T20 INDONESIA 2022 THINK

Policy Brief

TEACHER-TECHNOLOGY COMPLEMENTARITY FOR A RESILIENT EDUCATION SYSTEM

Task Force 5
Inequality, Human Capital and Well-being

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Abstract

Even before the Covid pandemic, many students in low- and medium-income countries lack foundational literacy and numeracy skills. The pandemic further exacerbated such a learning crisis. Emerging digital technologies can complement teachers and hold much promise to help recover learning and build more resilient education systems. However, much work remains to be done. The G20 must play a crucial role in this endeavor. This policy brief proposes four inter-related recommendations for the G20 to support governments in integrating technology that fit the capacity and social context of their education system through (1) assessing the education system's capacity to use technology; (2) choosing the most appropriate technology and providing teachers with the necessary training; (3) aligning stakeholders to accept the technology, and; (4) developing effective, efficient, and equitable technology.

Challenges

Many low- and medium-income countries had faced a learning crisis before the pandemic. Primary education attainment had become virtually universal, yet school quality had primarily stagnated. Around half of the children in low- and middle-income countries could not read a simple text by ten (Azevedo et al., 2021). In South Asia and Sub-Saharan Africa, school quality has been on a sharp negative trend (Le Nestour, Moscoviz, and Sandefur, 2022). In many countries, most graduates complete their formal education with deficient foundational skills, without sufficient skills to be workplace-ready.

Digital technology has been introduced to address the learning crisis. They range from providing students with a laptop (One Laptop Per Child - OLPC) to delivering content according to students' current learning levels (Major, Francis, and Tsapali, 2021). Technology has also provided teachers professional development and increased school accountability (Rodriguez-Segura, 2021). Some have hoped that technology could substitute for ineffective teachers (Trucano, 2015).

The Covid pandemic brought by far the longest and the most widespread school closure compared to other disruptions. Between March 2020 and January 2022, schools in G20 countries were closed for an average of 48 weeks (UNESCO Country Dashboard). As a response, governments resorted to various technological solutions to continue some form of learning. These include low-tech solutions like radio or television-based instructions, labor-intensive solutions like text messages and scanning books, and high-tech solutions like online tutoring and artificial intelligence-based adaptive learning software.[1] The most popular solutions chosen by governments were online media, television, paper-based take-home materials, and mobile phones (Muñoz-Najar et al., 2021).

The school closure and virtually instantaneous adoption of technology significantly disrupted teachers (Li, Liu, and Ma, 2021). Not only that they have the pandemic as a source of stress and health risk, but they also had to immediately modify their teaching methods and plans. Many teachers had to use technology they had not been trained to use before, with minimal support from the school leadership and governments (Arsendy et al., 2020). They also had to adjust from

[1] An adaptive learning software adjusts instruction and delivers material based on initial diagnostics and documented progress of individual students, as opposed to curriculum demands or the median or average students' skills. Put simply, an adaptive learning software is a technology-based differentiated learning.

daily face-to-face interaction with their students to much less frequent and virtual interaction on a screen.

The available evidence about the effectiveness of education technology, so far, is mixed. A recent study finds education technology potentially highly cost effective (Rodriguez-Segura, 2021). Yet, another study finds that significant learning loss occurred during the Covid-19 pandemic even in countries where remote learning is prevalent (Moscoviz and Evans, 2022). Thus, a key challenge is to successfully integrate technology into the education system, to make the system more resilient.

Proposals for G20

Many problems plagued the implementation of education technology during regular times: the wrong choice of technology, lack of infrastructure, unprepared teachers, and disengaged students (Muñoz-Najar et al., 2021). These were exacerbated during the pandemic. The key, therefore, is to integrate suitable technology appropriately.

A characteristic of an appropriate manner is to ensure technology complement, not substitute, teachers (Falck, Mang, and Woessmann, 2018; Evans, 2021). Recent empirical studies lend support to this argument. A study in Pakistan compared the impact of integrating curriculum-based videos and providing students with personal tablets (Beg et al., 2020). The former is an approach where technology, in this case, videos, augments the material already delivered by teachers. The latter, in contrast, detaches material taught in the classroom from what the technology offers. The first approach improved teaching effectiveness and student test scores. In contrast, the students provided with tablets fell behind in their scores.

In Japan, introducing adaptive learning technology-based instruction helped teachers save time in teaching the fundamental topics in the Grade 7 curriculum by half. This enabled teachers and students to explore advanced topics by allocating the saved time for inquiry-based cross-curricular learning activities (METI, 2021). Therefore, combining teaching task assignments along the comparative advantages of teachers and adaptive technology could increase the efficiency and effectiveness of teaching foundational and higher order skills. The approach could be implemented in other G20 countries, and piloting is underway (Education Commission, 2020).

We propose four steps that should be taken to choose the suitable technology to create enabling environments facilitating scaling up, and develop better technology, ultimately resulting in an effective teacher-technology complementarity. These steps are ideally done in sequence.

Step 1. Assess the education system's capacity to use technology. Characteristics of suitable technology would depend on the education system's features and environment (Global Education Evidence Advisory Panel, 2020). Null or even negative impacts of technology were observed in the cases where its use was not planned or implemented well (Snilstveit et al., 2015; Ma et al., 2020).

As a first step, therefore, it is essential to understand the context of the education system and determine the priorities in the short, medium, and long term. A short-term focus, for example, is to recover learning losses as schools reopen. In this case, the technology that could be immediately adopted would require relatively little investment in equipment and can be readily used without significant teacher training. A long-term priority, for example, would be to create

an online ecosystem where teachers from around the country can exchange ideas and lesson plans. Such an ecosystem would require a significant physical investment and teacher training.

Education administrators should diagnose the system elements, such as people (students, parents, and teachers), infrastructure, economic resources, and enabling environments. The diagnostics could be done at the national, subnational, or even at the school level as relevant.

The diagnostics should look at the elements that comprise a broader education ecosystem (UNICEF, 2021; World Bank, 2021; Xu, 2021), including the following aspects:

- Students and parents: average and distribution of learning levels, both overall and within subgroups, readiness to use technology, access to devices and an internet connection, and the extent of parental attention and involvement in education
- Teachers: experience, motivation, and capacity. This will inform the kind of necessary capacity building. Also, the level of acceptance from teachers on using technology to improve their teaching effectiveness should be measured.
- School management: principals' endorsement of using technology, commitment to allocate funds and recruit necessary staff, and willingness to allow teachers to undergo capacity building.
- School infrastructure: available facilities, such as internet, computer lab, devices, technicians
- Funding: the budget for upfront investment and maintenance; financing from the community/parents.
- Service providers: high-quality education technology products for students with different learning conditions, reliable education technology providers, and availability of products delivered in local languages.
- Political, policy, and government support: the commitment by legislators, the government, and education administrators, reflected in concrete policies and programs to support the integration and use of education technology.

Step 2. Choose the most suitable technology and provide teachers with the necessary training. The diagnostics should be the basis for choosing the technology. Four principles govern this step. First, education administrators should avoid a situation where the chosen technology could only benefit a minority of students (Rodriguez-Segura, 2021) or is only used for a short period before being discarded. In this context, small-scale pilots should be done to build consensus and inform the decision to scale up.

Second, choosing multiple technologies will be necessary. However, learning from the experience during the Covid-19 pandemic, Muñoz-Najar et al. (2021) state that a multimodal approach would increase the proportion of students that may benefit from technology. Also, a multimodal approach could combine complementary technologies. For example, a one-way

radio program could complement a text-based tutorial system, where students could send questions on specific topics they need further study.

Third, the choice of technology should depend on the education stakeholders. For example, an education system that prioritizes the average education quality may choose a different technology portfolio than one that prioritizes lagging or talented students. In addition, efficiency and equity considerations may call for trade-offs. These choices should be taken in consultation.

Finally, the decision-makers: depending on the governance setting, for example, the authority to allocate funding and enact policies, and the capacity of stakeholders, the decision could be made at the national, subnational, local school board, or school level. The principle is that both policy- and classroom-level actors should have a voice in choosing the technology.

After the technology suite is chosen, teachers must be provided with sufficient training and support to use the technology (Nelson, Voitthofer, and Cheng, 2019). The lack of training of teachers on technology-assisted instructions or integration into the existing learning approaches often explains the lack of impact of technology (Snilstveit et al., 2015). Given the generally inadequate quality of teacher training in low and middle-income countries (Popova et al., 2022), such training should be considered a necessary component in bringing in the technology.

Teachers should know how to integrate technology into the curriculum and the teaching and learning process alongside technology (Goddard, 2014). In addition to the technical aspects of using the technology, the training should transform teachers' attitudes and motivation to change their conventional pedagogical approaches.

Step 3. Align stakeholders to accept the technology. Acceptance from stakeholders is essential for a particular technology to be adopted and used accordingly. Their acceptance must be assured rather than simply assumed. For example, teachers may not necessarily accept the introduction of new technology. They may not want to learn new skills or could view the technology as a competitor. Similarly, parents may be wary of their children intensively using technology in school (Brossard et al., 2021). Rejection from teachers and parents may compel politicians to refrain from investing in education technology.

Convincing government policymakers may require finding their preferences on the kind of advice and how to receive it (Crawfurd et al., 2021). Their buy-in is also necessary before they would adequately invest in the necessary supporting infrastructure, such as reliable broadband internet and computer labs. Parents could be convinced through workshops and sessions to address their concerns and promote the benefits of integrating technology into children's academic

performance (Tsuei & Hsu, 2019). Gaining acceptance may require an incremental process of trust building and capacity development.

Finally, teachers need training and support, as well as assurances. Teachers must use the technology rather than resist it (Jimenez, King, and Lee, 2018). As discussed earlier, interventions aiming to transform the mindset of teachers in service are desirable as their teaching training and experiences have been established without the involvement of technology. However, in most countries, teacher pre-service training curricula do not include the use of technology for teaching. In addition, teachers already have a heavy workload. Therefore, they must be convinced that using technology could save time and unlock a better education for their students before they agree to invest time in learning the new technology.

Also, school management and administrators must create a supportive environment to enable technology to be integrated and function within the school ecosystem. For instance, school leaders could reorient and redefine priorities, so teachers can secure sufficient time to reskill themselves to technology-based instruction.

Step 4. Develop effective, efficient, and equitable technology. Despite the plethora of technology solutions available, most products are geared towards those who can afford them rather than who need them the most. In other words, the products are mainly designed for highly motivated teachers, eager students, and relatively well-off and attentive parents. It could result in a two-tier equilibrium, with the advantaged fully benefiting from technology that better matches their needs while the disadvantaged could not fully benefit from technology. In this situation, market failure would occur, and technology may increase learning gaps.

Interventions by governments, international organizations, and non-government organizations are necessary to ensure technology can benefit all students. However, first, they need to fund research and evaluation on integrating technology in schools and communities that otherwise would not have adopted it. These are the users to whom the introduction of technology could bring substantial benefits. However, the stakes are higher with this segment of potential users, as they do not have the resources to try different products.

As part of the above, there is a need to work with technology providers to create products that suit these schools' conditions. This implies working with teachers who are not necessarily motivated to improve their students' skills, parents who cannot afford a commercial technology product, and policymakers whose preferences may not align with learning goals. As a result, further teacher support may be needed. In addition, the technology may have to be less advanced, as supporting infrastructure may be lacking. Finally, it may need to be geared more towards students lower in the ability distribution rather than the median.

Second, they need to ensure that the market is sufficiently thick. A thick market, characterized by many technology providers competing to sell their products to many potential customers (Roth, 2016), would lower price and volatility. It would also improve product quality. It is also vital to ensure a thick market exists for the segment of schools and students that are not the usual customers of education technology products. Furthermore, in an infant market, governments also can consider providing financial assistance to increase the provision of services to schools that need them. Edtech firms require initial capital to build their products, contextualize them into the education curriculum, and adapt them to various local languages and cultures. The firms must also develop training programs suitable for teachers and school systems. Grants could be provided to Edtech companies for research and development, and this effort could be expanded further.

In the long term, integrating technology into education requires stakeholders to continue redefining how teachers and technology can complement each other. It calls for a transformation of teachers' roles and potential. Infrastructure must be upgraded. Governments should ensure that appropriate technology is adopted for specific objectives and that obsolete technology is replaced. An education system that can successfully integrate technology will be better placed to overcome the learning crisis and mitigate and adapt in the face of disruptions.

References

Arsendy, Senza, C. Jazzlyne Gunawan, Niken Rarasati, and Daniel Suryadarma. 2020. *Teaching and Learning during School Closure: Lessons from Indonesia*. ISEAS Perspective Issue 2020 No 89. Singapore: ISEAS Yusof Ishak Institute.

Azevedo, Joao Pedro, Diana Goldemberg, Silvia Montoya, Reema Nayar, Halsey Rogers, Jaime Saavedra, and Brian Stacy. 2021. *Will every child be able to read by 2030?* World Bank. https://blogs.worldbank.org/developmenttalk/will-every-child-be-able-read-2030

Beg, Sabrin A., Adrienne M. Lucas, Waqas Halim, and Umar Saif. 2019. *Engaging teachers with technology increased achievement, bypassing teachers did not*. No. w25704. National Bureau of Economic Research. https://www.nber.org/papers/w25704

Brossard, Matt, Marta Carnelli, Stephane Chaudron, Rosanna Di-Gioia, Thomas Dreesen, Daniel Kardefelt-Winther, Celine Little, and Jean Luc Yameogo. 2021. *Digital Learning for Every Child: Closing the Gaps for an Inclusive and Prosperous Future*. T20 Policy Brief. https://www.t20italy.org/wp-content/uploads/2021/09/TF4-PB2-Brossard-1.pdf

Büchel, Konstantin, Martina Jakob, Christoph Kühnhanss, Daniel Steffen, and Aymo Brunetti. 2020. "The relative effectiveness of teachers and learning software: Evidence from a field experiment in El Salvador." *Journal of Labor Economics*. https://www.journals.uchicago.edu/doi/abs/10.1086/717727?journalCode=jole

Crawfurd, Lee, Susannah Hares, Ana Minardi, and Justin Sandefur. 2021. *Understanding Education Policy Preferences: Survey Experiments with Policymakers in 35 Developing Countries*. https://www.cgdev.org/publication/understanding-education-policy-preferences-survey-experiments-policymakers-35-developing

Education Commission. 2020. *Country Report on High Touch High Tech Learning Vietnam*. https://educationcommission.org/wp-content/uploads/2020/07/2020-EC-Country-Report-Vietnam-ENG.pdf

Evans, David K. 2021. *Education Technology for Effective Teachers*. World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/35079/Education-Technology-for-Effective-Teachers.pdf

Falck, Oliver, Constantin Mang, and Ludger Woessmann. 2018. "Virtually no effect? Different uses of classroom computers and their effect on student achievement." *Oxford Bulletin of Economics and Statistics* 80(1): 1-38. https://onlinelibrary.wiley.com/doi/abs/10.1111/obes.12192

Global Education Evidence Advisory Panel. 2020. *Cost-Effective Approaches to Improve Global Learning*. https://documents1.worldbank.org/curated/en/719211603835247448/pdf/Cost-Effective-Approaches-to-Improve-Global-Learning-What-Does-Recent-Evidence-Tell-Us-Are-Smart-Buys-for-Improving-Learning-in-Low-and-Middle-Income-Countries.pdf

Goddard, Mark. 2002. "What do we do with these computers? Reflections on technology in the classroom." *Journal of Research on Technology in Education* 35(1): 19-26. https://www.tandfonline.com/doi/abs/10.1080/15391523.2002.10782367?src=recsys

Le Nestour, A., L. Moscoviz, J. Sandefur. 2022. *The long-run decline of education quality in the developing world*. Center for Global Development. https://www.cgdev.org/publication/long-run-decline-education-quality-developing-world

Jimenez, Emmanuel, Elizabeth M. King, Ju-Ho Lee. 2018. *Innovating to learn*. International Initiative for Impact Evaluation. https://www.3ieimpact.org/blogs/innovating-learn

King, Elizabeth, Daniel Suryadarma, Michelle Kaffenberger, Dieter Dohmen, and Tetsushi Sonobe. 2022. *Building Resilient Education Systems to Mitigate the Adverse Effects of COVID-19 and Future Disruptions of Learning*. Think7 Policy Brief. https://www.think7.org/publication/building-resilient-education-systems-to-mitigate-the-adverse-effects-of-covid-19-and-future-disruptions-of-learning/

Li, Haizheng, Qinyi Liu, and Mingyu Ma. 2021. *How the COVID-19 Pandemic Affects Job Stress of Rural Teachers*. IZA Discussion Paper Series No 14366. https://docs.iza.org/dp14366.pdf

Ma, Yue, Robert W. Fairlie, Prashant Loyalka, and Scott Rozelle. 2020. *Isolating the "Tech" from Edtech: experimental evidence on computer assisted learning in China*. No. w26953. National Bureau of Economic Research. https://www.nber.org/papers/w26953

Major, Louis, Gill A. Francis, and Maria Tsapali. 2021. "The effectiveness of technology-supported personalised learning in low-and middle-income countries: A meta-analysis." *British Journal of Educational Technology* 52(5): 1935-1964.

Ministry of Economy, Trade, and Industry. 2021. *Basic Reference Materials for Working Group on Autonomous and Individually Optimized Learning.* Government of Japan. https://www.meti.go.jp/shingikai/sankoshin/shomu_ryutsu/kyoiku_innovation/manabi_jidoka_wg/pdf/001_03_00.pdf

Moscoviz, Laura, and David Evans. 2022. *Learning Loss and Student Dropouts during the COVID-19 Pandemic: A Review of the Evidence Two Years after Schools Shut Down*. Center for

Global Development. https://www.cgdev.org/publication/learning-loss-and-student-dropouts-during-covid-19-pandemic-review-evidence-two-years

Muralidharan, Karthik, Abhijeet Singh, and Alejandro J. Ganimian. 2019. “Disrupting Education? Experimental Evidence on Technology-Aided Instruction in India.” *American Economic Review*, 109(4): 1426-1460.

Nelson, Michael J., Rick Voithofer, and Sheng-Lun Cheng. 2019. "Mediating factors that influence the technology integration practices of teacher educators." *Computers & Education* 128: 330-344. https://www.sciencedirect.com/science/article/abs/pii/S0360131518302689

Popova, Anna, David K. Evans, Mary E. Breeding, and Violeta Arancibia. 2022. "Teacher professional development around the world: The gap between evidence and practice." *The World Bank Research Observer* 37(1): 107-136. https://academic.oup.com/wbro/article/37/1/107/6292021

Rodriguez-Segura, Daniel. 2021. "EdTech in developing countries: A review of the evidence." *The World Bank Research Observer*. https://doi.org/10.1093/wbro/lkab011

Roth, Alvin E. 2016. *Who Gets What and Why: The New Economics of Matchmaking and Market Design*. Boston: Mariner Books.

Snilstveit, B, Stevenson, J, Phillips, D, Vojtkova, M, Gallagher, E, Schmidt, T, Jobse, H, Geelen, M, Pastorello, M, and Eyers, J, 2015. *Interventions for improving learning outcomes and access to education in low- and middle- income countries: a systematic review*, 3ie Systematic Review 24. London: International Initiative for Impact Evaluation. https://www.3ieimpact.org/sites/default/files/2019-05/SR24-education-review_2.pdf

Tauson, Michaelle and Luke Stannard. 2018. "EdTech for learning in emergencies and displaced settings." Save the Children. http://resource-centre-uploads.s3.amazonaws.com/uploads/edtech-learning.pdf

Trucano, Michael. 2015. *Will Technology Replace Teachers? No, but…* World Bank. https://blogs.worldbank.org/edutech/tech-and-teachers

UNESCO Country Dashboard. Covid-19 response https://covid19.uis.unesco.org/global-monitoring-school-closures-covid19/country-dashboard/

UNICEF. 2021. *Ensuring Equal Access to Education in Future Crises*. New York: UNICEF. https://data.unicef.org/resources/remote-learning-readiness-index/

World Bank. 2021. *EdTech Readiness Index*. Washington DC: World Bank. https://documents1.worldbank.org/curated/en/811011628250703800/pdf/World-Bank-EdTech-Readiness-Index-ETRI.pdf

Xu, Jeffrey Jian. 2021. *Digital Education Readiness Index Toolkit and Framework*. 9th International Skills Forum, Asian Development Bank. https://events.development.asia/materials/20210824/digital-education-readiness-index-toolkit-and-framework-ecosystem-approach