Sadikin, 2020). The interchangeable sets of data thus collected will in turn generate data sources that can be used for decision making through artificial intelligence to promote a more efficient national strategy.

Meanwhile, in line with the National Priority Programme on Strengthening Cybersecurity and Resilience, the National Cyber and Crypto Agency has promoted the formation of a computer security incident response team in each ministry/public institution, including the Ministry of Education, Culture, Research and Technology. In response, Pusdatin launched the Education Computer Security Incident Response Team on 5 August 2020 (Pusdatin, 2020). The team provides reactive services, such as cyber incident alerts, and carries out proactive activities, such as capacity-building workshops, security assessments (including security audits) and building awareness of cybersecurity issues (Kemdikbud, 2020).

2.5 Digital literacy and digital skills

School connectivity can be leveraged so as to accelerate Freedom to Learn and upgrade student skills from "digital natives" to "digital skills" and "digital economy".

Connectivity, digital literacy and practical technological solutions that are tailored to the real needs of students, teachers, school administrators and, by extension, parents and nearby communities are key drivers of effective and meaningful school connectivity. There is no point in providing infrastructure and connectivity if they are not accompanied by human resource capabilities in terms of the management, technical maintenance and use of digital technologies.

The term "digital literacy" refers to the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for learning, employment, decent jobs and entrepreneurship. The term "digital skills" refers to an individual's grasp and use of hardware, software and operating systems in their daily lives (Roadmap Digital Literation 2020-2024, 2021).

The Ministry of Communication and Information Technology Digital Indonesia Roadmap 2021-2024 aims to develop Indonesian human resources by accelerating digital transformation and competitiveness. Through various capacity-building programmes (webinars, workshops, training) and the dissemination of publications, infographics and videos, the national digital literacy movement has reached 17 million beneficiaries in 34 provinces in Indonesia.

The Ministry of Education, Culture, Research and Technology, for its part, through its *Guru Penggerak* (Agents of Change) scheme, has equipped selected teachers with the skills needed to provide "student-centred learning" and act as agents of change for a better education ecosystem. The teachers selected have been given the digital skills required to enhance student engagement, however, much remains to be done. As of September 2021, only about 8 400 teachers had become agents of change out of a target population of 405 000 by the end of 2024 (Kemendikbud, 2021).

Regional disparities in digital competitiveness also come into play. The island of Java, for instance, scored 51.3 points in the human resources category of the East Ventures Digital Competitiveness Index 2020, whereas the rest of Indonesia scored 20.6 points. The index is compiled based on the number of students with digital skills, growth in the number of students with digital skills, the number of lecturers in digitalization-related learning subjects, and the number of digitalization-related study programmes.

A recent study conducted as the COVID-19 pandemic waned showed that teachers still encounter difficulties using the Internet and that students have experienced problems with online learning. In the meantime, data shows that almost half of respondents use the Internet for entertainment purposes, such as watching videos and playing online games, and only 13 per cent to access educational content.

The Ministry of Communication and Information Technology has launched the National Digital Literacy Programme, which aims to encourage 12.4 million citizens to deal with the technological changes of the future, so that they can be more capable and responsive in using digital technology in line with the four components of the Indonesia Digital Literacy Index described in Table 7. Over time, Indonesia has witnessed a considerable increase in terms of digital culture, digital ethics and digital skills, while digital safety has increased at the slowest pace (Aisyah, 2022).

Table 7: Indonesia Digital Literacy Index

Digital skills

Digital skills are related to the individual's ability to know, understand and use ICT hardware and software as well as digital operating systems in everyday life. These skills include:

- basic knowledge of information search engines, how to use and sort data;
- basic knowledge of conversation applications and social media;
- basic knowledge of digital wallet applications, marketplaces and digital transactions.

Digital ethics

Digital ethics is the individual's ability to realize, exemplify, adapt, rationalize, consider and develop ethical governance on the Internet (netiquette) in daily life. Digital ethics skills include:

- knowledge of how to detect information
 containing hoaxes, hate speech, pornogra phy, bullying and other negative content;
- basic knowledge of how to interact, participate and collaborate in the digital space
 in accordance with digital ethical rules and applicable regulations;
- basic knowledge of how to interact and transact electronically in the digital space in accordance with applicable regulations;
- knowledge of minor safety issues(catfishing).

Digital safety

Digital safety is the ability to recognize, pattern, apply, analyse, weigh and increase awareness of personal data protection and digital security in everyday life. The skills in question are:

- basic knowledge of digital identity and personal data protection on digital plat-forms;
- basic knowledge of digital fraud;
- basic knowledge of digital track records in media (downloading and uploading).

Digital culture

Digital culture is the ability to read, decipher, familiarize oneself with, examine and build national insight into the values of *Pancasila* and *Bhinneka Tunggal Ika* in everyday life. This skill is intended to:

- digitize culture through ICT;
- cultivate basic knowledge that encourages appreciation for domestic products and other productive activities;
- safeguard digital rights.

Source: Roadmap Literasi Digital 2020-2024

The Ministry of Education, Culture, Research and Technology has taken urgent measures to enhance digital skills by launching a teachers digital learning and sharing space in 2020. The *Guru Belajar* (teachers self-learning) scheme helps teachers choose professional self-development programmes in topics such as digital-based teaching and learning. The *Guru Berbagi* (teachers sharing) scheme provides the space for teachers to share their learning media and good practices in ICT-enhanced learning. Dedicated ICT-based professional development for teachers is also provided through the ICT-based learning programme run by the Pusdatin. The importance of ICT skills acquisition is also demonstrated by the launch of the *Merdeka* curriculum (Kemdikbud, 2022), which made informatics, previously an elective, a compulsory subject in the transformative schools and will gradually make it compulsory in all schools in 2024.

Rapid and proper acquisition of digital literacy and skills remains challenging. Efforts must be made to encourage and support teachers, students, school administrators and, by extension, parents and nearby communities as they acquire the attitudes, knowledge, skills, awareness and values needed to engage with school connectivity; enhance their digital competencies to take advantage of school connectivity; and muster individual creativity and innovation in the school learning environment.

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2.6 Utilization of edtech

The rapidly expanding world of digital technology and connectivity can be tapped to explore the wider edtech options.

The use of edtech has increased exponentially, especially during the COVID-19 pandemic. edtech is particularly important in facilitating learning and improving performance through the creation, use and management of the technological processes and resources made available by school connectivity.

Edtech started being developed in Indonesia as of the middle of the last decade. The startups that have emerged since 2004 include Zenius Education Ltd. and Ruang Guru. Zenius Education Ltd, provides online courses in the form of video lectures for K-12 students and has approximately 15 million student users. Since 2014 Ruang Raya Indonesia Ltd (Ruang Guru) has provided educational content, virtual classes, online examinations, private tutoring, online consultation and technical skills development in its Skills Academy, which can be accessed via its website or mobile applications. Ruang Guru is registered as a non-formal education provider with 22 million students and 300 000 teachers covering approximately 100 subjects (Ruangguru, n.d.).

Edtech has increasingly become an integral part of digital transformation and involves the widespread availability of broadband connectivity, the acquisition of devices and familiarity with apps, and digital penetration in everyday life - trends from which young people are only just starting to benefit but which could broaden the scope of edtech to support the Fourth Industrial Revolution and the traditional academic curriculum.

Indonesian edtech generally helps students with learning and upskilling, educators with student management, communication and teaching, and educational institutions with administration (World Bank, 2020). There are several major categories of edtech on the market. E-learning generally offers learning materials online in the form of interactive content, on-demand videos or online tutoring. The content also varies, ranging from courses for students and personal skills development in fields such as accounting and programming, to foreign language courses. Some providers target adults from the general public as well as school-age users in formal education. In terms of delivery, some provide "blended learning" opportunities, combining online and offline learning activities.

Learning management systems target educational institutions, businesses and individuals who require learning activity planning services. They can include a management system for teaching and learning activities, and the development, preparation and exchange of learning materials.

A closer look at the recent edtech reality² reveals that learners are not satisfied with the free educational content made available through digital technologies. Standards in terms of quality and quantity are not being maintained, for various reasons related to the equipment needed to produce digital content, the competencies needed to create learning media, the curation process, etc. Mainly for reasons of convenience and cost considerations, 98 per cent of teachers, students and parents chose to use text messages, compared to only 42 per cent who use online methods, as the main medium for online teaching and learning.³ This mode of engagement

² Validation review conducted by experts from the Ministry of Education, Culture, Research and Technology in December 2020.

³ Ministry of Education, Culture, Research and Technology Rapid Survey on Innovations, 13-14 April 2020.

places a heavier burden on the teacher collecting and scoring the student's work and providing feedback.

2.7 School-community partnerships

Digital connectivity opens opportunities to improve the quality of education, to catalyse economic development and to drive national economic growth.

School-community partnerships are a shared responsibility and reciprocal process whereby the school and the community engage with one another in meaningful and culturally appropriate ways, with the families and communities actively supporting their children's development and learning. According to a study by the EIU (2021), school connectivity has the potential to boost GDP by at least 20 per cent in the least connected nations (see Figure 12).

Figure 12: Framework model for the impact of school connectivity on GDP



Source: EIU Report - Connecting Learners

According to the Ministry of Education, Culture, Research and Technology, one of the challenges facing teachers is how to take full advantage of connectivity so that communities near the school can also benefit outside school hours, for instance, by providing access to training on Internet use for the community (Pusdatin, 2016).

The experience of Common Room Network Foundation in promoting community-based connectivity shows that partnerships between schools and nearby communities can generate benefits for all parties (Commonroom, n.d.). Common Room, which started as a centre for the development of multidisciplinary arts studies and practices, is now a centre of partnership and collaboration that uses connectivity to promote best practice, knowledge, and development of community-based creativity such as literature, media, music, fashion, etc. Rural ICT-Camp is one of their annual activities that aims to promote the meaningful use of connectivity to stimulate the growth of context-specific applications of digital technology. As an example, the Rural ICT-Camp 2022 introduced a bamboo-made internet tower, and launched the Tembok Village application, as well as signing off on an official cooperation between vocational high schools 1 Tejakula with Tembok village. By conducting this event, the Tembok Village is promoted as a smart village pilot scheme that will support the development of Buleleng (Kementerian Pendayagunaan Aparatur Negara dan Reformasi Birokrasi, 2022) as a smart city. Those Coommon Room and community efforts are a proof that connectivity that is built jointly by schools and communities can foster stronger relationships, and improve student work that directly benefits the community.

Connectivity partnerships can provide better continuity of service throughout the day and year, making it easier for schools to maintain the connectivity infrastructure, devices and applications, especially outside school hours. Such partnerships also have the potential to facilitate access to a broader range of learning opportunities, providing opportunities for students and teachers to explore more added values to connectivity; facilitate information sharing between school and community; and provide families as community members with alternative entry points into the school to support their children's learning.

School-community connectivity partnerships could potentially provide new opportunities to enrich the curriculum with a wider range of community-related activities that otherwise might not be available as part of the conventional curriculum. For instance, the current curriculum in vocational high schools aims to equip students with relevant competencies and to prepare them as entrepreneurs. The Creative and Entrepreneurship Project exposes students to real-world experience to develop creative products or services. By involving small-medium enterprises communities and utilizing connectivity for access to learning resources, online consultation, as well as online marketing and sales, students get more engagement and experience in the process of becoming an entrepreneur. These practices can be seen as reinforcing the lessons taught in schools with community norms and practices; improving school cultural and social activities; and sharing other community resources to support school learning.

Communities, for their part, can benefit from connectivity partnerships with schools to enhance community programmes and engagement, particularly when there is crossover between school and community. Schools can share their academic knowledge and competencies related to digital skills with the community and then case studies from the community will enhance the learning process and its relevancy with the real world. The partnership could foster better alignment of programming to support a shared vision for learning, and maximize the use of resources such as facilities, staff, data and the curriculum.

Learning activities can take place anywhere with sufficient connectivity to use applications and materials. In this sense, there is scope for students and teachers to actively explore the learning atmosphere in and with the community, in order to sustain learning momentum even when there are school disruptions. Schools can also have the possibility of exchanging learning materials with communities and increasing student knowledge of various subjects even in constrained learning circumstances. In cooperation with local communities, schools can share their knowledge, experience and skills with students, and students can show their projects/ products to families and local communities.

School-community partnerships can also be purpose-based, knowledge-based, practice-based and task-based. Students can join community activities as part of their apprenticeship to gain more knowledge. In such cases, teachers may play a significant role in guiding the students to appropriate community organizations.

Village connectivity can be leveraged for schools. During the pandemic, some unconnected schools relocated temporarily to village offices and other public areas such as parks in order to access the Internet for their digital learning activities. The Ministry of Villages, Development of Disadvantaged Regions and Transmigration has issued a directive to allow village governments to use the Village Funds to establish network connections and to provide public Wi-Fi access. The connections are on public premises, to ensure that they are accessible to the public, and therefore support online learning while at the same time encouraging the digitalization of village micro and small businesses.

The smart village concept is similar to the smart city concept but has been considerably adapted to the context of villages and sub-districts. It aims to improve community welfare and quality of life through the use of technology in various aspects of village development. It serves as a framework for accountability and the roles and responsibilities of decision-making authorities, enabling them to become more effective and efficient by taking advantage of advances in information technology supported by connectivity. Beyond digitization, the smart village concept takes into account environmental concerns, infrastructure considerations and the villagers' quality of life, including in terms of education.

3 The way forward

Indonesia's investments in telecommunication infrastructure have resulted in a remarkable improvement in Internet connectivity. Notwithstanding, challenges remain in terms of the middle and last mile connectivity, and a significant share of schoolchildren do not yet have access to the basic requirements needed to connect to, and benefit from, the ongoing digital transformation. A number of recommendations emerging from this research are worth considering as a basis for further discussion.

Research shows that a school connectivity implementation framework can play a crucial role in unifying the various mandates, perspectives and portfolios of government ministries at national level, of the education authorities at local level, and of the telecommunication sector, including the ministry and industry stakeholders. In Indonesia, such a framework is, at best, currently nascent. Nevertheless, a number of recommendations that merit consideration could be fused into one framework that is generally acceptable by all concerned. If designed correctly, the school connectivity implementation framework could serve as a unifying platform for otherwise differing perspectives, potentially combining mandates and conflicting interests. Additionally, a number of specific implementation-related areas can be addressed in conjunction with the proposed framework.

3.1 Programme synchronization

The acceleration of school connectivity as a cross-cutting concern involves, at least, the education sector for substantive content, the telecommunication sector for infrastructure and connectivity, and the local government for implementation on the ground. Synchronization should be promoted so as to optimize the potential to address the root causes of gaps and delays. Such efforts would best be made under Presidential Regulation No. 105 of 2021 concerning the National Strategy for Accelerating the Development of Underdeveloped Regions 2020-2024. This could potentially lead to greater "sharing" of resources among public and private stakeholders.

The accelerated deployment of infrastructure would need to be followed by actual connectivity arrangements, governance and sustainable financing on both capex and opex, dissemination of devices and enhanced digital competence on the ground. Synergy and coordination would have to be strengthened among central and local governments, ministries and public stakeholders, supported by the private sector, to promote mutual benefits and equitable access to connectivity. The *Merdeka Belajar* (Freedom to Learn) and associated *Sekolah Penggerak* (Transformative Schools) schemes could be vehicles for further promoting programme synchronization.

3.2 Digital skills and competency

The ongoing accelerated development of connectivity infrastructure should be accompanied by national digital literacy programmes to increase active use of ICTs for all students and teaching staff and their communities. In this regard, it is crucial that programme synchronization is also undertaken to synergize the various national ministry programmes referenced in this proposal.

On the ground, these need to be integrated under Government Regulation No. 2 of 2018, on Minimum Service Standards of Local Governments, with regard to the education sector.

3.3 Alternative funding models

Depending on the local context, different sustainable funding models for school connectivity frameworks would need to be explored. Giga research (Giga, 2021) proposes that four country-specific models for financing and delivering school connectivity could be rolled out to obtain a proof-of-concept, validating the model and to gain additional insights, especially into the possible implications for existing ecosystems:

- Model A: Coverage as a service revenue-sharing, commercially operated private company/consortium;
- Model B: Government increases school funding, government contribution operating model;
- Model C: One-off government subsidy with spectrum auction and USF financing;
- Model D: Community contribution, operated cooperatively and on a voluntary basis.

In this regard, the government should consider co-financing connectivity with Internet service providers, private companies, communities, schools and even household users. Some of the options that can be important drivers for the Giga sustainable business models are:

- adding services, on a case-by-case basis, to provide the service most in line with customer needs, such as e-commerce applications for local community production centres, discussion groups and website-building services for local trades and social groups, digital promotion for local stores and tourism hotspots, etc. (the added-value service can be used as leverage to ensure sustainable revenue streams);
- optimizing the USF to deliver access to telecommunication services in hard-to-reach regions or to underserved groups or populations, despite the absence of an immediate or compelling commercial incentive to do so. To support policy-makers to effectively utilize the USF, ITU released the Universal Service Financing Efficiency Toolkit: <u>https://www.itu.int/itu-d/reports/regulatory-market/usf-financial-efficiency-toolkit/</u>.
- re-energizing the BOS scheme, particularly in the form of "flexible BOS", to allow schools to plan expenditures, including for connectivity, more independently. There is an opportunity to integrate connectivity costs into the BOS both the one transferred directly from the central budget as well as those allocated by local provincial/district budgets in order to ensure adequate, uninterrupted and meaningful school connectivity.

It is important to widen the scope of the government pandemic response of subsidising school connectivity to stimulate and sustain the existing USF funding, to expand the BOS and to explore possible private sector revenue-sharing and community-funding mechanisms.

3.4 Capitalize on One Education Data

Mapping school locations and access to infrastructure is one of the fundamental strategies for heightening awareness of the situation and improving decision- and policy-making. As Indonesia is aggressively pursuing e-governance, which relies heavily on data availability and requires connectivity, the Indonesia One Data Policy and the Indonesia One Map Policy should be considered as pillars for strengthening the Education One Data Policy and, by extension, upgrading the ITU pilot connectivity infrastructure map and analysis map relating to school connectivity. All the agencies concerned should be called upon to further enhance data structure, reliability and consistency. The government should strengthen the capacity of data-entry operators at sub-district level for primary and secondary schools, and at district level for high schools, especially data on school connectivity through remote monitoring. This could enhance the integrity of school connectivity data and, at the same time, allow the data to be accessed by and shared among central and local governments in line with data standards, metadata and data interoperability based on the master of population data as the reference. Such a measure would entail synchronization of the many stand-alone and disconnected education data platforms and applications, optimizing an education one-data portal and data integration while making available the requisite data tools and technologies. The findings of a national survey on the demand for and supply of potential ICT for learning during the pandemic conducted by Statistics Indonesia could serve as a springboard for linking education data with national socio-economic statistics to promote a multi-sectoral analysis enhancing awareness of the situation and help shape decision- and policy-making.

3.5 Public-private partnerships

Complementary action by the government, the market and society in pursuit of accelerated school connectivity could generate tremendous advantages, although it also needs to be acknowledged that such an arrangement is not always trouble free. Criticisms include concerns that private sector involvement only benefits business and lacks sustainability. It is key, nonetheless, to tap into the sizable government education budget to address the issue of sustainable financing while catalysing a more inclusive, effective and mutually beneficial public-private partnership for sustainable financing. Ultimately, such combined resources would provide a huge push for infrastructure, networks, devices, applications and other requirements for equitable and comprehensive school connectivity.

3.6 Incentivize the use of fast growing edtech

Edtech provides engaging, inclusive and individualized learning experiences delivered through school connectivity. There are, however, gaps in use that may require one or a combination of several interventions, as set out below.

- Optimize government spending on education. The education budget could be defrayed by accelerating the adoption of edtech and thereby enabling individual users or agencies to tap into government funding to upskill, in line with the aim of the government to accelerate the use of edtech.
- Enhance teacher quality. By investing more in promoting edtech use by teachers, student learning and creativity can be facilitated and inspired. Teachers could design and develop digital-age learning experiences and assessments; act as models for how to learn and work in the digital era; and set an example of responsibility in the digital society.
- Incentivize edtech use. Besides financial and career-related incentives, it is important to invest time and energy in communicating the benefits of edtech to teachers in terms of learning, problem solving and progress.



Bibliography

Adam. (2020, January 5). *BAKTI VSAT Still An Barrier to USO Network Deployment*. Retrieved from Itworks.id: <u>https://www.itworks.id/24209/vsat-bakti-masih-jadi-hambatan-penggelaran</u>-jaringan-WA.html

Aisyah, K. (2022, January 21). *Indonesia's Digital Literacy Index Increases*. Retrieved from Opengovasia.com: <u>https://opengovasia.com/indonesias-digital-literacy-index-increases/</u>

Anjani, A. (2021, July 23). 6 Facts about Local Laptop Products for Schools, Budgeted in Trillions. Retrieved from Detik: <u>https://www.detik.com/edu/sekolah/d-5653988/6-fakta-laptop-produk</u>-lokal-untuk-sekolah-dianggarkan-triliunan

APJII. (2020). *Indonesia Internet Profile Survey 2022*. Retrieved from <u>https://apjii.or.id/: https://apjii.or.id/survei</u>

Arradian, D. (2021, July 30). What are the Plus and Minus of Chromebooks, Laptops for Students of the Ministry of Education and Culture's Choice? Retrieved from Sindonews: <u>https://tekno.sindonews.com/read/497364/123/apa-plus-minus-chromebook-laptop-untuk-pelajar-pilihan</u>-kemendikbud-1627650461/10

Asian Development Bank. (2022, 4 6). *Indonesia's Economic Growth to Strengthen in 2022*. Retrieved from adb.org: <u>https://www.adb.org/news/indonesia-economic-growth-strengthen</u> <u>-2022-2023-adb</u>

Bakti Kominfo. (2018, April 18). *Multifunction Satellite*. Retrieved from <u>https://www.baktikominfo.id/id/layanan/list-service/satelit_multifungsi-385</u>

Bakti Kominfo. (2019, October 3). The Challenge of Building Bts In Community, Buffaches And Campaign Become A Maintenance. Retrieved from Bakti Kominfo: <u>https://www.baktikominfo</u>. <u>id/id/informasi/artikel-media/tantangan bangun bts di pelosok kerbau dan sampan jadi</u> <u>andalan-1031</u>

Burhan, F. A. (2021, July 13). *Riset: Perluasan Akses Internet di Sekolah Kunci Ekonomi Tumbuh 20%*. Retrieved from Katadata: <u>https://katadata.co.id/intannirmala/digital/60ed65f26cd9d/riset</u>-<u>perluasan-akses-internet-di-sekolah-kunci-ekonomi-tumbuh-20</u>

Central Bureau of Statistics. (2018). *Indonesian Statistics Compilation, 2018*. Central Bureau of Statistics (BPS).

Commonroom. (n.d.). About Commonroom. Retrieved from https://commonroom.info/about/

Data.go.id. (n.d.). Retrieved from Indonesian Data, In One Portal: <u>https://data.go.id/home</u>

Elena, M. (2021, December 8). *Berikut 5 Fakta Penting Presidensi G20 Indonesia*. Retrieved from Ekonomi.bisnis.com: <u>https://ekonomi.bisnis.com/read/20211208/9/1475301/berikut-5</u>-fakta-penting-presidensi-g20-indonesia

35

Fiska, M. (2021, November 6). Astra Opens School Internet Network Access Via Satellite in Remote Areas. Retrieved from Suara Merdeka: <u>https://www.suaramerdeka.com/nasional/pr-041609010/astra-buka-akses-jaringan-internet-sekolah-lewat-satelit-di-daerah-pelosok</u>

GIGA. (2021, March 26). Scaling AI to map every school on the planet. Retrieved from Giga Connect: <u>https://gigaconnect.org/scaling-ai-to-map-every-school-on-the-planet/#:~:text=UNICEF's%20Giga%20Initiative%20endeavors%20to..</u>.

Giga in collaboration with Boston Consulting Group (BCG). (2021). *Meaningful school connectivity: An assessment of sustainable business models*. Giga. Retrieved December 2022, 14, from <u>https://giga.global/bcg-report/</u>

Global Broadband Pricing League Table 2022. (2022). Retrieved from Cable.co.uk: <u>https://www</u>.cable.co.uk/broadband/pricing/worldwide-comparison/

Husna, M. A. (2020, Desember 7). *Tribunnews*. Retrieved from Installation of 380 Km Internet Fiber Optic Network in DIY Targeted to be Completed by the End of 2020: <u>https://jogja.tribunnews</u> .com/2020/12/07/pemasangan-jaringan-fiber-optic-internet-380-km-se-diy-ditargetkan-selesai -akhir-tahun-2020

(2023). Indonesia's Economic Growth to Strengthen in 2022. Asian Development Bank.

Jatmiko, L. D. (2021, Desember 23). *Internet Prices in Indonesia Drop, Here's the Data*. Retrieved from Bisnis.com: <u>https://teknologi.bisnis.com/read/20211223/101/1480865/harga-internet-di-indonesia-turun-ini-datanya</u>

Kemdikbud. (2020, Agustus 7). *Optimizing Educational ICT Services, Ministry of Education and Culture Forms EduCSIRT*. Retrieved from Setjen Kemdikbud: <u>https://setjen.kemdikbud.go.id/</u> berita-optimalkan-layanan-tik-pendidikan-kemendikbud-bentuk-educsirt.html

Kemdikbud. (2021, September 17). *High Interest, Motivating Teacher Program Targets 405 Thousand Teachers by 2024*. Retrieved from Kemdikbud: <u>https://www.kemdikbud.go.id/main/blog/2021/09/animo-tinggi-program-guru-penggerak-targetkan-405-ribu-guru-hingga-2024</u>

Kemdikbud. (2021). *Special Allocation Fund*. Retrieved from Ditpsd: <u>http://ditpsd.kemdikbud</u>.<u>.go.id/hal/dana-alokasi-khusus-dak</u>

Kemdikbud. (2022, February 14). *Restore Learning, Minister of Education and Technology Launches Kurikulum Merdeka and Platform Merdeka Mengajar*. Retrieved from Setjen Kemdikbud: <u>https://setjen.kemdikbud.go.id/berita-pulihkan-pembelajaran-mendikbudristek</u>-<u>luncurkan-kurikulum-merdeka-dan-platform-merdeka-mengajar.html</u>

Kemenag. (2020). *Recapitulation of Islamic Education Principles*. Retrieved from EMIS Dashboard: <u>http://emispendis.kemenag.go.id/dashboard/</u>

Kemendikbud. (2021, Febryary 21). *Kemendikbud Luncurkan Merdeka Belajar Episode 7: Program Sekolah Penggerak*. Retrieved from <u>https://www.kemdikbud.go.id/:</u> <u>https://www.kemdikbud.go.id/main/blog/2021/02/kemendikbud-luncurkan-merdeka-belajar-episode-7</u> <u>-program-sekolah-penggerak</u>

Kemendikbud. (2021). *Merdeka Belajar, Episode 16*. Retrieved from <u>https://merdekabelajar</u>. <u>.kemdikbud.go.id/: https://merdekabelajar.kemdikbud.go.id/episode_16/web</u> Kementerian Pendayagunaan Aparatur Negara dan Reformasi Birokrasi. (2022, November 1). Gelar Rural ICT Camp 2022, Diharapkan Desa Tembok Jadikan Pilot Projek Bagi Desa Lain. Retrieved from SIPPN - PAN RB: <u>https://sippn.menpan.go.id/berita/detil/dinas-komunikasi</u> -informatika-persandian-dan-statistik/gelar-rural-ict-camp-2022-diharapkan-desa-tembok -jadikan-pilot-projek-bagi-desa-lain

Kemp, S. (2022, February 15). *DIGITAL 2022: INDONESIA*. Retrieved from Data Reportal: <u>https://datareportal.com/reports/digital-2022-indonesia?rq=indonesia%202022</u>

Khatri, H. (2022, May 31). 5G provides a significant boost in Indonesia's mobile speeds, video streaming and multiplayer mobile gaming. Retrieved from Open Signal: <u>https://www.opensignal.com/2022/05/31/5g-provides-a-significant-boost-in-indonesias-mobile-speeds-video-streaming-and-multiplayer-mobile</u>

Kompas. (2022, January 25). The Fate of 5G in Indonesia in 2022, Commercialization and Frequency Limitations. Retrieved from Tekno Kompas: <u>https://tekno.kompas.com/read/2022/01/25/09020077/nasib-5g-di-indonesia-pada-2022-komersialisasi-dan-keterbatasan-frekuensi</u>?page=all

Kristo, F. Y. (2019, October 29). The Challenge of Building BTS in Remote Areas, Buffalo and Rafts are the Mainstay. Retrieved from Detik Inet: <u>https://inet.detik.com/telecommunication/d</u> -4764547/tantangan-bangun-bts-di-pelosok-kerbau-dan-sampan-jadi-andalan

MoEC. (2020, 9 3). 98 Persen Kampus PJJ Daring, Kemdikbud Klaim Mahasiswa Siap. Retrieved from CNN: <u>https://www.cnnindonesia.com/nasional/20200903012249-20-542198/98-persen</u>-kampus-pjj-daring-kemdikbud-klaim-mahasiswa-siap

Muslim, A., Arnoldus, K., & Emanuel, K. (2021, November 26). *Local Governments Don't Be an Obstacle to Digital Infrastructure Development*. Retrieved from Investor.id: <u>https://investor.id/it-and-telecommunication/272330/pemda-jangan-menjadi-kendala-pembangunan-infrastruktur-digital</u>

Nasution, A. (2016). *Government Decentralization Program in Indonesia*. Tokyo: Asian Development Bank Institute.

Pusdatin. (2016, December 5). Internet Connection Must Provide Benefits for Students and Local Communities. Retrieved from Pusdatin Kemdikbud: <u>http://pusdatin.kemdikbud.go</u>.id/sambungan-internet-harus-memberikan-manfaat-bagi-peserta-didik-dan-masyarakat -setempat/

Pusdatin. (2020, Agustus 11). For Cyber Security, Ministry of Education and Culture Forms EDuCSIRT. Retrieved from Pusdatin Kemdikbud: <u>https://pusdatin.kemdikbud.go.id/demi</u>-keamanan-siber-kemendikbud-bentuk-educsirt/

Putera, P. B., Manik, L. P., Rianto, Y., Sari, A. A., & Sadikin, R. (2020). How Indonesia uses Big Data "Indonesian One Data" for the Future of Policy Making. *International Journal of Advanced Science and Technology*.

Renuki, R. (2021, June 2021). *Digitalisasi Sekolah Dasar di Indonesia, Ini yang Harus Diperhatikan*. Retrieved from Medcom.id: <u>https://www.medcom.id/pendidikan/news-pendidikan/IKYrzOQN</u> -digitalisasi-sekolah-dasar-di-indonesia-ini-yang-harus-diperhatikan *Roadmap Digital Literation 2020-2024.* (2021, January 29). Retrieved from Literasi Digital: <u>https://literasidigital.id/books/roadmap-literasi-digital-2020-2024-full-deck/</u>

Ruangguru. (n.d.). *About Ruangguru*. Retrieved from Ruang guru: <u>https://www.ruangguru.com/</u><u>about-us</u>

Satriya, E. (2020). Effective Strategy for Digital Economy Transformation in Indonesia. *FGD Wantiknas, The Strategic Direction of Digital Transformation in Indonesia* (p. 26). Jakarta: Coordinating Ministry for Economic Affairs.

Tanatidung. (2019, November). *Terima Bantuan VSAT Di 7 Titik Permudah Akses Internet di Desa*. Retrieved from Tana Tidung: <u>https://tanatidungkab.go.id/pustaka-817-Penyerahan-Bantuan</u> <u>-VSAT-untuk-Sekolah-Pelayanan-Kesehatan-dan-Desa-JPG</u>

The Inclusive Internet Index. (2022). *Inclusive Internet Index 2022*. Retrieved from Economist Impact: <u>https://impact.economist.com/projects/inclusive-internet-index?category=overall</u>

UN Indonesia (2022). The United Nations in Indonesia: <u>https://indonesia.un.org/en/about/about-the-un</u>

UNICEF. (2020). Strengthening Digital Learning across Indonesia: A Study Brief. UNICEF.

World Bank. (2021, December 16). Indonesia Economic Prospects (IEP), December 2021: A Green Horizon, Toward a High Growth and Low Carbon Economy. Retrieved from The World Bank: <u>https://www.worldbank.org/en/country/indonesia/publication/indonesia-economic</u>-prospects-december-2021

Yarrow, N., Eema, M., & Rythia, A. (2020). *Estimates of COVID-19 Impacts on Learning and Earning in Indonesia*. Washington DC: World Bank.

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Office of the Director International Telecommunication Union (ITU) **Telecommunication Development Bureau (BDT)** Place des Nations CH-1211 Geneva 20 Switzerland

bdtdirector@itu.int Email: +41 22 730 5035/5435 Tel.: +41 22 730 5484 Fax:

Digital Networks and Society (DNS)

Email:	bdt-dns@itu.int
Tel.:	+41 22 730 5421
Fax:	+41 22 730 5484

Africa

Ethiopia International Telecommunication Union (ITU) Regional Office Gambia Road Leghar Ethio Telecom Bldg. 3rd floor P.O. Box 60 005 Addis Ababa Ethiopia

Email:	itu-ro-africa@itu.in
Tel.:	+251 11 551 4977
Tel.:	+251 11 551 4855
Tel.:	+251 11 551 8328
Fax:	+251 11 551 7299

Americas

Brazil União Internacional de Telecomunicações (UIT) Escritório Regional SAUS Quadra 6 Ed. Luis Eduardo Magalhães, Bloco "E", 10º andar, Ala Sul (Anatel) CEP 70070-940 Brasilia - DF Brazil

Email: itubrasilia@itu.int +55 61 2312 2730-1 Tel.: Tel.: +55 61 2312 2733-5 +55 61 2312 2738 Fax:

Arab States

Egypt International Telecommunication Union (ITU) Regional Office Smart Village, Building B 147, 3rd floor Km 28 Cairo Alexandria Desert Road Giza Governorate Cairo Egypt

Email: itu-ro-arabstates@itu.int Tel · +202 3537 1777 +202 3537 1888 Fax:

CIS

Russian Federation International Telecommunication Union (ITU) Regional Office 4, Building 1 Sergiy Radonezhsky Str. Moscow 105120 **Russian Federation** itumoscow@itu.int Email: +7 495 926 6070 Tel.:

Digital Knowledge Hub Department (DKH) Email: bdt-dkh@itu.int +41 22 730 5900 Tel.: +41 22 730 5484 Fax.

Cameroon Union internationale des télécommunications (UIT) Bureau de zone Immeuble CAMPOST, 3º étage Boulevard du 20 mai Boîte postale 11017 Yaoundé Cameroon

Email:	itu-yaounde@itu.int
Tel.:	+ 237 22 22 9292
Tel.:	+ 237 22 22 9291
Fax:	+ 237 22 22 9297

Barbados International Telecommunication Union (ITU) Area Office United Nations House Marine Gardens Hastings, Christ Church P.O. Box 1047 Bridgetown Barbados

Email: itubridgetown@itu.int +1 246 431 0343 Tel.: +1 246 437 7403 Fax.

Asia-Pacific

Thailand International Telecommunication Union (ITU) Regional Office 4th floor NBTC Region 1 Building 101 Chaengwattana Road Laksi. Bangkok 10210, Thailand

Mailing address: P.O. Box 178. Laksi Post Office Laksi, Bangkok 10210, Thailand

itu-ro-asiapacific@itu.int Email: +66 2 574 9326 - 8 Tel.: +66 2 575 0055

Europe Switzerland International Telecommunication Union (ITU) Office for Europe Place des Nations CH-1211 Geneva 20 Switzerland

eurregion@itu.int Email: Tel.: +41 22 730 5467 +41 22 730 5484 Fax.

Office of Deputy Director and Regional Presence Field Operations Coordination Department (DDR) Place des Nations CH-1211 Geneva 20 Switzerland

Email: bdtdeputydir@itu.int +41 22 730 5131 Tel· +41 22 730 5484 Fax:

Partnerships for Digital Development Department (PDD)

bdt-pdd@itu.int Email: +41 22 730 5447 Tel.: +41 22 730 5484 Fax:

Senegal Union internationale des télécommunications (UIT) Bureau de zone 8, Route du Méridien Président Immeuble Rokhaya, 3º étage Boîte postale 29471 Dakar - Yoff Senegal

Email: itu-dakar@itu.int +221 33 859 7010 Tel.: +221 33 859 7021 Tel · +221 33 868 6386 Fax:

Chile Unión Internacional de **Telecomunicaciones (UIT)** Oficina de Representación de Área Merced 753, Piso 4 Santiago de Chile Chile

Email: itusantiago@itu.int +56 2 632 6134/6147 Tel.: Fax: +56 2 632 6154

Indonesia International Telecommunication Union (ITU) Area Office Sapta Pesona Building 13th floor JI. Merdan Merdeka Barat No. 17 Jakarta 10110 Indonesia

itu-ro-asiapacific@itu.int Email: +62 21 381 3572 Tel.: +62 21 380 2322/2324 Tel.: +62 21 389 5521 Fax:

Zimbabwe International Telecommunication Union (ITU) Area Office USAF POTRAZ Building 877 Endeavour Crescent Mount Pleasant Business Park Harare Zimbabwe

Email: itu-harare@itu.int +263 242 369015 Tel.: +263 242 369016 Tel ·

Honduras

Unión Internacional de Telecomunicaciones (UIT) Oficina de Representación de Área Colonia Altos de Miramontes Calle principal, Edificio No. 1583 Frente a Santos y Cía Apartado Postal 976 Tegucigalpa Honduras

Email: itutegucigalpa@itu.int +504 2235 5470 Tel.: Fax: +504 2235 5471

India International Telecommunication Union (ITU) Area Office and **Innovation Centre C-DOT Campus** Mandi Road Chhatarpur, Mehrauli New Delhi 110030 India

Fmail[.] itu-ro-southasia@itu.int

International Telecommunication Union

Telecommunication Development Bureau Place des Nations CH-1211 Geneva 20 Switzerland



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