

EXECUTIVE SUMMARY

Students
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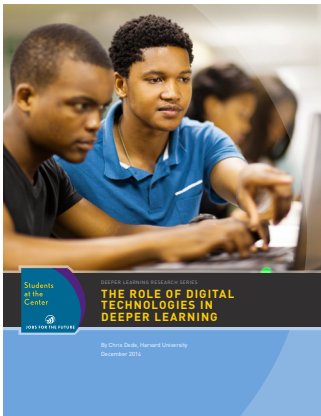


JOBS FOR THE FUTURE

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THE ROLE OF DIGITAL TECHNOLOGIES IN DEEPER LEARNING

By Chris Dede, Harvard University



A wealth of recent research has shown that, in order to become truly well-prepared to succeed in college and careers, young people require not just high-level academic knowledge and skills, but also a range of inter- and intra-personal competencies. These include the capacities to regulate and reflect on one's own learning, to solve complex problems, to participate effectively in teams, and to persist in the face of challenging tasks.

This paper argues that digital technology will be indispensable to the effort to scale up deeper learning in the nation's high schools. However, in order to realize the vast potential of digital tools, school reformers will have to rethink their own assumptions about the purpose of investing in such resources.

Educational technology is valuable not because it allows us to produce fancier textbooks and more elaborate presentations. Rather, it can and should be used to help teachers provide richer opportunities for students to debate complex issues, analyze challenging material, explore real-world problems; and assess their own learning. In other words, the point isn't to help schools do the same old things better, but *to help teachers and students do better things*.

Moreover, argues the author, Chris Dede, it's hard to imagine that the nation's educators could make a large-scale shift

toward deeper learning *without* reinventing their teaching tools and platforms to create new types of instructional environments in which students are empowered to do active, collaborative learning.

NEW DESIGNS FOR LEARNING: TWO PROVEN STRATEGIES

Along with colleague Barry Fishman, Dede recently completed an exhaustive survey of the empirical research into digital technology's impact on teaching. To date, they found, technology has been used mainly to automate conventional models of teaching, rather than to empower students

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and engage them in deeper learning. It is no surprise, then, that the results have been generally disappointing. The evidence suggests that school and district leaders should think carefully before investing in expensive new devices and software, especially ones that do little more than convert textbooks, worksheets, and rote activities into digital form.

At the same time, the research also shows that when technology has been designed to support effective instruction—especially to provide opportunities for deeper learning—then it does tend to have great benefits, suggesting that digital tools can serve as effective vehicles for large-scale school improvement.

Two technology-based instructional strategies have been found to be particularly effective: using **digital teaching platforms** and teaching with **immersive authentic simulations**.

DIGITAL TEACHING PLATFORMS

In brief, a digital teaching platform (DTP) is a classroom environment, featuring a network of computers that have been designed to empower teachers and students to interact in a range of ways that rarely occur in conventional teaching. DTPs are not meant to replace teachers or control their work; rather, they allow teachers to offer a form of blended or hybrid learning, mixing face-to-face and virtual student experiences. Teachers use the DTP to create lessons and assignments and to manage and evaluate student work, which can be individual or collaborative. A DTP also gives students access to curriculum content and assessments in digital form and supports real-time, teacher-directed online interaction in the classroom.

Most important, though, DTP's are powerful teaching tools only insofar as they are used to promote knowledge integration, personalize instruction, and promote collaboration among students.

Using DTPs to Promote Knowledge Integration

In classrooms that emphasize knowledge integration, teachers invite students to share their own emerging ideas and theories, help them detect gaps in their knowledge, and engage them in using new ideas to address compelling problems. The Web-based Inquiry Science Environment ([WISE](#)) is one example of a DTP-like environment that supports knowledge integration using case-based, collaborative learning. Students learning in a classroom using WISE might predict the sequence of events in specific chemical reactions, conduct virtual experiments on those chemicals, reassess their initial predictions, and discuss and debate their evolving ideas online. WISE also includes built-in assessments and rubrics that ask students to connect and distinguish their ideas, and give evidence to support their claims.

Using DTPs to Personalize Instruction

Digital teaching platforms can aid teachers in adapting instruction to meet the needs of individual students. For example, the [ASSISTments](#) provides data management and content for online learning. Its assessment tool identifies gaps in students' background knowledge so teachers can decide precisely which skills they need to strengthen in order for students to grasp new material. ASSISTments then tracks student progress so that teachers can continue to effectively target individual instruction.

Using DTPs to Promote Collaborative Learning

Digital teaching platforms can provide powerful support for collaborative learning. For example, the mathematics program [SimCalc](#) is configured to enable engaging whole-class discussions by sharing student thinking and work in a networked classroom. Much of the pedagogy in SimCalc classrooms involves the teacher facilitating discussions among students about the dynamic representations on their computer screens. Research shows that these mathematical dialogues tend to involve the entire class, are highly engaging, and lead to deep understandings of mathematical formulas and theorems.

IMMERSIVE AUTHENTIC SIMULATIONS

Digital simulations can create powerfully immersive experiences for students, allowing them to learn and practice new skills and content in a virtual environment, then transfer what they've learned to the real world. In particular, two kinds of immersive media have been shown to be effective tools for promoting deeper learning: **multiuser virtual environments** (MUEs, or “virtual worlds”) and **augmented realities**.

MUEs (or “Virtual Worlds”)

In a virtual world, students can interact with digital objects and tools, simulated characters, and avatars controlled by their peers in order to access educational experiences and environments not otherwise available in their classrooms.

For example, the [EcoMUVE](#) give students the opportunity to explore realistic, three-dimensional ponds and forest ecosystems while assuming the role of scientists. Over the course of the simulation, teams work together to investigate a complex problem, and collect and analyze data from a variety of sources over time, and generate and test hypotheses. Research studies across a range of classroom settings have validated the utility and effectiveness of teaching with EcoMUVE, showing that it motivates and engages students while helping them learn key scientific concepts, develop individual and collaborative skills related to scientific inquiry, and gain a deep understanding of complex causality (a concept that is often quite difficult for middle grades students to grasp).

Augmented Realities

Applying academic insights to the real world—and translating real-world experience into academic insights—is an essential feature of deeper learning. Augmented reality enables students to blend virtual and real-world experiences by using mobile wireless devices to superimpose digital information onto a physical landscape. For example, the [EcoMOBILE project](#) (designed to complement EcoMUVE), takes students on a field trip to a nearby pond, where they use handheld devices to help them collect data and record observations about the ecosystem; identify specific plants, wildlife, and geological features; call attention to particular aspects of the environment; show them illustrations of what's going on beneath the surface of what they see, and so on.

In short, whereas MUEs allow students to learn by simulating real-world activities, augmented reality enhances their experience of the real world. In both cases, teachers can use the technology to help students connect abstract scientific content to actual, lived experience, giving them a much deeper grasp of the material than they would otherwise have.

RECOMMENDATIONS

The paper concludes by recommending three priorities for the coming years:

STAY FOCUSED ON REDUCING ACHIEVEMENT GAPS

The technology-enhanced innovations discussed here are meant not just to strengthen teaching and learning overall, but to help reduce the achievement gaps that divide our nation's students by ensuring that all children have access to powerful educational resources that can be customized to meet their learning needs.

More research and development will be required to identify precisely which digital tools will help us close these achievement gaps. But we know these instructional strategies are more likely to succeed than continued attempts to provide one-size-fits-all instruction.

BUILD PROFESSIONAL CAPACITY TO USE DIGITAL TOOLS EFFECTIVELY

Ultimately, the effectiveness of technology will depend on educator capacity. Technology is not an end in itself, but a tool that can empower people to change the structure and delivery of education.

However, this requires professional development that helps educators not only learn new content and skills, but also rethink their basic ideas about teaching, a process that can be emotionally and intellectually challenging. Technology itself holds significant promise in this area, as online learning, community, and support can play a crucial role in helping teachers build capacity and reconsider their core beliefs about education.



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INVEST IN RESEARCH AND DEVELOPMENT

To date, researchers have found that digital technologies have dramatic potential to promote deeper learning. However, much work must be done to make those technologies truly practical, affordable, and scalable. This will require greater and more targeted support for research and development than today's piecemeal funding.

The most important priorities are to build, test, and study high-quality teaching tools that promote deeper learning, and to help education stakeholders grasp the value of such tools, identify good ones, and invest in them wisely. This work will be best accomplished by a community of researchers, practitioners, and policymakers from a variety of fields, not by scholars working in isolation.

With investment, we can have the technology infrastructure to implement deeper learning models of education that prepare all students for the very different future they face. Whether we have the commitment and will to actualize such a vision remains to be seen.



Students at the Center—a Jobs for the Future initiative—synthesizes and adapts for practice current research on key components of student-centered approaches to learning that lead to deeper learning outcomes. Our goal is to strengthen the ability of practitioners and policymakers to engage each student in acquiring the skills, knowledge, and expertise needed for success in college, career, and civic life. This project is supported generously by funds from the Nellie Mae Education Foundation and The William and Flora Hewlett Foundation.

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