

EFFECTIVENESS OF DIGITAL LEARNING SOLUTIONS TO IMPROVE EDUCATIONAL OUTCOMES: A REVIEW OF THE EVIDENCE

Low- and lower-middle-income countries (LMICs) are currently facing a myriad of challenges in education; from large increases in school enrolments putting pressure on already strained school resources, to having millions of children out of school, with a sizable proportion of those in school learning poor. Education stakeholders in high- and low-income countries alike have tried innovative ways to counter these challenges. Digital learning¹ offers a solution to many of the above challenges. Numerous countries have implemented various digital learning solutions for various purposes; from expanding classroom boundaries to reach more children, to facilitating teacher training and personalizing learning and many more. With COVID-19 causing extensive school closures and forcing schools to go remote, more countries have turned to digital learning solutions to support distance education to ensure learning continuity.²

A growing number of studies have documented digital learning solutions' effectiveness to improve learning outcomes with varying results. The question of whether digital learning solutions have any impact on learning outcomes has become much more important to inform policymakers. This evidence brief summarizes the existing literature's key findings on the application of digital learning solutions in low- and high-income countries. It examines literature specifically on the role of technology in improving learning outcomes from early childhood education to secondary education. The brief reviews 53 publications by government agencies, academic researchers, NGOs and independent research organizations.

THOUGHTFULLY DESIGNED SOLUTIONS FOR DIFFERENT CONTEXTS ARE KEY TO SUCCESS:

Expanding access to devices alone, for instance computers, does not yield a clear and positive impact on learning outcomes at basic education level.^{3 4} However, generally it may increase usage and proficiency in them.^{5 6} Application of digital learning solutions has demonstrated considerable promise in improving learning outcomes when it is thoughtfully designed around a carefully identified contextual issue (as opposed to an 'off-the-shelf' solution),⁷ and when it is innovatively integrated in teaching and learning processes to augment other learning-oriented interventions.^{8 9} In addition to better preparing students for a workforce that is increasingly becoming technology-dependent globally,¹⁰ integrating technology in education can facilitate flexibility in teaching and learning, provide students with more control over their learning, and encourage the development of cognitive competencies and understanding.¹¹

SOLUTIONS THAT EXPAND AND ENHANCE TEACHING PRACTICES ARE MOST IMPACTFUL:

Digital learning solutions that are designed to improve teacher instruction tend to be the most effective in improving learning outcomes,¹² especially when they are designed to supplement – and not to replace - best practices for teaching.¹³ Well-designed digital learning solutions often can facilitate a teacher-student feedback mechanism that in turn allows the teacher to assess students' learning needs, customize educational materials as needed (for personalized/differential instruction),¹⁴ increase or allow student-teacher

interaction time to focus more on problem-solving, and allow the teacher to gauge students' understanding of the material being taught, in turn allowing either the teacher or student to adjust the pace of instruction or learning.^{15 16}

BLENDING ENHANCES LEARNING: Blending online learning with face-to-face teaching generally produces better outcomes than face-to-face or online learning alone.^{17 18} Digital learning solutions supporting self-led learning in a flipped classroom or other blended learning models have been found to be effective in improving student performance.^{19 20 21 22} This is partly due to their potential to overcome traditional classroom constraints such as having a wide range of student learning levels, minimal student-teacher interaction and large class sizes.²³ Additionally, digital learning solutions has been shown to engage students emotionally - students' attitudes, enjoyment and interests towards learning is shown to increase.²⁴

SOLUTIONS TO ACQUIRING FOUNDATIONAL SKILLS: Regarding its role in facilitating acquiring numeracy and literacy skills, digital learning solutions has also demonstrated great promise in not only supporting students' efforts to comprehend content and improving math skills,^{25 26 27 28} but also improve reading skills. Some studies contend that the increased supply of literacy materials and books through educational apps, search engines, videos, portable technologies, and interactive activities provides students with a 24/7 learning environment that can contribute to improved reading.²⁹ However, it should be noted that some studies argue that students who read texts in print score significantly better in reading comprehension than those who read them digitally.³⁰

STEM: The variety of digital learning solutions now available (i.e. online interactive learning, simulation, augmented and virtual reality, and digital gaming) provide both teachers and students with additional teaching and learning opportunities for science, technology, engineering and math (STEM).³¹ Digital learning solutions have made it possible for students to explore and interact, often without worrying about economical and ethical issues, with aspects of science that historically were only in the domains of expert scientists and engineers. Digital learning solutions have also been proven to engage students behaviorally - it can motivate them to spend more effort and time participating in learning activities.³² Digital learning solutions designed to facilitate collaborative learning by enhancing interaction among students, for instance through project-based learning or other joint activities, has been shown to develop synergy, higher-level thinking, enhance communication skills, hands-on learning, and an increased awareness of self-motivated and -directed learning.^{33 34 35 36}

ASSISTIVE TECHNOLOGY AND INCLUSIVE LEARNING: Although a dearth of evidence exists regarding the efficacy of digital learning solutions for students with learning difficulties and disabilities,^{37 38} some studies have shown assistive technology (AT) can not only make learning more accessible to students with disabilities,³⁹ but also improve their performance. Studies have shown a positive effect of AT in improving the reading skills of dyslexic students,⁴⁰ enhancing math skills for the deaf and hard-of-hearing^{41 42} and the visually impaired and blind.⁴³ AT has also been used to support the development of employment-focused skills in young people with disabilities.⁴⁴

The cost and sustainability of digital learning solutions are critical questions for which existing research has mixed results. Sustainability and scalability are big concerns for policymakers and education stakeholders, particularly in LMICs where there are often infrastructural challenges (limited access to electricity, internet, and cell phones penetration) in significant parts of the countries. While digital learning solutions do not always represent the best value for money in such countries,^{45 46} there are examples that have produced impressive learning gains at cost and can be implemented in a low-resource setting on a large scale without negatively affecting the solutions' design.^{47 48} Such examples include high frequency text messaging programs in Chile, Botswana and USA designed to increase parental involvement in schooling by providing parents with data related to their children's education.^{49 50 51}

DIGITAL LEARNING IN EMERGENCIES AND CRISES: There is limited research in emergency settings, perhaps a reflection of the existing gap in the application of digital solutions in such contexts. Among the challenges unique to emergencies and crises settings, infrastructure has presented a major barrier to application of digital learning solutions.⁵² However, some lessons from research in other contexts can still be applied in design and implementation phases, with more caution taken to ensure sustainability and existing inequalities are addressed. Despite the positive effects digital learning is found to have, it has been known to exacerbate existing educational inequalities in both development and (more so) emergency settings.⁵³ Disadvantaged children such as girls, children in poor households and those living with disabilities can be left behind. Such inequalities have particularly been brought into sharper focus as countries, especially LMIC, grapple with the COVID-19 crisis.

Customizing digital learning solutions to the constraint at hand and seamlessly integrating them in the learning process works best in improving learning outcomes. It is feasible to develop solutions that can be scaled - possibly through public-private partnership, among other strategies. Planning and implementation should ensure the solutions can reach the disadvantaged to help alleviate existing disparities.

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