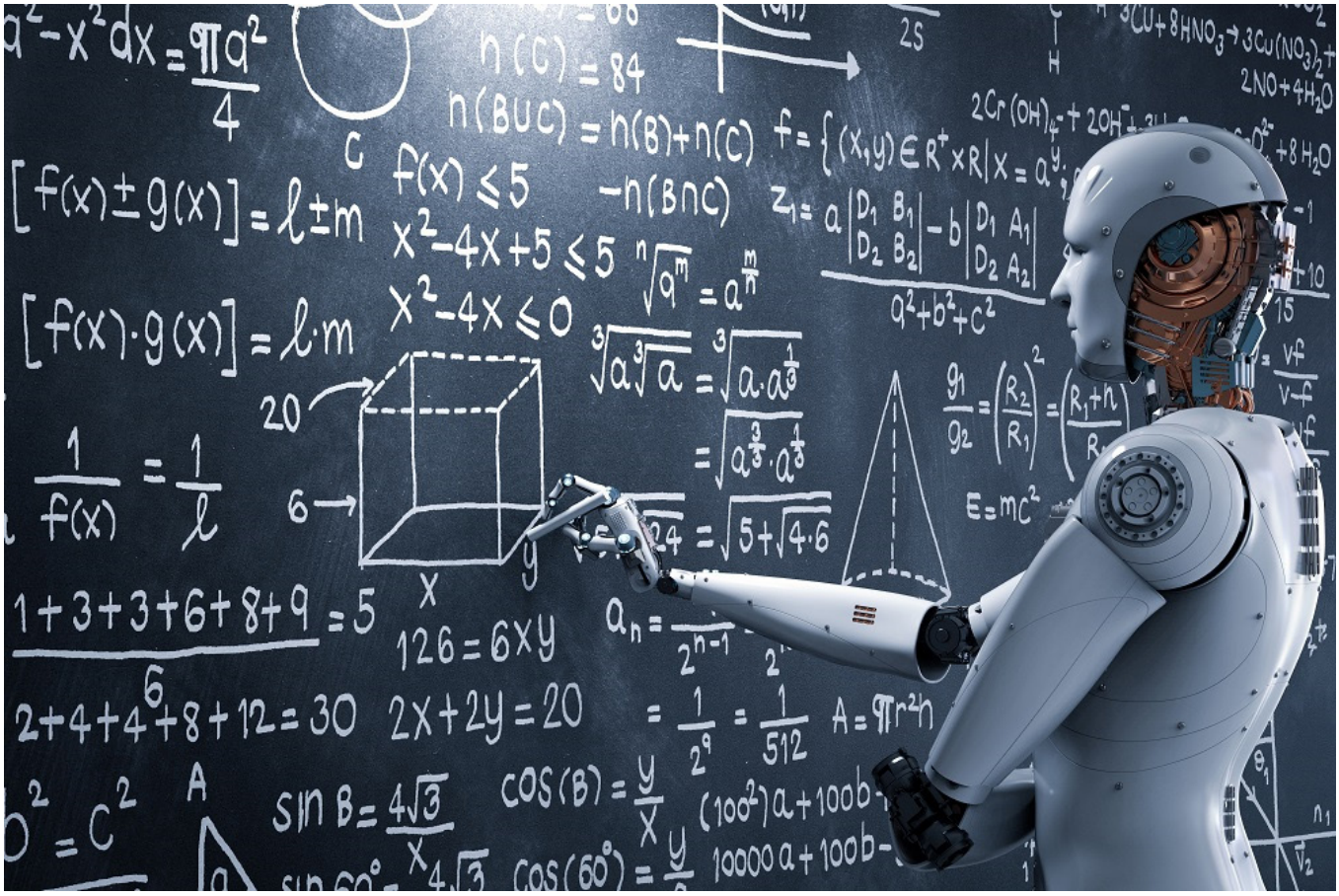

The Future of Work & Learning: 2030

March 2018

Exclusively prepared for CoSN Members and CoSN 2018 Attendees

CoSN

LEADING EDUCATION INNOVATION

The Future of Work and Learning: 2030 – Getting the Conversation Started

Exclusively for CoSN Members and CoSN 2018 Attendees

We are living during a time of unprecedented and rapid change. New technologies like artificial intelligence and smart machines are emerging with the potential for having a transformative impact on industry, the economy and society as a whole.

Our physical and digital worlds are fusing, resulting in breakthroughs that were only imagined in the past. The speed and scope of this technlogical transformation is exponential with the potential for unlimited possibities and endless opportunities.

What are the implications for schools, educators and students? How do we provide leadership in a time of rapid change?

Building on CoSN 2018's theme of Exponential Change: Designing Learning in the 4th Industrial Revolution, three excellent resources have been synthesized to help you begin the conversations in your school district and your community.

- We've excerpted materials based on a ground-breaking new report, from Pearson, called Future of Skills: Employment in 2030 to help you set the foundation for why this is an important short and long term discussion to have. You can access the full free report and other terrific resources at https://www.futureskills.pearson.com.
- KnowledgeWorks, a national nonprofit, has prepared an excellent discussion and facilitation guide: Shaping the Future of Readiness. We also recommend you read their excellent free report on Thinking About the Future of Learning at https://www.knowledgeworks.org/get-inspired/future-learning/future-of-learning.
- Finally, CoSN's new member-only EdTechNext report on Artificial Intelligence (Spring 2018) is a great backgrounder for you and your team. As an additional benefit of attending CoSN 2018, we are giving conference attendees access to read and reproduce this resource in your school district.

Using these sources will help you start the conversations regarding these questions:

- What is the 4th Industrial Revolution and how will is shape our economy?
- How will this shape the future of work? What knowledge, skills and dispositions might help young people thrive in a new world of work and what learning experiences they may need?
- Finally, what does that mean for the future of education and learning? How should our classrooms change to prepare for the 4th Industrial Revolution in our school/school district?

Let's make this important conversation happen!

Thank you to Pearson and KnowledgeWorks for the use of their material/resources.

Pearson KnowledgeWorks

Additional Resources

General Information

- Podcast: What is the Fourth Industrial Revolution?

Impact on Learning

- The Future of Learning: Education in the Era of Partners in Code
- Redefining Readiness from the Inside Out
- Shaping the Future of Readiness: A Discussion and Facilitation Guide
- Digital Education and Developing 21st Century Skills
- EIU Infographic

Impact on Workforce

- The Future of Jobs by World Economic Forum
- No, That Robot Will Not Steal Your Job
- Future of Skills: Employment in 2030
- Brookings Institution Study

Focus on Artificial Intelligence

- The AI Revolution by Toby Walsh
- The AI Revolution on Campus
- Ask About AI: The Future of Learning and Work
- The Future of Learning and Work Microsite
- "Knowledge for the Age of Artificial Intelligence"

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FUTURE OF SKILLS

EMPLOYMENT IN 2030

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OXFORD MARTIN SCHOOL

Preparing people for the jobs of the future is core to Pearson's mission of helping people make progress in their lives through learning. A student entering formal education today will be making decisions about his or her career by the year 2030.

That's why Pearson decided to work with researchers from Nesta and machine learning expert Michael Osborne of the Oxford Martin School, to build a research project that moves the conversation about the future of work past simplified scaremongering about automation.

It's the most comprehensive research project on this topic to date, and better predicts how major societal and economic trends—and the interactions between them—will affect the future of work.

Much of the current conversation about the future of work revolves around fears of technology making workers obsolete. It imagines a world where people are relegated to unemployment or meaningless work by advances like driverless cars and artificial intelligence. But, if we are only talking about how automation will change the nature of work or machines replacing human workers, we're missing the bigger picture.

We wanted to take a step back and a take deeper look at what's happening with jobs and work.

Through our research we've found that the future of work is brighter than conventional wisdom suggests. This document will provide high-level findings, but the upshot is that many jobs we recognize today will still be in demand by 2030 and beyond. *However,* the job you have today may require different skills for success tomorrow.

We know that megatrends like demographic change, political uncertainty, globalization, income inequality, environmental sustainability, urbanization—along with emerging technology—will all have significant influence over the jobs of the future.

For this research, we convened thought leaders to predict how megatrends will affect the future demand for different types of jobs and the skills needed for that work. We also surfaced the ways that these trends might interact.

For example, although an aging society could lead to increased health care spending, it's possible that technology could deliver productivity advances that would alleviate these spending pressures.

Then we applied advanced machine learning algorithms to our experts' forecasts to predict which jobs would be on the rise, which would be in decline, and the skills needed.

The bottom line of our research: we can all stop agonizing about machines taking our jobs.

The future will be about leveraging both human and machine capabilities, and this research provides a blueprint for how we might reform education to meet the demands of the future head on.

This is a complex and important conversation. We need to cut through the scary headlines so educators, learners, and employers can focus on taking a new, more dynamic approach to education and the careers that drive all of us to a better job and a better life.

We invite you to explore The Future of Skills: Employment in 2030.

The future of work isn't only influenced by automation. Our methodology included an analysis of these seven megatrends to understand the bigger picture of work.

Key trends influencing U.S. and U.K. labor markets:

TECHNOLOGICAL CHANGE

- Perennial fears about impact of automation on employment.
- Estimates of future automation impact range, from 47 percent of U.S. employment at risk to only 9 percent.
- Conversely, technology amplifies human performance in some occupations—and gives rise to entirely new occupations and sectors.

GLOBALIZATION

- Global labor markets increasingly integrated.
- Benefits (e.g.,advanced manufacturing, knowledge-intensive services) and costs (e.g., employment and wage impacts, trade deficits, legacy manufacturing).
- Post-financial crisis headwinds (e.g., sluggish world trade growth, rising protectionism).

DEMOGRAPHIC CHANGE

- Pressures to control age-related entitlements vs. investments in education, R&D, infrastructure.
- Ripple effects through health care, finance, housing, education, recreation.
- Rising Millennial generation, with divergent consumption and work behaviors.

ENVIRONMENTAL SUSTAINABILITY

- Climate change consensus largely intact, but with notable cracks.
- Structural changes resulting from emerging "green economy sector" and "green jobs" vulnerable to political reversals.

URBANIZATION

- More than half of world population lives in cities—70 percent by 2050. Cities attract high-value, knowledge-intensive industries; offer more varied employment and consumption opportunities.
- Uncertainties include fiscal policy, infrastructure investments, high public debt ratios.

INCREASING INEQUALITY

- Rise in income and wealth inequality, middle class squeeze.
- Disparities in education, health care, social services, consumption.

POLITICAL UNCERTAINTY

- Indices of geopolitical uncertainty have remained high since 9/11 spike.
- Mirrored by political and policy uncertainty—capacity of institutions and policymakers to act credibly and consistently.
- Uncertainty negatively affects economic activity in government-influenced sectors, such as defense, finance, construction, engineering, and health care.

INTERPRETING THE RESEARCH

Our human experts and machine intelligence algorithm worked in combination to help our researchers gain a more nuanced understanding of the future of employment and skills than has been previously possible.

1 **We forecast that only one in five workers are in occupations that will shrink. This figure is much lower than recent studies of automation have suggested.**

Occupations related to agriculture, trades and construction, which in other studies have been forecast to decline, exhibit more interesting and heterogeneous patterns with our research, suggesting that there may be pockets of opportunity throughout the skills ladder.

2 **We forecast that one in ten workers are actually in occupations that are likely to grow.**

These jobs are in sectors such as education and healthcare, where the overriding effect of technology is likely to be an improvement in outcomes, not a reduction in workforce. Therefore, as trends such as demographic change raise demand for these services, the prospect for employment is also likely to rise.

3 **We forecast that seven in ten workers are in jobs with where there is greater uncertainty about the future. However, contrasting the negative outlook of other research, our finding indicate that we can do a great deal to help people prepare for the future.**

Our findings rank knowledge areas, skills, and abilities that will be in greater demand in the future. These findings, if implemented by educators and employers, can help individuals better prepare for the workforce of the future.

4 **Although there is broad understanding that "21st century skills" will be in demand, this research leads to a far more nuanced understanding of which skills will be in greatest demand.**

In the US, there is particularly strong emphasis on interpersonal skills. These skills include teaching, social perceptiveness, service orientation, and persuasion.

Our findings also confirm the importance of higher-order cognitive skills such as complex problem solving, originality, fluency of ideas, and active learning.

In the UK, skills related to systems-oriented thinking (i.e., the ability to recognize, understand, and act on complex sets of information), such as judgment, decision-making, systems analysis, and systems evaluation also feature prominently.

5 **Our research definitively shows that both knowledge and skills will be required for the future economy.**

In our U.S. results, knowledge and skills are fairly equally represented in the top half of all features we ranked according to predicted future demand.

In the U.K. results, the ranking leans more towards skills than knowledge, but not by a wide margin.

6 **Occupations and their skill requirements are not set in stone. Occupations can be re-designed to pair uniquely human skills with the productivity gains from technology to boost demand for jobs.**

For example, we know that eventually robots will be able to build bridges and diagnose diseases. But humans will retain the unique ability to engineer a bridge and care for a sick child. How we balance those skills with technology productivity will chart the course of our workforce.

IMPLICATIONS

This research on the future of jobs and skills has implications for education systems, employers, and individuals. Some of the ideas described below are already being explored; our findings provide research support for these strategies. In addition, the research points to new areas for exploration by Pearson and our fellow education stakeholders.

FOR EDUCATION SYSTEMS

The research findings have significant implications for education systems around the US and UK:

MOVING BEYOND GENERIC DEFINITIONS OF "21ST CENTURY SKILLS"

Education systems will need to support better understanding, teaching practice, and assessment of the granular skills that will be in greater demand.

DEVELOPING PEDAGOGIES TO SUPPORT DYNAMIC KNOWLEDGE AND SKILL DEVELOPMENT

Educational institutions will need to provide supports to educators as they are asked to teach these new skills. This could require significant retooling of teacher education or faculty incentives in educational institutions.

ADAPTING FASTER TO THE CHANGING NEEDS OF THE LABOR MARKETS

One thing that is clear from the research is that the pace of change will continue to accelerate. Education systems developed 20-30 years ago will actually need to plan for a future 20-30 years away.

OFFERING MORE FLEXIBLE AND ADAPTIVE PATHWAYS

As the pace of change accelerates, learners will demand more ways to convert learning to earning. Although there will likely always be some demand for traditional brick-and-mortar experiences, more learners will want accelerated and flexible pathways, such as credentials or badges.

FOR EMPLOYERS

Employers serious about resolving future uncertainty for their workforce will need to think about:

REDESIGNING ROLES TO BALANCE TECHNOLOGY AND HUMAN RESOURCES

The path to maximizing productivity will be through the effective use of technology to supplement uniquely human skills. In education, we talk about technology supplementing (not supplanting) the educator to personalize learning. This will be true in many other industries as well and employers will need to proactively redesign the jobs most at risk.

MOVING BEYOND THE COLLEGE DEGREE AS THE PRIMARY SIGNAL OF EMPLOYABILITY

As education systems offer more flexible and adaptive pathways for learners, employers will also need to learn how to identify and develop talent. The college degree has long been an imperfect signal for employment readiness and this is likely to become even more complex.

FOR INDIVIDUALS

Despite its technical nature, this research has a very human angle. It forecasts impacts of megatrends on real people and the findings provide a roadmap for how to thrive in the future workforce. Individuals will need to:

DEVELOP SKILLS THAT ARE UNIQUELY HUMAN

Although the advance of automation and artificial intelligence may feel like a losing battle to some, individuals will need to focus on developing the uniquely human skills identified in this research, such as originality, fluency of ideas, and active listening.

COMMIT TO LIFELONG LEARNING AND RESKILLING

The pace of economic change all but guarantees that a single degree started in your teens or a career picked in your 20s will not be everlasting.

KnowledgeWorks Forecast 4.0

Shaping the Future of Readiness:
A Discussion and Facilitation Guide

Katie King • Katherine Prince • Jason Swanson

KnowledgeWorks

Introduction:
Redefining Readiness for a New Era

Employment, educational, and community leaders face a critical window of choice. Even today, graduates' skill sets and employers' needs are often out of sync.[1] As explored in KnowledgeWorks' strategic foresight publications, work is changing rapidly, which could widen that gap.[2] Exponential advances in digital technologies, the rise of smart machines, and the decline of full-time employment suggest that our future could look dramatically different from today's realities. By looking at changes on the horizon, leaders have the opportunity to redefine readiness for this new era and align their work to meet learners', workers', and employers' future needs. Due to the magnitude of change on the horizon, no one organization or system can address future readiness needs on its own. The level and pace of change require both long-term thinking and cross-sector action.

This discussion and facilitation guide aims to assist community conveners in supporting meaningful multi-sector and action-oriented discussions that lead to concrete next steps that support future workforce development.

1. Strada Education Network & U.S. Chamber of Commerce Foundation. (2017). Learning to Work and Working to Learn. Retrieved from https://www.uschamberfoundation.org/reports/learning-work-working-learn.
2. Prince, K., Saveri, A. & Swanson, J. (2017) The Future of Learning: Redefining Readiness from the Inside Out. KnowledgeWorks. Retrieved from http://www.knowledgeworks.org/redefining-readiness.

Using This Discussion and Facilitation Guide

This guide contains three structured group activities:

- **EXPLORING THE FUTURE OF WORK**
  Explore broad and local changes on the horizon and consider how the future of work might unfold.
- **CREATING A NEW PROFILE OF A GRADUATE**
  Consider what knowledge, skills, and dispositions might help young people thrive in a new world of work and what learning experiences they might need.
- **LEVERAGING CROSS-SECTOR OPPORTUNITIES**
  Highlight ways different sectors and organizations can collaborate to support future college and career readiness.

When facilitating an event using this guide, consider the following factors:

Time: Each activity can be completed in 45 minutes. The activities are meant to be used in sequence, though they do not need to be completed all at once. Conveners are encouraged to extend discussion or reflection time as useful.

Space: The activities should be completed in a space appropriate for small-group work and all-group discussion and sharing.

Group size: The ideal size for these types of discussions is fifteen to forty people. The exercises within each activity are designed to be completed by groups of three to five people. The discussion and reflection questions can be completed either individually, in small groups, or in a larger group.

Materials: Each group of three to five people will need at least one copy of the charts included in this guide to complete the exercises. Conveners may decide that each individual should have a copy or that groups should recreate the charts on larger flip chart paper.

Audience: The discussions and exercises are designed with a cross-sector group of K-12, business, postsecondary, and community leaders in mind. When possible, involving students, recent graduates, and parents can also yield important insights. Conveners are encouraged to bring together audiences that represent diverse perspectives and areas of expertise and that reflect and represent the communities in which the conversations are being held.

Customization: These activities are based on KnowledgeWorks' extensive experience facilitating interactive workshops with multi-sector audiences. However, conveners are encouraged to adapt the activities and timing and to incorporate them into their programs in ways that meet the needs of their groups and communities.

We owe it to current and future students to reframe our approaches to readiness. How we choose to engage on this topic will shape how equitable, productive, and vibrant our collective futures will be. Redefining readiness for the emerging era is the most urgent issue on the horizon for education and employment stakeholders.

Activity 1: Exploring the Future of Work

Objective

Participants will identify trends, drivers of change, existing efforts, and potential disruptions that could change the future of work and will consider their potential impacts.

Process

- Read and discuss "Introduction: The Changing Nature of Work" **(10 minutes)**
- Complete the "Changes on the Horizon" exercise **(15 minutes)**
- Complete the "Considering Possible Futures" exercise **(10 minutes)**
- Discuss "Reflection: Your Work Today" **(10 minutes)**

Introduction: The Changing Nature of Work

KnowledgeWorks' publication, "The Future of Learning: Redefining Readiness from the Inside Out"[3] outlined two major drivers that could shape the future of work.

The Rise of Smart Machines

Advances in artificial intelligence, machine learning, and robotics and other forms of automation are leading to the rise of smart machines that will increasingly be able to perform tasks that people carry out today. As smart machines develop further and get cheaper, they will alter or eliminate many routine cognitive and manual tasks, or tasks that are rule-based and repetitive. They will also increasingly impact the non-routine cognitive and manual tasks that are often associated with knowledge-based work, creative work, and care-based professions.

The Decline of the Full-Time Employee

Technology is also changing the structure of work, due in large part to the lower coordination costs afforded by the Internet and the access to an expanded labor pool resulting from globalization. The Internet is making it increasingly cost effective for firms to access people with specialized skills on the open market instead of employing people full-time. Globalization has opened up an international talent pipeline and continues to give firms access to cheaper labor markets and specialized talent. Such shifts are contributing to shortening employment tenure, the spread of contingent and project-based work, and the rise of taskification, or the breaking down of formal jobs into discrete tasks, often at lower wages and with informal job structures.

These drivers of change are being made more pronounced by technological acceleration. While it is clear that these drivers of change are transforming work, there is significant uncertainty about what work will look like in 2040.

Discussion Questions

- What are your initial reactions to these drivers?
- What aspects of the drivers feel most relevant locally?
- How are stakeholders in your region responding to the changing nature of work?

3. Prince, K., Swanson, J. & King, K. (2015). Shaping the Future of Learning: A Strategy Guide. KnowledgeWorks. Retrieved from http://www.knowledgeworks.org/shaping-future-learning-strategy-guide.

Exercise: Changes on the Horizon

Discuss how other trends, drivers of change, existing efforts, or potential disruptions might affect the future of work in your area. Use the examples in the chart to guide you, and complete the chart with your own ideas.

TIP

Trend: A pattern of change over time. Can be characterized as "more of" or "less of" something or as something "increasing" or "decreasing." Consider trends across categories: social, technological, economic, environmental, and political.

Driver of Change: A major shift combining multiple trends that creates a broad pattern of change.

Effort: An existing plan, intention, or program.

Potential Disruption: An event that could alter a pattern of change.

TRENDS	DRIVERS OF CHANGE	EFFORTS	POTENTIAL DISRUPTIONS
– Increasing income inequality	*– Rise of smart machine* *– Decline of full-time employment*	*– Regional effort to match students to internships and apprenticeships for in-demand industries and careers.*	*– Major employer leaves/arrives*

Compare the changes in your chart with those identified by another individual or group, noting similarities and differences.

ACTIVITY 1: EXPLORING THE FUTURE OF WORK

Exercise: Considering Possible Futures

Given the changes from KnowledgeWorks' research and those that you identified, explore what employment landscape today's youngest children might find themselves entering in 2040. Select one or more of the trends, drivers of change, efforts, or potential disruptions and extrapolate forward to envision a different future. Use the examples in the chart to guide you, and complete the chart with your own ideas.

TIP

As you work, remember that exactly how a change will shape the future is uncertain; considering a range of possible futures, some of which may contradict one another, can help stakeholders consider and plan for any number of possibilities that might emerge.

CHANGE *Trend, driver, effort, or disruption that could change the future of work*	**POSSIBLE FUTURES OF WORK** *Possible future outcomes of those changes*
– Rise of smart machines	*– What if smart machines augmented the contributions of people in the workplace, creating new jobs; reconfiguring current work; and making many jobs safer, easier and more interesting?*

ACTIVITY 1: EXPLORING THE FUTURE OF WORK

Reflection: Your Work Today

Looking at the possibilities that you identified, reflect on what they might mean for your organizations and for your local area. You may use the following questions to guide your reflection.

1. Do your existing structures, policies, programs, and missions support people in ways that would help them thrive in the futures of work you envisioned?

2. What might need to change to orient your organizations and your offerings toward future possibilities?

3. Where might you need to explore new forms of collaboration or deepen existing partnerships?

4. Where might the region need new developments to help address issues related to future readiness?

Activity 2: Creating a New Profile of a Graduate

Objective

Participants will identify the knowledge, skills, and dispositions that will be critical for workers to thrive in a changing and uncertain landscape.

Process

- Read and discuss "Introduction: A New Foundation for Readiness" **(10 minutes)**
- Complete the "A New Profile of a Graduate" exercise **(15 minutes)**
- Complete the "Attributes of a Future Learning Experience" exercise **(10 minutes)**
- Discuss "Reflection: Today's Learning Experiences" **(10 minutes)**

Introduction: A New Foundation for Readiness

Despite critical uncertainties about how the future might unfold, we can expect the employment landscape to change very rapidly. Stakeholders need to anticipate how work might evolve and need to redefine readiness for a new era. The new foundation for readiness shown on the next page promises to provide a foundation for success regardless of exactly how the rise of smart machines and decline of the full-time employee end up affecting work in 2040. It contains three elements as detailed below:

- Future work characteristics, which describe likely features of any future work landscape;
- Core social-emotional skills, which outline the foundational skills that will enable people to thrive in future workplaces; and,
- Foundational cognitive and metacognitive practices, which represent knowledge, skills, and dispositions that will help people navigate, adapt, and grow in the emerging work environment.

Discussion Questions

- What are your initial reactions to this new foundation for readiness?
- Which of these skills and practices are already a focus of education and workforce development efforts in your area?
- How do you think these skills and practices could be developed alongside additional academic and job-specific skills?

ACTIVITY 2: CREATING A NEW PROFILE OF A GRADUATE

A New Foundation for Readiness

ACTIVITY 2: CREATING A NEW PROFILE OF A GRADUATE

Exercise: A New Profile of a Graduate

Discuss which knowledge, skills, and dispositions from the new foundation for readiness seem most critical and what else young people might need to thrive in the future. Use the examples in the chart to guide you, and complete the chart with your own ideas.

KNOWLEDGE	SKILLS	DISPOSITIONS
– Historical context	*– Learn anything, anywhere*	*– Thrive in ambiguity and uncertainty*

ACTIVITY 2: CREATING A NEW PROFILE OF A GRADUATE

Exercise: Attributes of a Future Learning Experience

Given the knowledge, skills, and dispositions you identified, consider the attributes future learning experiences should and should not have to support their development. Use the examples in the chart to guide you, and complete the chart with your own ideas.

TIP

Consider K-12, postsecondary, employment, and community-based experiences that could support learners of all ages.

ATTRIBUTES FUTURE EXPERIENCES NEED TO HAVE	ATTRIBUTES FUTURE EXPERIENCES NEED TO AVOID
– Opportunities for reflection	*– One-size fits all*
– People to collaborate with diverse groups	*– Disconnection from life outside of school*

ACTIVITY 2: CREATING A NEW PROFILE OF A GRADUATE

Reflection: Today's Learning Experiences

Looking at the possibilities that you identified, reflect on what they might mean for your organizations and for your local area. You may use the following questions to guide your reflection.

1. To what extent do experiences in your community have the attributes that you identified as being desirable?

2. To what extent do they have the attributes that you identified as being undesirable?

3. What might need to change to orient your organizations and your offerings toward the future graduate profile you created?

4. What gaps might need to be filled in your region?

Activity 3: Leveraging Cross-Sector Opportunities

Objective

Participants will identify opportunities to work across sectors and boundaries in ways that support college and career readiness and meet the needs of the region.

Process

- Read and discuss "Introduction: Opportunities to Shape the Future" **(10 minutes)**
- Complete the "Future Opportunities in Your Context" exercise **(15 minutes)**
- Complete the "Defining Next Steps" exercise **(10 minutes)**
- Discuss "Reflection: Influencing Future Readiness" **(10 minutes)**

Introduction: Opportunities to Shape the Future

To identify opportunities to shape the future, KnowledgeWorks explored future possibilities with a wide range of stakeholders. The following five opportunities from "Shaping the Future of Learning: A Strategy Guide"[4] capture stakeholders' key insights. These opportunities can serve as starting points for leaders who hope to influence how young people are prepared for the future.

360 Degree Learners

How can we **educate the whole person** and enable lifelong learning that supports academic and social-emotional growth?

The Whole, and the Sum of Its Parts

How can we **personalize learning in community**, reorienting education around learners while strengthening society?

Elastic Structures

How can we **create flexible approaches to learning and coordination** that respond to learners' needs?

Innovation with Intent

How can we **ground systems change in equity**, including and supporting underserved learners?

The New A+

How can we **renegotiate definitions of success**, examining what education systems aim to achieve and who gets to say?

Discussion Questions

- What are your initial reactions to these areas of opportunity?
- Which of these opportunities are already being addressed by stakeholders in your region? How?
- Which of these opportunities, if addressed fully, would have the most impact on readiness locally?

4. Prince, K., Swanson, J. & King, K. (2016). Shaping the Future of Learning: A Strategy Guide. KnowledgeWorks. Retrieved from http://www.knowledgeworks.org/shaping-future-learning-strategy-guide.

ACTIVITY 3: LEVERAGING CROSS-SECTOR OPPORTUNITIES

Exercise: Future Opportunities in Your Context

Select the opportunity from the introduction that promises to have the most impact locally or that is already the focus of stakeholders' efforts in your region.

TIP

Consider local efforts, levers for and barriers to change that relate to the opportunity, and aspirational ideas that could lead to meaningful change.

LOCAL EFFORTS *What is already underway locally to address this opportunity?*	**LEVERS FOR CHANGE** *What could be leveraged to address the opportunity? Think of partnerships, policies, funding sources, events, or new efforts that could promote change.*	**BARRIERS TO CHANGE** *What might get in the way of being able to address the opportunity fully?*	**ASPIRATIONAL IDEAS** *How might you address the opportunity if you had no limits? Think in terms of "What if we...?"*

ACTIVITY 3: LEVERAGING CROSS-SECTOR OPPORTUNITIES

Exercise: Defining Next Steps

Complete the chart below, considering what stakeholders in your area would need to start doing, stop doing, do more, and do less to address the opportunity you have been exploring in ways that could lead to meaningful change.

START DOING	
ACTION	WHO SHOULD TAKE THAT ACTION?

STOP DOING	
ACTION	WHO SHOULD TAKE THAT ACTION?

DO MORE	
ACTION	WHO SHOULD TAKE THAT ACTION?

DO LESS	
ACTION	WHO SHOULD TAKE THAT ACTION?

ACTIVITY 3: LEVERAGING CROSS-SECTOR OPPORTUNITIES

Reflection: Influencing Future Readiness

Looking at the possibilities that you identified, reflect on what they might mean for your organizations and for your local area. You may use the following questions to guide your reflection.

1. Which of the actions that you identified seem most likely to impact the future of readiness in your area?

2. Which actions seem most approachable; which ones, most difficult?

3. Where do you see room to take even a small step forward in addressing future readiness in your area?

4. What would you want others in your organization, sector, or collaborative to be thinking about to respond to future possibilities?

Conclusion: Leading the Future

Navigating the future is always challenging work. Charting a course forward is like aiming for a blurry horizon that shifts constantly as forces of change swirl together in different ways and as people's decisions and actions change the landscape along the way. At this time of rapid change and increasing complexity, with profound changes on the horizon for the future of work and readiness, the course can seem especially challenging. But stakeholders must be willing to exercise courageous leadership to address the crucial issues of our time. We need to develop strong future-facing visions that will guide our efforts to overcome the inertia of the status quo, form effective strategies, and bring others along on the journey. We must collaborate to help everyone be ready to navigate the new employment and readiness landscape on the horizon.

Further Reading

DOWNLOAD

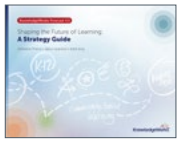
The Future of Learning:
Redefining Readiness from the Inside Out

This resource explores how readiness for further learning, work and life may be redefined to better prepare students for an uncertain future. By proposing a new foundation for readiness based on core social-emotional skills, it offers education stakeholders a framework for helping all students develop the skills needed to succeed in possible employment landscapes of 2040.

DOWNLOAD

The Future of Learning:
Education in the Era of Partners in Code

Over the next decade, our lives will become so inextricably linked with our digital companions that we can expect to find ourselves living as partners in code. These changes will open a wide set of possibilities for education that we all can help shape. Order print copies of KnowledgeWorks' fourth comprehensive forecast on the future of learning to explore how five drivers of change might impact people, structures, and society, as well as potential opportunities and challenges on the horizon.



DOWNLOAD

Shaping the Future of Learning:
A Strategy Guide

This resource explores five foundational issues facing education as we look ahead to 2025 and summarizes strategies to help K-12 schools; informal and community-based learning organizations, such as museums and libraries; and higher education institutions create a future that serves all learners well.

KnowledgeWorks is a nonprofit organization dedicated to advancing personalized learning that empowers every child to take ownership of their success. With nearly 20 years of experience exploring the future of learning, growing educator impact and working with state and federal policymakers, our passionate team partners with schools and communities to grow a system-wide approach to sustain student-centered practices so that every child graduates ready for what's next.

Learn more at KnowledgeWorks.org.

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Spring 2018

EDTECHNEXT®
Emerging technology
for K–12 education

Artificial Intelligence

Could emerging technologies "humanize" teaching & learning?

For some time now, K–12 leaders, educators and educational technology professionals have been shepherding teaching, learning and school enterprises through digital transformations. If proponents and prognosticators of artificial intelligence (AI) are correct, however, K–12 education has barely scratched the surface of the nascent digital landscape.

The potential of AI for K–12 education is stunning:

- **Micro-personalized learning for students.** Exceptionally smart, perceptive digital tutors could micro-personalize learning for every student across the curriculum—not just on flat-screen devices, but in the connected physical world.

  AI-powered tutors may become experts in domain knowledge, pedagogy, learning objectives and progression paths, and the science of learning. They may take into account every student's past performance, and continually learn about students' strengths and weaknesses, interests and preferences. They may monitor student engagement, predict how every student will perform and deftly guide students through common and not-so-common obstacles toward competencies.

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COSN'S EMERGING TECHNOLOGIES

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Through it all, AI tutors may deliver an unflappable human touch, mimicking human speech and behavior.

"What catches everybody's attention is the individualized or personalized learning for every student," says Damon Jackson, chief technology officer, Lubbock (TX) Independent School District.

- **Pedagogical support for teachers.** AI platforms could assist teachers, who can offload rote tasks, such as grading assignments and record keeping, and concentrate on teaching at the top of their licenses. AI may track and assess student performance at granular levels, aggregate and analyze results in minute detail, and create in-depth, longitudinal profiles of every student—enriched with teacher observations. AI may pinpoint individual learning needs and offer tailored lesson plans. individual learning models and instructional resources for teachers to consider to keep every student moving forward.

  Empowered by AI to work more efficiently and effectively, teachers could gain bandwidth to apply instructional methods that people do best, such as providing targeted support and engaging students in discussion, inquiry and project-based learning (Pearson, 2016). AI may help with this as well, by suggesting homogeneous or heterogeneous groups for differentiated instructional activities.

- **Insight for administrators.** At the school and district levels, AI platforms could provide new insights into school, classroom and student factors that support or impede learning, giving administrators information to improve learning opportunities and performance.

The rise of AI in K–12 education will bring new challenges to district leaders, educational technology professionals and teachers. "There is a big, growing fear among parents and parent advocates that teachers will be replaced with robots," says Linnette Attai, president of PlayWell, a privacy and marketing compliance consultancy, and project director of CoSN's Privacy Initiative and Trusted Learning Environment program. "Another big fear is screen time."

Parents also worry about big data collection—and the privacy, security and use of data about their children, Attai says.

"We already have a whole litany of issues around data privacy and ethics," says Kelly Calhoun Williams, research director, Gartner. "In order to effectively leverage what AI can do, we need data, we need big data, we need volume and variety of data in order to see patterns … and look at why students are or are not learning. Zooming in with that microscope on the learning process for students collects data that we're not collecting today. I think that's what people are finding scary—this vague unknown, this magical machine gathering all this data, making judgments, and identifying or typing students in ways that I may not agree with."

"There is the potential that this could follow the child forever," adds

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AI and the Arc to the 4th Industrial Revolution

Power defines industrial revolutions, according to the World Economic Forum (Schwab, 2016):

- **Water and steam to mechanize production (1st Industrial Revolution)**
- **Electric power for mass production (2nd Industrial Revolution)**
- **Electronics and information technology to automate production (3rd Industrial Revolution)**
- **"A fusion of technologies that is blurring the lines between the physical, digital and biological spheres" (4th Industrial Revolution)**

If you find this intriguing, here's a heads up: The theme of the *CoSN 2018 Annual Conference* is *Exponential Change: Designing Learning in the 4th Industrial Revolution.*

Humanize? *continued from page 2*

Beatriz Arnillas, senior educational advisor at itslearning and a member of CoSN's Emerging Technologies Committee. For example, if a child is categorized as a struggling reader in third grade, will this label circumscribe learning opportunities for years to come?

These issues have implications for district leaders, educational technology professionals and teachers, who should begin thinking through the concerns now, Williams says: "How do we build trust in the community to understand how we'll use this data, and what will or won't happen to this data? How do we use AI and how will AI ultimately serve an advisory role, not a decision-making role?"

Understanding AI

"In general, AI is about getting computers to do things that human can do—things that we previously thought *only* humans can do."

—Steve Ritter
Founder and Chief Scientist
Carnegie Learning

Artificial intelligence is a term with a "constantly shifting" meaning in a rapidly evolving, interdisciplinary field, according to a Pearson paper on AI in education (Luckin et al., 2016). Plus, as AI capabilities such as predictive analytics are infused into learning management systems and other mainstream applications, people no longer think of them as AI.

Oxford English Dictionary defines AI as "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision making and translation between languages." AI is also defined as "'intelligent agents': any device that perceives its environment and takes actions that maximize its chance of successfully achieving its goals (Poole, Mackworth & Goebel, 1998) and is capable of learning and problem solving from complex data sets and in com-plex situations.

In a *white paper* for a new Getting Smart initiative, *Ask About AI: The Future of Work and Learning*, Tom Vander Ark (2017) summarizes the ingredients of AI, some of which have been in development for decades:

- **Machine learning**—A subset of artificial intelligence that uses algorithms to learn from data and then make a determination or prediction
- **Neural networks**—A subset of machine learning inspired by the human brain. But unlike the brain, neural networks have discrete layers that direct the data flows.
- **Deep learning**—The use of neural networks to process and learn from massive data sets

Along with big data, AI capabilities are amplified by smart, inexpensive computing and storage devices and other advanced technologies—including 3D technologies, robotics, natural speech recognition, artificial and virtual realities, and sensors, cameras and RFID tags that connect the physical world. Collectively, this is known as the Internet of Things (Vander Ark, 2017).

AI in Education—Now and in the Future

In the consumer world, AI powers self-driving cars, TV and movie recommendations on streaming services, and virtual assistants such as Amazon's Alexa and Google Home. In K–12 education, AI is making its way into classrooms in myriad ways, all of which personalize learning in their own right and help teachers deliver more personalized instruction. Some examples:

Mixed reality. In the Montour (PA) School District, young students stack blocks to build towers, just as children have done for centuries. What's different is their interaction with *NoRILLA*, a mixed-reality educational system that bridges the physical and virtual worlds to improve STEM (science, technology, engineering and mathematics) learning.

Children gather in small groups at a table with an embedded touchscreen tablet in front of a big screen, where a cartoon gorilla character guides them as they try to construct block towers of different shapes and sizes that will withstand "earthshaking" movement. Towers go up, children push the "shake" button on the tablet, the table judders, towers fall, and children squeal with laughter. Then they try again, as motion sensors and cameras allow the system to "see" what students are doing (Barshay, 2017). The gorilla keeps students on task with successively harder challenges, along with suggestions, questions and praise.

NoRILLA combines physics with the scientific method of making predictions, observations, and explanations through a series of interactive questions from the gorilla. At the same time, the system helps students develop such skills as critical thinking, collaboration and persistence.

Ken Koedinger, a professor of human-computer interaction and psychology at Carnegie Mellon University and a NoRILLA founder, explains why this AI-enhanced learning experience is "super powerful":

- Because the AI vision algorithms can "see" what students are doing, the system can provide targeted and structured—but minimal—guidance that's "very much oriented towards active learning and maximizing students' constructing their own knowledge." Students learn the science of stability and the physics principles of height, base, symmetry and center of mass from a carefully scaffolded experience.
- AI combined with 3D learning is a force multiplier. Students who build towers with their own hands, collaborate with others and observe the outcomes of the "earthshake" show five times more pre–posttest learning gains than students who only watch a video of the same activities.
- Students learn more when they engage in the effort to explain why their towers fall or stand up to the shake tests. This productive dialogue develops their vocabulary and content knowledge.

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"...the system can provide targeted and structured—but minimal—guidance that's very much oriented towards active learning and maximizing students' constructing their own knowledge."

—Ken Koedinger
Professor of Human-Computer Interaction and Psychology
Carnegie Mellon University

AI now and in the future *continued from page 4*

"Amazingly, students transfer that science learning to better engineering of the towers," Koedinger says. "They build better towers on their own without direct practice on that."

NoRILLA has changed teaching and learning in Montour classrooms for younger students. "We're so used to 25 kids in a big U-shaped classroom, and every kid looking at their screen and the teacher in the middle so they can see every screen," says Justin Aglio, Montour's director of academic achievement (K–4) and district innovation. "So now this big machine is interacting with kids independently, they're talking to each other and the teacher doesn't even have to be around anymore for these kids to interact."

This has inspired Montour teachers to shift their pedagogy to more small-group and project-based learning. While some students are engaged with AI and other technology-enhanced innovations, such as stations for engineering or arts learning, teachers can work more closely with other students.

Augmented reality (AR). AI could equip teachers with superpowers—"eyes in the back of their heads" and the ability to see which students are really stuck and which ones are "almost there and just need a nudge" (Holstein, 2017).

Montour is piloting AI smart glasses for teachers that are under development at Carnegie Mellon. Known as Lumilo, the smart glasses are billed as "real-time, wearable cognitive augmentation for K–12 teachers" (Holstein, 2017)—a concept that won a 2018 Gold Award for virtual/augmented reality from *Reimagine Education*.

While middle school students interact with math software, teachers wear the Lumilo smart glasses. An intelligent tutoring system and classroom sensors track student engagement and performance in real time and convey that information to teachers via emojis that pop up through the smart glasses.

"So if Johnny is sitting in the back and he has not answered a question within three minutes and he's not doing any type of movement on his computer, a sleepy emoji will appear above his head," Aglio says. "The teacher from the front of the class can touch Johnny's emoji and instantaneously his screen will pop up above his head and the teacher can see what question he's on, and to the right of it see areas he's struggling with. She can look over to the wall inside of the class where only she can see the whole class's progression around this question and standards." In this application, AI and AR connect to promote teacher engagement with students and more personalized attention for individual students.

Cognitive tutors. Adaptive and intelligent tutoring systems that provide customized instruction and feedback to students have been around for a couple of decades. Now, a mashup of computer science, cognitive science and big data is resulting in smart systems that mirror the best human tutors—with new insights for teachers as well.

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Fun Fact

Virtual teaching assistants can answer 40% of students' routine questions.

Source: McKinsey Global Institute, 2017

AI now and in the future *continued from page 5*

Carnegie Learning's *MATHia* (formerly Cognitive Tutor) is a case in point. Even before the latest advancements, a "gold standard" study showed that its blended approach to middle and high school algebra (classroom instruction, textbook activities and the tutoring software) nearly doubled growth in student performance relative to typical students in the second year of instruction (Pane et al., 2013).

Steve Ritter, founder and chief scientist at Carnegie Learning, explains the thinking behind MATHia: "In a straight AI mode, you can build a system that solves math problems. Solving math problems is a reasonably complicated human-like task, so that's a reasonable accomplishment to have AI solve math problems. What's different in education, or at least in our approach—and the reason why we call them cognitive tutors instead of just AI tutors—is the goal isn't really to solve the math problem. We want to solve math problems not necessarily in the best way, but in the way that students solve problems."

An AI model that thinks like students do also makes the same kinds of mistakes that students make—and it reveals the "thinking" behind the mistakes. "So when a student makes a mistake, we know why," Ritter says. "That's why we can give students guidance, because we know not just that there was a mistake, but we know the thought process that led to that mistake."

Thus, MATHia can intervene early to keep students from going down a rabbit hole. "When a student makes a mistake on step 4 in a 12-step process," Ritter says, "we can give students guidance. Because once you're down to step 12, it's really hard to unwind and go backwards."

In the past, Carnegie Learning tested prototype tutoring programs the old-fashioned way—with small groups of students. Now, data miners and product developers on the company's research team and learning engineers on the cognitive science team are constantly probing the programs, using aggregated data from 10,000 students.

Big data is surprising them with deeper understandings about student learning. That's because intricate data from 10,000 students can reveal infrequencies, Ritter says. For example, 1% of students might solve problems differently. Why not support students with instruction around less common strategies and thinking processes? Armed with revelations from big data, the Carnegie Learning team also can push out program updates more quickly.

Machine learning from big data sets also can help teachers recognize their blind spots, Ritter says. For example, from a math perspective, there's no difference between solving equations with positive or negative coefficients. But the data show that negative numbers trip up students—an issue that expert math teachers might not recognize. Likewise, conventional wisdom holds that word problems are more difficult for students to solve than equations. In algebra, the data show otherwise. For students, tackling

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the unknown *x* in algebraic equations is akin to deciphering a "foreign language," Koedinger says, and it takes time for them to learn mathematical semantics, grammar and structure.

Harbingers in higher education. AI could turn out to be transformational in K–12 education. In the near term, however, "I suspect we're going to see AI-enhanced products," says Gartner's Williams.

In higher education, AI shows promise in targeted applications focused on specific goals and problems, Williams says. For example:

- **To support student learning at scale,** Deakin University in Australia created Deakin Genie, a digital personal assistant that uses a chat interface, voice recognition and machine learning. From their smartphones, students can manage tasks, deadlines and schedules—and access learning resources through Genie's integrated learning management system, library and student information system. Genie is both reactive and proactive—it responds to questions and requests and reminds students of upcoming deadlines and events (Williams, 2016; Deakin University, 2017; Deakin Genie, 2017).
- **To reduce "summer melt,"** George State University and AdmitHub created Pounce, a personalized, conversational chatbot. "'Summer melt' describes the phenomenon wherein high school graduates who intended to enroll in universities fail to matriculate in the fall" (Reding, 2016). Pounce answers questions and sends reminders tailored to enrollment tasks, such as filling out forms, providing test scores, applying for loans and paying tuition. In its trial run with 3,500 students (half of the prospective class of incoming freshmen), Pounce handled 50,000 messages, contributed to a 21 percent reduction in the summer melt rate among Pounce users and reduced the staff burden for nudging students to less than 1 percent of all interactions (Williams, 2016).
- **To scale enrollment,** Codify Academy created an interactive, cognitive chat bot to answer more than 200 common questions about enrollment, program details, tuition and more, resulting in a 10 percent increase in converting visitors into students.

AI applications like these could be a smart place to start for K–12 educators. "What if we didn't start with changing Western civilization as we know it?" Williams asks. "What if we started with enhancements to help desk products, where your top 100 most frequently asked questions get answered automatically via a chat bot? This is usually helpful and for the most part completely unthreatening—and it gives your organization an opportunity to understand a learning technology and have it help with something districts desperately need help with because there are not enough bodies out in the field."

"...data miners and product developers ... are constantly probing the programs, using aggregated data from 10,000 students. Big data is surprising them with deeper understandings about student learning."

—Steve Ritter
Founder and Chief Scientist
Carnegie Learning

IBM: "The Promise of Personalized Learning Is Now Deliverable, Available and Real"

IBM Watson Classroom aims to bring together all of the big data from digital technologies and from teacher, parent and student insights under the umbrella of an AI-powered analytic system. The goal is to provide a rich, 360-degree view of students and help personalize instruction.

With the rise of cognitive technologies and big data, IBM sees opportunities for K–12 districts to benefit from a more disciplined approach to their management and use of data. Bruce Gardner, North America program director for IBM's Education Industry Group, summarizes IBM's four-pronged emphasis in K–12 education:

1. Infrastructure management in districts
2. Data integration planning
3. Data integration and analytics
4. Teacher resources and tools

"It can be any one of those things or it can be all of those things," Gardner says. "The work in all of those areas has led to our focus on personalization. The promise of personalized learning is now deliverable and available and real."

IBM arrived at this point through sustained inquiry with global thought leaders in the IBM Industry Academy, and in partnership with Apple Education, into how AI tools could be most impactful in education, says Alex Kaplan, global sales leader of IBM Watson Education and a member of the IBM Industry Academy. The first manifestation of this thinking is Watson Classroom for Educators, a tool that is "purpose-built" to help teachers do important work.

"Teachers want to know what's going on with their kids," Kaplan says. "It's that simple. They're frustrated that districts can't provide this. So there's this groundswell from teachers saying, 'I'm tired of going through six different systems with five different logins that I then have to download and do a spreadsheet. Then I have to figure out what to do with it.'"

Watson Classroom automates this cumbersome process to provide "a unified view of all the information that there is about a student in one particular place, so that teachers aren't poking around in a student information system or learning management system or a data warehouse or a dashboard to get a view of the student," Kaplan says. "We wanted to have a more cohesive and comprehensive view of the student, because our point of view on this is that teachers have to understand a student as a complete human being."

Historically, this information has been limited to grades and test scores. Now, the data also reflect academic performance in terms of mastery of academic standards and skills, as well as student accomplishments and interests in and out of school. Students and parents will be able to contribute to a "personality insight profile" that provides teachers with a 360-degree view of every student. Teachers will be able to record their observations of students—and benefit from the observations of other teachers. A "tone analyzer" will extract insights and patterns about student performance and engagement from this longitudinal data, which will help teachers provide personalized support and targeted interventions.

To that end, Watson Classroom embeds AI in instructional content, which before now has been essentially static. "What that means is that Watson actually reads every piece of instructional content that a school district is using—and this allows us to do really interesting things," Kaplan says. Watson can automatically align content to academic standards and tag it by key words, reading level IBM and other attributes. "But the objective of all of that is that once a teacher understands where a student is struggling academically against a particular piece of a standard, then we can suggest a particular piece of instructional content, whether that be a chapter out of a textbook or a Khan Academy video, that would be specifically aligned to that individual student's needs."

That's Watson Classroom today. In the future, IBM will be adding administrator, parent and student "personas," using AI to create highly complete sentence: tailored experiences for users depending on their role.

IBM is also deeply engaged in coupling AI with cognitive science to further personalize learning experiences. Using machine learning, IBM is in the process of training Watson as a master of all K–12 subjects, which entails Watson digesting the entire corpus of academic standards and domain knowledge and creating progression paths for students to achieve competencies. Then, using its knowledge of individual student learning needs and preferences, Watson will be able to break the hard-code model of tutoring programs and online courses and engage in direct, personalized dialogue with students to support their learning.

Predictions for AI's Future in Education

AI could merge learning, assessment and life experiences. In the not-too-distant future, AI will challenge students with sophisticated tasks—and predict and assess student performance on every academic standard and competency in the course of learning. "If we're monitoring students every day in class we've seen them solve hundreds of problems," Ritter says. "We've seen their opportunities to demonstrate their knowledge in all sorts of different contexts than in just a limited number of questions that could possibly be put on a single test."

Likewise, AI could blend life experiences into a holistic, "mega learning environment," Aglio says. Already, students are beginning to earn digital badges for accomplishments in and out of school. Eventually, community service, work experiences and attributes like social and emotional diligence will become part of comprehensive student profiles.

Pearson (Luckin et al., 2016) asserts that AI also will augment the physical world, overlaying the real environment with virtual information and personal avatars, mentors and tutors that guide people as they learn and explore the world. AI-connected devices and sensors also will be attuned to other dimensions to learning, such as feelings and movements, and adapt to learners' emotional and physical states.

AI could close opportunity gaps and accelerate competency-based learning. There's good evidence that achievement gaps are actually opportunity gaps, Koedinger says. "Everything we've looked at with our data backs that up," he says. Given AI's delivery of quality practice, personalized feedback and instructional principles, student learning improves at "surprisingly consistent rates"—no matter where students start on the learning curve.

Plus, learning doesn't have to adhere to state testing cycles. If a student demonstrates competencies on content in February, that student doesn't have to wait for the rest of the class to catch up, or until the next school year, to move ahead, Ritter says.

Developing countries could lead the way with AI. "Let's not lose sight of the global dimension to this," Kaplan says. "The challenge we face globally is that the demand for education both at the primary and secondary levels far outstrips the supply of it. Countries are not able to build enough infrastructure and train enough teachers to meet the demands of the current middle class around the world." This means that countries without legacy education infrastructures could be the most eager to implement AI models.

Kaplan believes the "consumerization of information" lies ahead for education. People around the world will pick and choose from a mix of education products that best meet their needs. This will include face-to-face instruction in physical schools, online courses, micro-credentialing and certification—all enabled by AI.

"The most powerful uses will come from scenarios with good algorithms and really big data."

—Kelly Calhoun Williams
Research Director, Education
Gartner

Fun Fact

58%

of U.S. consumers and business leaders say that AI will help solve global education challenges.

Source: PwC, 2017

Questions to Ask Your AI Vendor

1. What does AI mean to you (the vendor)? How does this product fulfill that definition?
2. How is your product superior to current options that have no AI?
3. Once I have your product installed, how will its performance improve through AI?
4. How should I expect to devote staff and time to such improvements?
5. How can I see what will happen with data that is related to my project?
6. What data and computing requirements will I need to build the models for the solution?
7. What resources are available to gather and refine data that the AI solution can use such that its outcomes improve?

Source: Kelly Calhoun Williams (2016). "A.I. in Education—And Why We Shouldn't Be Afraid!" Gartner.

Advice for District Leaders

Get smart about data. To prepare for the coming wave of big data-driven AI technologies, now is the time for district leaders and teachers to become more educated consumers and users of data, Williams says. "We really are so rudimentary in our use of data in K–12," she says. She cites several data challenges:

- **Algorithmic bias.** Even without AI, performance and observational data about students can be biased, Williams says. "AI could only magnify the problem."

  Algorithmic bias can be mitigated with best practices in data collection and use, Williams says. Districts likely will need to work with vendors to identify and root out bias and determine ethical, appropriate ways to input and use data.
- **Algorithmic aversion.** Access to AI-generated data is no guarantee that educators will use it to improve teaching and learning. Some will continue to "go with their gut," Williams says.
- **Overreliance on algorithms.** At the other end of the spectrum, algorithms could lull some educators into the default position that AI knows best. AI can provide recommendations and advice, but it does not substitute for human judgment, Williams says. Ultimately, it's up to educators to make decisions—with much better insight than they've ever had.

Consider your culture. Districts in which leaders and staff are excited about the intersection of personalized learning and emerging technologies are good candidates for AI applications. Small and mid-sized districts tend to be the most facile and can move forward quicker, Kaplan says.

Take stock of your technical readiness. Districts that consider themselves data-driven learning communities, with teachers who work together to use data to improve instruction, are prime candidates for comprehensive AI initiatives such as IBM Watson Classroom, Kaplan says. A basic technology infrastructure, including a student information system, assessment data, digital instructional resources and bandwidth to schools, is essential. Data quality matters. Having data sets, gradebooks and assessments aligned to standards helps—and the more granular that alignment, the better.

Keep in mind that not all AI or AI-enhanced products are intended for use in K–12 classrooms. Use caution when determining which products are and are not appropriate for your district, Attai says.

Start small. Piloting AI technologies on a small scale yields insights into how well they perform and reveals unanticipated challenges. Take calculated risks, start with teachers who are willing to try out new technologies, challenge them to discover how they can use new technologies in their curriculum and learn from their experiences.

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Advice *continued from page 10*

Train teachers. While AI technology can be easy to use, they present professional challenges to teachers. With access to more data on their students, and new types of data, teachers need to learn how to use and contribute to this data appropriately and with care, in collaboration with their colleagues, Kaplan says. Teachers also need to consider the impact that AI technologies can or should have on pedagogy and instructional practices, Aglio says.

Protect and model safe, ethical use of data. As with all digital technologies, it's important to protect student data privacy and security with AI implementations. Before bringing any technology into the classroom, ensure that your district has vetted it thoroughly to ensure that it can and does comply with applicable federal and state laws, and meets your district requirements for privacy and security. Be sure your district has the proper agreements in place with the technology provider to protect student data.

In the Montour district, data practices include not just safeguarding data, but also coaching students to practice safe behaviors and manage their "digital footprints," Aglio says. "But you can't just teach students, or tell them what to do, you actually have to do it with them." For example, first graders draw selfies and talk about their self-image, which helps develop awareness of how they present themselves in the digital world.

Partner with experts. Collaborating with AI researchers and developers can deepen knowledge and practice. The Montour district partners with Carnegie Mellon to pilot and research AI technologies—and explore how students learn best with AI. Through a foundation grant, the district hired a research fellow who works with teachers to conduct customized action learning projects with AI technologies. With the university, the district recently hosted a National K–12 Educational Research in Practice Summit.

CoSN Student Data Privacy Tools

Protecting Privacy in Connected Learning Toolkit **is an in-depth guide to key federal student data privacy laws. It also includes guidance on how key laws operate together, suggested contract terms, explanations of metadata and data de-identification, use of click-wrap agreements, and additional privacy-related resources, including:**

- **Navigating Key Federal Student Data Privacy Laws**
- **10 Steps Every District Should Take Today**
- **Security Questions for Service Providers**
- **Vetting Online Tools**
- **School Officials FERPA Exception**

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This CoSN resource is related to the following skill areas from *CoSN's Framework of Essential Skills of the K–12 CTO:*


Data


Ethics


Leadership/Vision


Instructional Focus

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LEADING EDUCATION INNOVATION

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