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Digital education 2.0

From content to connections

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The year is 2021, and 14-year-old Anna dreams of becoming an aerospace engineer. From the moment she wakes up, Anna begins communicating with her personal "wizard," a phablet with advanced artificial intelligence (AI) and cognitive analytics features—both verbally and via smart glasses embedded with AI features such as gesture control, facial expression coding, motion tracking, and speech recognition. Anna's wizard connects via the Internet to the education coordinator (EC) of a government agency dedicated to researching the universe.

"Without a broader vision of social change, new technologies will only serve to reinforce existing institutional goals and forms of social inequity. Many prior attempts to mobilize technology in the service of educational reform have failed because interventions have focused narrowly on the deployment of particular media or technologies, without considering broader social, political, or economic conditions.

"Connected learning is socially embedded, interest-driven, and oriented toward expanding educational, economic, or political opportunity. It is realized when a young person is able to pursue a personal interest or passion with the support of friends and caring adults, and is in turn able to link this learning and interest to academic achievement, career success, or civic engagement. Unlike efforts at educational change that focus on technology deployment or institutional reform, connected learning takes a networked approach to social change that aligns with our ecological perspective."

– Mizuko Ito, professor in residence, University of California, Irvine.[1]

The EC is a computerized virtual assistant that helps groom prospective candidates such as Anna by providing job-readiness skills. The wizard shares Anna's performance dashboard with the EC to create an individualized learning plan encompassing digital content and virtual reality games, experiential learning exercises, and interactive opportunities with professional aerospace engineers in her approved network. Anna's parents are contacted by the wizard to approve the lesson plan and make any purchases and agreements for Anna to proceed.

Anna carries her wizard to a virtual learning center at her high school. There she works with other students on a two-hour spacecraft modeling simulation in a cloud-based environment, in which students learn by virtually building a life-scale model. This approach allows students globally to both compete and collaborate with each other at different phases, receiving points for speed, accuracy, and teamwork. When Anna has completed the spacecraft modeling simulation, the 3D printer at the learning center produces a miniature model for her. Anna's science teacher, stationed at another learning center in the school, is connected to the wizard and has automated access to Anna's work, scores, and activity patterns to offer feedback and guidance on the spacecraft model. Based on Anna's eye movements, as tracked by her smart glasses, the wizard gauges and communicates interest level and focus to her teacher, who dynamically changes content and delivery depending on where Anna needs guidance.

Leveraging the learning center's adaptive learning system and the learning plan designed by the EC, Anna's teacher reconfigures her performance dashboard on the wizard to reflect her progress.

Anna can change her learning objectives anytime, and her wizard's dashboard will dynamically account for all prior work done and align with her new learning objectives. Anna can also share her learning progress with her friends and family via several social media interfaces. The wizard maps her progress and will continue to evolve throughout her journey from primary to secondary school to corporate learning.

THE IMPETUS FOR CHANGE

The "first wave" of digital education—almost 10 years in the making—focused on creating, sharing, and accessing instructional content in digital forms, including online courses, digital libraries, games, and apps. Digitizing educational content, bringing devices to school, and one-off stand-alone learning apps were basic steps in the drive toward bringing technology into classrooms.[2] Despite the initial efforts to digitalize education, K-12 (elementary schools), higher education, and beyond still face three key issues: skills gaps; low return on investment (ROI); and the need for innovation, entrepreneurship, and job creation.

1. ***Enhancing student job readiness and addressing skill shortages:***

   Graduating students increasingly find themselves underprepared to take on corporate positions. Emphasis on conventional methods of book learning and didactic lectures has resulted in a lack of practical and applied knowledge.[3] The needs and requirements of employers are ever changing, further shortening the half-life of skills—acquired through primary, secondary, and graduate education—to five years, and schools and colleges find it challenging to keep pace.[4, 5] One solution developed has been the Common Core State Standards in the United States, expected to help raise student skill levels in foundational subjects such as basic math and English language.[6] Though some schools have adopted Common Core standards, there is less certainty about the actual implementation across all schools by the end of 2015.[7]

2. ***Increasing ROI from K-12 and higher education:***

   Though the United States spends a greater proportion of its GDP on education than other OECD countries, it does not rank among the top 10 in terms of reaping the rewards of that investment.[8] Research also shows that 80 percent of adults in the United States consider college education to have poor ROI.[9] Rising education fees and the resulting student debt, coupled with

the declining quality of graduates' job readiness, undermine the perceived value of education in the United States.[10] Personalizing learning more to the specific needs of each student will likely help generate better ROI from education.[11]

3. ***The innovation imperative in a global and competitive workplace:***

   Macroeconomic conditions have led to a decline in jobs and new firm growth, especially in high-wage industries in the United States.[12] These trends are exacerbated by the competitive effects of a global workplace. Innovation and entrepreneurship are vital to driving job creation and economic growth, as exemplified by the life sciences industry.[13] In this context, K-12 schools can design specialized education programs to help foster innovation and entrepreneurship at an early age, which in turn will help students create new jobs and carve their own career paths.[14]

MOVING DIGITAL EDUCATION FROM CONTENT (1.0) TO CONNECTIONS (2.0)

Is technology the answer, or at least part of the answer, to these problems? Many certainly seem to think it is, judging by the investment in educational technologies ("ed-tech"). US education spending doubled over the past 20 years to $1.17 trillion in 2013, and the fastest-growing segment of spending is digital education technologies, which is expected to rise from $23.6 billion in 2014 to $26.8 billion in 2018.[15, 16, 17] Since the advent of the computer 35 years ago, learning across schools, colleges, and universities has systematically incorporated technology into the classroom. Businesses, especially, have embraced technology for employee training and development.

Ubiquitous access to learning content has only intensified the need for effective, efficient methods of delivery and utilization.[18] Thanks to advanced technologies available today, it is possible to personalize and securely deliver instructional content. As a case in point, Khan Academy's "anytime, anywhere" educational model delivers personalized learning to students worldwide and even provides diagnostics and dashboards to teachers.[19] Some technologies can design adaptive learning methods to offer differentiated learning experiences.[20] Nonetheless, merely adding technology to the classroom—which we saw in the first wave of digital education—is not enough to address the impetus for change.

With government, schools, and businesses now demanding connected learning, there will likely be a second wave of digital education.[21] Participants in the education ecosystem—school administrations, teachers, students, parents, ed-tech solution providers, and government educational agencies—will need to build stronger relationships to create learning environments like Anna's. Integrated next-generation

technologies will likely make it easier for students of all ages and backgrounds to continue their education their entire lives, both inside and outside the classroom.

These technologies can address the three drivers of change: fortifying student skills, increasing education's ROI, and enabling students to be more innovative and entrepreneurial. To address these challenges, ed-tech solution providers will likely need to shift focus from content to connections.

SHIFTING GEARS: THE THREE CONNECTORS THAT DEFINE DIGITAL EDUCATION 2.0

Three "connectors" are widely viewed as fundamental to digital education:

Connector 1. An integrated digital education ecosystem: Parents, teachers, peers, and administrators, as well as individuals outside the formal educational system such as mentors and potential employers, form a collaborative network to deliver instruction to and guide the student at the center of the ecosystem.

Connector 2. An integrated student learning life cycle: To offer a continuous learning experience—right from K-12 to the workplace—educators and trainers should connect in-classroom and real-world learning in a way that is tailored to the needs, learning styles, passion, and potential of each student.

Connector 3. Integrated technology solutions: Ed-tech solution providers can draw upon their individual technology strengths and competencies to partner and offer integrated solutions.

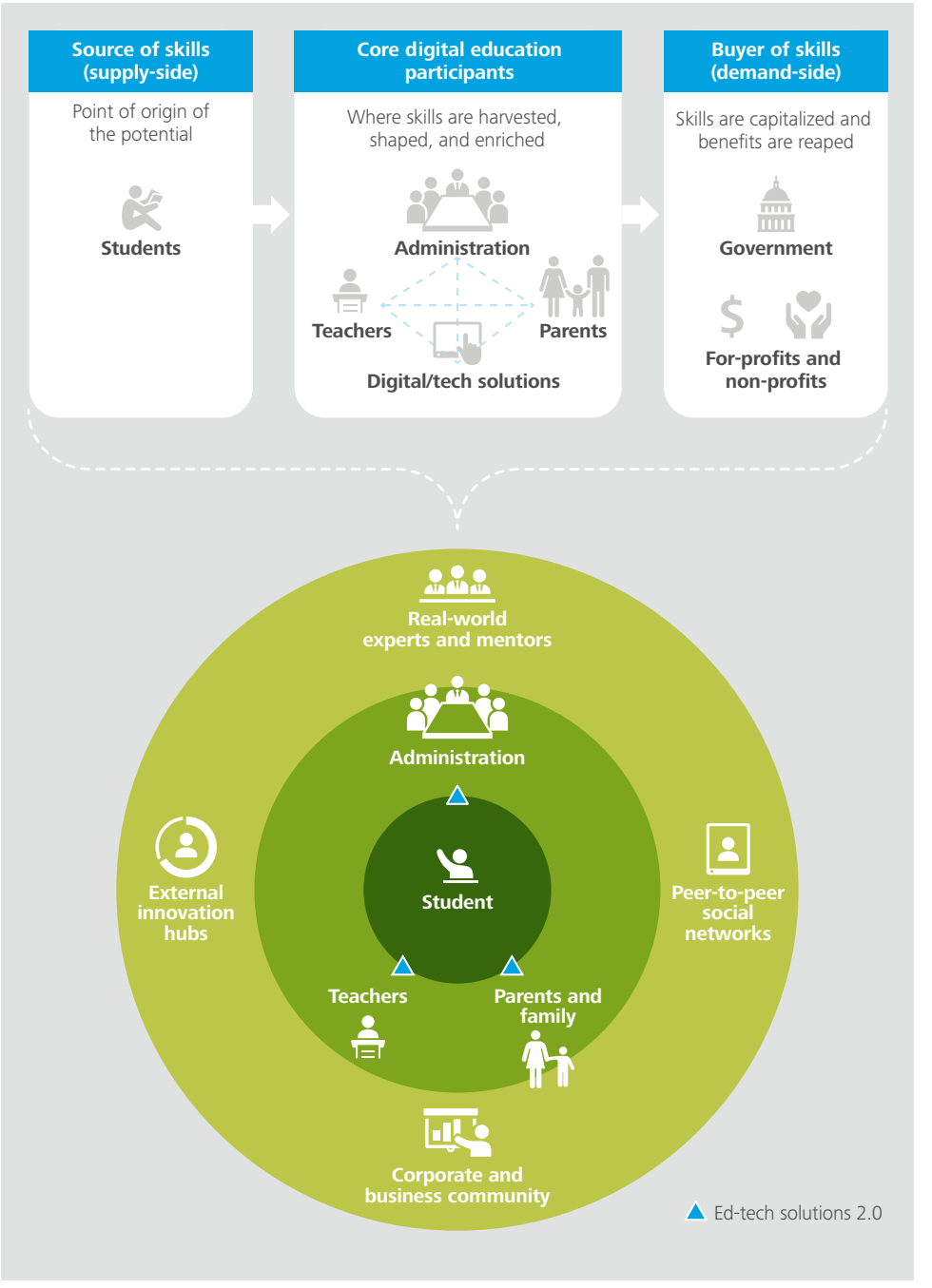
Through specific case studies and examples, we present how the three connectors can transform the complete learning experience, with ed-tech solution providers acting as enablers.

Connector 1: Integrated digital education ecosystem

In Anna's learning environment, her teacher, peers, parents, and real-world experts come together to provide a holistic learning experience. Similarly, the digital education model is rapidly evolving from transaction-based relationships to an integrated value chain (figure 1). With digital education 2.0, the education ecosystem continues to evolve around students, with their passions and interests at the center. Classrooms may extend virtually to encompass relationships with real-world experts in areas aligned with student interests; with the corporate world through internships and business-based projects; and external innovation hubs such as maker movement spaces, research labs, and business incubators and accelerators. The new ecosystem may also include peer-to-peer social learning platforms that promote open learning and enhance collaboration between students. For example, edX, a joint nonprofit online learning initiative by Massachusetts Institute of Technology and Harvard University, connects like-minded individuals through the latest

peer-to-peer social learning tools; Udacity, a provider of online education courses, enables individuals of all ages to collaborate on projects and receive feedback from real-world experts.[22]

Figure 1. From single value chain to integrated ecosystem



Graphic: Deloitte University Press | DUPress.com

CASE STUDY: HIGH TECH HIGH CHARTER SCHOOLS

Strong partnerships between education ecosystem participants augments student performance

High Tech High (HTH) operates 12 charter schools in San Diego and Chula Vista counties, including three elementary schools, four middle schools, and five high schools. The first charter school was founded in 1998 when top tech company executives partnered with civic authorities to address the skills gap in science, technology, engineering, and math.

HTH schools bring together students, teachers, administrators, and parents through "practical hands-on training, experiential learning, coupled with traditional academic education to prepare students for college in both technical fields and liberal arts," says Ben Daley, chief academic officer and chief operating officer of the HTH Graduate School of Education.[23] Each student is paired with a faculty advisor whose responsibility includes ensuring continuous interaction, monitoring academic progress, and facilitating career planning. The advisor also stays in close touch with the student's family. To maximize connectivity, HTH employs PowerSchool, a web-based student information portal that allows teachers to record attendance and grades. Parents and students use PowerSchool to access real-time learning and performance information, communicate with teachers, and track assignments. Administrators interface with PowerSchool to create an efficient school schedule that accounts for multiple constraints such as room capacity, teacher preparation periods, and student scheduling priority.[24] Another tool HTH uses is Naviance, which helps bring together core ecosystem participants.[25]

HTH's connected learning initiatives showed positive results in student performance. HTH students have completed more than 1,000 experiential learning projects in over 300 community businesses and organizations, including Qualcomm and Fox News. Of HTH's high school graduates, 98 percent attended college, while over 30 percent entered science or math fields.[26]

Connector 2: The student learning life cycle

For students like Anna, technology can play a role in integrating all the aspects of their learning life cycle. Connecting learning activities across the various stages of their schooling and careers can help students continually track their learning progress, receive real-time or longitudinal feedback, identify learning needs and gaps, reach out for assistance in a more risk-free environment, and ultimately build their competencies. Technology can help build and annotate an education history

based on an individual's competencies, using different heuristics at different life stages across various subjects and modules. This history can then be used to connect the student to meaningful real-world opportunities.

As students work on real-life projects and link this learning to their formal institutional education, they can earn badges that become competency-based credentials. Personalized tools and techniques, such as PathSource and Pathbrite, can further help a learner manage the various types of content within a lesson plan and across one's career.[27]

CASE STUDY: THE MET

Connected learning bolsters classroom learning with outside experience for school-to-career transitions

Big Picture Learning (BPL) envisions redesigning K-12 to adult education in the United States through the innovative use of personalized learning. The Metropolitan Regional Career and Technical Center (MET), the first BPL school, opened in 1996 in Rhode Island under the guidance of experienced educators Dennis Littky and Elliot Washor. They were given a mandate to design a 'school for the 21st century' that would impact the community by producing skilled graduates, lifelong learners, and responsible citizens.

Since its inception, the MET school has adopted Learning Through Interest (LTI) in which students spend two days per week engaged in learning outside of the classroom with a mentor, who is an expert in the students' field of interest. Advisors meet with students and mentors at the LTI site, to help students develop real-world projects and build long-term personal relationships with their mentors—paving the way for lifelong learning. "The students don't get credit necessarily for being in an internship, but they get credit for what they create while at an internship and how they present," says David Berg, vice principal at the MET Sacramento High School in Sacramento, CA.[28] With LTI, the MET gives academic credit for technology use, both inside and outside the classroom. "Students can develop deeper understanding by actually doing and making things and applying their knowledge rather than just gathering information online," says Elliot Washor, codirector of Big Picture Learning.[29]

The LTI-driven personalized and connected learning approach has equipped MET's students to transition from school to a career. The school has maintained a 98 percent college acceptance rate.[30] As Elliot Washor highlights, a Big Picture alumni survey[31] revealed that for over two-thirds of MET graduates, work-based learning and the opportunity to work with advisors at internship sites were important aspects that contributed to success in life after high school.[32]

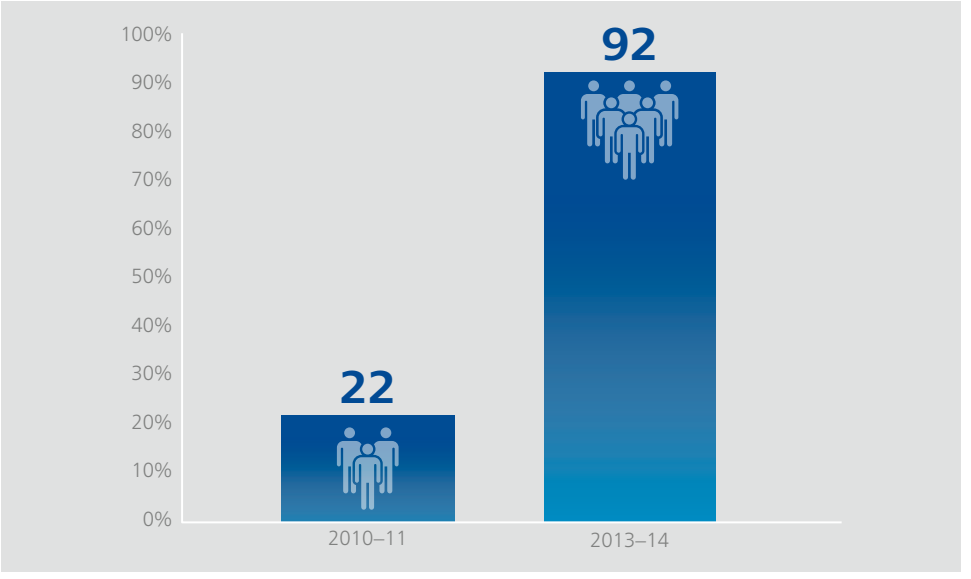
Connector 3: Integrated technology solutions

Underlying both connector 1 and 2 is the third type of connector, the integration between diverse technology solutions to create better learning experiences for students—similar to Anna's wizard. As a case in point, consider the customizable "toolkit," a type of universal remote for the digitalization of education.

"Toolkits should allow teachers to address not just what is being taught but how it is being taught—which is different from class to class, from school to school, and from community to community," says Antero Garcia, assistant professor at Colorado State University.[33] "Teachers can use toolkits to cocreate and adapt content real-time to either bolster existing curricula or design a course from scratch, offering an enriched learning experience to students." With toolkits, students can engage in blended learning: face-to-face classroom methods combined with computer-mediated activities that help students discover and pursue interests at their own pace.

As described by Philipp Schmidt, MIT Media Lab director's fellow and cofounder of Peer 2 Peer University, "Technology does not replace the teacher but is the glue to connect isolated experiences in support of core values of learning: project-based, peer-supported, passion/purpose-centric, and play-oriented."[34] To that effect, ed-tech companies are collaborating (figure 2) to integrate elements of game-based learning and simulation, experiential learning, augmented reality, and

Figure 2. Number of partnerships and alliances between ed-tech solution providers, 2010–11 and 2013–14



Source: Based on our analysis of 18 ed-tech solution providers. We studied the number of partnerships and alliances formed by those 18 companies during two different time periods: September 1, 2010, to August 31, 2011, (noted as 2010–11) and September 1, 2013, to August 31, 2014, (noted as 2013–14). We primarily looked at company press releases and third-party data sources to gather data around partnership/alliance announcements.

Graphic: Deloitte University Press | DUPress.com

interactive tools as part of their offerings.[35] Some partnerships aim to improve the integrity, security, and flow of data between products.[36] Others bundle hardware and software designed to help manage a "classroom of devices."[37] Many partnerships offer personalized learning experiences for students and assist in managing their learning goals.[38] In addition, infrastructure providers play an important role in facilitating connections among core education ecosystem participants: students, teachers, administrators, and parents. For example, partnerships between cloud companies and learning management system (LMS) providers are helping students and teachers access and supervise learning content virtually anytime, anywhere, on any platform.[39]

As our case studies have shown, the three connectors address the impetus for change: bridging the skills gaps, increasing ROI from education, and enabling students to be innovative and entrepreneurial. By adopting unique strategic positions with varying depth and breadth across the three connectors, ed-tech solution providers can become catalysts of change for students.

BRINGING IT TOGETHER FOR DIGITAL EDUCATION 2.0

Many educational institutions that benefit most from digital learning solutions are starting to move toward the cloud, upgrading their LMS, investing in network infrastructure, and leveraging social networks for education support and training—all to improve connections across education. In order to capitalize on building and supporting the integrated education ecosystem, executives—including CEOs, CTOs, and product and R&D heads at ed-tech solution providers—should choose a strategic position that captures the broadest possible role in the value chain while exploiting internal competencies or easily acquirable assets.

Ed-tech solution providers should consider the three core needs of an integrated education ecosystem:

1. Infrastructure to provide the underlying foundation for connectors
2. Content that is engaging and based on students' passions and interests
3. Evaluation and assessment tools to build personalized learning journeys

Ed-tech companies can consider three strategic positions that meet each of these needs, depending on their solution offerings, competencies, and role in the ecosystem. For each of the three strategic positions, we have identified specific strategic choices that companies can adopt to create value, as well as questions that executives should consider while selecting and implementing a chosen strategy. Our goal herein is to illustrate potential strategic options and related questions rather

than providing definitive recommendations and an exhaustive survey, because each company will need to find its own highest-value strategic position.

Foundation builder

The foundation builder provides core technology infrastructure and services—the building blocks of next-generation education solutions. The role involves developing next-generation LMS and cloud-based services for efficient data storage, information retrieval, accessibility, and security, by integrating discrete elements such as core technology infrastructure, student information, instructional content, and learning technologies. Cloud technologies can be used dually: to create the base infrastructure and to enable connections. Foundation builders can also use virtual learning spaces, which facilitate the shift from a unidirectional education value chain to an integrated education ecosystem.

As you consider a strategic position within the foundation builder category, here are a few questions to consider:

- What can foundation builders do to provide "anytime, anywhere" courses to students? For example, they may consider creating select connectivity solutions in partnership with learning analytics or content solution providers.
- How can virtual learning spaces be used to provide a connected learning experience for students? Examples of infrastructure for such spaces include existing business incubators, innovation hubs, and maker spaces.

Content specialist

The content specialist delivers a combination of content creation, content aggregation, and customized delivery solutions on learning devices to ecosystem participants. Traditional content can be transformed into interactive, visualization-rich content to enable learning through experience, discovery, and exploration. Wearable devices can capture eye and body movement to facilitate cognitive learning. Cloud technologies can be used to pull content from diverse sources, curate it, and present it to students in a real-time and engaging way.

As you consider a strategic position within the content specialist category, here are a few questions to consider:

- What are the opportunities for integrating wearables with health applications into classroom learning? For example, digital health data such as circadian rhythms can be used to determine "learning blocks," or focused learning times when an individual is at his or her most productive both physically and mentally.

Figure 3. Potential ecosystem representing digital education 2.0

Graphic: Deloitte University Press | DUPress.com

- How can content weave practical and creative problem-solving aspects with existing learning solutions such as educational devices and digital classrooms to better cater to the individual needs of students and teachers? For example, in the Faulkes Telescope Project, students use real science data and reach out to astronomers, other scientists, and fellow students for advice when carrying out an experiment to solve real-world problems.[40]

Learning customization provider

The learning customization provider focuses primarily on providing students and teachers with analytics, advanced learning, and assessment solutions. In the United States, venture capitalists are actively investing in ed-tech companies that offer analytics and LMS solutions, presenting a significant opportunity for these companies.[41] An LMS solution can capture students' competencies and help them manage their career paths over time in line with their lifelong learning needs. Personalized and adaptive learning solutions can humanize collaboration among ecosystem participants. Technology can be used to "gamify" the learning experience, with badges to reward interest-based learning. Next-generation technologies such as semantic analytics can be used to more closely understand student and teacher preferences, interests, and inhibitions.

As you consider a strategic position within the learning customization provider category, here are a few questions to consider:

- How can existing analytics and data mining capabilities incorporate predictive analytics solutions? For instance, gamification and badging could be standardized to complement existing certifications and become part of next-generation analytics and assessment solutions.
- What technologies can humanize assessment solutions? As an example, holographic technology—such as the recreation of Michael Jackson at the 2014 Billboards Music Awards—can create "avatars" of teachers, mentors, and real-world experts.

Connectors can enable individuals, organizations, and technologies to meet the dynamic needs of new-generation students like Anna. In the coming wave of digital education 2.0, ed-tech solution providers can transform their roles in the value chain from technology providers to solution partners who can help create and foster an integrated education ecosystem. Ed-tech solution providers looking to establish a differentiated position should consider factors such as the standardization of learning platforms, technology security, data privacy, content life-cycle management, and a changing education ecosystem. The choice of a company's strategic position depends on its role in the ecosystem, core competencies, and optimal business model. Solution providers who consider all these and explore the latest technology trends can capitalize on the imminent wave of digital education 2.0. DR

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35. Pearson announced a partnership with GlassLab, a group of institutions focused on game- and simulation-based learning and assessment. (Source: Pearson, "Pearson and GlassLab: Game on!" December 2012.) In March 2013, McGraw-Hill Education launched the McGraw-Hill Practice, a suite of hands-on, experiential learning games that provides digital and personalized learning experiences. Government in Action is one such game, which McGraw-Hill Education developed in conjunction with Muzzy Lane Software. (Source: McGraw Hill Education, "McGraw-Hill Education enters higher education gaming market with launch of McGraw-Hill Practice line of simulations at SXSWedu," March 2013.) Pearson collaborated with augmented reality provider Layar to allow parents, teachers, and students to instantly launch interactive instructional content directly from a textbook page. (Source: Pearson, "New app makes print textbook pages come to life on a mobile device," October 2013.)
36. PRWeb, "Blackboard and Pearson collaborate in effort to better support K-12 schools," February 12, 2014, <http://www.blackboard.com/news-and-events/Press-Releases.aspx?releaseid=122714>.
37. D. Frank Smith, "Samsung's first K–12 tablet strikes the right balance for the classroom," *EdTech*, May 16, 2014, <http://www.edtechmagazine.com/k12/article/2014/05/samsungs-first-k-12-tablet-strikes-right-balance-classroom>.
38. Knewton, "Houghton Mifflin Harcourt and Knewton announce pioneering partnership to deliver adaptive learning solutions to K–12 students," June 6, 2013, <http://www.knewton.com/about/press/houghton-mifflin-harcourt-and-knewton-announce-pioneering-partnership/>.
39. Canvas Network, "Box builds ecosystem to modernize collaboration in education," August 8, 2013, <http://www.instructure.com/news/press-releases/box-builds-ecosystem-to-modernize-collaboration-in-education>.
40. Faulkes Telescope Project, "Research-based learning," <http://www.faulkes-telescope.com/education/rbl_approaches> accessed October 17, 2014.
41. Based on our analysis of VentureSource data from 2010 to 2014 (July 2014 YTD) and next-generation ed-tech companies that received venture capital funding.