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Learning experience with the help of technology

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Abstract
Leading up to the 75th anniversary of the UN General Assembly, this "Realizing the promise: How can education technology improve learning for all?" publication kicks off the Center for Universal Education's first playbook in a series to help improve education around the world. It is intended as an evidence-based tool for ministries of education, particularly in low- and middle-income countries, to adopt and more successfully invest in education technology. While there is no single education initiative that will achieve the same results everywhere—as school systems differ in learners and educators, as well as in the availability and quality of materials and technologies—an important first step is understanding how technology is used given specific local contexts and needs. The surveys in this playbook are designed to be adapted to collect this information from educators, learners, and school leaders and guide decision makersin expanding the use of technology.

Keywords: learning, experience, help, technology

Introduction

While technology has disrupted most sectors of the economy and changed how we communicate, access information, work, and even play, its impact on schools, teaching, and learning has been much more limited. We believe that this limited impact is primarily due to technology being been used to replace analog tools, without much consideration given to playing to technology's comparative advantages. These comparative advantages, relative to traditional "chalk-and-talk" classroom instruction, include helping to scale up standardized instruction, facilitate differentiated instruction, expand opportunities for practice, and increase student engagement.

When schools use technology to enhance the work of educators and to improve the quality and quantity of educational content, learners will thrive. Further, COVID-19 has laid bare that, in today's environment where pandemics and the effects of climate change are likely to occur, schools cannot always provide in-person education—making the case for investing in education technology. Here we argue for a simple yet surprisingly rare approach to education technology that seeks to:

Understand the needs, infrastructure, and capacity of a school system—the diagnosis; Survey the best available evidence on interventions that match those conditions—the evidence; and closely monitor the results of innovations before they are scaled up—the prognosis**.**

The framework

Our approach builds on a simple yet intuitive theoretical framework created two decades ago by two of the most prominent education researchers in the United States, David K. Cohen and Deborah Loewenberg Ball. They argue that what matters most to improve learning is the interactions among educators and learners around educational materials. We believe that the failed school-improvement efforts in the U.S. that motivated Cohen and Ball's framework resemble the ed-tech reforms in much of the developing world to date in the lack of clarity improving the interactions between educators, learners, and the educational material. We build on their framework by adding parents as key agents that mediate the relationships between learners and educators and the material (Figure 1).

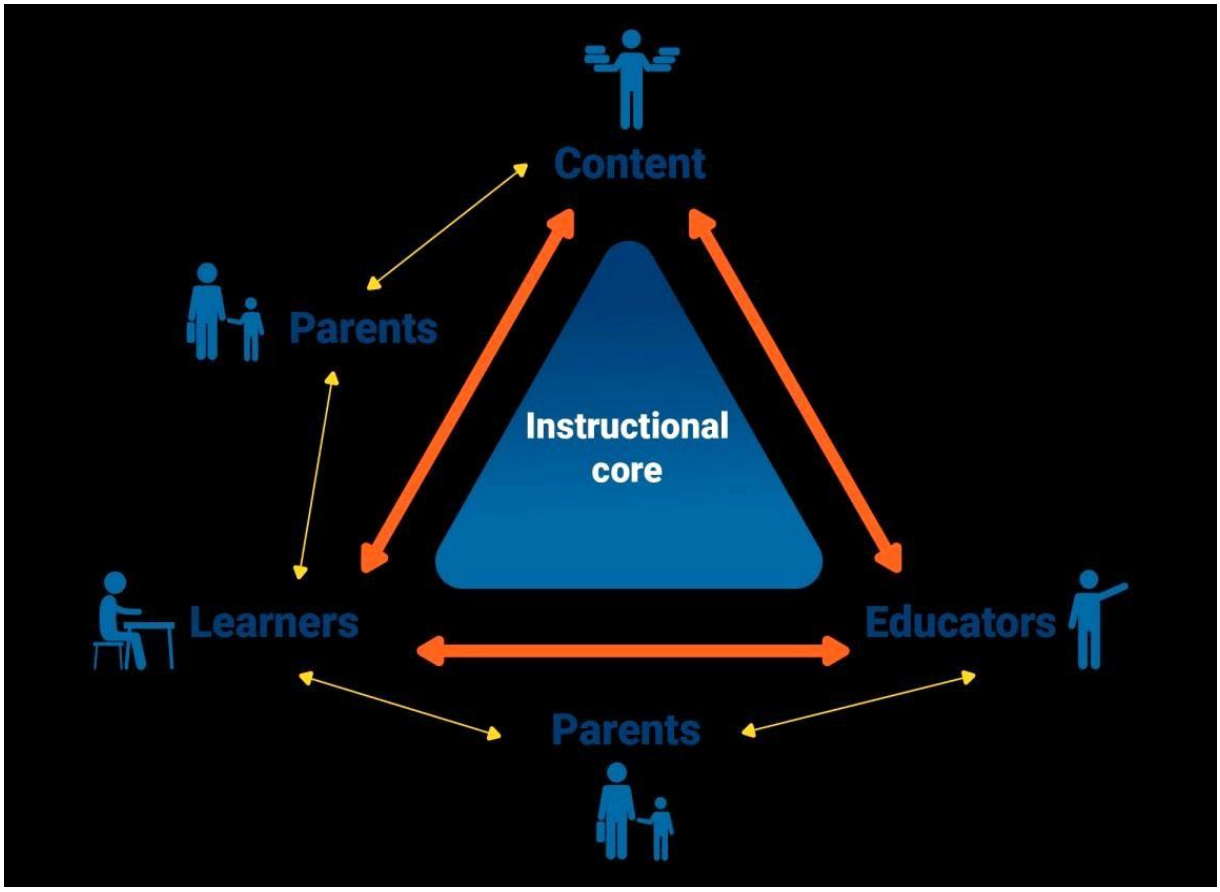

Fig 1: The instructional core

As the figure above suggests, ed-tech interventions can affect the instructional core in a myriad of ways. Yet, just because technology can do something, it does not mean it should. School systems in developing countries differ along many dimensions and each system is likely to have different needs for ed-tech interventions, as well as different infrastructure and capacity to enact such interventions.

Fig 2

- **The diagnosis**

How can school systems assess their needs and preparedness?

A useful first step for any school system to determine whether it should invest in education technology is to diagnose its:

- Specific needs to improve student learning (e.g., raising the average level of achievement, remediating gaps among low performers, and challenging high performers to develop higher-order skills);
- Infrastructure to adopt technology-enabled solutions (e.g., electricity connection, availability of space and outlets, stock of computers, and Internet connectivity at school and at learners' homes); and
- Capacity to integrate technology in the instructional process (e.g., learners' and educators' level of familiarity and comfort with hardware and software, their beliefs about the level of usefulness of technology for learning purposes, and their current uses of such technology).

Before engaging in any new data collection exercise, school systems should take full advantage of existing administrative data that could shed light on these three main questions. This could be in the form of internal evaluations but also international learner assessments, such as the Program for International Student Assessment (PISA), the Trends in International Mathematics and Science Study (TIMSS), and/or the Progress in

International Literacy Study (PIRLS), and the Teaching and Learning International Study (TALIS). But if school systems lack information on their preparedness for ed-tech reforms or if they seek to complement existing data with a richer set of indicators, we developed a set of surveys for learners, educators, and school leaders. Download the full report to see how we map out the main aspects covered by these surveys, in hopes of highlighting how they could be used to inform decisions around the adoption of ed-tech interventions.

Fig 3

- **The evidence**

How can school systems identify promising ed-tech interventions?

There is no single "ed-tech" initiative that will achieve the same results everywhere, simply because school systems differ in learners and educators, as well as in the availability and quality of materials and technologies. Instead, to realize the potential of education technology to accelerate student learning, decision makers should focus on four potential uses of technology that play to its comparative advantages and complement the work of educators to accelerate student learning (Figure 2). These comparative advantages include:

- Scaling up quality instruction, such as through prerecorded quality lessons.
- Facilitating differentiated instruction, through, for example, computer-adaptive learning and live one-on-one tutoring.
- Expanding opportunities to practice.
- Increasing learner engagement through videos and games.

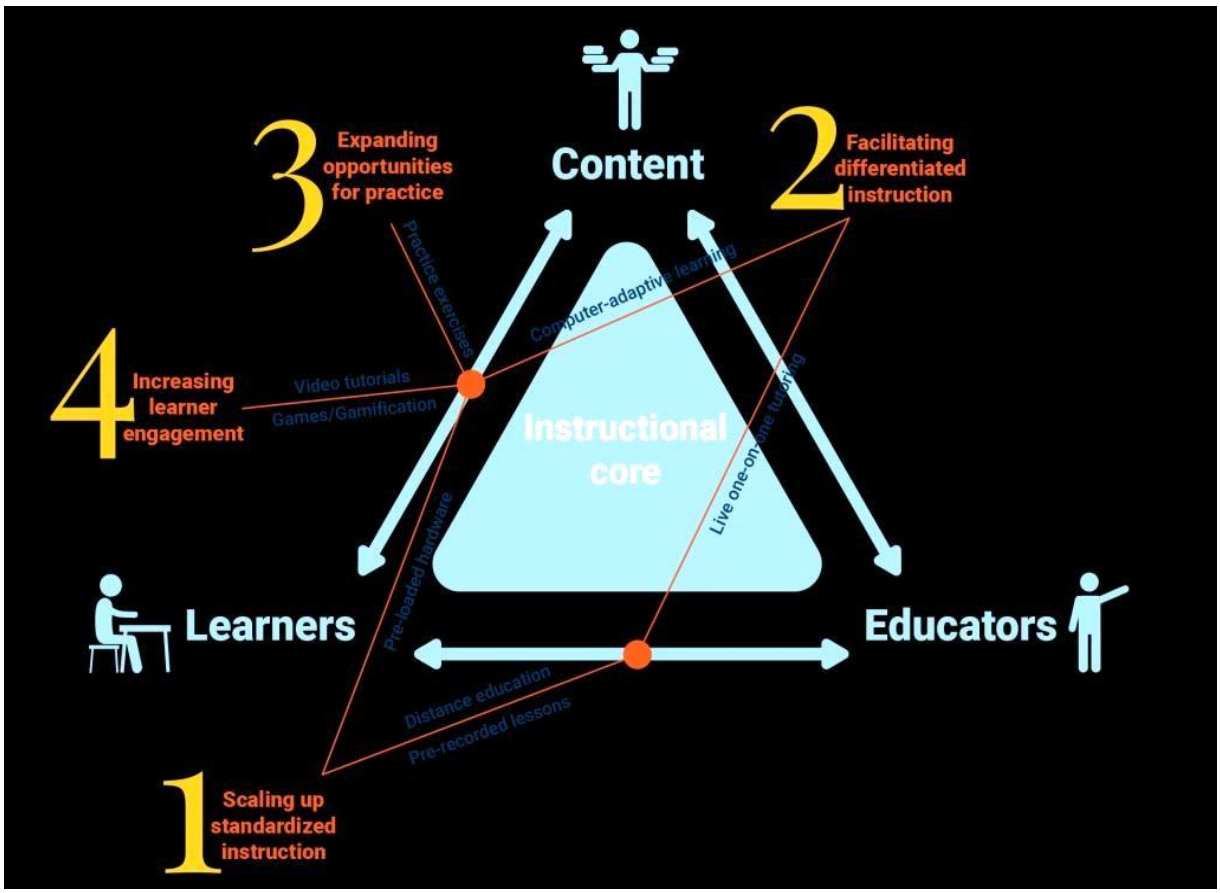

Fig 4: Comparative advantages of technology

- **Preloaded hardware**

Technology also seems well positioned to disseminate educational materials. Specifically, hardware (e.g., desktop computers, laptops, or tablets) could also help deliver educational software (e.g., word processing, reference texts, and/or games). In theory, these materials could not only undergo a quality assurance review (e.g., by curriculum specialists and educators), but also draw on the interactions with learners for adjustments (e.g., identifying areas needing reinforcement) and enable interactions between learners and educators. In practice, however, most initiatives that have provided learners with free computers, laptops, and netbooks do not leverage any of the opportunities mentioned above. Instead, they install a standard set of educational materials and hope that learners find them helpful enough to take them up on their own. Students rarely do so, and instead use the laptops for recreational purposes—often, to the detriment of their learning (see, e.g., Malamud & Pop-Eleches, 2011). In fact, free netbook initiatives have not only consistently failed to improve academic achievement in math or language (e.g., Cristia *et al*., 2017), but they have had no impact on learners' general computer skills (e.g., Beuermann *et al*., 2015). Some of these initiatives have had small impacts on cognitive skills, but the mechanisms through which those effects occurred remains unclear.

- **Computer-adaptive learning**

One of the main comparative advantages of technology is its ability to diagnose students' initial learning levels and assign students to instruction and exercises of appropriate difficulty. No individual educator—no matter how talented—can be expected to provide individualized instruction to all learners in his/her class simultaneously. In this respect, technology is uniquely positioned to complement traditional teaching. This use of technology could help learners master basic skills and help them get more out of schooling. Although many software products evaluated in recent years have been categorized as CAL, many rely on a relatively coarse level of differentiation at an initial stage (e.g., a diagnostic test) without further differentiation. We discuss these initiatives under the category of "increasing opportunities for practice" below. CAL initiatives complement an initial diagnostic with dynamic adaptation (i.e., at each response or set of responses from learners) to adjust both the initial level of difficulty and rate at which it increases or decreases, depending on whether learners' responses are correct or incorrect.

- **Expanding opportunities for practice**

A third way in which technology may improve the quality of education is by providing learners with additional opportunities for practice. In many developing countries, lesson time is primarily devoted to lectures, in which the educator explains the topic and the learners passively copy explanations from the blackboard. This setup leaves little time for in-class practice.

Consequently, learners who did not understand the explanation of the material during lecture struggle when they have to solve homework assignments on their own. Technology could potentially address this problem by allowing learners to review topics at their own pace.

- **Games and gamification**

Technology can also increase learner engagement by presenting exercises as games and/or by encouraging learner to play and compete with others (e.g., using leaderboards and rewards) — anapproach known as "gamification." Both approaches can increase learner motivation and effort by presenting learners with entertaining opportunities for practice and by leveraging peers as commitment devices.

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