In higher education, we are entering a period in which it is the connections between everything and everyone that are of importance. This development is most conspicuous in teaching and learning and is enabled by information technology, social media, and mobile devices. We are witnessing—and contributing to—the advent of connected learning, which is having an impact on all colleges and universities, faculty, and students.
Today’s learner is in a position to integrate a wide array of personal connections, resources, and collaborations—both local to and external to the learner’s campus—in order to construct the pathways that are needed to meet personal educational goals. Similarly, instructors have an unprecedented number of options among ways to plan, design, and execute a course, among ways to connect with and support learners, and among ways to situate learning in a wider variety of settings. Institutions have important opportunities as well to deliver highly personalized student support using analytics, to establish collaborations with traditional and non-traditional partners, and to construct entirely new models for courses and degree programs.

In many respects, this new emphasis on connections is a classic instance of the disruptive impact of disintermediation. When the traditional value propositions and business models are challenged and come under scrutiny, the door opens to new ideas, new relationships, and new players. We’ve all witnessed the growth of the for-profit higher education sector, the rapid increase in venture capital investment, and the continuing rise in importance of the online components in higher education. Today the campus must revisit many of the long-standing assumptions about how it conducts its business—even its teaching and learning “business”—and make explicit decisions about which assumptions to retain, which ones to revise, and which ones to retire. Because information technology is strategically fundamental to this process, it is vital that the CIO and other senior IT leaders be fully engaged.

A connected learning environment offers new ways to connect things that were previously considered disparate and “un-connectable”: people, roles, resources, experiences, diverse content, and communities, as well as experts and novices, formal and informal modes, mentors and advisors. Connected learning cuts across a wide variety of contexts, cultures, and perspectives; it is global with respect to reach. The connected learner now has greater personal agency with respect to his/her learning and academic progress. The learner can connect to an ever-widening circle of peers, mentors, coaches, resources, and instructors, even beyond those directly affiliated with a course. Instead of “island hopping” from one course to the next, learners can now craft and connect together all the elements of their learning experiences, both before and after graduation.

Connections enable the construction of pathways. The myriad of personalized and individual pathways is assuming an importance equal to that of the traditional pathways predetermined by higher education institutions. These new pathways are built out of the interplay of learners, faculty, and support teams—all on the foundation of IT infrastructure. Much like social networks, the new pathways and communities form organically, they come and go, and they often form in ways that can’t be anticipated, requiring new levels of agility by all participants in order to take advantage of the opportunities they offer.

This means that personalization in education will continue to grow and increase in importance. A consequence is that the new landscape is both complex and “messy.” In an era of BYOE and, increasingly, DIY, the academic landscape can’t be tidied up or standardized to the degree that is has been in the past. Nor can the campus IT infrastructure adequately serve this new environment without evolving in ways to keep in step. New questions arise: Which services should the IT organization continue to provide locally? Which ones should it outsource? Equally important is organizational culture: how can the IT organization be agile and flexible enough to keep pace with the rapid changes in teaching and learning?

This is not how our parents attended college. It is not how we attended college. The ground rules are changing. Connected learning both requires and drives a wider range and more rapid evolution of technology. The challenge for higher education is to design a new architecture for its learning mission. At the foundation and core of that architecture is information technology, in its role as the strategic enabler of connected learning. If we are to support students and faculty as connected learners and instructors, we must rethink our approach to academic technology architecture.

**Toward a New Architecture**

To date, many campus IT organizations are viewed not as partners for but rather as barriers to academic innovation. Their role is simply to administer the Learning Management System (LMS) and maintain the status quo. The status quo represents a barrier to connected learning and often forces those faculty who want to innovate to go around the central IT organization.

When we think of the current institutional IT infrastructure in higher education institutions, the turtle is an apt metaphor: slow and steady. The reasons for this slowness in adding services and applications are many, including processes that were designed for a less open and less connected world: security reviews, procurement, legal reviews, and system integration and testing. In the best of circumstances, it could take many months to go from a faculty request for a new service or application to the availability...
of the service or application. This “turtle effect” means that there is little incentive to explore new applications and services, let alone encourage personalization. The result is that this bureaucracy often serves as an impediment to academic innovation by faculty.

One key finding from the June 2013 report The State of E-Learning in Higher Education, published by the EDUCAUSE Center for Analysis and Research (ECAR), is that across every Carnegie institutional classification, survey respondents identified their optimal staffing level to support e-learning as more than double their current staff: the median desired percentage increase was 124 percent. The lack of staffing is clearly a barrier to innovation because staff are too busy to consider new ideas and approaches. With the advent of connected learning, the rate of change in the appearance and therefore evaluation for potential use of new technologies is already far exceeding that in the traditional e-learning infrastructure. Since staff increases to support technical innovation are highly unlikely to occur in the future, it is all the more important for CIOs to engage with their organization and with their institution to come up with scalable approaches for academic technology support as connected learning accelerates.

In a similar vein, the challenges in relationships between institutions and suppliers in terms of the fears of getting “locked in” or charged exorbitant license fees have led to a variety of open-source and institutional-led product alternatives. Unfortunately the net result has often been large institutional investments in the development of software that largely mimics the features and functions of accepted commercial products. Thus, rather than focusing on innovation in teaching and learning, IT expenditures go toward keeping up with the status quo via homegrown software that is not any better at fostering innovation than are their commercial counterparts. Therefore, although the justifications for campus-led and open-source software initiatives have been valid, IT leaders need to think about ways to take community software development to a new phase focused more on enabling connected learning innovation.

What will campus leaders and IT leaders need to do to evolve to an IT architecture that readily supports, and indeed enables, the connected learning scenarios described above? To get from here to there requires a new vision that sees a much more substantial role for IT leaders in supporting learning innovation and making investments targeted toward innovation. But those leaders will also need an open architecture that can provide a much more efficient foundation for adding and evolving innovative technologies. By “open architecture,” we do not mean open-source software, though we encourage open source to lead the way in promoting interoperability and connected learning. Instead, what we mean is an architecture based on “open standards” much akin to the open architecture provided by the Internet and the World Wide Web—both of which are based on open standards, developed and evolved through a community process. Such an open foundation, if one could be adopted by the higher education IT community, would enable unprecedented collaboration across institutions and suppliers, potentially accelerating learning technology innovation throughout the higher education segment in much the same way that the adoption of the web has accelerated innovation globally.

Specifically, this new open architecture for connected learning needs to support and enable unprecedented agility, flexibility, and personalization. What do these terms mean in the context of IT support for learning innovation?

Agility, in the IT context, means a focus on quick deployment and integration. It must be easy to pilot innovative technologies while they are connected to enterprise systems. Connection must occur with low risk of causing an interruption of service.

Flexibility, in the IT context, means building a catalog of services, or
“educational apps,” so that instructors can mix and match tools from a wide array of sources (i.e., traditional vendors, instructors, institutions, open sources) to best support their pedagogical goals. Flexibility also means the ability for teachers or students to try alternative resources or applications to aid in learning.

Personalization may seem alien to traditional IT cultures. But in the IT context, it means allowing faculty (and potentially students) to easily combine diverse sets of tools. Thus, the new IT architecture must afford a high degree of usability in the “mash-up” of resources and applications. Faculty must be able to easily include technology in the delivery of a course and to easily reconfigure the technology to meet their needs while teaching the course.

In short, the new IT architecture needs to enable an instructional environment in which technology “gets out of the way” and becomes highly supportive of teachers’ and students’ needs.

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A single application coming from a single source but is really a mash-up of services from multiple sources (e.g., a Google map included in a web page, or Dropbox leveraged as a web-based file repository).

The new IT architecture also requires that tools be able to “work together” to provide better information (analytics) to both faculty and students on their progress and to administrators on their usage. This may mean that data provided by apps is easily made available to an analysis service or even that one tool provides information directly to another tool. For instance, a classroom clicker application might import assessment items created in an LMS and transfer the results data back to the LMS, to a classroom capture system, or to both. An e-textbook application might accept links inserted by the instructor and send data on quiz performance to the LMS and send usage information to the bookstore.

To make the discussion more tangible, Figure 1 shows the types of content, software, and systems that need to be encompassed by the new architecture. In the upper left is the wide variety of learning environments that are today exemplified by the course, LMS, and portal and that in the future will evolve into diverse new forms, such as MOOCs. In the upper right is the growing number of learning tools and content that can be plugged into the learning environments. Such tools can be content-neutral, like a collaboration system, or content-specific, like an adaptive tutoring homework application that goes along with a specific textbook or content area. In the lower right are the other traditionally isolated academic applications, including the new or expanded standalone cloud services that provide specialized learning tools or services, many of which are already in use today.

**FIGURE 1. A NEW ARCHITECTURE FOR LEARNING**

![Diagram showing types of content and systems](image)
These include library systems, lecture capture, e-portfolio, and assessment systems used by faculty to create, grade, and analyze exams. Though these are typically siloed, in the future they will need to be seamlessly integrated for use by faculty and students so that data can be easily exchanged between systems. Finally, in the lower left are the “back office” enterprise systems that typically manage the “system of record.” These enterprise systems are critical in the context of learning analytics, since they provide a wide range of demographic and performance data and can be used to look at how student success changes over time.

The center of Figure 1 highlights some of the key areas of open standards and associated services (web services and application programming interfaces) that the higher education community (colleges and universities and suppliers of all types) must converge on in order to enable low-cost, agile, and seamless integration and data exchange among the four categories of software. This is not an exhaustive list but, rather, is representative of the types of exchanges that enable “connectedness” of applications within the context of an institutional or system-wide IT environment.

Most of the technologies and applications shown in Figure 1 are on campuses already. The problem is that they are not easily and seamlessly integrated—which is a key reason new technologies are not as valuable as they could be and are not as widely adopted as they were expected to be. The IT architecture for learning enables this integration by utilizing a collection of agreed-upon services, APIs, and data-exchange formats—all of which are captured in, and evolved as, community-managed open standards. These community standards and services reduce the effort and cost associated with developing applications that can be integrated into the architecture, as well as costs associated with supporting the architecture. Developing to these standards not only enables plug-and-play integration into an enterprise but also enables the sharing of innovative applications across communities that want to cooperate and share. Without wide agreement on services based on open standards, the future of educational information technology will remain the current “tale of two cities”: characterized by siloed applications or the large costs and time delays associated with custom integrations.

**Without wide agreement on services based on open standards, the future of educational information technology will remain the current “tale of two cities.”**

The following are several specific examples of what the open standards and services must enable to make this new architecture for learning a reality:

- Digital content and applications must be easily, quickly (ideally, within a few minutes versus months), and seamlessly integrated into any platform that supports a set of vendor-neutral open standards and, importantly, are not trapped inside a single platform.

- User, course, and context information must be synchronized among selected applications so that neither the manual transfer of information nor multiple logins to different applications are required—thus making set-up and use of new software much easier for all concerned.

- Data that describes usage, activities, and outcomes must flow from learning content apps to the enterprise system of record, learning platforms, and analytics platforms.

- Systems, services, and tools must be virtualized and must increasingly move toward the elastic computing model that enables sharing scenarios across systems or other federations of users.

Imagine what would happen if CIOs could safely add services and applications in a matter of days instead of months, if instructors could seamlessly combine these tools into their courses with one click, and if analytics data would begin to flow immediately thereafter. This new IT architecture would revolutionize the support for academic
We want to leverage the expertise in our community to identify and fill in the gaps that make connected learning a challenge today.

A Call to Action

The rise of the MOOC illustrates how important innovations often happen outside of established channels: by faculty who, interested in innovation, put together their own technology solutions outside their college or university. This should be a wake-up call for the higher education community to do better. Enterprise IT organizations need to enable such innovation, not stand in its way.

Through initiatives such as the Next Generation Learning Challenges, or NGLC (http://nextgenlearning.org/), much work has been done under the guidance of EDUCAUSE to work on different aspects of the learning infrastructure, with a goal of using technology to improve learning outcomes and student success. At the same time, organizations such as the IMS Global Learning Consortium (http://www.imsglobal.org/) have focused on standards development and the interoperability of learning environments and tools (the top half of Figure 1), while groups such as Internet2 (http://www.internet2.edu/) and InCommon (https://incommon.org/) have focused on enterprise integration across the institution and integration extending to and enabling cloud services (the bottom half of Figure 1). As a result, we now have the basis for developing an IT architecture for connected learning. This community effort toward such an IT architecture has been building for more than a decade, leveraging the work of thousands of people, hundreds of commercial vendors, and millions of dollars of support from the Bill & Melinda Gates Foundation, the Lumina Foundation, and the Andrew W. Mellon Foundation. But even though all parties have been moving toward the broad common goal of using technology to improve teaching and learning outcomes, we still need more direct collaboration to align our respective organizations in a way that will accelerate change and quickly promote adoption.

If we in the community come together to promote utilizing a collection of agreed-upon services, APIs, and data-exchange formats—all of which are captured in, and evolved as, community-managed open standards and services—we will be able to identify and address the remaining gaps. We know this is possible. In just a few years, IMS Global has been able to achieve more than 200 voluntary conformance certifications across a wide range of applications and tools based on community-developed and community-managed standards. It is now time for a new phase of leadership. This new phase requires help from institutional leaders to guide not only the standards themselves but also a new collaboration among institutions to accelerate deployment of these standards to enable the IT architecture that will support connected learning.

To reach this goal, groups such as IMS Global, Internet2, InCommon, and EDUCAUSE are proposing a series of initiatives to engage the community in developing and building a shared vision to define and build an IT architecture for connected learning. We want to leverage the expertise in our community—from groups such as ITANA (the higher education enterprise, business, and IT architects work group, http://itana.org), the InCommon Technical Advisory Committee, and commercial or open-source developers—to identify and fill in the gaps that make connected learning a challenge today. We are proposing a series of meetings over the next twelve months:

- Fall 2013: ITANA releases the first draft of its reference architecture for teaching and learning. We hope that this document will generate interest across the community, and it will...
be discussed during the fall at the EDUCAUSE annual conference, InCommon Identity week, and the IMS Global Developer meetings.

Winter 2014: At the EDUCAUSE Learning Initiative (ELI) annual meeting, we hope to publish a roadmap and identify some quick opportunities for success that can be delivered in 2014.

Spring/Summer 2014: We plan to deliver on the quick opportunities to implement the roadmap and continue the broad efforts at outreach in the community through the regular meetings of IMS Global, EDUCAUSE, and Internet2.

We expect these meetings to bring about the following results:

1. InCommon, IMS Global, and ITANA will begin to address interoperability issues in the respective efforts.
2. The Internet2 NET+ Services (http://www.internet2.edu/netplus/) will continue to work to define contract and procurement terms that will quickly enable the procurement and adoption of new services in learning.
3. IMS Global will convene vendors and institutional stakeholders to adopt and adhere to community-developed standards.

What has been missing and is needed for success in this effort is for campus IT leaders to make connected learning one of their priorities. We must collaborate across our Carnegie classifications to develop solutions that will work effectively for all institutions. At the same time, recognizing that institutions will move to adopt at different paces, we need as many institutions as possible to communicate a shared vision to vendors at the meetings noted above.

It is up to the community of IT leaders in higher education to be the drivers of this new architecture for connected learning. In coming together, everyone wins—colleges and universities, vendors, faculty, and most important, students.

Notes

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