Top 10 Strategic Technologies Impacting Higher Education in 2017

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Gartner identifies the top 10 strategic technologies relevant to the higher education industry in 2017, highlighting the impact on IT organizations, and provides recommendations to higher education CIOs.

Key Findings

- Technology is increasingly seen as a crucial enabler for new strategic capabilities in higher education institutions, and CIOs are being asked to identify and implement game-changing technology.
- Some technical innovations are emerging from within higher education, but most will emerge outside of higher education, driven by major forces such as consumerization and the industrialization of IT.
- Four technologies from last year’s top 10 list have been replaced in the 2017 top 10 list. The new technologies are virtual reality and augmented reality, hybrid integration platforms, institutional video management, and robotic telepresence.

Recommendations

Higher education CIOs focused on executing a digital strategy:

- Focus on technologies that are appropriate for your institution's strategy. Some can help you run the institution, while others can help you grow or transform the institution's business model.
- Make sure that senior leadership considers the top 10 business trends and top 10 strategic technologies when building the institutional strategy and evaluating IT projects.
- Take a broad approach to technologies, and consider those outside the higher education community. As always, also look for lessons learned from your peers.
- Review the top 10 business trends and top 10 strategic technologies, and their implications on your institution, at least twice a year as part of your regular technology planning exercises.
Analysis

The technologies discussed in this research are those that higher education CIOs should have on their radars in 2017. This research is strongly related to the top 10 business trends described in the accompanying piece, "Top 10 Business Trends Impacting Higher Education in 2017." It is not a list of what higher education CIOs spend the most time or money on; it is a list of strategic technologies according to Gartner (see Note 1).

Education leaders have long been looking at how technology can reduce costs and drive efficiencies. Now, they are increasingly looking at how technology can enhance competitive advantage and support emerging business models — and ultimately, the institution’s main missions of education and research. Some technical innovations from the mainstream of the IT world, or from other industries, are creating opportunities to leverage technology that did not exist previously in the
higher education community. So, need (which is driven internally) and opportunity (which arises externally) are influencing the overall technology adoption, as well as informing institutional strategies.

The expanding education ecosystem is increasingly competitive. For institutions to thrive in this environment, they must become more innovative, and it is often technology that will underpin that innovation. The Gartner top 10 strategic technology list aims to inspire CIOs to stay current and leverage key technologies early on.

CIOs should consider these key points when assessing strategic technologies in higher education:

- For technology advances that reach across multiple industries — that is, cloud, big data, mobile, social media, advanced analytics and the Internet of Things (IoT) — apply best practices and lessons from other early-adopter industries.
- For new education technologies, develop strategies, such as bimodal (see "Deliver on the Promise of Bimodal"), to assess, adapt and respond to new technologies, making sure they are a good fit.
- Before embarking on a particular technology initiative, look at Gartner research, such as Hype Cycles and Strategic Technology Maps, and anticipate the technology adoption risks. Some trends are at an early stage of enterprise adoption, with a consequently higher risk of failure.
- Understand the interdependencies of some of these strategic technologies and top business trends. Ensure that new developments in multiple areas are coordinated and done in lock-step where necessary.

The top 10 ranking is based on several different sources, including non-industry-specific Gartner research (see "Top 10 Strategic Technology Trends for 2017" and "The 2017 CIO Agenda: Seize the Digital Ecosystem Opportunity"), our ongoing research and interaction with higher education clients globally, and our increasing collaboration with institutions in strategic planning involving senior academic leaders. We define the context for this top 10 list as a large public university in a mature market (such as the Western market). This is also what we refer to as "Everybody’s U" in the Gartner higher education business model scenarios (see Note 2).

Build a Customized List of Top 10 Technologies for Your Context

We are fully aware that this ranking, or even the content of the top 10 list, may vary between regions, and even between institutions in each region. Therefore, we produced "Toolkit: Workshop for Building a Customized List of Top 10 Strategic Technologies in Higher Education, 2017." The Toolkit includes a template for clients to rearrange the order of the strategic technologies presented here, as well as in previous top 10 lists, and — most importantly — add their own strategic technology trends.

In addition, we offer a visualization of the top 10 strategic technologies, building on the concepts of two of our most popular tools: the Gartner Hype Cycle and the Strategic Technology Map. This view helps clients look at the trends from various points of views to gain additional information about their relative maturity and importance. It is worth noting that, in the case of the top 10 strategic
technologies, there will be a certain overlap with the "Hype Cycle for Education, 2016." However, we aim, through this top 10 selection and the corresponding Toolkit, to bring another hands-on dimension to strategic technology coverage for our clients.

Assess the Top 10 Strategic Technologies in Education

Our top 10 strategic technologies impacting higher education are:

1. Open Microcredentials
2. Digital Assessment
3. Predictive Analytics
4. Adaptive Learning
5. Virtual Reality (VR)/Augmented Reality (AR) Comeback
6. Hybrid Integration Platforms
7. Institutional Video Management
8. Artificial Intelligence
9. Listening and Sensing Technology
10. Robotic Telepresence

These top 10 technologies fuse with the top 10 business trends we have highlighted for higher education (see Figure 1 and "Top 10 Business Trends Impacting Higher Education in 2017").

Figure 1. More Than Aligned: Technologies and Business Trends in Higher Education Are Fused

Source: Gartner (December 2016)
1. Open Microcredentials

*Analysis by Jan-Martin Lowendahl and Terri-Lynn B. Thayer*

**Description/Definition**

Open microcredentials are ecosystems of open digital "signs," "certificates" or "badges" of accomplishments that can be used by an individual to indicate skills learned, no matter the circumstance (for example, in a university or in the workplace). They are referred to as "micro," because they often represent more-granular levels of achievement, rather than the multiyear endeavors represented by a diploma.

**Key Findings**

Open microcredentials have the following characteristics:

- Represent smaller, well-defined chunks of learning, accomplishment or achievement.
- Are closely related to gamification, and have won acclaim for their use by education ecosystem players such as Khan Academy.
- Enable big data through harvesting data — for example, open badge information on the internet.
- Support the real vision of the e-portfolio in that it makes accomplishments a visible part of lifelong learning outside any particular organization where the learning happens.
- Offer employers a new vehicle for assessing competency, and encourage employer involvement in outcomes.
- Enable new higher education business models.

**Implications**

Microcredentials in the form of various badges or points have existed for some time in digital social environments in general, and in learning environments in particular (often as part of a gamification strategy). Open badges, in particular, are a low-cost, high-value option to improve student experience. If designed properly, it can give the institution more data (even big data) about its student population by harvesting badges from preinstitution and postinstitution learning. Furthermore, it can build the institution’s brand and help market it.

A key problem is that, to date, many of these environments are proprietary and closed, which makes it difficult to display achievements outside of these "walled gardens." The aim of open microcredentials is to remedy that problem, allowing anyone to issue credentials that can be portably collected and displayed by an earner, with a built-in verification mechanism back to the issuers. Creating a truly open and trusted microcredential ecosystem is a challenging task, but we believe that open standards such as the Open Badges standard can make it happen.
At the very least, open microcredentials bring promise to do what the e-portfolio never quite managed — that is, to create portable recognition for achievements on a global scale. This is a good impact in itself, and can improve mobility in the workforce, leading to a better fit between skills and employment. On the other hand, this poses another potential threat to traditional education institutions that rely on the value of government-accredited degrees. If Open Badges is a success (that is, it is accepted by employers), it will strengthen open, but individualized, programs of study for credit or noncredit in their competition with the many community colleges and public institutions that have limited entrance restrictions, and are driven by a clear government mission to provide cost-effective, accessible and relevant education. Open Badges will be a significant disruptive force, pressuring the long-standing higher education business model that is largely predicated on the universal acceptance of the value of a bachelor’s degree.

Some very interesting developments might take this idea further, such as the combination of standardized (international) e-transcripts, secure distributed ledgers based on blockchain, and an extension of the open badge idea to an ecosystem (including "requirement badges" and "attainment badges") that allows for artificial intelligence (AI) matching of skills. However, these will need to mature considerably before they can make an impact.

Open microcredentials are still relatively immature as a technology. Yet, they are gaining traction in the education community, and we see them as a clearly strategic technology that needs a relatively small investment to get started — thereby making it a low-hanging fruit with good ROI. As microcredentials become more mainstream, it will become imperative that the institution’s student information system (SIS) and learning management system (LMS) support the issuance and tracking of these credentials.

**Recommendations**

Higher education CIOs:

- Identify the necessary system changes required (such as to the LMS and SIS) to enable the institution to both issue and accept an "open credential" that is verified by a relevant trusted party, and is attached to a secure digital identity.

- Identify potential external collaboration partners, such as Credly, to leverage education ecosystem player capabilities.

- Work with the academic institutional leadership (such as the provost and registrar) to make sure that open microcredentials are an academically led project and not a technology-led project.

- Experiment with issuing microcredentials for noncredit activities, such as internships, volunteering and extracurricular endeavors.

**2. Digital Assessment**

*Analysis by Glenda Morgan*
Description/Definition

"Digital assessment" refers to the application of digital technologies to create, administer, report and manage tests and examinations.

Key Findings

- Digital assessment is an increasingly important aspect of online learning as it feeds into a number of growing areas, such as analytics; adaptive learning; competency-based education; and new regimes of scrutiny, transparency and accreditation.
- Digital assessments provide much raw data on which other systems build, such as CRM for retention and predictive analytics.
- Innovation in digital assessment is occurring in terms of the scale at which it occurs and in new methods, techniques and technologies being developed.
- Many institutions are making increasing investments in new assessment technologies. Often, the impetus for these investments is coming from disparate parts of the organization, driven by different assessment needs.

Implications

There are two essential types of digital assessment technologies: (1) those used for reporting and compliance; and (2) those that are a core part of improved learning environments.

In the reporting and compliance group are technologies such as:

- Assessment management systems for collecting, collating and reporting learning outcomes and objectives at the departmental, program and institutional levels
- Authentication systems for online learning to ensure that students are who they say they are
- Technologies for administering exams in a secure fashion, including proctoring and invigilation technologies to ensure that cheating does not happen in remote learning and that, if it does, it is easy to catch and prove
- Course evaluation and survey systems

In the group of digital assessment technologies that form a core part of learning are tools such as:

- Moving assessments online and making them available via mobile technologies
- Gamification systems and ways of building in gamification, based on assessment of learning, into applications
- Invisible assessment, where formative data is gathered from learners without their being aware that they were in an exam
More-complex means of creating and grading questions, especially open-ended and text-based questions, and sharing question banks as well as analyzing assessments and answers to pinpoint areas of student misconceptions and misunderstanding

Automated and real-time creation of assessments, including those embedded in technologies such as competency-based education and adaptive learning platforms

Currently, the technologies are more mature in the reporting and compliance group of assessment technologies. Many of these technologies are in response to new needs or are replacing homegrown solutions, and this can be a burden on IT budgets, as the lines for these items did not exist previously. The demand for many of the systems in this group of technologies frequently comes from disparate parts of the campus, such as institutional research, an assessment office or a center for teaching excellence. This can sometimes present a challenge to IT when disparate groups purchase systems without consultation, as there are frequently integration and data implications.

Over time, the more innovative technologies in digital assessment tools that support teaching and learning are likely to find their way into learning systems such as LMSs or virtual learning environments (VLEs), adaptive learning systems, mobile learning applications, and all forms of content delivery. New assessment technologies reflect a shift away from a focus on summative assessment to formative assessment as a critical pedagogical tool. The results of these formative assessments are then used to craft more personalized and targeted delivery of instruction to address knowledge gaps. In this way, assessment tools are becoming a critical aspect of achieving personalization at scale.

**Recommendations**

Higher education CIOs:

- Work proactively with departments on campus to identify needs and technologies for digital assessment reporting and compliance so that you are not having to find ways to implement and support purchased systems after the fact.

- All digital assessment technologies rely on and produce data, often in prodigious quantities. As a result, make sure you have a data governance framework in place, and that digital assessment is part of that framework.

3. **Predictive Analytics**

*Analysis by Glenda Morgan and Terri-Lynn B. Thayer*

**Description/Definition**

Predictive analytics involves extracting an analytical model from multiple sources of data to predict future behavior or outcomes.
Key Findings

- Predictive analytics are seen by higher education leaders as a key part of strategies to improve student success and save money through improved retention.
- Predictive analytics has the highest profile among analytics approaches in higher education today, to the point where it has become almost synonymous with analytics.
- A majority of the higher education analytics tools currently on the market claim to use predictive analytics, but many of them rely on a constrained model and relatively few sources of data.
- Most higher education CIOs express an interest in jumping right into predictive analytics as a first step into analytics.

Implications

Predictive analytics are used to analyze multiple data sources to answer the question of what will happen. In this way, predictive analytics are different from descriptive analytics (What happened?), diagnostic analytics (Why did it happen?) and prescriptive analytics (Tell me what to do.).

In higher education, predictive analytics can be used in many parts of the institution to answer many types of questions, for example:

- In enrollment, predictive analytics can be used to determine which students are most likely to accept an offer, and what level of financial aid is likely to be sufficient to ensure that certain types of students will accept an offer.
- In advancement, predictive analytics can be used to determine what groups of people are likely to donate what amounts to institutions.
- In terms of student learning, predictive analytics can be used to determine the following:
  - Which transfer students are most likely to be successful
  - Which students are most likely not to be retained
  - Which types of courses present more of a barrier to student success
  - What types of instructional strategies work better than others

It is clear that the use cases for predictive analytics are so broad and the data sources so wide and potentially deep that it is unlikely that one toolset will be appropriate for all of these scenarios. That said, care should be taken not to become too distracted by the mounting market options that one loses sight of the business problems to be solved. In Gartner’s experience, the institutions that are getting the most value from predictive analytics are those that have had clarity around business questions and institutional analytics objectives, modest and simple pilots, and fewer rather than more technologies to learn and integrate.

As the volume of data increases, so does the predictive nature of the analysis. For this reason, a number of services amass data from multiple institutions and offer analysis that relies on the larger
dataset for both predictive institutional insights and cross-institutional benchmarking. While this has proven to be a more difficult task than originally understood, this is clearly an important future for the use of predictive analytics in higher education.

**Recommendations**

Higher education CIOs:

- Develop a high-level analytics strategy for your institution that includes predictive analytics as part of a broader approach to use data to inform decisions and take action.
- Always start your analytics initiative by identifying the key questions you want predictive analytics to address, and what data you have.
- Walk before you run. Start by exploring the "lower order" analytics (such as descriptive and diagnostic analytics), and building these capabilities before moving on to predictive analytics (see extensive Gartner research on these forms of analytics).
- Explore opportunities through consortia (such as the Council of Independent Colleges) and vendors (such as Civitas Learning and Hobsons) to benchmark your institutional data with those of peer institutions.
- Prepare your institution to engage in an analytics cycle that involves steps to define the problem and associated algorithm, and then measure, analyze and act on the results, followed by refining the algorithm (applied on, for example, enrollment and adaptive learning). Predictive analytics is about applying an algorithmic approach to data and is best approached as an iterative activity.

4. Adaptive Learning

*Analysis by Glenda Morgan*

**Description/Definition**

Adaptive learning dynamically adjusts the way that instructional content is presented to students based on their comprehension of the material as revealed in their responses to embedded assessments or to learner preferences such as visual presentation of materials. Adaptive learning is increasingly dependent on a large-scale collection of learning data and algorithmically derived pedagogical responses.

**Key Findings**

- Adaptive learning takes two major forms: (1) textbooks, where algorithms are packaged with content from a publisher for an end user; and (2) platforms, where end users add their own content to an adaptive learning environment.
- There are two major types of adaptive learning: macroadaptive systems and microadaptive systems. Macroadaptive systems tailor learning to an audience, usually based on a prior profile
of the learner’s or group’s needs. Microadaptive systems continuously tailor learning delivery, based on the student’s ongoing actions at every stage.

- Microadaptive systems provide variable learning paths and content, based on a rule-based engine (if-then), based on the learner’s asserted preferences or based on an algorithm fed by statistical analysis of learner assessment data.

- Institutions are increasingly looking to adaptive learning to help solve the challenge of providing scalable personalized learning as shown by, for example, the growing ecosystem of vendors.⁴

**Implications**

An increased interest in scalability, personalized learning and improved learning outcomes is driving a growth in the number of institutions interested in and actually implementing adaptive learning in higher education. This trend is coming to the attention of CIOs due to the growing prevalence of adaptive learning platforms. Adaptive textbooks are selected by the instructor or sometimes the department, and are purchased by students. The most that the CIO or IT department became involved was to integrate an application into the institutional LMS.

With adaptive platforms, this all changes. A majority of the adaptive learning platforms are now available to institutions to license. Institutions can thus have instructors and instructional designers work to build adaptive content onto the platform through which students work either as a supplement to a course or as the entire course. Institutions that have piloted or implemented adaptive learning in this fashion are reporting positive results in terms of student learning and satisfaction.

Many of these institutions do report that using adaptive learning platforms requires a large effort on the part of instructors and instructional designers. There are additional concerns about the applicability of adaptive learning to upper-division courses, and to some disciplines where the nature of the content does not lend itself to being broken down into fact-based chunks. Many adaptive learning tools are still a bit immature, a problem exacerbated by the fact that the algorithms are not transparent, and many overhyped claims are made about the efficacy of adaptive learning, without an acknowledgment of the limits and challenges of implementing the technology.

**Recommendations**

Higher education CIOs:

- Identify a small core group of faculty in a department that could benefit from an adaptive learning approach, and work with the group to pilot one or more platforms. Do a thorough evaluation of the pilot to identify successes, challenges and lessons learned.

- If your current LMS includes an adaptive learning tool, then identify instructors who are using the tool, or incentivize instructors to do so in order for you to learn the promise, the challenges and the best practices involved in using the technology.
To avoid political push-back, work to build alliances and collaborations across multiple groups of stakeholders on campus. Be aware of the depth of support needed to implement adaptive learning, especially adaptive learning platforms.

5. VR/AR Comeback

Analysis by Glenda Morgan

Description/Definition

Virtual reality and augmented reality are two different, yet related technologies that are both rapidly maturing. VR technologies create computer-generated environments to immerse users in a virtual environment. AR technologies overlay digital information on the physical world to enhance it, guide action and allow for more freedom of movement.

Key Findings

- There is renewed interest in and adoption of VR and AR applications in higher education in specialized settings, such as medical schools, and more general-purpose settings (see, for example, "The NMC Horizon Report: 2016 Higher Education Edition").
- The renewed interest is driven in part by increased availability of VR and AR tools and platforms often at lower price points than has been the case, as well as substantial investment by a number of companies such as Facebook to develop educational content.
- However, there is still a significant trade-off between price and quality in many of the VR and AR tools available, based on interviews with early adopters.
- Adoption of these tools on a large scale is still in its very early stages (for example, Saint Louis University School of Medicine and Case Western Reserve University), and we are likely to see substantial development of new applications over the next few years.

Implications

The new generation of VR and AR applications and tools promises to support a wide variety of learning activities, including:

- Field trips, allowing users to virtually experience trips to remote and unlikely places, such as historical settings (for example, the Google field trips using Cardboard, or using Oculus Rift to tour a virtual version of the ancient Egyptian Tomb of Menna).
- Vocational or practical training, providing simulated experiences or guiding activity with a digital overlay.
- Collaboration and engaged teaching environments that leverage shared-viewing-enabled applications and platforms to enhance social and teaching presence, as well as bring content and special effects into lecture environments to improve the experience and outcomes.
Virtual classrooms, which are self-contained learning environments in which instructors can simulate events and experiences (for example, Immersive VR Education's Engage Educational Virtual Reality Platform).

More-engaged interaction with content (products such as zSpace, Unimersiv, Alchemy VR, Curiscope or IndyLab VR).

A deeper and richer engagement in order to understand 3D objects and spaces more completely (for example, viewing a holographic rendering of the functioning of the human heart in Anima Res’ Insight Heart application, or walking through a virtual rendering of the design of a physical space with the SketchUp Viewer for HoloLens).

VR and AR are also beginning to play a role in areas such as athletics — for instance, for football training. We are likely to see increased adoption of these technologies to support administrative functions and other aspects of the student experience — for example, in delivering campus tours. Research is an obvious area that is ripe for application of VR and AR, but as yet, adoption of VR and AR for pure research outside of education and training has been slow. However, there are growing signs of its adoption — for example, to support visualization in the advanced computational sciences and manufacturing.

**Recommendations**

Higher education CIOs and IT leaders:

- Develop a potential set of use cases for VR and AR (such as AR guided tours of archeological sites, or VR labs to learn to recognize and handle chemistry equipment) to help you identify VR and AR technologies that will work well for your institution and avoid costly mistakes (see also "Market Guide for Augmented Reality" or "Competitive Landscape: HMDs for Augmented Reality and Virtual Reality").

- Experiment and evaluate the different AR and VR vendor platforms to identify key requirements relative to pedagogical goals particular to your institution before scaling up. At this early phase, the platforms vary significantly, according to interviewed early adopters and Gartner research (see, for example, "The NMC Horizon Report: 2016 Higher Education Edition").

- Experiment with small, contained pilots (such as historical site recreation) leveraging engaged campus partners (such as history faculty and students) to better understand the scope of support and skilled staff time needed to maintain a larger VR and AR presence on campus.

- Consider using VR and AR educational applications to be a key institutional differentiator and a powerful tool for marketing and name recognition. Use development options through in-house teams or vendor partnerships (as suggested by "The 2017 CIO Agenda: Seize the Digital Ecosystem Opportunity"), consulting top performer data to deliver new applications not yet on the market.
6. Hybrid Integration Platforms

*Analysis by Terri-Lynn Thayer*

**Description/Definition**

Integration technologies link applications and data to each other. A hybrid integration platform takes advantage of the best cloud-based and on-premises integration approaches — assembling a federated set of on-premises solutions such as an enterprise service bus (ESB) and cloud-based integration technology to link together business applications both on-premises and in the cloud.

**Key Findings**

- Integration abilities are a key component of interoperability, which is an enabler of digital business.
- Education institutions are increasingly adopting cloud-based business applications, resulting in a hybrid portfolio of cloud and on-premises systems.
- These hybrid business application environments, sometimes referred to as "hybrid ERP," drive a diverse set of integration requirements that often cannot be met by one toolset or approach.
- Not only are the requirements diverse, but also the tools available are diverse and include API management, ESB, integration platform as a service (iPaaS) solutions, and integration brokerages and frameworks.
- The growing importance of data in the digital business world is expanding the interest in data access and integration capabilities beyond technical experts in central IT into the business units, spawning the need to support the emerging role of citizen integrator.

**Implications**

As institutions increasingly adopt cloud-based business applications, while retaining some applications on their premises, the result is what Gartner has defined as the postmodern hybrid ERP scenario (see the "Hybrid ERP" technology profile in "Hype Cycle for Postmodern ERP, 2016"). These multisourced environments demand a more complex set of integrations that include cloud-to-cloud and cloud-to-ground elements, in addition to the traditional ground-to-ground integrations that have existed for years. Compounding this is the need to integrate a broad range of systems that include not only the ERP, but also other large systems of record, such as the CRM, LMS, advancement, research management and data warehouses.

Many institutions today have an integration strategy and corresponding toolset that were established largely based on their on-premises integration needs. Integrations in that environment were often based on the transfer of data via flat files in batch. Some institutions have implemented on-premises ESB technology to serve as the centerpiece of their integration frameworks, thus allowing them to better manage these integrations. However, today, as institutions procure cloud business solutions, they are faced with how to integrate these elements. It is also now increasingly common to see SaaS vendors in the higher education marketplace, such as Workday bundling
integration tools like iPaaS as part of its offerings. There are also a growing number of independent iPaaS offerings, and some vendors specifically focused on the higher education space such as N2N Services. Compounding the choices in toolsets are growing demands for more real-time integrations between applications, rather than batch.

This convergence of more components to integrate, with more complexities in the integration requirements, diverse tool options, real-time needs and growing interest for support of self-service integrations from the business, will require the CIO to take a leadership role by developing an integration strategy that aligns with the institution's ERP and business application strategy. For institutions that have a "hybrid" business application environment, it will likely mean that a hybrid integration platform will be the best strategy for the institution. This will require identifying key technologies for on-premises and cloud integrations (see "Market Guide for Hybrid Integration Platform-Enabling Technologies"). The integration strategy and tool selection must be done with consideration of the new citizen integrator role, with CIOs recognizing the diversity in citizen integrators' requirements and skills as compared with those of central IT integration staff. The CIO should exhibit an openness and promote a supportive culture relative to the citizen integrators by enabling their self-service needs (see "Comparing Three Self-Service Integration Architectures").

Recommendations

Higher education CIOs:

- Ensure the development of an integration strategy that aligns with your ERP and business application strategy. If your application environment is hybrid (both on-premises and cloud), then your integration strategy should be a hybrid integration platform (see "Address Integration for Hybrid Postmodern ERP and Business Application Scenarios").

- As you move from strategy to implementation, consider the broad range of tools available to address the diversity of integration requirements. Make sure to apply the right tool for the right integration job (see "Market Guide for Hybrid Integration Platform-Enabling Technologies"). Be cautious about letting a single tool dominate your integration strategy.

- Recognize the importance of citizen integrators, and remove barriers to their success. Consider piloting a do-it-yourself integration effort to show support for and better understand the requirements of the citizen integrators in your institution (see "Market Guide for Integration Software as a Service").

7. Institutional Video Management

Analysis by Adam Preset and Glenda Morgan

Description/Definition

Institutional video management is the use of dedicated and college- or university-branded software, appliances or SaaS to manage and facilitate the delivery of one-to-any, on-demand video.
Key Findings

- Many colleges and universities are rapidly increasing their use of video in teaching and learning, research, and service.
- Increased adoption of online learning and innovative teaching methods, such as flipped classrooms, are helping drive adoption of institutional video management, as these modes are increasingly reliant on video as a means of delivering content.
- Video is an increasingly important aspect of college and university outreach through the use of streamed events to the public, prospects, academic communities and alumni.
- Institutions require a dedicated means of managing and delivering video as a way of controlling the message and brand.
- Because of the prevalence of consumer-grade options available, many parts of the institution may have pursued localized solutions, and implementing an institutional dedicated, consolidated solution can be daunting.

Implications

As institutions' video needs expand, they are increasingly investing in dedicated video management services either on-premises or in the cloud. The institutional video management services that higher education institutions require generally include the following:

- A means of cataloging and indexing the content
- Extensive search capabilities
- The ability to control access in a very granular manner
- Video streaming
- The ability to integrate with key systems such as the institutional LMS and lecture capture
- Simple tools that enable user-generated content
- Workflow automation to ingest class meeting recordings and desktop microlecture capture for use in flipped classroom scenarios
- The ability to share, comment on and build additional features such as quiz questions into the video
- A way to report and visualize usage metrics and other analytics

Sample vendors include Kaltura, Panopto, Tegrity and Sonic Foundry (this is not an exhaustive list).

Video management is a key component allowing for broadcast of lecture capture and desktop capture content. Yet those use cases are only part of a broader set of uses that higher education institutions are finding for video and video management systems, such as outreach, marketing and preservation of content.
Providing access to video content for people with disabilities is also a key requirement for many higher education institutions, and is a key capability they look for in a provider, but an issue with which many providers struggle as standards and requirements evolve. Student-created video is likely to be a growing aspect of this area, but potentially poses a big challenge for higher education CIOs as they seek to manage storage and bandwidth costs in a SaaS environment.

Some of the leading LMS providers are beginning to expand their offerings by adding video management capabilities, expanding the kinds of options available to CIOs.9

**Recommendations**

Higher education CIOs:

- Work with stakeholders (such as faculty, education technology department and audiovisual support) across the institution to develop an organizationwide media strategy before investigating and deploying any particular solution.
- Do a thorough needs analysis of your current and near-term institutional needs for video management and streaming, including developing use cases, to design an architecture that is both holistic and sustainable.
- Do a total cost of ownership (TCO) analysis of an on-premises solution versus a cloud or a hybrid approach. Include in this analysis a consideration of available staff and skills, as well as likely growth in the service and how this will affect costs.
- Make plans to review your institutional video management strategy at least every three years as this product space is changing rapidly.
- For those who choose to adopt a SaaS provider, explore what options are available for hybrid storage and other ways of managing cost.

8. **Artificial Intelligence**

*Analysis by Jan-Martin Lowendahl*

**Description/Definition**

Deep neural-network-based AI systems analyze massive amounts of data beyond simple algorithms. They learn to identify and classify input patterns, probabilistically predict, and operate unsupervised.

**Key Findings**

- AI can be used for analytics, student and faculty advice, adaptive learning, and improving research productivity.
- Increasingly complex data sources (such as tweets, Facebook, campus cards and a plethora of IoT devices), combined with larger volumes of traditional data (such as SIS, LMS and CRM
data), drive the need to use AI such as IBM Watson Analytics for finding correlations with student success.

- AI is envisioned as the next natural evolution of current adaptive learning approaches, such as Knewton. Use cases range from more near-term practical, such as automated tagging, to long-term visions such as IBM Watson serving as a lifelong tutor.

**Implications**

As globalization and political belief in a market force approach to higher education continue to increase competition, AI will be a key differentiator in personalizing the student experience, as well as increasing research productivity.

AI is already changing the professions for which higher education is teaching, such as medical doctors. This is leading to a potential surge in relearners, and a change in the focus of skills sought after by new students. The most prominent example is the use of IBM Watson in healthcare, but many professions stand to be impacted, from practical professions, such as driving vehicles, to more theoretical professions, such as accounting and even research. Higher education institutions will need to adapt to the change in prospective student profiles to recruit effectively.

Institutions such as Deakin University have already deployed smart machine advisors that enable 24/7 student support (see "Deakin University Uses Smart Machines to Innovate Student Engagement"). Deakin is also actively working on increasing student productivity by facilitating collaboration, as well as supporting the analysis of learning materials (see the Deakin Genie video — in particular, 2:15 to 3:05). The "Watson Discovery Advisor" has aided a research team from Baylor College of Medicine to analyze more than 70,000 articles related to a protein (p53) that has been linked to many cancers and identify six related proteins to target for new research — all in a matter of weeks as opposed to, on average, one protein candidate per year previously (see "Automated Hypothesis Generation Based on Mining Scientific Literature"). The productivity increase promised by AI cannot be disregarded if institutions want to remain competitive in some fields.

Higher education institutions gain a competitive advantage in preparing students for success if they can change the way they are teaching for professions that will have a machine on the team — as well as use the machine on their own teaching teams. This will also improve the scaling of scarce resources, leading to better chances of sustained funding.

**Recommendations**

Higher education CIOs:

- Create, collect and categorize data sources to prepare for use with AI. Make sure that any contract that your institution enters with a service or product provider also includes ownership and easy access to employee-, student- and faculty-generated data.

- Adopt exostructure standards (see Note 3), such as Caliper, LTI and xAPI, and look into ideas such as personal learning graphs (PLeGs). Even if AI systems are supposed to digest natural language, structured or semistructured data will enable data sharing and larger datasets, and will improve the quality of AI advice.
- Experiment with services for AI analytics such as Watson Analytics now (for example, to analyze social media such as Twitter to gauge sentiments and brand recognition, together with enrollment prospect data demographics).
- Encourage academic leadership to assess how AI is changing the professions they are teaching for, as well as how AI can change the way they teach.
- Engage research teams in exploring how AI can improve research productivity and, ultimately, competitive advantage in grant applications.

9. Listening and Sensing Technology

*Analysis by Terri-Lynn B. Thayer*

**Description/Definition**

Listening and sensing technologies are a broad collection of virtual capabilities that range from social listening and sentiment analysis through capture and interpretation of social activities, such as tweets to technologies that operate in the IoT space.

**Key Findings**

- Digital business and the IoT are enabling the use of technologies that leverage social and mobile, while also blurring the line between the physical and the virtual worlds. For example, beacon technology can be used to understand student movements on campus and to deliver content.
- The higher education industry is immature in the use of listening and sensing technology and can learn from industries like retail, which are more mature with these tools as primary elements of social marketing.
- Higher education use cases for these technologies span administration, academics and research, such as campus tours, classroom attendance and collection of research data in the field.

**Implications**

The use of technology to listen to and sense what higher education constituents are saying or doing is a relatively new phenomenon. Other industries, most notably retail, are far out in front in using technology to assess sentiment, and protect and nurture the brand, a practice that is referred to as "social marketing." In higher education, the use of social listening tools and social harvesting tools is in a nascent stage, and when employed, it is most often used to aid in recruiting and enrollment. There is potential for it to play a significant role across the entire student journey. However, most institutions are at very low maturity levels with these tools today (see "Maturity Model for Social Marketing"). CIOs and institutional leaders must recognize that social media plays a critical role in the student journey and can have profound impacts on the institution's brand. CIOs who enable
their institutions to listen to these important channels to improve the student experience and elevate the brand will provide significant competitive advantage to their institutions.

In addition to listening tools, a number of sensing technologies have useful applications in the higher education space. Like the listening technologies, these sensing solutions, such as beacons, are only now emerging on early-adopter campuses. The term "beacon" is an umbrella descriptor for a physical object that contains embedded information, such as a location that is broadcast to a gateway or mobile client where the information is used in an application (see "Best Practices for Implementing Beacons in IoT Solutions"). In simple terms, the beacon broadcasts a signal that allows a device such as a smartphone to determine proximity, interact with a smartphone app and deliver custom location-based content.

Again, the retail industry is leading the way with this technology, but early-adopter institutions are identifying many higher education use cases. These use cases include campus wayfinding and tours, classroom and event attendance, campus life enhancers such as dining menus and food coupons, communicating useful information in high-traffic areas such as stadiums and campus bookstores, collecting research data in the field, and even delivering course content in the classroom (see "Cool Vendors in Education, 2016").

Listening and sensing technologies collect large volumes of data, so institutions will need to plan for a host of issues that arise from this, ranging from privacy and security concerns to the practical questions around how to discern actionable insights from the data payload. The potential benefits for improving student recruitment, engagement and retention are significant, thus compelling institutions to grapple with these challenges and begin experimenting with these technologies.

**Recommendations**

Higher education CIOs:

- Understand the role that social media plays in the student journey so that you can best determine when and how to use social listening tools (see "Strategic Technology Map of the Enrollment Opportunity Digital Education Moment"). Inventory your institution’s social media assets, and identify when and how they play a role in the student journey — for example, how the institution’s Facebook profile impacts the student recruitment process (see "How to Determine the Role of Social Media in Your Customer’s Journey").

- Evaluate how the use of listening and sensing technology can mature your social marketing, moving you beyond the stage of just monitoring into two-way communication with constituents to deepen engagement (see "Digital Education Moment: Tap Into the Extended Education Ecosystem to Improve the Student College Selection Process").

- Evaluate how the use of sensing technology on your campus could provide low-cost, high-value solutions to further engage your constituents, such as improving campus wayfinding, enhancing campus life activities (for example, sporting events) or providing valuable just-in-time content in class.
Align initiatives to implement listening and sensing technologies with your campus CRM and predictive analytics platform. This ensures that you have a place to store this data and can leverage it for actionable insights.

Evaluate how social analytics tools can make sense of this often very raw and unstructured data (see "Market Guide for Social Analytics"). Seek solutions that help you with sentiment analysis, offer visualization capabilities to support rapid comprehension of large volumes of data, and provide automated alerts to increase your ability to respond and act on the insights.

10. Robotic Telepresence

_Analysis by Jan-Martin Lowendahl_

**Description/Definition**

Robotic telepresence is video endpoint technology implemented in conjunction with remotely controlled form factors that facilitate remote video presence where fixed endpoint solutions are too static.

**Key Findings**

- There is an increasing blurring of boundaries between on-campus and online education to enable true anywhere, anytime and any-pace education. Robotic telepresence represents a new physical dimension to remote participation that is appealing to deeply rooted human traits.
- For institutions with remote learners, and even for those that want to offer an alternative to students with prolonged health issues or special needs, telepresence robots provide an obvious addition to the teaching and learning technology toolkit.

**Implications**

Robotic telepresence in education is a relatively low-tech, stand-alone solution that can be used to bring remote participants into classrooms and other learning environments in ways that are engaging and do not require great change on the instructor’s part. There are usually two versions: one free-moving, and the other desk-based.

These devices do not need any special technical setup; rather, they need only Wi-Fi and a power outlet for the charging station. Robotic telepresence does not need a special classroom, and most importantly, it does not require the professor to change the lecture. It is as close to plug-and-play as you can get with technology, and yet it brings very tangible benefits. With a telepresence robot, a remote learner can take part in on-campus, face-to-face classes with a sense of control that is not available from other types of virtual-presence technology.

Early trials indicate that the psychological effect is substantial. When students can be mobile, choose where they are in the classroom and turn to face the classmates they work with, they become much more engaged and get more out of the learning experience. Similarly, the professor in the classroom starts treating the remote learners much more like equals who are participating in the
class. However, the key benefit is probably the faculty’s ready acceptance, which is largely built on the fact that instructors do not have to change their ways. Thus, this represents no extra burden of adapting style or material to a technology that has a learning curve.

This flipped telepresence works well with existing campus pedagogical setups. However, one of the more successful setups is for working professionals — for example, nurses, who “teleport” into a nursing lab setting, as they do at Duke University School of Nursing.

One use case for robotic telepresence will always be special due to the profound impact it can have on a person’s life. Kids who have been homebound for various reasons — such as immune deficiency diseases or special needs — can suddenly participate in class on a much more equal footing than was previously possible.

**Recommendations**

Higher education CIOs:

- Invest in pilots of this kind of technology now — especially if you have off-campus students or students with special needs. Several options cost less than $5,000 (some with or without tablets or phones), making pilots very affordable.

- Evaluate whether you can take the next step and use this technology for personalized lecture capture. For example, make a Double robot follow the professor, capturing a lecture from the student’s point of view. Also, consider personalized lecture-type technology (for example, Swivl), because robotic telepresence and personalized lecture capture are expected to merge.

- Ensure that the wireless, security and privacy policies and infrastructures at your organization and institution can support the widespread use of robotic telepresence. (These issues become interesting as more types of robots mix with humans, and policies and procedures should evolve as you gain experience.)

**Consider Changes in the Top 10 Strategic Technologies in Higher Education**

In this, our third annual top 10 list of strategic technologies, we note the following changes since last year. These trends are new this year:

- VR and AR make a comeback as this type of technology has matured, become more available and come down in cost. The pedagogical promises are evident, but can VR and AR deliver this time around?

- Hybrid integration platforms reflect the exponential increase in the need to collect and connect data to feed the many analytics applications and, increasingly, machine learning applications.

- Institutional video management reflects the necessity to manage ever-increasing volumes of video data. This includes storage, as well as indexing and retrieval.

- Robotic telepresence represents a truly low-hanging fruit and just makes the top 10 list this year.
Changes from last year include:

- CRM is still very important, but it has been left out of this year's top 10, since it is mostly mature and can be expected to represent a foundational capability, rather than a new technology.

- Exostructure is still an important overarching strategy and still emerging, but it has been superseded by more-specific trends, such as hybrid integration platforms and open microcredentials on this year's list.

- Open educational resource (OER) ecosystem is still an important technology-supported capability, but it is maturing quickly, and we have taken it off this year's list in favor of new technologies.

- Collaboration technology is still an important set of technologies that is not yet fully embedded in university strategies. However, it affects mostly research-intensive institutions and has thus been outcompeted in this year's list.

- The term "smart machines" has been replaced by "AI" this year to reflect a more commonly used language for this type of technology.

In "Toolkit: Workshop for Building a Customized List of Top 10 Strategic Technologies in Higher Education, 2017," we provide all technologies covered over the three years, including two "runner-up" technologies for each year. This means that there are now a total of 22 strategic technologies to choose from when customizing the list.

Visualize the Top 10 Strategic Technologies

In this final section, we offer a visualization of the top 10 strategic technologies building on the concepts of our most popular tools, the Gartner Hype Cycle and the Strategic Technology Map. The frameworks and diagrams in this research are inspired by, but should not be confused with, Gartner Hype Cycles and Strategic Technology Maps, which follow rigorous, standardized methodology. They are solely meant to help clients look at the trends from various points of views to gain additional information about their relative maturity and importance (see Figure 2). See "Understanding Gartner’s Hype Cycles" and "Introducing Visual Strategic Planning Using Four Higher Education 'Business Model' Scenarios and Strategic Technology Maps" for further insight into how these visualization tools can be used.
In this view, we can see that AI appears as our least-mature technology-based capability, while hybrid integration platforms is our most mature. The latter technology illustrates the fact that several of the technologies or technology-based capabilities on this list are very broad categories that often need to be further subdivided into tactical areas. The Hype Cycle view of the top 10 strategic technologies (capabilities) list has AI, VR/AR comeback, listening and sensing tech, robotic telepresence and predictive analytics in the Technology Trigger phase. Only digital assessment is currently in the Peak of Inflated Expectations phase. Open microcredentials and adaptive learning are in the Trough of Disillusionment phase, and finally, institutional video management and hybrid integration platforms are in the Slope of Enlightenment phase.

Figure 2 should not be confused with the Gartner Hype Cycle for Education (see Figure 3). Most of the top 10 strategic technologies in the conceptual view match the Gartner Hype Cycle in placement. However, for top 10 strategic planning purposes, some technologies have been added or modified by intent, which you may also modify further to suit your customized Hype Cycle. Here, we have added or modified a few entries. For example, institutional video management is added, together with predictive analytics, which have not been explicitly covered in the official Hype Cycle for Education, but represent strategic technology groups we want to highlight in relation to the top 10 higher education business trends.
This use of the Hype Cycle concept does not apply all of the standardized methodology, such as assessing the time to plateau (hence the black dots). Consider this adaptation of the Gartner Hype Cycle concept as a visual organizer, or mental shorthand, to gain new insights fast. See “Toolkit: Workshop for Building a Customized List of Top 10 Strategic Technologies in Higher Education, 2017” for how to use this lightweight approach, and “Toolkit: My Hype Cycle, 2016” for a more formal customization of the Hype Cycle.
Figure 3. The Official Hype Cycle for Education, 2016

Source: Gartner (June 2016)
Figure 4 shows the relative importance of each technology as seen through the concept of the Strategic Technology Map. This map fundamentally visualizes who benefits — the institution or the individual.

The y-axis, "organizational effectiveness," which relates to institutional ROI, indicates a predominantly institutional impact or benefit — "What do we have to do together?" The x-axis, "personal effectiveness," which relates to student, faculty or staff experience, indicates a predominantly individual impact or benefit — "What’s in it for me?" When we built this particular map, we did it from the point of view of a CIO at a large public university. The predictive analytics entry is toward the top, left-hand corner in the Corporate Green Light quadrant, since it is, in most
institutions, still focused on institutional decisions (however, new applications that engage end users slowly move it toward the right).

VR/AR comeback is farthest to the bottom, right-hand corner in the People’s Choice quadrant, since it many times needs consumer technology such as smartphones and tools that faculty leverage without involving the institution. It would have been in the Hot Spot quadrant if it was more aligned to institutional strategy. Adaptive learning ends up in the top-right-hand corner of the Hot Spot quadrant, because it combines clear impact on retention and helping students to learn in a way that supports their learning mode, and thereby increases the likelihood of getting better grades, faster. In other words, both the organization and the individual are impacted and benefited equally.

These are not traditional uses of the Gartner Hype Cycle and the Strategic Technology Map, but we hope they help those who are more visual learners to digest the top 10 list.

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Hype Cycle for Education, 2016"

"Analytics, Assessment and Adaptive Learning Will Prepare You for the Algorithmic Education Evolution"

"Deakin University Uses Smart Machines to Innovate Student Engagement"

Evidence

1 There are many examples of increasing traction. Innovative institutions such as University of California, Davis and University of Washington are experimenting with badges for core competencies that have been verified with employers and are available as part of a "University Learning Store" shared by six universities. This exemplifies a key feature of the open badge or microcredential ecosystems that span formal and informal education, as well as employer recognition. (Sources: J. Bolkan. "6 Universities Partner on Credentialing Initiative." Campus Technology. 22 March 2016. P. Fain. "Badging From Within." Inside Higher Ed. 3 January 2014.)


3 The BadgeChain initiative is an attempt to transfer the technology underpinning the Open Badges specification to blockchain. This is now extended with efforts such as BlockCerts supported by, among others, MIT Media Lab, pointing to a potentially new field of learning recognition technologies. (Source: D. Hickey. "Competencies in Context #1: New Developments at Portfolium." Re-Mediating Assessment blog. 14 November 2016.)

4 There is a growing market for adaptive learning applications and platforms, with a number of new suppliers such as CCKF (Realizeit) and CogBooks with their adaptive learning platforms, alongside more-established providers of adaptive applications such as Pearson with its MyLab and Mastering
series and McGraw-Hill with its LearnSmart and ALEKS products, among others. The LMS provider D2L has also made the LeaP adaptive learning platform available, embedded within the LMS. See also "Analytics, Assessment and Adaptive Learning Will Prepare You for the Algorithmic Education Evolution."


7 Engage Virtual Reality Education Platform.

8 Virtual Reality and Immersive Visualization Group at RWTH Aachen University.


Note 1 Strategic Technologies in Education
We recognize the work done by organizations such as EDUCAUSE, leading to publications such as EDUCAUSE Top 10 IT Issues, the NMC Horizon Report and IEEE’s Top 10 Technology Trends, as well as national higher education top 10 lists such as from CAUDIT in Australia.

Note 2 Gartner’s Higher Education Business Model Scenarios
This is also what we refer to as "Everybody’s U" in the Gartner higher education business model scenarios. (For more detail on characteristics of the different scenarios, see "Visual Strategic Planning Using the Gartner Higher Education ‘Business Model’ Scenarios and Corresponding Strategic Technology Maps.")

Note 3 "Exostructure" Explained
In an increasingly networked world, competitive advantage depends on the speedy leverage of external services. The power of the education ecosystem comes from interoperability — not isolation. This need to focus on external interoperability, the exostructure, is an inevitable consequence of cloud and consumerization. The exostructure is necessary to leverage the full potential of the education ecosystem. The exostructure concept is about building an "exoskeleton" of services that support the institution from the outside, rather than from the inside.

The building blocks are standards such as eduPerson and Metadata for Learning Opportunities (MLO) that allow a freer flow of information between education ecosystem players. When done right, the exostructure approach enables institutions to leverage industry (and other) best-practice services from the cloud, rather than having to bring them inside the campus walls.

The exostructure strategy enables a much more flexible and agile IT service approach that can adapt to the seemingly inevitable disruption of the education ecosystem. This institutional shift of
mindset from infrastructure to exostructure is a key to success in an increasingly dynamic and expanding education ecosystem (see "Gaining Competitive Advantage in the Education Ecosystem Requires Going Beyond Mere Infrastructure to Exostructure").

More on This Topic
This is part of an in-depth collection of research. See the collection:

- Research Roundup for Top 10 Business Trends and Strategic Technologies Impacting Higher Education in 2017