Microsoft

Transforming Education

Empowering the students of today
to create the world of tomorrow

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Foreword

Empowering the students of today to create the world of tomorrow.

Anthony Salcito, Vice President, Worldwide Education, Microsoft

We are in an exciting time of change.

As schools and education systems around the world drive to transform and improve learning outcomes, we must recognize that the most important changes have already taken place.

Our students, their view of their world and the way they learn, create and share have changed. And the workplace and skills needed to fuel growth has changed. With such tremendous cultural change comes a pivotal moment in education - an opportunity to embrace the immense potential technology presents.

Over the past few decades, technology has been introduced into classrooms with great intention. But with great intention must also come thoughtful planning, understanding and evaluation that best supports educators and accelerates learning.

With motivated school leaders, technology can transform curriculum and better prepare students for the new world of work. Digital transformation must be a people-centric journey; with a sharp focus on helping students unleash their talent, celebrating the critical and growing role educators play and preparing school leaders to harness possibility.

After nearly three decades, we now have the research, evidence and experience to understand how to achieve the ambitious change needed in our schools.

Our aim is to candidly examine both the failures and successes of the past and to recommend best practice so that school leaders and educators are inspired to embrace digital transformation, confident that their efforts will be successful, safe and empowering.

This guide acknowledges that while students should be at the heart of the transformation journey, the careful and deliberate empowerment of leaders and educators is what will build the cultural capital our world needs.

Because despite all the technological advances of the modern age, empowering great educators to design and support the learning experience using technology, remains the highest goal.

At Microsoft, we aim to empower every person and every organization on the planet to achieve more.

This guide is a contribution toward that vision.

> “The growing role of education as the engine of economic change makes the work happening to transform our schools and classrooms fundamental to global progress. For me it starts with mindset. We need to first inspire students to embrace a limitless future and to see their learning as purposeful to what they can make and do.”
>
> *Anthony Salcito, Vice President, Worldwide Education, Microsoft.*

How to use this guide

> Many leaders ask, "Does technology improve learning?" A much better question is "When, and under what circumstances does technology improve learning?"
>
> *Sean Tierney, Microsoft.*

This guide brings together best practice from decades of experience working in countries across the globe, using contemporary education research to provide a practical resource for educational leaders. Each section deals with an essential aspect of holistic education transformation and how we can navigate the change affecting our systems, schools and classrooms.

Section One
Transformation: why it's critical

This section considers how the impact of the Fourth Industrial Revolution demands a change in schools and teaching practice. It shows how emerging technologies, including analytics and artificial intelligence, deliver far greater understanding of student capabilities and support new approaches to teaching and learning.

Section Two
Education transformation: strategies

This section looks at the practical considerations you will make when researching and designing a strategy for the digital transformation of education in a country, district, department or school. The chapters use academic evidence to work through the key challenges you can expect to encounter.

Section Three
Future-ready learning skills

This section provides academic evidence and practical guidance as to how technology can be used to support and encourage the development of key future-ready learning skills in students. These include: STEM, problem solving, collaboration, creativity, communication, social and emotional skills, and entrepreneurship.

Section Four
Practical templates and guides

This section is action and solutions focused. It provides a suite of helpful templates that you can use to support your Digital Transformation Program including: a device selection checklist, tips for keeping kids safe online, and a cloud and Internet acceptable use policy for students and staff.

Red flags and green flags

Many chapters conclude with a section for reflection. This includes red flags—things to watch out for and avoid—as well as a summary of the key concepts covered in the chapter. These provide a shortcut to best practice recommendations, enabling you to flip forward to quickly avoid common pitfalls and emulate success. The powerful questions are designed to help you think outside the square, challenge the status quo and open the debate.

Expert views

Throughout this guide we feature insights from leading educationalists who provide updates on academic research into different aspects of the digital transformation of education. These highlights equip you with key facts and evidence-based opinions to use and share with your education community.

Contents

Section 1

Digital Transformation and Why it's Critical

As the world changes, so does the future of our students. We cannot sit back and let them enter a drastically shifting employment market without transforming the pedagogy, culture and approach to technology that is a legacy of the previous century.

This section of the book examines digital transformation of learning and how you can plan for it.

- Welcome to the Fourth Industrial Revolution
- A Proven Approach to Transformation
- What Could a Transformed School Look Like?
- A New Disruptor: Cloud Computing
- Technology to Enable Transformation

> "They need to know how to learn because we don't know what it is they're going to need to learn."
>
> *Professor Glenys Thompson, Deputy Principal, the Australian Science and Mathematics School.*

Welcome to the Fourth Industrial Revolution

Digital transformation is is an indisputable force revolutionizing our industries, reinventing our products, redefining our services and reshaping the way we work. The impact is so dramatic that Klaus Schwab, founder of the World Economic Forum, has dubbed it the fourth industrial revolution. Our students will enter this very different world. So how do we prepare them for it?

New ways of working mean new opportunities for teaching

Today's students need real-world skills to thrive in the not-too-distant future. Qualities like critical thinking, collaboration, creative problem solving, self-awareness, self-management, responsible decision-making, and the ability to construct complex solutions. This is true regardless of subject area. Complex skills are as important for artistic, service and human-oriented professions as they are for more scientific, technological or industrial employment.

Digital skills are now vital for all

On top of critical thinking and problem solving, the digital skills that were once the province of computer science students are now crucial across the entire spectrum of education. It's increasingly difficult to imagine how your students will succeed without digital facility, be they looking to pursue careers in healthcare or banking, academia or the performing arts. For education systems, this requires a deliberate effort to create conditions where learners can demonstrate and develop these capabilities.

Coming Soon

Technology we'll see by 2025

- 30 percent of corporate audits will be performed by AI.
- More than 10 percent of all cars on US roads will be driverless.
- The first government taxes will be collected via Distributed Ledger Technology (DLT) – also known as blockchains. The Australian Stock Exchange has already moved to DLT.
- One trillion sensors will be connected to the Internet.
- We'll see the first robotic pharmacists and other service roles.
- Implantable cell phones will be commercially available.
- Governments will replace the census with Big Data sources.
- More journeys will occur via car sharing than by private cars.
- 10 percent of reading glasses will be connected to the Internet.
- 50 percent of Internet traffic will be from home appliances and devices.
- 3D printed cars will hit the roads.
- We'll see the first 3D printed liver transplants.
- 1 in 10 people will be wearing clothes connected to the Internet.

(Source: Deep Shift Technology Tipping Points and Societal Impact, World Economic Forum report (2015)

Labor economists agree: Technology requirements are increasing for all jobs

Today, one in two jobs worldwide require technology skills. But in fewer than ten years, we estimate three in four jobs will require deep and specific technical skills. But what does this mean for our students? The OECD Deputy Director for Education, Andreas Schleicher, has stated that the future world economy will no longer pay for what people know, but what they can do with what they know. In other words, students now need to develop skills in an environment that focuses less on knowledge transference and more on knowledge use. In a world where students have instantaneous, unlimited access to knowledge, it is time to refocus our curriculum, policy, management, and legislation to embrace this skills shift.

With new skills come new opportunities for students to thrive

We've seen the rise of Silicon Valley, start-up culture and virtual working. We now live in a world where the largest taxi company owns no cars (Uber), the largest movie provider owns no cinemas (Netflix), and the largest social media network creates no content (Facebook.) For today's businesses, agility is everything and only the bravest innovators rise to the top. We're also anticipating robotics, automation and artificial intelligence, which are likely to have profound, lasting impacts on the nature of work, life and education. It's easy to be worried by this, but it's better to be inspired. If we can equip our students with technological fluency, high-level knowledge skills and an agile mindset that embraces innovation, creativity and "market disruption," they will be ready to face almost anything.

The key is focusing on student centricity

Daniel Pink—futurist and author of the bestseller *A Whole New Mind*—believes success in the 21st century depends on having a purpose, a sense of self-efficacy, a growth mindset, and the right tools or access to those tools.[1] To achieve this, Pink argues, the role of the school is to help students identify their purpose, learn how to pursue that purpose, and experience achieving self-defined goals.

For learning transformation, student centricity should be the core of your 'disruption.' This makes it possible to move successfully from a traditional model based on mastery of a curriculum, to a model of learning that is about giving students the practical experience to achieve their personal potential. The Canadian province of British Columbia put it perfectly in their vision statement, when they redefined a school as "a place to discover and find one's dignity, purpose and future options."

Rosy Future: Daniel Pink's vision for student-centric education

Purpose: Schools help individual students identify and pursue their unique purpose.

Self Efficacy: Schools help students develop motivation, self-sufficiency, self-awareness and self-management.

Growth Mindset: Schools help students move from simply absorbing knowledge to constantly applying, improving and innovating that knowledge.

Digital Tools: Schools equip students with the right platform, software, devices and tools to succeed in a digital economy.

Every economy in the world depends on a workforce that is equipped for our rapidly changing world. The World Economic Forum states "Education is our deepest source of hope—we must plant the seeds now for a better future tomorrow."

Today the pace of change presents education systems with a real challenge. No country wants to be turning out students with skills and qualifications for jobs that may no longer exist. So our focus has shifted to equipping young people with future-ready skills for jobs that are yet to be invented or which are unlikely to be automated.

To try to get to grips with the magnitude of what this will entail, the McKinsey Global Institute[2] looked at the fastest growing professions and analysed the skills they demand.

Their research found that they will require more cognitive, social and emotional skills. In simple terms our students will need the resilience to navigate an increasingly dynamic world. They'll need to be creative problem solvers capable of re-imagining products and services in line with technological advances. And they'll need to be skilled entrepreneurs, with the technological skills to bring their ideas to fruition fast.

To ensure that today's youth have these skills and are employable in the workforce of the future, the 2016 World Economic Forum observed: "The education system will need to adapt to prepare individuals for the changing labor market. At the same time, recent IT advances offer new and potentially more widely accessible ways to access education."

This guide looks at how we can use technology to build and equip education systems to that they can advance the teaching of future-ready skills.

Net impact of automation on occupations 2016-2030

Occupation	% change	Net change (millions)	Number of jobs in 2010 (millions)
Technology Professionals (Software developers, etc.)	25 to 30%	+ 0.8 to 1.0	3.9 to 4.0
Care Providers (Doctors, nurses, childcare workers, etc.)	20 to 30%	+ 3.0 to 5.0	19.2 to 21.1
Builders (Architects, construction workers, etc.)	-5 to 35%	+ 0.4 to 2.7	7.4 to 10.5
Managers and Executives	5 to 15%	+ 0.5 to 1.1	7.9 to 8.6
Professionals (Engineers, lawyers, scientists, finance specialists)	5 to 10%	+ 0.8 to 1.7	16.6 to 17.5
Educators (Teachers, education support workers, etc.)	3 to 9%	+ 0.3 to 0.8	9.9 to 10.4
Creatives (Artists, designers, entertainers, media, etc.)	6 to 8%	+ 0.1 to 0.2	2.1 to 2.2
Jobs in Unpredictable Environments (Specialized mechanics, emergency response)	-3 to 8%	− 0.4 to 1.0	12.5 to 13.9
Customer Interaction (Personal care, food service, sales, etc.)	-3 to 1%	− 0.9 to -0.4	26.8 to 27.3
Office Support (Computer support, clerks, administrative assistants)	-23 to -20%	− 5.4 to -4.6	17.8 to 18.6
Jobs in Predictable Environments (Production, transport, equipment operators)	-30 to -25%	− 7.4 to -6.6	17.9 to 18.6

Source: US Bureau of Labor Statistics, McKinsey Global Institution Analysis

Key Trends

1 Soft skills come into sharp focus

Social and emotional competencies become fundamental for navigating learning, working and living.

2 Voice, choice and agency

Young people want the skills, tools and opportunity to explore and solve significant problems, choosing and using the people, tools, places and spaces to achieve their goals.

3 Technology becomes more human

Current and emerging tools amplify the characteristics that make us human including creativity, empathy and collaboration. New interfaces support continuous learning feedback, gesture, mixed reality, voice and touch.

A Proven Approach to Transformation

Transforming an entire education institution is an exciting and critically important opportunity. But it's also fraught with stumbling blocks. That's why we developed the Microsoft Education Framework—a research- and experience-driven driven way to fast-track success.

The Education Transformation Framework

Ensure success with global best practice

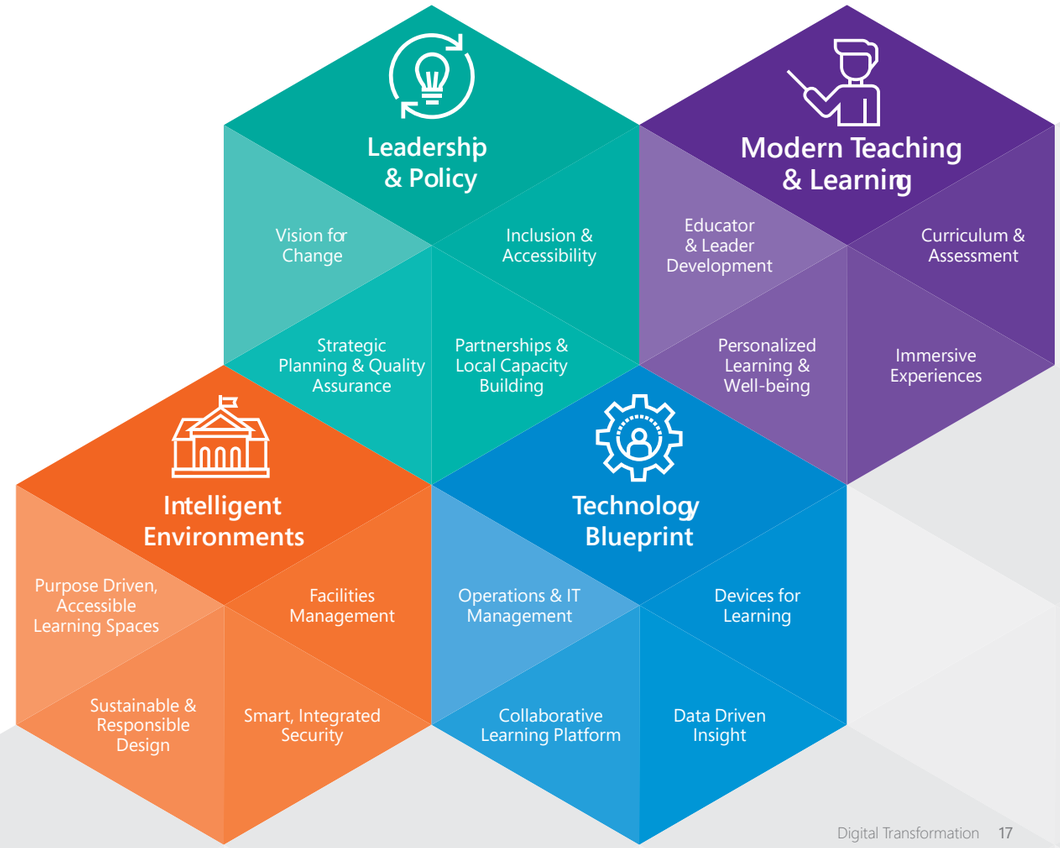
Microsoft worked with 130 leading policy makers and academics to evaluate studies of schools, school districts and countries where learning transformation initiatives have made dramatic improvements.

By recording and analyzing their evidence and research data and working in consultation with academics, experts and policy makers, we've identified what works and what doesn't. The most successful transformation projects globally share the same approach—one that's holistic, methodical and systematic.

We also distilled the key findings and made them available to school leaders everywhere.

The result is an Education Transformation Framework grounded in the latest research into effective policy, leadership and pedagogy transformation. You can quickly see what global leaders are recommending and tap into their best practice and experiences, with links to go deeper if required. Examples of what has worked and what hasn't can help you avoid repeating the same mistakes.

Recognizing that school contexts vary, and that change can be 'whole school' or 'incremental,' the framework is open and non-prescriptive, providing a flexible starting point. It is underpinned by a suite of executive summaries, white papers and provoking questions, all designed to stimulate conversations, and provide guidance for managing the critical aspects of change. Visit **www.microsoft.com/education**



To inspire discussion, we've summarized the ten components of The Education Transformation Framework here. To learn more, download executive summaries, white papers and resources at microsoft **microsoft.com/education/leaders**

Leadership and Policy

Vision for Change

It's about developing a clear, succinct vision to drive change. By creating a rationale that's shared by leaders and other stakeholders, you can create the momentum for long-term impact.

Strategic planning and quality assurance

It's about taking a program management approach. Start with an effective plan to achieve multiple workstreams. Include quality assurance metrics and establish a strong governance model.

Partnerships and local capacity

It's about partnering with public and private organizations in a long-term strategy. Partners can help build capacity, whether through digitizing administration and management or upgrading staff skills.

Inclusion & Accessibility

It's about supporting social inclusion through making technology more accessible, both through customized interfaces and tools for students with special needs and by embedding supports in teacher training.

Modern Teaching and Learning

Educator and leader development

It's about professional learning that's more inspiring than traditional trading. By participating in an active community of practice that shares ideas, successful strategies and content, educators motivate each other to grow and adapt.

Personalized learning and wellbeing

It's about new approaches and tools. These help educators unlock students' sense of purpose and inspire them to achieve more. At the same time, students develop important 21st century competencies.

Immersive experiences

It's about taking students vividly outside their own experience. What if they could go virtually into a volcano or walk around a living cell in 3D? Or even build their own medieval village or sub-Saharan ecosystem?

Curriculum and assessment

It's about creating multifaceted learning content for students—and evaluating them on competencies, not content recall. And it's about linking them to the community for education, employment and entrepreneurship.

Intelligent Environments

Purpose-driven, accessible learning spaces

It's about matching physical learning spaces and furniture with learning goals to provide flexible learning choices. One strategy is to build learning labs and studios next to common, quiet, and collaborative spaces. A low-fi approach is to split existing spaces into specialized zones.

Sustainable and responsible design

It's about creating healthy, thriving environments with plenty of fresh air, light and natural views to keep learners alert, positive and engaged while reducing costs and environmental footprint.

Smart integrated security

It's about using intelligent safety systems to proactively make schools safer and reduce bullying and other threats. Such systems can track people and assets, alerting the school community to safety issues. They can also control access to school facilities dynamically, aiding emergency response.

Facilities Management

It's about using the Internet of Things (IoT), the cloud and data analytics to manage complex school environments more efficiently. Connect digital whiteboards, computers, vehicle fleets, lighting, climate control, parking, security and more to improve visibility of assets while using automation and analytics to save cost.

Technology Blueprint

Operations and IT

It's about creating an agile, flexible and responsive operations and IT environment. Your aim is to put in place a platform and applications that serve the needs of every learner, teacher and administrator across your educational system or institution.

Collaborative learning platform

It's about enabling the next-level collaboration central to modern teaching and learning. The right platform brings together people, learning content and insights. This can make the difference between success and failure for teachers and students.

Data-driven insight

It's about using evidence-based decision making to transform student learning and your education system. There's no need to turn everyone into data scientists —simply offer easy-to-use tools so they can gauge progress and improve.

Devices for learning

It's about choosing devices that offer superior value and support for learning. Powerful devices can run real-world software, preparing students for life beyond school, and enable rich 3D learning experiences not available on simple web content and apps.

What Could a Transformed School Look Like?

Here are some of the visionary outcomes you can aim for when developing your transformation roadmap.

School leaders

- Accelerate continuous improvement in student and teacher performance, health, wellbeing and achievement—across a class, a school or the entire system—thanks to real-time information and analytics.
- Connect and collaborate with the wider school community using convenient new social communications.
- Improve rankings and graduation rates, and reduce drop-out rates.

Teachers

- Understand more about their students, and the support or guidance they need.
- Can augment their lessons with experts from anywhere in the world.
- Provide powerful feedback and guidance, freed from the traditional, repetitive methods usually required to do this.
- Open up new pedagogical opportunities, with tools to understand and refine impact.
- Support their own ongoing professional development with access to training and peer networking.

Students

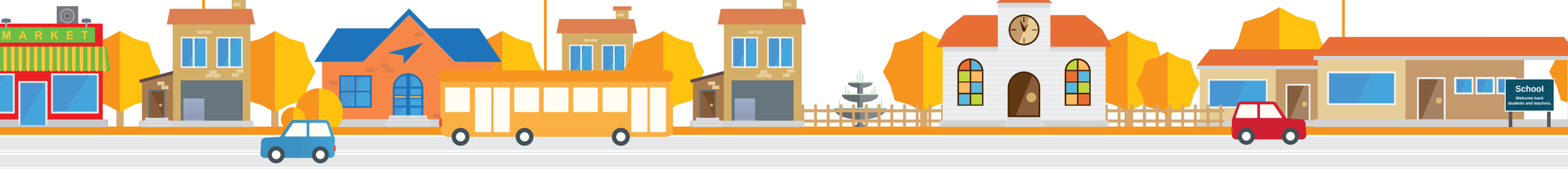
- Are more engaged, included, empowered and supported.
- Receive powerful digital tools and learning resources for personalized learning.
- Can learn, study and interact with a keyboard, pen, touch, voice and other natural interfaces.
- Are able to co-create, co-author, communicate and collaborate with classmates, mentors and teachers.
- Can explore ideas and concepts more deeply, with "anywhere, anytime" access to coursework, apps and feedback.
- Can decide their own learning pathways, work at their own pace and pursue topics that engage them within the core curriculum.
- Engage in virtual excursions, conversations or collaborations with experts from anywhere on Earth.
- Develop essential skills for employability.

Parents

- Receive detailed, easy-to-understand information of their children's needs, performance and wellbeing.
- Can support their child's learning with direct access to information, teachers and staff, e-learning resources, and services.

Technology Leaders and IT Managers

- Can simplify processes with intelligent, automated procedures.
- Minimize costs through simple, pay-per-use cloud models.
- Optimize existing investments by connecting them to a single, unified system.
- Improve the ROI on all investments.



A New Disruptor: Cloud Computing

One way to refocus your digital technology on human needs is to move to the cloud. Schools around the world are making this move—and it may not be why you originally thought. The cost benefits are well known: Schools can use the cloud to sidestep hefty capital investment, IT management overheads and technology obsolescence. But the real benefit is access to the heavy computing power they will need to deliver truly personalized learning.

Cloud computing allows schools to cheaply rent a holistic, unified platform that caters to changing student, teacher and staff needs. On a technical level, that's a single offering with best-in-class data models, industry-standard core systems and cloud services, optimized specifically for education.

The advantage of this approach is the flexibility to add new technologies and capabilities when required, or to scale capacity up and down with the demands of the school year. In this way, schools can continually innovate and advance over time, without breaking the budget.

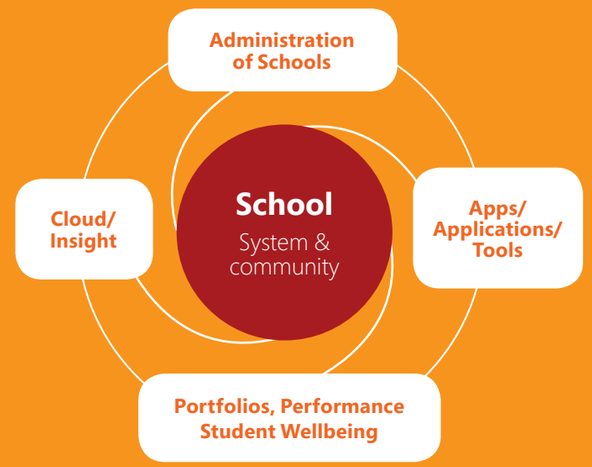
Transformation: What does it look like?

- Visibility across the entire system and other schools.
- Clear understanding of where to allocate resources or support.
- Smart asset management.
- Courses that can be shared across campuses.
- Digital, automated payroll.

Visibility across the system

Analytics can consolidate most data across education systems into a single comprehensive data model that delivers end-to-end analytics and reporting. This ensures consistent high-integrity data that is up to date and provides simple, elegant user interfaces for more accurate data input that are integrated with the familiar tools teachers use every day. This enables schools to simplify analytics and take advantage of new, precise modeling that can reveal:

- Comparisons of the use of technology with student performance.
- Effects of interventions on learning outcomes.
- Efficiency of school budgets.
- Clusters of learning improvement.



Technology to Enable Transformation

Each school operates differently, with variations in how it uses its applications and systems. These systems have often been "bolted on" over time, resulting in inconsistent, fragmented data and experiences.

System before transformation

User Experience

- Fragmented systems with multiple access points that create inefficiency.
- Limited visibility of student progress and outcomes.

School Administration

- Data is stored in systems that don't connect to each other.
- Complicated maintenance with multiple licensing fees.

Principals and Administration

Disparate systems and services with multiple sign ons

Student management systems

Timetable solutions

Mail server

Curriculum content delivery platform

Productivity software

File server

Marksbook

Intranet

Teachers, Students and Parents

Discrete system

Learning Management System

System after transformation

The integration of multiple systems and data into a single, intelligent platform paves the way to better educational outcomes and streamlined processes.

User Experience

- Simplified single access to software and tools.
- New learning tools and insights with purpose-built interactivity, enabling reporting and analytics.

School Administration

- Fully integrated - removing manual synchronization.
- Reduced long-term licensing costs.

Principals

Administration

Teachers

Students

Parents

Your portal

Red Flags

Though it is inspiring to focus on best practice, it's useful to also be aware of the common stumbling blocks in a digital transformation project. Keeping an eye out for red flags can help your team identify problems earlier and work quickly to correct your trajectory.

Data security and privacy protection is essential

Lack of Data Security

It's exciting to consider the potential features of cloud-based apps, such as Office 365. But what a lot of schools do not consider, unfortunately, is the data protection they provide. Legislation surrounding data protection is an important consideration, not just to ensure your technology is compliant, but for the safety and security of your students, and staff.

According to this Masaryk University Journal of Law and Technology article, "The [user] contract for Microsoft Office 365 was found to be compliant with data protection law." However, "The contract for other major providers suffers from several deficiencies that may cause a breach of data protection law."[3] The study found that advertising-based providers were data harvesting through school-issued technology. A syncing feature set to 'default' was providing advertisers with access to students' passwords, search history, browsing history and more.[4]

Lack of Information Privacy

Much like data security, it's important to ensure your user's right to privacy when they input personal information, such as names, addresses and social security numbers.

The General Data Protection Regulation (GDPR), is due to take effect by May 2018. Developed by the European Union, this law will affect all systems and institutions globally if they have one or more students or employees from the European Union. This will impose new rules on companies, government agencies, non-profits, and other organizations that offer goods and services to people in the European Union (EU), or that collect and analyze data tied to EU citizens. The GDPR applies no matter where you are located.

Microsoft has extensive expertise in protecting data, championing privacy, and complying with complex regulations. We currently comply with both the EU-U.S. Privacy Shield and the EU Model Clauses. In other words, though we offer free access to our software through a school email account, Microsoft does not mine student emails or student work for data, nor do we capture data for the purpose of targeting advertising to student accounts.

Policy Recommendations

The Microsoft publication, 'A Cloud for Global Good,' makes the following key recommendations:[5]

- School systems should establish clear, enforceable privacy frameworks that include strong privacy protections while enabling schools, teachers and students to take advantage of the benefits of cloud computing that are dependent upon data.
- Privacy frameworks should provide meaningful autonomy for individuals and require organizational accountability for strong privacy protections and fair data use.
- Privacy frameworks should build on long-standing privacy principles. Chief among these is that people should have reasonable choice over whether personal data is collected and how it is used.
- Privacy frameworks should not be so restrictive that they prevent school systems, schools, teachers and students from using data analytics to draw insights in an ethical manner.

Evidence and Further Reading

Explore the topics mentioned in this section with some recommended further reading.

Bloem, J., Doorn, M.V., Duivestein, S., Excoffier, D., Maas, R. and Ommeren, E.V. (2014) *The Fourth Industrial Revolution—Things to Tighten the Link between IT and OT*. Sogeti VINT2014.

Pink, D. H. (2006). *A whole new mind: Why right-brainers will rule the future.* Penguin.

Siemens, G. & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE review, 46*(5), 30.

Microsoft. (2014). *Education Transformation Framework Overview: Transformation Framework.*

Critical Concepts

This chapter explored some provocative, early-stage thoughts that can help you find the right pathway to your own digital transformation.

Essential steps to success

The fourth industrial revolution is here

Ensure students are provided with opportunities to demonstrate and develop the digital skills they need to thrive in future economies.

We cannot carry on in the same way

All of the research and statistics show that today's youth are entering a vastly different world and must be prepared for it.

Humanity should drive change

Even the best technology in the world will fall short if students, teachers and staff don't feel that it understands, supports or enables their ideas.

Transformation begins with a strong foundation

Be ambitious about what technology will make possible on your transformation journey. Failures of the past are guideposts for the future, not indications of what is and is not possible.

Let other schools and systems inspire you

By researching the incredible achievements of other schools and school systems, you can visualize the perfect transformation for your school or system and develop a roadmap to get there.

Use the Microsoft Transformation Framework

If you're finding the challenge a little too momentous, this resource offers a flexible, proven way to move forward.

Choose technology that supports your vision

Explore the tools that can support your desired outcomes and build deeper learning relationships, in an affordable, safe and secure way.

Look out for red flags

Go into your transformation with your eyes open, ready to anticipate some of the common stumbling blocks others have encountered.

Powerful Questions

Challenge your assumptions by asking the following five questions:

1. **What's our state of play?**
   Are we at technology ground zero, or are we contending with several incoherent technologies? What's working? What's not?

2. **How could we use analytics to get a clearer vision of our situation?**

3. **What human needs should drive our transformation?**
   What are the common complaints, desires and ideas? How can we enable change?

4. **What are other school systems doing?**
   How can we emulate thier success and avoid the common pitfalls?

5. **Where do we want to be?**
   What does success look like—for the entire school system, individual schools, teachers and students?

Section 2

Transformation Programs

Whether it's brought in by students or introduced by schools, technology typically lands in our classrooms before we can fully evaluate its impact. Change is so rapid and so profound that we often continue to apply age-old learning constructs to modern technology. As a result, many programs are poorly implemented, or expensive failures. In general, expectations for what technology makes possible have lowered, when in fact its potential to positively affect education has increased.

This section reflects on the successes and failures of the past and provides best practice guidelines.

- Transformation Programs: Critical Steps to Success
- Using Data Analytics to Optimize Transformation
- Teaching and Leadership
- Devices, Curriculum and Assessment
- Physical Learning Spaces
- Creating an Inclusive Classroom

> "For decades now we have been burdened with a plague of low expectations."
>
> *Anywhere Anytime Learning Foundation.*

Transformation Programs: Critical Steps to Success

> Transformation is about more than technology the goal is to enable a complete re-imagining of learning, anytime, anywhere, and to be ruthless in studying and adjusting when and how technology makes things better."
>
> *Bruce Dixon, Co-founder, Anywhere Anytime Learning Foundation.*

The Opportunity

Technology can make learning far more engaging, rewarding and equitable, equipping students with the skills and knowledge to become confident, happy, contributing participants to our world. There are now simple affordable ways to revolutionize teaching and learning. Getting it right means infinitely better opportunities and experiences for our students, and a more efficient, effective and rewarding work experience for our teachers and staff.

The first large-scale transformation in K-12 was a one-to-one learning program, which launched as early as 1991 in Victoria, Australia. Since then, similar transformations have become commonplace across the world, with real momentum building in the last decade.

The successes of transformation programs tend to present themselves quickly. Dozens of researchers report increased scores on standardized tests,[6] better student engagement[7] and attentiveness, as well as improved literacy,[8] collaboration[9] and problem-solving skills[10] for students as young as the fourth grade.[11]

However, the disappointments of these programs are often slower to register, can run more deeply or are less likely to be considered. They are also where the real value of hindsight can be realized. Struggling to see this, some schools phase out their programs entirely, citing rising costs,[12] low take-up,[13] or little noticeable improvement in student performance.[14] Others blame the technology itself, misunderstand the reasons for failure, or ultimately find themselves unwilling to contend with the magnitude of change required.

How can things go so wrong, or so right? In this chapter, we take an unflinching look at the enormous challenge of planning a transformation program and how to use the right policy recommendations to get it right.

What's what?

One-to-One Learning

The provision of one fully functional, laptop or tablet for every student. Properly managed, this is most effective and proven model for transformation.

Bring your own device

Students bring any device to school. This can be disruptive because schools have to support multiple brands and teachers have to teach to the lowest common denominator.

Laboratories or carts

Providing a "class set" of laptops or tablets to support learning works well in lower grades if students spend less time working with technology, but can limit learning in higher grades.

The Challenge

For every step forward, there is a complexity or risk that needs to be understood, and mitigated. These range from online predators, data mining and student profiling to potentially opening a doorway to inappropriate content for students. Less apparent are the risks of implementing technology that undermines learning, creates distraction, fragments attention, or creates a "hyperlinked" mindset at the expense of focus.

Questions are often the answer

Albert Einstein once famously said, "If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask; for once I know the proper question, I could solve the problem in less than five minutes."

Of course, most of us couldn't possibly solve the enormous challenge of developing a school system transformation in just five minutes, but approaching the problem from the right angle saves hours—if not weeks or months—of valuable time.

Five essential questions

Start with a simple framework of five maddeningly simple questions. These can help you open debate on the important issues and evaluate the potential impact of change.

1. What's our strategic goal?
2. How will we achieve it? Who do we want to emulate and what do we want to avoid?
3. Who could help us?
4. How will we manage change?
5. How will we stay on track and measure success?

Policy Recommendations

The best foresight is hindsight. Drawing on the wealth of research, policy documents and real-life implementation experience available is the best way to ensure successful, holistic change. The Microsoft Education Transformation Framework ties these elements together, with tools, templates and activities to help your institution achieve the best.

Build a powerful, shared vision

Looking at the huge challenge of a digital transformation, it can be easy to think it hinges on implementing the right technology in the right way. But while critical, this is one of the last checkboxes on the list on page 46.

"The most successful initiatives all have one main characteristic in common," says Bruce Dixon, co-founder of the Anywhere Anytime Learning Foundation. "They are first and foremost concerned with learning, not laptops or other devices."

All too often, new technology proves irrelevant to teachers, either because schools are unable to execute a structured implementation, policies are not congruent with technology use, or the culture of the school is not supportive of technology adoption.[15]

> "Digital transformation of education is as much about cultural change as it is about technology."
>
> *Mr. Sunil Hettiarachchi, Secretary Ministry of Education, Sri Lanka.*

So, what's the answer? Start with investing in the development of a strong, shared vision. A vision document is an expression of a desired end state.

A device ratio of one to one isn't an adequate description of the desired state, it is only one mechanism to realize this. Instead, the vision expresses what this technology will make possible in the context of the learner, the school, the system and the community.

To get a more concrete idea about what this means, an example of a vision statement can be found in the state-wide vision for learning in Victoria, Australia: "All teachers and students have access to contemporary technology and world-class digital content with which to create, communicate and collaborate locally and globally. Student learning is engaging, personalized and authentic to enable them to become confident and creative individuals and active and informed citizens of the 21st century."

> "The first thing people typically think about is devices. But digital transformation is about more than the technology. In fact, the Anytime Anywhere Learning Foundation estimates that less than 10 percent of the work required to make one-to-one successful involves a device."
>
> *Bruce Dixon, Co-founder, Anywhere Anytime Learning Foundation.*

What does a successful vision look like?

Two typical schools below provide a useful comparison of how an ill-considered and well-considered technology program can be justified and explained. On the surface the claims from School A look promising, but they are unlikely to deliver successful outcomes, according to best practice.

School A

Ill-considered, shallow vision

B

All our kids have devices. Walk into any classroom, and they'll be engaged with apps.

We are moving textbooks to tablets. Bags will weigh less and curriculum will be more up to date.

Teachers are given PD on how to integrate technology into the classroom.

Technology is measured by how much students create amazing videos, digital stories, and animations.

We let students bring any device they like, as long as it has connectivity.

School B

Well-considered, directive vision

A+

Our students think more deeply. Technology allows them to ask bigger questions, to explore concepts more deeply, and to do things they couldn't do without technology.

We are moving away from textbooks to a critical literacy model on accessing and parsing information from contemporary sources.

Our teachers are coached on how to use technology safely, ethically, and in ways that can transform learning.

Technology is measured by how it increases discretionary cognitive load throughout the process of learning—it empowers us to focus less on finished products, and more on the learning journey.

We spent a lot of time to understand the research and, as learning experts, to ensure our students have the devices that are proven to increase the outcomes we value.

Research the proven components of change

With a vision and a framework in place, it's important to reinforce your digital transformation with research. There's no doubt that every situation is different, so it's useful to hunt around for case studies and articles published about schools from similar circumstances to your own. Incorporate meaningful research into the execution of your vision—and be very critical of any "evidence" that cites engagement as the major benefit.

Be keenly aware of what meaningful student engagement actually is, and how to measure it

Engagement is more than excitement or increased attention. These are just a few examples of behavioral engagement.[16] In other words, just because students are highly engaged with a device does not necessarily mean they are engaged with learning. True engagement requires emotional engagement and cognitive engagement, as well as behavioral engagement. These can be measured using the most appropriate combination of student self-questionnaires, teacher reports and observational data.

By understanding the proven components of change and tempering your enthusiasm with risk management, you can ensure student safety and wellbeing is front and center.

Plan your funding strategies

Consider the various funding options that are available to you, and plan for a sustainable initiative that addresses the critical issues of equity. You have the chance to either address or entrench a learning divide for your students. Almost every public system in the world offers "free education". This often creates reluctance to ask for a contribution to technology. However, global evidence reveals that one of the biggest mistakes a school system can make is to provide free technology to students. When families contribute they take ownership, there is less loss or damage, devices are better cared for and there is less downtime.

Consider a public-private educational partnership (PPEP)

Public-Private Educational Partnerships (PPEPs) are contractual relationships between governments and private sector entities that enable you to collaborate with a specialist in a specific area. This could be to help you with digital transformation planning and management, professional support services, device funding, management or technology deployment and maintenance. These PPEP elements can provide the increased choice that comes with taking advantage of specialized private sector expertise and skills. A review of the role of public-private partnerships in education put forward the following arguments in favor:[17]

- **Competitive quality:** By having the private sector compete for the contract.
- **Flexibility:** PPEP contracts can often be more flexible than most public sector, government-managed arrangements.
- **Service level agreements:** The government's competitive bidding process allows for defining specific requirements for the quality of educational services to be provided.
- **Reduced risk:** PPEP contracts inherently are predicated on risk-sharing between government and the private sector.

Core funding principles

- Funding should ensure all students can participate.
- Funding should be structured to ensure it can be sustained indefinitely.
- Device funding must be supported by a commitment to professional development.
- Everyone who benefits should make some contribution.
- When students / families contribute you experience:
  - Increased ownership.
  - Less loss / damage.
  - Better maintenance.
  - Less downtime.

Source: AALF

Get your entire community behind the project

Sometimes referred to as "buy in," getting everyone in your community to believe in your digital transformation is a complicated task that can spark success or spell doom. In a study of digital transformations across the United States, Canada and the United Kingdom, Fullan found that one of the most fundamental roadblocks to reform is when teachers and staff do not have a clear sense of the reasons for change, what it is and how to proceed.[18]

New York's Liverpool High initially proposed that every 10th, 11th and 12th grade student be required to lease a laptop. Unfortunately, they failed to effectively communicate their vision, leading to complaints from parents. Things went from bad to worse, when the school decided to then make the technology program voluntary.

Because only half the students signed up, "the school set up two tracks of classes—laptop and non-laptop—that resulted in scheduling conflicts and complaints that those without laptops had been shut out of advanced classes, though school officials denied that," reported Winnie Hu for *The New York Times*.[19]

Recognizing this lack of equitable access, the school later decided to purchase laptops for the remaining students, but then failed to implement a system to maintain them. "A room that used to be for the yearbook club became an on-site repair shop for the 80 to 100 machines that broke each month." As costs spiraled, the school eventually decided to shut down its program in 2007. Oddly enough, parents then complained about the program closing.

It's worth noting that Liverpool High was in a lower-income catchment area, in which one in four students qualified for a free or reduced-cost lunch. Costs were undeniably a huge barrier to success in this region—especially in the early 2000s, when devices were priced as a luxury and there was no option to lease network infrastructure.

But with successful digital transformation programs regularly rolled out in similar or less well-off schools around the world, it's worth investigating how structural and emotional changes could have made a difference. Bringing parents and the wider community into the planning stages can go a long way toward building a successful program that works for everyone.

> "A good vision isn't about technology. It's about intent. A device ratio of one-to-one isn't the goal of a technology transformation, but merely one of many components that make it work."
>
> *Bruce Dixon, Co-founder, Anywhere Anytime Learning.*

Always give teachers the technology first

One of the fastest ways to predict the success of a technology program is whether or not teachers are given technology first with a structured program to help them use it for 'personal benefit'.

Personal benefit means teachers have a reason to use the technology because it makes their life easier and more productive, or they can design more interesting learning activities, have more fun, or become more connected.

Until the teachers have a meaningful purpose to use technology to improve their own lives, they are far less likely to embrace transformation.

Measure success

Many schools use Business Intelligence (BI) software to connect data systems, such as records of attendance, grades, demographics and staff information. This enables you to see if your change program is translating into better student outcomes.

For example, after Tacoma Public Schools in Washington State connected their data systems together, they were able to identify the students at risk of dropping out, provide extra support to those students and ultimately boost graduation rates from 55 percent to 78 percent. With a national average of 81 percent, this was a huge leap forward, all thanks to data insights.

Make sure that student data is secure

Prepare for General Data Protection Regulation (GDPR)

In May 2018, the General Data Protection Regulation (GDPR) is set to take effect in Europe, with global impact. The GDPR imposes new rules on companies, government agencies, non-profits and other organizations that offer goods and services to people in the European Union (EU) or that collect and analyze data tied to EU residents. It includes rules related to personal privacy, controls and notifications, transparent policies and IT and training.

Microsoft has extensive expertise in protecting data, and championing privacy, and is committed to GDPR compliance across our cloud services.

Education leaders globally must ensure they are provided with robust GDPR-related assurances in ANY contractual agreements with cloud providers before embarking on a cloud-based digital transformation journey.

To learn more, and for useful tools and resources to ensure you are GDPR ready, visit:
www.microsoft.com/trustcenter

Identity and Access Management (IDAM) is one of the most critical and often overlooked foundations for a successful transformation

IDAM describes the management of individual users, their authentication, authorization, and privileges within or across system and enterprise boundaries with the goal of increasing security and productivity while decreasing cost, downtime and repetitive tasks. Systems that get identity and access management right are far more likely to successfully undergo robust, future-ready transformation.

Any IDAM strategy needs to start with a strong protected single identity. Institutions and education systems who're moving in part, or fully to the cloud need to be very careful to build a consistent, secure, scalable identity solution. As you move to the cloud, the identity becomes your control plane, safeguarding your core assets on the premises and in the cloud.

Most breaches can be traced back to compromised credentials. The more people rely on cloud services and online resources, the more difficult it is to efficiently and effectively manage the identity. Typically, each cloud service has its own unique user names and passwords.

In many cases people cope with this proliferation of multiple digital identities by using idiosyncratic methods to manage their online entrances and access to resources.

These coping mechanisms range from a low-tech approach of sticking computer monitors with sticky-note reminders of sign on information to the more sophisticated solution of password manager software, which stores and organizes an individual's many user names and passwords in one place. Some users resort to the "forgot user ID and password" option on the many sites they visit to reset their passwords and start fresh, with yet another password to manage.

Increasingly the trend in many schools, colleges and universities is to enable students, educators and staff to use a single sign-on ID to access appropriate online educational resources within their institutions—as well as at external sites/services.

7 Principles for Learning OECD 2010

To help schools re-imagine teaching and learning, the Organization of Economic Cooperation and Development (OECD) has laid down seven useful principles.

1. Learners should be at the center of what happens in the classroom with activities focused on their cognition, learning process and growth.
2. Learning is a social practice and can't happen alone. Structured, collaborative group work can be good for all learners. It pushes students in different ways.
3. Emotions are an integral part of learning. Students understand ideas better when we connect emotions, motivation and cognition. Positive beliefs are key.
4. Learners are different and innovative learning environments reflect the various experiences and prior knowledge that each student brings to class.
5. Assessment should be for learning, not of learning. Assessments are important, but only to gauge how to structure the next lesson for maximum effectiveness.
6. Students need to be stretched, but not too much. Students need to experience both academic success and the challenge of discovery.
7. Learning needs to be connected across disciplines and reach out into the real world. Learning can't be meaningful if students don't understand why the knowledge will be useful to them.

Embrace new possibilities for 21st century educators

Once a strong vision is in place, it's time to look at practical applications in the classroom. To truly unleash the power of technology, schools need to look at redefining curricula and how they get taught. In other words, it's time to completely re-imagine teaching and learning for the 21st century.

"A focus on facts and recall, on drill and practice, does not leverage the value of the computer," argue Professor Norris and Professor Soloway, from the University of Texas and University of Michigan respectively. "Having students investigate and collaborate in order to develop a deep, integrated understanding of underlying processes needs to be the focus of a one-to-one computing classroom."[20] Learning transformation requires a major conceptual shift. It is a movement away from viewing computing as a separate subject, or an appealing gadget that can hook in student interest, to a whole new idea of the classroom as a digital space, of the curriculum as a measure of what matters, and of the role of teachers and learners.

Future-ready learning is a mindset that empowers students to become co-authors of their learning and tailor activities to meet their needs, abilities and interests. This requires a big change in the way teachers function in the classroom, moving from what Deakin Crick terms "learning as script" to "learning as design."[21] In fact, in a seminal analysis of over 800 studies relating to student achievement, John Hattie found that teacher skills account for about 30 percent of the variance in student achievement.[22]

Dr Emma Bartle agrees, advising, "Teachers need to be willing and able to shift their pedagogy to a student centered approach—their ability to do this is a critical element of a personalized learning environment."[23]

> "It's all down to your approach. Technology, by itself, is not going to close the achievement gap between the rich and the poor, a gap that threatens so many of our minority students. But when technology is used correctly, we have seen powerful results."
>
> *Superintendent Alberto M. Carvalho, Miami-Dade Schools, USA.*

The Pygmalion Effect

Set high expectations with clear parameters

Setting high, clear expectations helps orient every aspect of a digital transformation. For staff, this involves dialogue with stakeholders.

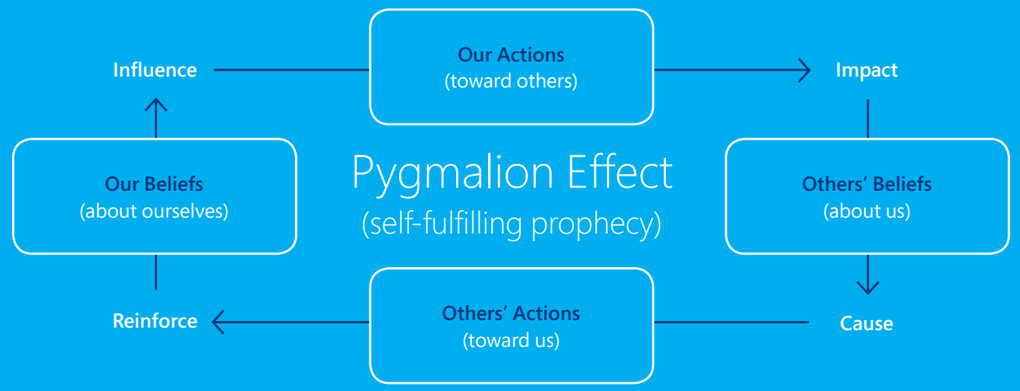
For teachers, setting expectations helps them understand their students and tailor learning experiences that keep them engaged. The effect of teacher expectations—also known as the Pygmalion Effect—means that when teachers expect more from their students, then perform better. This is reaffirmed by Hattie's research, which found the factor with the highest impact on student outcomes was the teacher's own estimation of student achievement.[24]

The reverse is also the case. If teachers and staff expect less by giving students limited technology, students will understand this low expectation and achieve less.

First applied in education in a now-famous 1968 study by Robert Rosenthal and Lenore Jacobson, the Pygmalion Effect revealed that if teachers were led to expect more from students, those students performed better. This effect includes gender and racial stereotyping.

Recently, the study inspired the Teacher Expectation Project by researcher Christine Rubie-Davies, who used video-taping to show teachers how unconscious feedback, such as winces, shrugs and frowns, can hugely discourage students.[25] Rubie-Davies also found that students treated to higher expectations performed better, and, on average, completed coursework three months faster than the control group.[26]

> "Providing children underpowered or compromised technology devices can be a powerful physical expression of low expectations."
>
> *Sean Tierney, Microsoft.*



Set up a change management program

When planning your transformation, don't neglect a change delivery strategy to inspire, skill and equip stakeholders for success.

The most commonly cited reason for project failure is the people. When students, teachers, school administrators and parents are not properly informed and prepared they have trouble implementing change. Initiatives with excellent change management teams are six times more likely to meet objectives than those with poor change management.

Activities might include parent information nights, posters, notices, or articles in the school newsletters. You can also hold staff introductory and professional development days to provide basic technology skills and a wider appreciation of system-wide goals, reinforced by continual support through online courses, communities of interest and recognition of success.

Empower teachers to manage today's students

Successful programs hinge on empowering teachers in five ways:

1. Making change relevant, specific and useful.
2. Setting high expectations of teachers and students.
3. Enabling teachers to adapt and grow through development opportunities.
4. Supporting teachers with enforceable school policy that sets clear guidelines on student technology use.
5. Coordinating with parents to manage technology use at home.

For an in-depth look at the role of teaching and leadership in your digital transformation, flip forward to page 58.

For a look into technology guidelines, a useful starting point is the work of Annika Andersson, Assistant Professor in Informatics at Sweden's Örebro University. She interviewed a range of teachers in digital schools, one of whom commented, "It takes a lot of time from the lessons just having to tell the students to close the computers... or tell them to leave Facebook."

Andersson's study found that the root of the problem was the lack of school practice guidelines when it comes to distractions like social media. She recommends shifting the responsibility school-wide by implementing policy. Andersson also suggests updating teaching practice, to avoid the dangerous pitfall of simply blaming weaker students for their lack of self-control, which would serve only to widen the gap between higher- and lower-achieving students. Andersson notes, "One of the responsibilities of the adult world is to protect children from challenges they cannot handle."

This brings us to the third way to empower teachers, which is through managing the addictive nature of newer technologies. In his book, *Digital Cocaine*, Brad Huddleston found that, neurologically, there is no difference in addiction between playing an hour of video games and half a line of cocaine.

Managing this level of risk requires a coordinated effort between teachers, parents and students. Teachers need to be educating students on appropriate use, while parents need to ensure this is upheld at home. Students, meanwhile, deserve to be respected, with a full and frank discussion of the dangers of accessing inappropriate content and how this can deeply affect their thoughts, relationships, actions and future prospects.

Many schools have developed contracts providing a clear set of rules on the use of technology covering:

- Security.
- Cyberbullying.
- Texts and calls.
- Internet access.
- App installation.
- Taking photos and videos.
- Use of tablet/smartphones in school.
- Responsibility over damage and repairs.

See page 253 for tips to help parents protect their children at home.

Technology transformation in 21 steps

Be deliberate in your approach and follow a proven framework. To help schools avoid common transformation pitfalls and fast-track success, the Anywhere Anytime Learning Foundation, in collaboration with Education Queensland and Sean Tierney from Microsoft, created this 21-step process. It was developed by combing through 30 years of successful technology transformations, and refining these strategies into simple steps, which are then divided into four clear phases.

Phase 1
Make a compelling case for change

1. Understand the context of your institution.
2. Build a powerful shared vision.
3. Clarify goals, expectations, and policy priorities.
4. Liaise with parents and community.

Phase 2
Research best practice

5. Explore contemporary learning examples.
6. Embrace new possibilities for 21st century educators.
7. Begin creating future learning environments.

Too many attempted transformation programs begin at step 20, usually because it's the most visible, politically saleable step. Retrofitting the previous 19 steps is far more complicated, and far less likely to positively affect learning.

Phase 3
Engage and prepare your community

8. Build a change culture.
9. Implement professional learning strategies.
10. Ensure equity and sustainability (funding strategies).
11. Build understanding (communication strategies) and policies.

Phase 4
Implement your plan

12. Conduct a readiness assessment.
13. Consider implementation options and project plan.
14. Select devices for teachers, applications, apps, and core tools.
15. Plan your infrastructure for scale.
16. Prepare the budget.
17. Establish critical partnerships.
18. Select student devices.
19. Clarify essential policies for effective use.
20. Deploy devices.
21. Review.

More than lip service?

What does the term "learning transformation" mean to you? And does it mean the same thing to your colleagues? Bruce Dixon, COE, change.school, provides this thought-provoking commentary.

Think for a minute. How differently do you and your colleagues define and interpret words such as achievement or success in an educational context?

A lack of shared language is the cause of many flawed educational initiatives. Terms like innovation or transformation have come to mean so many things to so many people, they end up meaning nothing to anyone.

Take the term "1-to-1" for example. Back in the early '90s when students were given access to their own fully functional laptop, it was widely referred to as a "laptop program," At the time I was annoyed that the focus was on the hardware, so in 1992, I coined the phrase 1-to-1. I wanted to reflect the personal ownership a child had of a portable computer. And the fact that this would allow them to have agency to learning what they want, when they want, with whomever they want, which today at change.school, we believe is the most important and disruptive development in education... ever!

Since then, I have had the satisfaction of seeing millions of young people empowered by 1-to-1 access. They've been able to take control of their own learning, co-create their curriculum with their teachers, and explore powerful ideas that were impossible before.

But then, they were the lucky ones.

I have sadly also seen this vision for learner enablement trivialized, minimized and bastardized by poorly informed policy and education leaders who have disabled the very power that we sought to provide. It's the result of poor decision-making and political expediency, which seems to be aligned with ensuring students are handed shiny new technology, usually referred to as a 'device.'

Where we sought student access to powerful personal computing, they limited the reach of student devices and "dumbed down" the possibilities.

Where we wanted students to explore big ideas, powerful concepts and deeper thinking, they limited how much students would be able to do by compromising power and functionality in their devices.

Where we wanted to break down walls for breakthrough thinking, they built barriers to contain any deviation from compliance to legacy curriculum.

It's not what our kids deserve, and it's certainly not what Seymour Papert and other pioneers had in mind when they had a vision for students to have their own "imagination machine."

It's time we stopped compromising our young people's future. It's time we set priorities that weren't built around 20th century practice, and it's surely time we decided that every child, not just some, should benefit from the power, the possibilities and the opportunity a child can have when they have 1-to-1 access to their own fully functional, mobile computer.

Bruce Dixon
is the co-founder and President of the Anywhere Anytime Learning Foundation. He consults to institutions and technology companies on 1:1 teaching and technology in education. In 1997, he was awarded by the Smithsonian Institute for his work in pioneering ubiquitous access to technology and, in 2006, he was named as one of the '20 People to Watch' by the National School Boards Association of America. Bruce's work was also referenced in Bill Gate's latest book, Business at the Speed of Thought.

Using Data Analytics to Optimize Transformation

Successful transformation is grounded in data insights. When your school system can accurately measure performance, learning outcomes and the effectiveness of budget choices, you can set a clear path to optimize the entire system.

> "As life and learning become increasingly digitized and 'datafied,' students leave detailed traces of their actions and outcomes at school in an array of apps, devices and databases. When schools can consolidate data from all of these sources, analytics can provide powerful predictions and recommendations that guide teachers and school leaders."
>
> *Cathy Cavanaugh, Head of Learning and Research, Catholic Education, Western Australiaauthor and education commentator.*

Once you have accessible, usable data, you can report accurately, demonstrate that you are spending tax dollars effectively, measure the impact of new initiatives and comply with new sustainable development monitoring requirements in line with the UN Sustainable Development Goals agenda. Equally important, with the capabilities that now exist you can obtain granular analytics at an individual student level. This holistic understanding of schools, classes and students is the foundation for personalized learning.

Your data is only as good as your ability to use it

Often school systems have cobbled together different IT systems over time. School leaders and teachers have to jump between interfaces to access different sources of information. And it's impossible to obtain a holistic understanding of students, classes or schools.

This makes it difficult to understand, measure or predict factors like school performance, technology usage or the overall efficacy of an investment, intervention or resourcing.

However, if you take the time to consolidate all of your data and implement analytics, you can transform your system with improved results, teaching and decision-making.

Data problems often arise during poor transformation attempts

There are four main phases most schools will go through in approaching transformation, and each of them has potential stumbling blocks that are worth identifying as soon as possible:

1. **Limited scope:** If the technology was only implemented in computer labs, or was distributed unevenly around the school, then success was severely limited by low scope. This kind of rollout is often heavily dependent on charismatic "pioneers"—those special teachers who created magic that was hard to scale.
2. **Bold mandates with soft impact:** This occurs when a large-scale deployment focuses only on technology or digitization, typically through a one-off device procurement. Implementing devices without an overarching vision that ushers in new processes, new understanding and new culture at every level is (unfortunately) doomed to fail.
3. **Scaling back:** Schools or systems that were unsuccessful in phase one and two often scale back their technology investments so they "just work."
4. **Outcome-based projects:** The rise of data drives a new mindset for holistic, measurable transformation.

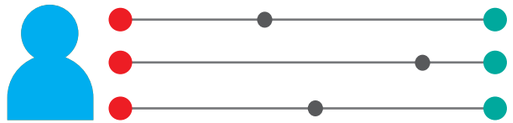
> When data from all student learning activities and assessments is understood, trends visualized, and complex relationships illuminated it can help make teachers, schools, and education systems more effective and efficient."
>
> *Cathy Cavanaugh, Head of Learning and Research, Catholic Education, Western Australia author and education commentator.*

What's missing from these transformations?

Analytics

Great teachers analyze data every day through observation, intuition and questioning. Now we can digitally support analytics that can help teachers notice more about their students with less effort, by intelligently consolidating extensive information and presenting it in a usable way. For example:

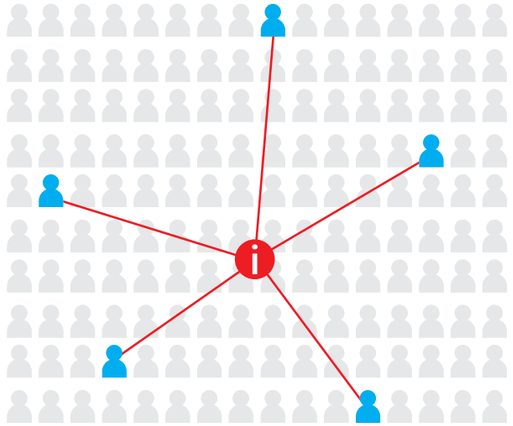
Student Wellbeing Indicators



This kind of data display can be useful for someone actively investigating the wellbeing of a student; however, when trying to understand a whole classroom or grade of students, it quickly becomes overwhelming.

Analytics also enable schools to see how they are tracking, so they can investigate the impact of new initiatives to quickly gauge the level of service they are providing. This helps schools continually refine their planning from an informed perspective.

The best part is teachers are not required to be data experts, or to actively investigate charts and diagrams to make decisions on how to best support learners. Analytics should proactively identify issues and export data in easily understandable formats.



The analytics trinity: data, cloud processing and machine learning

Intelligent platforms use big data, cloud processing and machine learning to analyze your information and provide meaningful recommendations in real time. Increasingly this type of computing is becoming known as augmented intelligence, as a deliberate counterpoint to artificial intelligence, which is often misrepresented in popular culture.

Augmented intelligence is about amplifying human action by harnessing collective knowledge to enable better decisions and reduce repetitive tasks.

For teachers, this means an intelligent platform that can, for example, automatically recommend courses or interventions based on student performance, needs and preferences. It's like a digital assistant, improving and adapting over time to become more useful and more personalized. But there's always a "human in the loop". Decisions are never automatic and when an investigation is required, tools like Power BI can allow teachers to 'deep dive' into data and make conclusions for themselves.

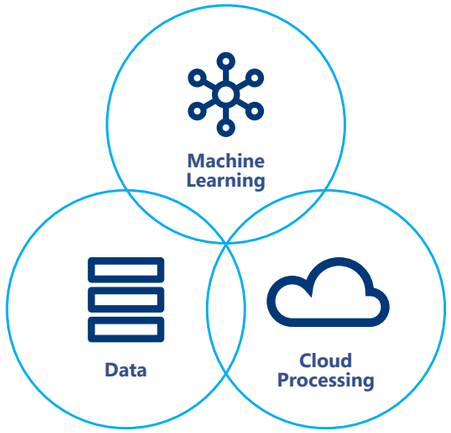
The Head of Digital Transformation Catholic Education Western Australia, Aidan McCarthy, explains: "When learning data is consolidated and analyzed over time for large groups of students, you can obtain powerful predictions and recommendations to guide teachers and school leaders. It can form the basis of just-in-time proactive prompts and notifications."

Using analytics on objects

The Internet of Things (IoT) allows objects to be sensed or remotely controlled across existing network infrastructure. This, in and of itself, creates interesting opportunities for the direct integration of the physical world into digital systems. But when analytics are applied, you can intelligently optimize your assets to reduce running costs, boost efficiency and reduce repetitive human tasks.

A school's physical environment can actively contribute to learning when outfitted with Internet of Things sensors that adjust sound, air quality, and light to suit individual learning preferences. An IoT lighting system, for example, can optimize itself to actual usage patterns, show which areas are highly trafficked, make better use of natural daylight, save on energy costs, and much more.

Three converging technologies



Dr Cavanaugh's Key Principles for Safety and Security

Moving to an intelligent platform with analytics requires clear planning and new learning-centric policies. There are three key principles to ensure this is done in a safe and secure manner:

1. Data must be associated with a student via a robust digital credential.
2. Data and analytical tools must be accessible in a safe and secure enterprise cloud data environment—not locked in proprietary apps and platforms.
3. Analytical tools should include dynamic visualization, agile algorithms, and services for unstructured data that interpret student cognitive and non-cognitive development.

Red Flags

Though it is inspiring to focus on best practice, it's useful also to be aware of the common stumbling blocks in a digital transformation project. Keeping an eye out for red flags can help your team identify problems earlier and work quickly to correct your trajectory.

Common reasons for underwhelming outcomes

Projects instead of policy initiative

It may be tempting to "start small," but the result is often a policy made in bits and pieces, which doesn't hold together. A bit like ripping off a sticking plaster, wholesale systemic change may appear painful, but it will offer the greatest, most powerful results.

Short-sightedness

Sometimes an initiative is implemented only to solve a short-term problem. Even if it is successful, it will struggle to grow and adapt with future requirements. Building in a permanent cycle of experimentation, evaluation and adjustment can help future-proof your one-to-one vision.

Current policies are replaced by the new government

While it's not always possible to predict how a government is going to legislate, it's worth taking the time to read up on their manifesto and policy documents to get a sense of where they are likely to focus.

The policy focuses mainly on ICT

Implementing the right technology policy is usually the easiest piece to get right, so don't let this fool you. The essential components that are required for success include culture, communication, processes and support.

The policy is based on bad assumptions

Despite decades of evidence, systems too often trade evidence for convenience.

Devices don't go home

Students only spend 16 percent of their waking hours at school so if devices don't go home with students, they lose 84 percent of their potential immediately.

Teachers don't have access to technology first

Teachers should ALWAYS have access to technology and professional development before the students start to use it. New teachers entering a one-to-one school need additional support.

People confuse digitization with transformation

Moving traditional content to a computer or tablet is not transformational.

The policy is organizationally isolated

When the vision isn't shared across your community, it is difficult to orchestrate a committed response to the initiative.

The policy does not specify measurable goals

It's impossible to evaluate success or pick areas for improvement if you don't know how your efforts have fared.

A gap between government policy and education practice

This unfortunate outcome can occur when government rhetoric is at odds with the realities of education.

Evidence and Further Reading

To delve deeper into some of the topics in this chapter, here is a selection of recommended reading and relevant case studies to serve as a useful starting point.

Hattie, J. (2009)
Teachers make a difference: what is the research evidence? Melbourne, Australia: Australian Council for Educational Research.

Huddleston, B. (2017)
Digital Cocaine: A Journey Toward iBalance. Vereeniging, South Africa: Christian Art Press.

Oviatt, S. (2012)
Multi-modal Interfaces. Handbook of Human-Computer Interaction, Lawrence Erlbaum: New Jersey.

Cavanaugh, C.
(2015). *Online, blended and distance education in schools: Building successful programs.* Stylus Publishing, LLC.

Fullan, M.
& Quinn, J. (2015). *Coherence: The Right Drivers in Action for Schools, Districts, and Systems.* Corwin.

Critical Concepts

Forget about just automating old paradigms. Transformation is about finding new, better ways of doing things. It is about embracing a new culture and mindset apart from just being IT-savvy. It means embracing lightweight processes and governance, and should adopt agile and lean methodologies.

Essential steps for success

Don't start your transformation program by selecting devices

It's the quickest route to failure. Start by setting your vision and deciding how you to achieve, manage and measure the transformation.

Understand the role of data in unlocking a school system's potential

Once you consolidate all of your data and implement analytics, you can transform your schools with improved results, teaching and decision-making.

Be ready for a major conceptual shift

Take this as an opportunity to completely re-imagine teaching and learning in your school or school system. It is a movement away from viewing computing as a separate subject, or an appealing gadget that can hook in student interest, to a whole new idea of the classroom as a digital space, of the curriculum as a measure of what matters, and of the role of teachers and learners.

Get your entire community behind the project

Public relations are essential to success. Invite all of your education community to be part of the journey.

Set high expectations with clear parameters

Setting high, clear expectations helps orient every aspect of a digital transformation. If you provide teachers and students with limited technology and minimal plans for improvement, they will understand this low expectation and achieve less.

Don't confuse entertainment for engagement

Don't mistake just playing a game or using a device (behavioral engagement) for emotional engagement and cognitive engagement.

Look for support in the private sector

Public-Private Educational Partnerships (PPEPs) are one way of tapping into specialist expertise and funding, as well as creating student training pathways.

Empower teachers

Successful programs hinge on empowering teachers with professional development opportunities and clear policies for student use of technology that are upheld rigorously.

Scaffold learners

Provide flexible, temporary support—such as twinning competent students with less confident learners as they learn to use and manage devices, apps and tools.

Encourage collaboration and teaming

Encourage teachers and students to work together as they discover and share new ways of learning. This can be augmented with technologies, such as Microsoft Teams for impromptu sharing of insights, advice, tips and tricks.

Set up a change management program

When planning your digital transformation, don't neglect a change delivery strategy to inspire, skill and equip stakeholders for success.

Measure success and report on it

Use Business Intelligence (BI) software to connect data systems, such as records of attendance, performance, etc., so that you can monitor and report on progress.

Powerful Questions

Start your digital transformation by asking the following five questions.

1. What's our strategic goal for digital transformation?
2. How will we achieve it. Who do we want to emulate and what do we want to avoid?
3. Who could help us?
4. How will we manage change?
5. How will we stay on track and measure success?

Teaching and Leadership

The Opportunity

Empowering teachers to confidently and positively embrace change is usually an institution's top concern. When teachers are given the attention, development and support to become leaders, outcomes improve across the board. Students do better. Schools improve their standings. And teachers can enjoy progression and esteem in a difficult job that deserves more respect.

Teachers matter. John Hattie's groundbreaking Visible Learning series—the largest ever meta-analysis of the factors affecting educational outcomes—revealed that five of the strongest influences on student achievement involve teachers.[27]

From understanding the impact of their behavior on student achievement, to improving efficacy and teaching strategies, it is clear we must support, develop and empower our teachers if we want to ensure the best for our students. Most importantly, we need to find ways to reveal the potential in every child, so teacher estimates of student achievement do not hold so much sway over student success. Data analytics can reveal student ability at a far more granular level and this holds the promise of truly personalized learning approaches. But ongoing professional development in how to apply these new technologies and strategies is key.

Unfortunately, the state of teacher and leadership training does not look good. Few teachers report professional learning as useful.[28] But when professional learning is done well, it can significantly improve student learning.[29] So how can schools ensure they get it right? Again, we look at what works, what doesn't and what's worth doing.

Respect for teachers

"In Finland, teaching is considered so vital to the country's success that all primary and secondary school teachers are qualified with a 5-year master's degree. Finnish teachers are also largely free from inspections, standardized testing and government control.

Teacher education in Finland is also strongly research-based, with all the students on the primary school master's course engaged in research. As a result, Finland's teachers have kept the nation near the top of the influential PISA performance rankings since they were first published in 2001."

The Challenge

With many teachers trained for a completely different classroom, it's a huge challenge to get widespread commitment to the digital paradigm shift. Without the right tools, training, tech support, financial support and morale, teachers can easily fall back on old strategies out of pure stress.

Ensure teachers have the technology tools required for transformation

One of the biggest mistakes schools and school systems make is to fail to give teachers the technology required for transformation. The most common examples include:

- Implementing a one-to-one program and giving students devices but not teachers.
- Investing in professional development that can't be practiced or implemented because teachers don't have access.
- Providing "training" on software tools that teachers can't run on their technology.
- Failing to give teachers adequately powerful technology to design the best possible teaching and learning experience.

Therefore, it is critical to give teachers the right technology as early as possible to ensure the professional development is as effective as possible.

Scaffold teachers with professional development that is measurable

Top-performing schools tend to place huge focus on school-based professional development.[30, 31] Several studies have also highlighted the important link between professional development and the success of a digital transformation program.[32, 33] While it's clear that professional development is fundamental to success, it's also important to measure its impact so that you can refine your techniques. And it's also key to make professional development an integrated part of your school system. The rapid pace of innovation and change means that new technologies and new learning opportunities continually present themselves and teachers need to be equipped to evaluate and understand them.

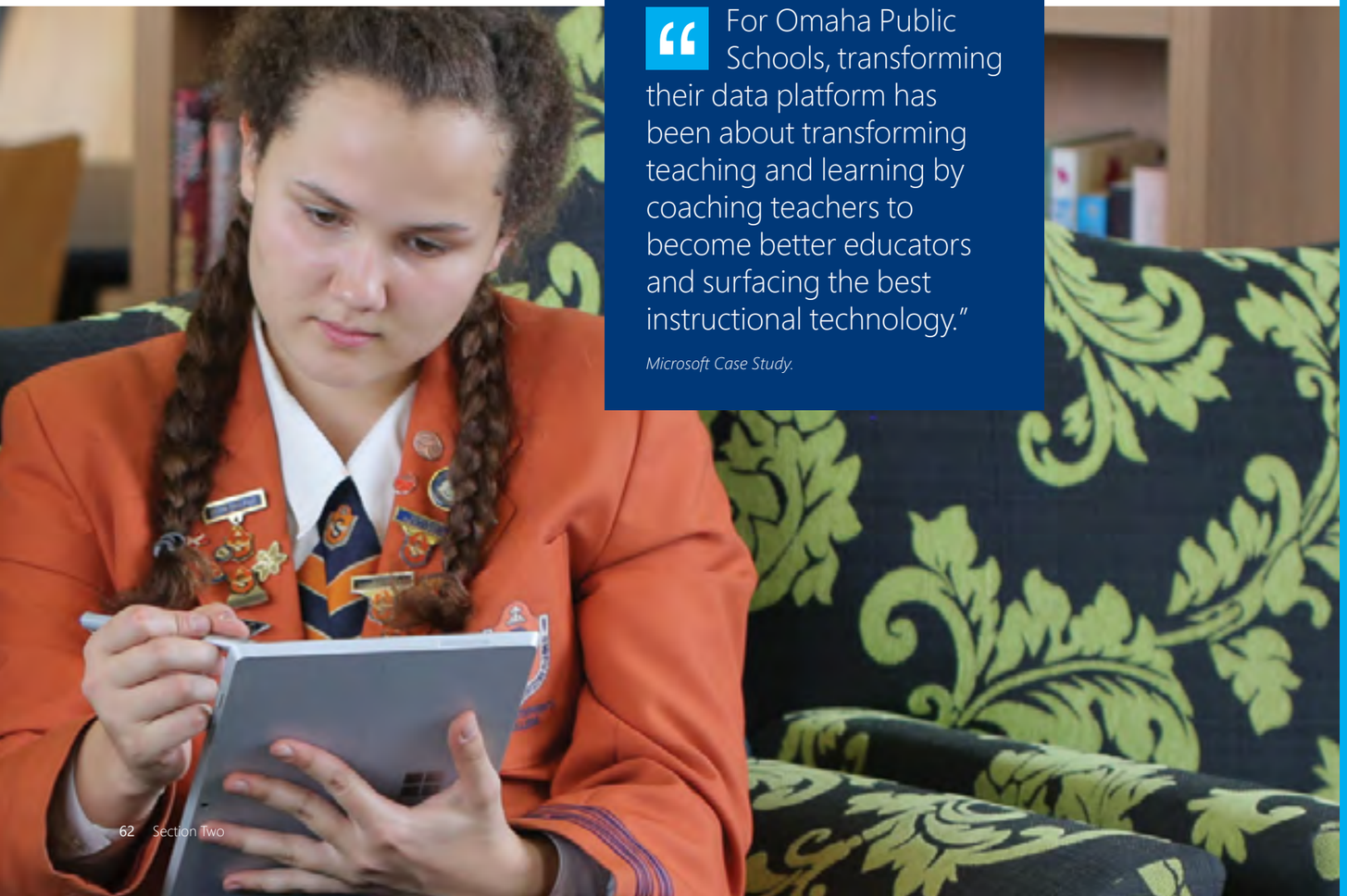
> "We respect teaching. It is as important as training doctors."
>
> *Kimmo Koskinen,*
> *Viikki teacher training school, Helsinki.*

School Leadership

Create learning leaders

Fullan criticizes the idea that principals should focus on instructional leadership, noting that it requires principals to be fully knowledgeable of—and even partially involved in—teaching, and this can lead to micromanaging.[34] DuFour and Marzano, similarly, found that "time devoted to building the capacity of teachers to work in teams is far better spent than time devoted to observing individual teachers".[35] In other words, it's far more effective to build a teacher's capacity to lead, rather than draw principals into teaching.

Hattie calls this new role the "learning leader". He explains that while instructional leaders look at what is taught, learning leaders emphasize how that information is taught and how we know it was taught well.[36] What's more, because a learning leader is better integrated with his or her peers, they can create a collegial environment where teachers trust they can learn from each other.[37]



> "For Omaha Public Schools, transforming their data platform has been about transforming teaching and learning by coaching teachers to become better educators and surfacing the best instructional technology."
>
> *Microsoft Case Study.*

OECD Recommendations[38]

1 (Re)define school leadership responsibilities

With the autonomy to make their own decisions, school leaders can make a real difference in school and student performance. But granting autonomy does not automatically lead to improvements. Leaders must be well supported, with their core responsibilities clearly defined through an understanding of the practices most likely to improve teaching and learning.

2 Distribute school leadership

The increased responsibilities and accountability of school leadership creates a need for that leadership to be better distributed within and across schools. The trouble is, while middle-management responsibilities are considered vital for effective school leadership, these practices are often totally unclear; or those involved are not well recognized for their tasks. It's time to broaden the concept of school leadership and adjust policy and working conditions accordingly.

3 Develop skills for effective school leadership

School leaders need specific training to respond to their increasing responsibilities and to help improve school outcomes. Strategy should include treating leadership development as a continuum, ensuring it is provided consistently, and ensuring it has an appropriate level of variety.

4 Make school leadership an attractive profession

Potential applicants are deterred by the heavy workload of principals and the fact that the job does not seem to be adequately remunerated or supported. Uncertain recruitment procedures and career development prospects for principals may also deter potential candidates.

5 Empower teachers to become 'learning leaders'

As schools worldwide have tended to experience increased autonomy and decentralization over the past few decades, principals have been put under pressure to take on more responsibilities. One of the key responsibilities that has emerged is coordinating school-based and classroom-based strategies to improve teaching and learning. This type of instructional leadership gained influence in the 70s and 80s, but its usefulness is now being questioned by some more recent studies.

Leading the Change

Education transformation is a process of people change as much as digital. The role of a leader in driving this change cannot be underestimated. They are responsible for the culture, strategies, structures and politics involved in change.

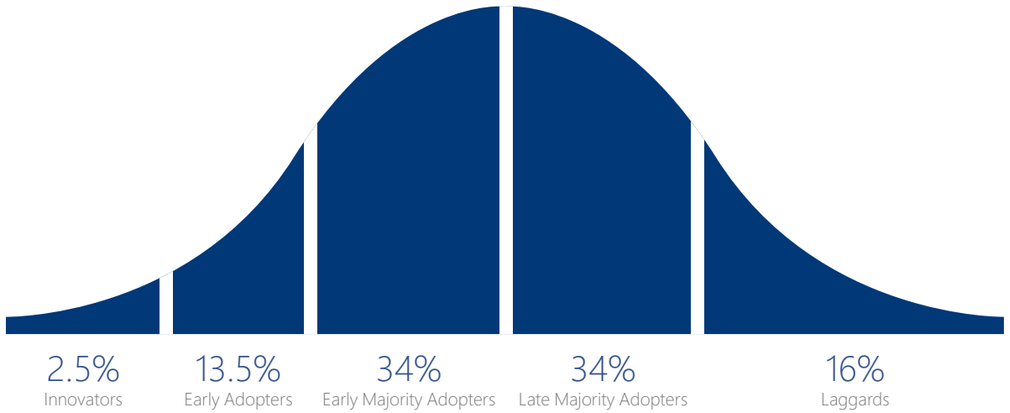
Some teachers will be more willing to participate in the process of digital transformation than others. Leaders need to be deliberate about identifying and supporting change agents and empowering them to lead those who lag behind. This is a considerable and ongoing challenge. It is important to identify those who feel threatened or coerced in a change process, and those who see it as personally beneficial, enjoyable and worthwhile.

Idenify and empower change makers

Leadership isn't some lofty idea just to encourage teacher morale. It has a concrete effect on stakeholder outcomes. Everett Roger's Diffusion of Innovations adoption curve[39] can be useful in identifying who to work with first.

1. **Identify the right focus group for early adoption and advocacy:** There will always be around 2.5 percent of a teacher workforce who are innovators. They will embrace digital technologies early, but may not be accessible role models to the majority of staff. Around 13.5 percent will be early adopters, willing to embrace change and apply it across contexts.
2. **Use "natural selection" to identify early adopters:** Innovators and early adopters will often be the first to proactively approach leadership with new ideas when driving a digital change process. Once identified, these individuals (or teams) can be appointed as change agents, to motivate others to embrace transformation and to lead by example.
3. **Consider a 'buddy system':** Skeptics can be paired with safe and accessible peers who can guide them through the change process. It can help bring context and meaning to the benefits of a transformation that may not seem personally relevant on the surface. It can also give early adopters a chance to refine, practice and improve their own capabilities.
4. **Set out clear, digestible goals:** Great leaders spend significant time on communicating the impact, rationale and necessity of digital transformation. We have detailed many examples earlier in this resource. Additionally, they will set clear, achievable goals that tie consistently to these messages.

Innovation Adoption Curve



Source: Everett Rogers: DIffusion of Innovations Adoption Curve 1962.40

A social revolution via ditigal not a digital revoution via technology

John Hattie asks, "Have we missed the point?"

According to John Hattie, the digital revolution has been coming for 50 years. There have been over 150 meta-analyses (close to 20,000 studies) relating to digital technology and student achievement and the average effect-size (d=.34) has barely changed despite the enormous advances.

The main question is why has there been so much promise with so little return. Probably it is because teachers still use the "tell and practice" model, which has worked so well for 150 years, and at best ICT can supplement this method.

Have we missed the point?

But this misses the major revolution that has occurred; teachers are huge users of ICT in their planning, reporting, research, and seeking ideas from each other. For example, our AITLS (www.aitls.org) site has millions of hits by educators per year, the downloads of apps, podcasts and videos is huge, and the requests for interactions with others via the site continual. We have built a national community of educators via ICT.

Similarly, in the classroom, students are huge users, and when we unleash the power of social media in the class (without the downsides) we can create communities of learners outside the classroom walls.

Moreover, students can discuss what they do not know; and prioritize seeing errors as opportunities for learning as many are prepared to discuss errors via social media but not in front of others. I watched a teacher ask a young teen a question about his work and he replied, "I understand." But then I saw the student ask the teacher a question about what he did not understand via a social media app—while the teacher stood beside him. Social media has the power to privilege errors, misunderstanding, and learning in the pit of unknowns.

Is it time for a rethink?

Maybe we should not look for the next ICT solution as a teaching solution, but look for ways to connect teachers and students to others to foster learning solutions. We need to look for ways to provide resources relating to excellent reporting of progress, joining educators and students in collectives for planning, evaluating their impact, and debating what impact means. It can be a social revolution via digital, not a digital revolution via technology.

John Hattie
is a Laureate Professor and Deputy Dean of the Melbourne Graduate School of Education (MGSE). He also holds positions as Director of the Melbourne Education Research Institute, Chair, Board of the Australian Institute for Teaching and School Leadership and Associate Director of the ARC-SRI: Science of Learning Research.

Hattie's top 10 influences and effect sizes for student achievement (2017).[41]

Source of influence	Aspect	Factor	Effect size
Teacher	Teacher attributes	Teacher estimates of student achievement	**1.62**
School	Leadership	Collective teacher effficacy	**1.57**
Student	Prior knowledge and background	Self-reported grades	**1.33**
Teaching instruction strategies	Strategies emphasizing learning intentions	Cognitive task analysis	**1.29**
Teaching instruction strategies	Strategies emphasizing feedback	Response to intervention	**1.29**
Student	Prior knowledge and background	Paigetian programs	**1.28**
Teaching instruction strategies	Teaching instruction strategies	Jigsaw method	**1.2**
Curricula	Other curriculum programs	Conceptual change programs	**0.99**
Student	Prior knowledge and background	Prior ability	**0.94**
Student learning strategies	Learning strategies	Strategy to integrate with prior knowledge	**0.93**

Policy Recommendations

Professional development and training is the best way to overcome the knowledge gap between 20th and 21st century teaching. The most common reasons why teachers are unable to effectively integrate ICT in their classroom come down to a lack of knowledge, equipment, support or morale.[42]

The best professional learning is practical. It focuses on specific problems faced by teachers and supports this with multiple opportunities to try out new approaches in the classroom. This is important because adults often learn iteratively, needing to see evidence of something working several times before welcoming change.[43]

A sense of community is also important to professional learning. Once a practical program is established it can benefit hugely from peer collaboration, classroom observation and feedback.[44] Conversely, a top-down "enforced" style of change risks losing agency and trust.

So how do you factor all of this into a school's professional learning program?

> "It cannot be assumed that incoming university students are broadly technologically literate, just as it cannot be assumed that university staff are broadly technologically backward."
>
> *Educating the Net Generation Handbook 2009.*

Professional Learning

Give teachers more credit

There's a damaging assumption that no teacher is technologically savvy, yet every student is. To put this to bed, a coalition of researchers from Australian universities found that the concept of students as Digital Natives and staff as Digital Immigrants is in no way supported.[45] They also found that there was no single technology that all students, teachers and staff could agree was universally appropriate for learning.

It's important to recognize that students, too, are on a learning curve when it comes to using ICT in the classroom. The study found that many students gained unexpected benefits from Web 2.0 technologies. Students reported that using publishing and information-sharing tools, such as wikis, blogs and photo-sharing sites, had a positive impact on many students' engagement with the subject material, their peers and the general learning community. Meanwhile, the use of new and emerging technologies provided new opportunities for teachers in their assessment practice. Technology also opened up opportunities for "contingent teaching," because teachers could tailor their classes to better align them with the needs of students.

The takeaway here is students are not always the yardstick of technological ability, so encouraging teachers simply to adapt to the favorite technologies of students can be unproductive. Approaching the challenge as a collective experiment, by enabling teachers and students to pick and choose the right technology for the task at hand, is a much more effective strategy.

Provide demand-driven, just-in-time training

While MOOCs can be useful for professional development, there is also a plethora of new online courses that serve up recommendations based on a teacher's capabilities and interests to provide tailored professional development.

Microsoft has been working with partners to develop new models of professional learning, based on the best change management research, the latest gamification psychology, and the most cutting-edge reward, recognition and incentive programs available.

This has seen the development of sites that provide teachers with a simple way to develop teaching and technology skills, suggesting appropriate courses based on a teacher's interests and capabilities.

Many use similar psychology to Xbox games providing a proven mix of incentives like micro rewards, points and achievements along with gamification to make learning more rewarding and appealing. Some teachers love "upvotes". Other just like badges. And many like to accrue points that bring material benefits like being first in line for the next conference, a parking spot or a free period next time there's a relief teacher in the school.

These sites also include forums creating a community for sharing new ideas, support and best practice, as well as ways to track professional development and certifications to build up a portfolio.

For schools this opens the door to cost-effective, customized and up-to-date professional development for staff, reducing the cost of professional development and offering a far more flexible alternative.

They can also monitor professional learning and capacity across staff and recognize, incentivize and reward a lifelong learning mindset in teachers.

For teachers this is a more flexible way to tackle professional development, which can be achieved both off and online line with visibility to school leaders.

Empower teachers to develop new pedagogy and curricula

In a Dutch study investigating the reasons teachers find themselves unable to use digital tools, the results revealed three key influencing factors: The first two were the need for technical support and a principal with a positive attitude, but the most important factor was the teachers' own beliefs and skills. In fact, teacher beliefs and skills significantly outweighed all other factors.[46]

The most influential teacher beliefs were concerning what should be taught (curricula), and how it should be taught (pedagogy). The most influencing skills, meanwhile, were teacher competence in managing classroom activities, pedagogical skills, and, less importantly, computer-handling technical skills.

What this revealed, in a nutshell, was that if the technology matched the teacher's pedagogy, they used it. Teachers need to be given the evidence that ICT can make their lessons more interesting, easier, more fun for them and their pupils, more enjoyable and more motivating; otherwise, it simply doesn't happen.[47]

By setting up a Teacher Research Group (see opposite), you can foster an environment that homes in on the best pedagogy and curricula for schools. It's worth including reciprocal teaching, feedback and spaced practice.

Reciprocal teaching is when students become the teacher in small, managed reading sessions. Spaced practice, also known as distributed practice, is a technique in which learning is broken into smaller sessions over a longer period. And feedback is just that—specific, quality feedback that both encourages and challenges students. What these techniques have in common is that they are relevant to the needs of today's students. They allow students to help drive their own learning, but crucially, in a way that is fully scaffolded by the teacher. Spaced practice perfectly encapsulates the modern idea of bite-sized information digested for longer, and feedback reflects a desire for relevant, personalized support.

Professional Learning for teachers

5 areas that have a proven positive impact.

1 Mentoring and Coaching

According to Smith and Ingersoll, intensive mentoring and coaching that includes regular classroom observation and feedback helps improve teacher quality.[48] Mentoring and coaching is a great way to help teachers diagnose students' learning needs, develop classroom management skills and take on new pedagogy specific to their subjects.[49]

2 Lesson and Grade Groups

Teachers improve by observing each other's classrooms, identifying and solving problems as they arise, and jointly improving each student's learning.[50] Lesson and grade groups are a fantastic way to bring teachers together, so they can more easily discuss approaches, plan lessons and examine student progress. Working and learning together has also been shown to boost leadership skills and prevent stress and burnout.[51]

3 Tailor teacher training to specific, personal needs

Teacher success comes from training that is relevant and applicable. When teachers feel professional development activities are both aligned with the content they teach and attuned to their teaching practice, they are more likely to integrate technology into their teaching.[52] A sense of personal ownership is key. When teachers take an active control of their professional development and that of their colleagues, they are more likely to use technology with their students.[53]

4 Teacher Research Groups

These are like lesson and grade groups, except with a focus on research for the future. Teachers come together to select a research topic, such as "ways to introduce a new pedagogy," and work together to analyze evidence, best practice and case studies. They can then opt to trial any promising new practices and evaluate the impact on their students. The emphasis here is on collective teacher efficacy. Hattie found that teachers are more successful when they adopt evidence-based teaching strategies.[54]

5 Teacher Feedback

Teacher appraisal and feedback has a significant positive impact on professional learning. It helps teachers improve their teaching skills by identifying and developing specific areas of their teaching for improvement. Feedback also improves the way they relate to students and colleagues, boosts job satisfaction, and greatly improves student outcomes. Feeback can also include badges, certification, recognition from industry, and is promoted through sharing of resources and professional publications.[55]

Focus on practices that work, and discard practices that don't

Professor Gordon Sanson, and Associate Professor Nathan Bailey, formerly at Monash University, conducted a longitudinal study to understand the impact of digital delivery on higher education student attendance, grades, churn and satisfaction.

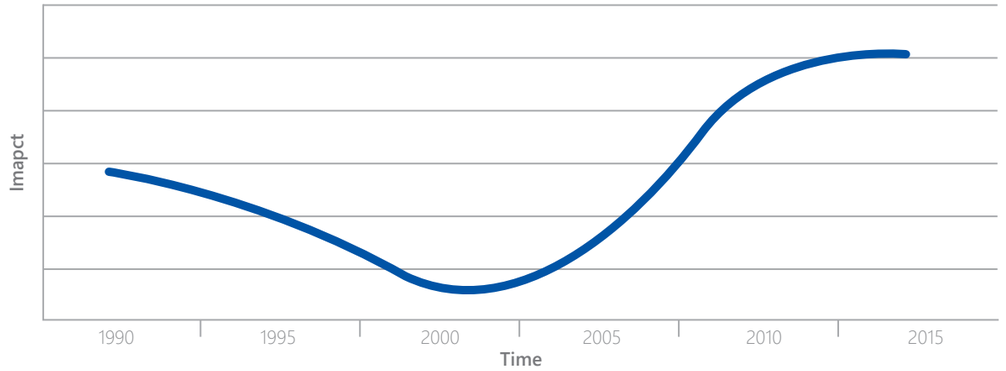
In 1990, attendance, satisfaction and average grades were significantly higher than in 2000. Churn was lower.

They discovered, that as more content was served to students in a digital form (high fidelity), students were less likely to consume it in a way that aided these key metrics. They posited that in 1990, the emphasis was on whiteboard, blackboard and overhead projectors (low-fidelity inputs), and the replacement of low-fidelity teaching came at a cost.

In the early 2000s, they realized that the combination of low and high fidelity works far better than either mode alone. What does this mean? That if a teacher presents content in a digital form, they should always balance this with low fidelity as well. They reported the best results occur when a teacher uses a digital pen to annotate on high-fidelity content at a ratio of 40 percent high fidelity, 60 percent low fidelity.

> "When the traditional laptop was compared with the Microsoft Surface device, it became apparent that adding the stylus interface had some real tangible impacts on teacher and student learning. The analysis indicated a greater number of those learning experiences that required students to engage in higher order thinking (understand, apply, analyse, evaluate and create)."
>
> *Dr Terry Byers, Anglican Church Grammor School, Brisbane.*

The impact of digital delivery on higher education student attendance, grades, churn and satisfaction



Source: Monash University.

Red Flags

Though it is inspiring to focus on best practice, it's useful also to be aware of the common stumbling blocks in a digital transformation project. Keeping an eye out for red flags can help your team identify problems earlier and work quickly to correct your course.

Common reasons for underwhelming outcomes

Lack of confidence in ICT

Every teacher is different. Some may be thrilled at the opportunity to teach with new technology, while others may have had bad experiences in the past. Be deliberate when pairing groups to balance experience, confidence and ability.

The reason for change isn't clear enough

It is vital to ensure the entire school community both understands and is committed to the goal of your digital transformation project, with processes in place for continual tweaking and review.

Tech support is inadequate

Technology can involve teething problems, so it's important to staff or outsource a dedicated technology support service. Teachers need to be able to call for immediate support if something goes wrong during class. Many schools have had great success with student-run help desks.

Teachers need new classroom management strategies

When new technology is introduced, teachers often require extra assistance monitoring students to ensure they are focused and behaving appropriately.

Lack of ICT specialist leaders

Identifying and championing technology leaders among teachers helps spread the burden of change and inspire confidence.

Unreliable technology availability

A positive transformation cannot be expected if the basic needs for technology access are not met.

Lack of ICT Process and Training

ICT teams need professional development on both processes and the latest tools for planning, design and deployment.

Teachers are not given enough time to successfully integrate technology into curriculum

Teachers often learn iteratively and need the time to try out new methods before they will be adopted effectively. Expecting results too soon can dampen enthusiasm and diminish confidence.

Cultural resistance

Many schools and individual teachers feel worried by the idea of a 'student-machine' relationship replacing the student-teacher relationship. Giving teachers the time to try small innovations over a longer period of time, while scaffolded by collegiate support, can help them see the positive human benefits of digital transformation for themselves.

Evidence and Further Reading

To delve deeper into some of the topics in this chapter, here is a selection of recommended reading and relevant case studies to serve as a useful starting point.

DuFour, R. & Marzano, R. (2009)
High-leverage strategies for principal leadership, Educational Leadership, 66(5), 62-68.

Hattie, J.A.C., & Anderman, E. (2013)
Handbook on Student Achievement. Routledge, New York.

Pont, B., Nusche, D., & Moorman, H. (2008).
Improving School Leadership, Volume 1: Policy and Practice, OECD Publishing.

Critical Concepts

Teachers are pivotal to success. Five of the strongest influences on student achievement involve teachers.[55] Scaffolding teachers with professional development to embrace change confidently and positively is critical to the success of a digital transformation program.

Essential steps for success

Support all pillars of professional learning

- Mentoring and coaching: regular classroom observation and feedback.
- Lesson and grade groups: teachers improve by observing each other's classrooms.
- Teacher research groups: teachers work together to analyze evidence, best practice.
- Teacher feedback: teachers improve teaching skills by identifying areas for improvement.

Offer personalized professional development

Use online courses that serve up recommendations based on a teacher's capabilities and interests.

Ensure teachers have the technology tools required for transformation

One of the biggest mistakes schools and school systems make is to fail to give teachers the technology or training they need.

Evaluate devices

Teachers need modern, powerful devices that are fully featured if they are to achieve true digital transformation, not just digital engagement.

Give teachers credit

Encouraging teachers simply to adapt to the favorite technologies of students can be unproductive. Enabling teachers and students to choose the right technology for the task at hand is more effective.

If teachers find technology matches their pedagogy, they use it

Teachers need evidence that ICT can make their lessons more interesting, enjoyable and motivating; otherwise, it doesn't happen.

Set up a teacher research group

Foster an environment that homes in on the best use of technology to pedagogy and curricula.

Empower teachers to become learning leaders

Teachers have close integration with peers, which creates a collegial environment that they trust.

Leadership has a concrete effect on student outcomes

An OECD study identified four major areas of responsibility that can improve student outcomes.[56]

- Supporting, evaluating and developing teacher quality.
- Goal-setting, assessment and accountability.
- Strategic financial and human resource management.
- Collaborating with other schools.

Follow the OECD best practice recommendations

- Leaders must be well supported, with their core responsibilities clearly defined.
- Broaden the concept of school leadership beyond the principal and adjust policy accordingly.
- School leaders need specific training. Treat leadership development as a continuum.
- Make school leadership an attractive profession by clarifying recruitment, remuneration and career prospects.
- Involve professional organizations of school leaders to create an open forum that promotes knowledge sharing and helps disseminate best practice between policymakers.

Powerful Questions

Challenge your assumptions by asking the following five questions.

1. Does our system or school make teaching an appealing rewarding career path?
2. How well supported are our teachers when it comes to embracing digital transformation?
3. How do we involve our teachers in undertaking and evaluating digital transformation?
4. How do we encourage, recognize and reward our best teachers to inspire others?
5. Where does our school leadership reside and how is it scaffolded in our system/school?

Key Tip

Many schools have had great success with student-run help desks.

Devices, Curriculum and Assessment

The Opportunity

Properly implemented, modern technology enables schools to deliver curriculum and assessment that is more engaging, equitable and personalized than ever before. Studies show that technology can improve student performance and support more flexible tuition models. It can also enable real-time feedback and adaptive assessment, and is crucial to the development of critical thinking and collaborative learning.

Today's teachers face a dazzling array of choices when it comes to using technology to enhance curriculum and assessment. Educational software, apps, simulations, videos and computer games, podcasts, webisodes, robotic kits and HoloLens simulations abound. Data-driven learning serves up personalized interventions. Cloud collaboration technologies support timely, contextual feedback. And the proliferation of lightweight devices enable learning to be delivered more equitably to more students.

Getting the balance right

It's essential to evaluate which technology is the best fit for your curriculum and provides the best opportunities for your students to undertake learning that is effective, authentic and sufficiently challenging. No small task. In this chapter we look at the evidence and best-practice guidance to help you take the right approach.

What does the evidence say?

There is clear evidence that technology can support teachers in effective integration of curricula and assessment in classrooms,[57] and that it serves as a "valuable and well-functioning instructional tool" in schools and classrooms in which teachers:

a. Have convenient access.

b. Are adequately prepared.

c. Have some freedom in the curriculum.

d. Hold personal beliefs aligned with a constructivist pedagogy.[58]

According to studies, blended learning, which combines the use of technology with face-to-face tuition, has achieved the best academic outcomes. Two meta-analyses both concluded that students who received blended learning performed better than those in traditional classroom environments by just over 33 percent of one standard deviation.[59 60]

What is blended learning?

A formal education program in which a student learns at least in part through online learning and in part in a traditional classroom setting, with both experiences connected to provide an integrated learning experience.

The Challenge

For every outstanding piece of learning technology there are many more poorly designed ones. Disappointing courseware that is little more than a text document. Shiny tablets that allow students to browse the Internet and use fun apps, but not to engage in deep learning. Without clear goals and guidelines, schools can be lured into unwise investments that short-change students and create distractions—or worse, fail to deliver a net positive benefit.

Take time to find the right blend of technology

Don't be dazzled by new technology. Or pressured by students and parents because it looks (or claims) to be somewhat educational. Start with your curriculum and the learning outcomes you are looking to achieve, then use the guiding questions below to evaluate which technologies support the teaching and learning approaches in your school.

Assess the proposed technology

Take time to carefully assess any proposed technology to ensure it fits your requirements, and ideally provides an opportunity for students to explore, model, interact with and learn something new in the context of a relevant, contemporary issue. Innovations in both curriculum and assessment work best when they are tied to academic content and practice[61] and when they are based in authentic, real-world problems.[62]

Ensure it promotes student ownership of learning

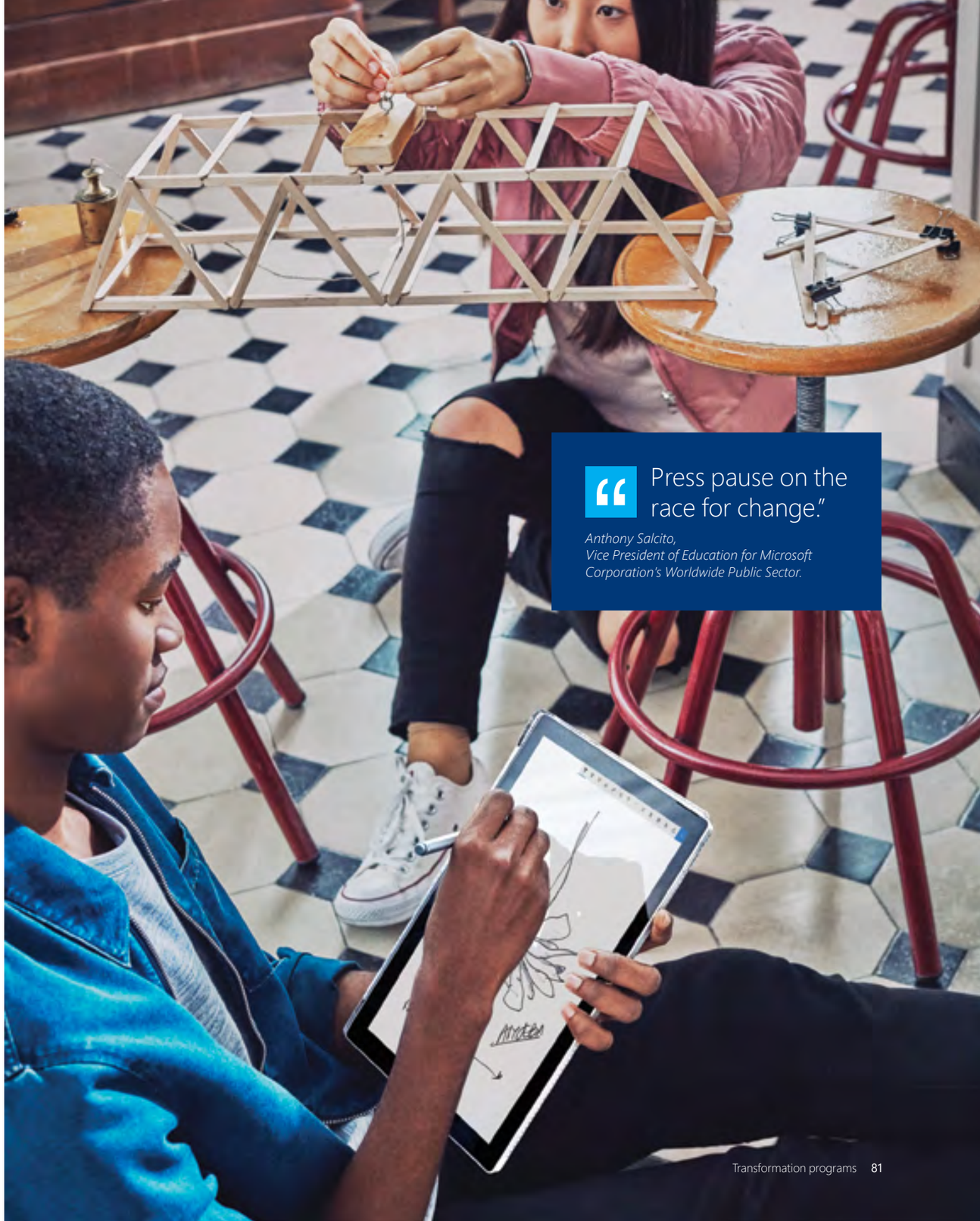
Important curricular and assessment innovations, especially in key learning areas such as STEM, must also provide learners with a sense of ownership in both the design of the problem and the solution.

Ensure it supports better communication and collaboration

Learning is frequently a collaborative and social activity, so look for technologies that support information conversation, reflection, dialogue and collaborative content generation. Make sure students can choose their digital tools to suit their context, and that they are supported by a knowledgeable teacher. McLoughlin and Lee stress the importance of students being able to select and personalize tools, and have the necessary scaffolding and support if they are to successfully undertake self-regulated learning.[63]

Ensure the technology supports rich assessment and feedback

Assessments must provide multiple opportunities for the creation of artifacts. When this occurs, assessment becomes more than just a processof learning; it becomes a process for learning.[64] In STEM, as well as other topics, the publication of artifacts provides teachers with a way to "infer the process by which students transform meanings and strategies appropriated within the social domain, making those strategies their own." This also provides opportunities for feedback from teachers and others which can promote knowledge construction, knowledge integration,[65] higher order thinking and self-regulatory behavior.[66]



> "Press pause on the race for change."
>
> *Anthony Salcito,*
> *Vice President of Education for Microsoft Corporation's Worldwide Public Sector.*

Policy recommendations

There are powerful ways for teachers to harness the latest technology to achieve great outcomes. But don't start with the next cool thing. Start by ensuring that the technology you plan to implement has the right capabilities for learning in your context. Below we consider best practice for selecting devices, implementing curriculum and managing assessment.

Choose technology that allows maximum pedagogical potential

Technological innovations to either curriculum or assessment are inevitably imbued with pedagogical strategies and/or beliefs. How closely they match your own will, to a large extent, determine the success of your implementation.

Sometimes technology drives pedagogical change, creating more effective opportunities to teach and assess students. Other times, technology, regardless of how engaging it looks, simply fails to match the pedagogical strategies of the teacher or the learning needs of the student. Research suggests that many current approaches to technology integration into teaching are "technology-centric" and that failing to consider the dynamic and complex relationships between content, technology, pedagogy, and context can lead to underwhelming results.[67]

Learn from the mistakes of the past

In 2015 LA Unified School District provided a district-wide rollout of iPads pre-loaded with curriculum software. It proved spectacularly unsuccessful. Michael Horn, executive director of the education program at the Clay Christensen Academy commented that it was a classic case of a school district getting caught up in the "ed tech frenzy" without fully thinking through why technology is important in the first place.[68] LA has since regrouped and the team now assess technology by asking four key questions.

1. What will students learn?
2. How will students learn?
3. What resources will be needed?
4. How will it work?

Ask essential questions

By putting measures in place to scaffold learners and train teachers, and evaluating technology to ensure it matches your pedagogical strategies, you will be far more likely to succeed. The U.S. Department of Education[69] outlines nine essential questions:

1. How does the use of computers, the Internet and other applications by teachers and students affect student performance, knowledge, and skills?
2. What is the impact of computer and Internet use on the way teachers teach and students learn, and what is the impact more broadly on educational reform?
3. How does the investment in technology compare with other educational innovations, such as smaller classes or individualized instruction, in terms of costs and benefits?
4. What are the types of technologies available in schools (e.g., quality/speed, types of Internet connections, software applications)?
5. What are the organizational changes to schools that will enable the increased use of technology (e.g., administrative efficiency, home-school connections, collegial communication) or the sustainability of technology implementation and use?
6. What are the fiscal expenditures of educational technology at the school, district, state, and national levels?
7. What are the professional development and technical support strategies for enhancing teachers' effective use of technology?
8. What are the duration and types of technology uses for teaching and learning both inside and outside of the school?
9. What are the effects of different types of technology applications on particular types of students (e.g., limited English proficiency, special education, gifted and talented)?

> "Our goal must be to find ways in which children can use technology as a constructive medium to do things that they could not do before; to do things at a level of complexity that was not previously accessible to children."
>
> *Professor Seymour Papert.*

Selecting devices for deep learning

When selecting devices, it is useful to map their capabilities to their student learning potential. The more capable the device, the more useful it is for learning and the development of higher order thinking skills. Minimally spec'd devices introduce a high level of compromise and often have limited capability to support deep learning.

Look for devices that support multi-modal learning

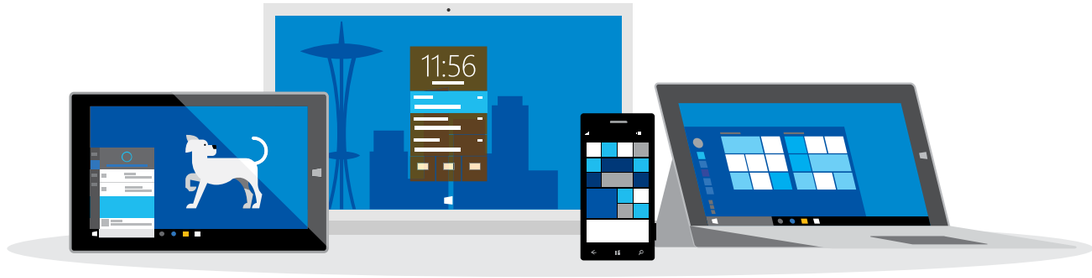
Recent academic studies have shed light on how a device can greatly enhance or seriously undermine student learning. It makes sense that different subjects and students require different interfaces—touch, type, pen, voice. More surprising are the findings that show that using the 'wrong' interface for a task can have a serious impact on student learning.

In her book "The Design of Future Education Interfaces", Professor Sharon Oviatt found huge discrepancies between the methodologies and outcomes of students depending on what devices they chose.

The upshot? Many schools may have inadvertently impeded learning by providing under-specified devices that have limited their students' cognition, ideation and representation of new ideas.

Transformation means using technology to help students to learn how to reach their potential through well-designed learning experiences, informational resources, and skills mastery practice. Technology should enable them to tackle real-world problem solving that requires creativity, critical thinking, collaboration, self-awareness and self-management, responsible decision-making, and the practice of constructing complex solutions.

Different devices and their capabilities



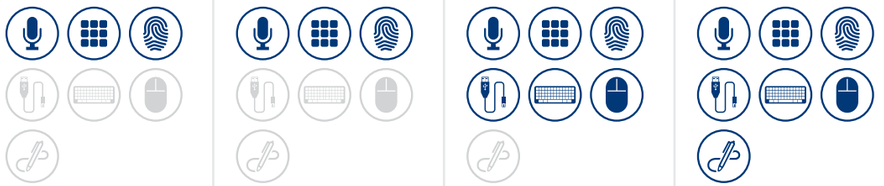
Smart Phone
Apps only, connected device.

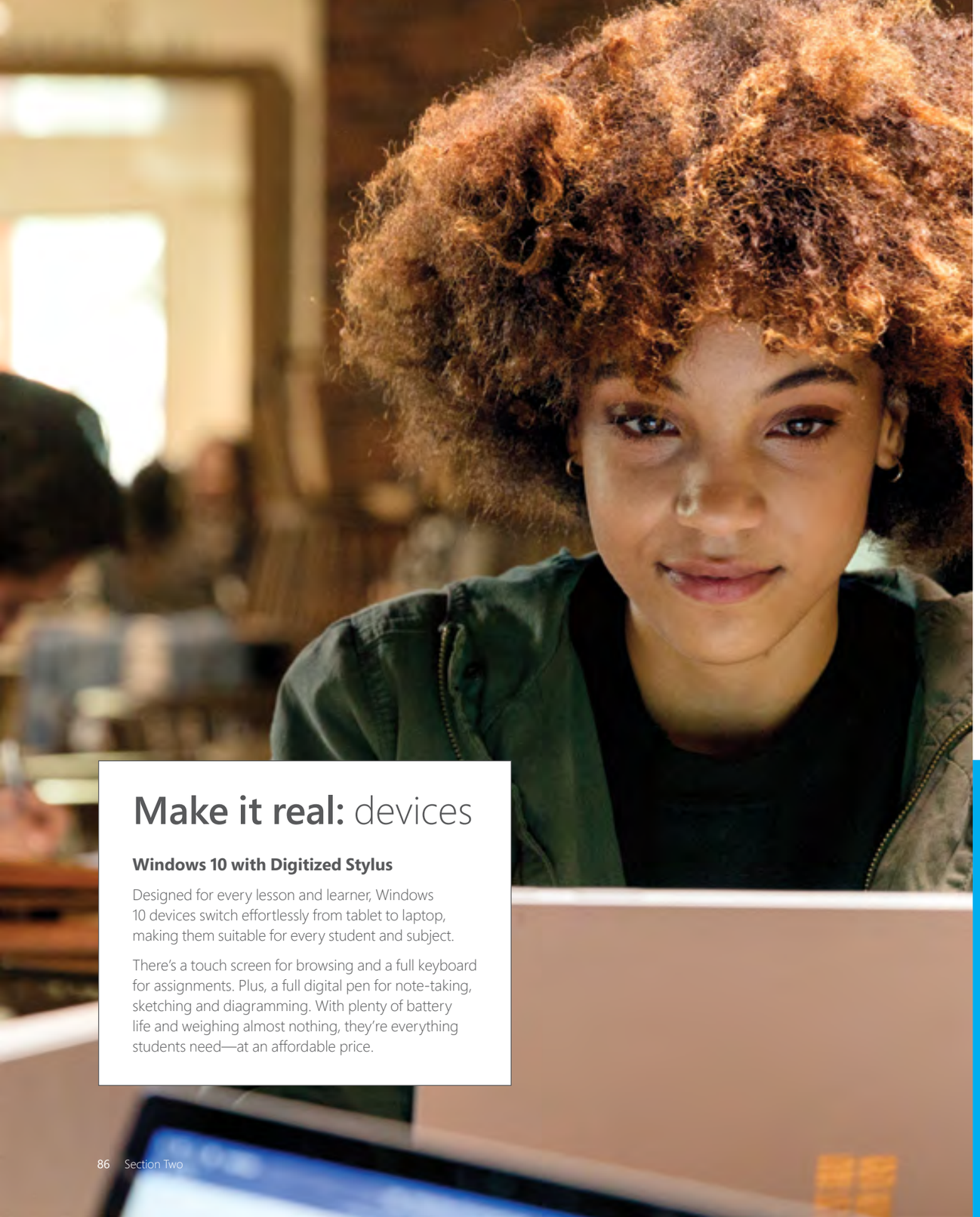
Tablet
Apps only, connected device.

Laptop
Fully functional, personal, portable computer (with touch).

Three in One
Fully functional, personal, portable computer (with touch, detachable keyboard and fully digitized pen).

Capabilities





Make it real: devices

Windows 10 with Digitized Stylus

Designed for every lesson and learner, Windows 10 devices switch effortlessly from tablet to laptop, making them suitable for every student and subject.

There's a touch screen for browsing and a full keyboard for assignments. Plus, a full digital pen for note-taking, sketching and diagramming. With plenty of battery life and weighing almost nothing, they're everything students need—at an affordable price.

Ensure the device doesn't force thought-limiting compromise

Restricting students to under-performing technology can seriously undermine thinking and performance. Wherever possible, empower students with a combination of interfaces including, at a minimum, touch, digital pen and keyboard. And, ensure students are empowered to take advantage of full software as well as apps and web tools.

With a high-resolution displays, text reads like a printed page, while a digitized pen's sensitivity makes sketching, writing and erasing feel natural and intuitive for students. When you combine Windows 10 and Office 365 Education with a quality device, you have the foundation for connected learning. Powerful apps and device features work together to nurture inquiring minds, unleash deep learning and inspire creativity.

Connectivity matters

Schoolwork is diverse. Your devices need to enable students to easily connect to printers, projectors, cameras, digital microscopes, robotic models, musical keyboards and graphics tablets.

You'll need to run software and apps

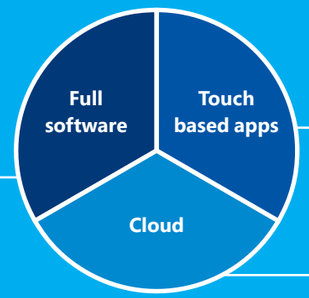
Make sure the devices you choose can run a wide range of apps and full software. Students should have access to the kind of applications they will use in the workplace, with limitless possibility to discover and express their ideas. Apps are often good to teach a specific concept or idea, but deep learning requires powerful, open-ended software. There are 669,000 apps in the Windows Store, and over 4 million full pieces of software available for Windows.

Good education interfaces:

- Increase students' expressive power (ability to create and refine rich content).
- Reduce students' cognitive load (simplicity, lack of distraction).
- Increase students' total activity (physical and/or communicative).
- Include input capabilities (e.g., representations, modalities) well matched with students' learning activity or content domain.
- Include input capabilities well matched with students' native language.
- Increase input capabilities well matched with students' ability level.

Providing optimized personal learning for all requires a web browser, touched-based apps and full software

- >4.5 million software tools (e.g., Minecraft).
- Caters to pen, voice, touch, natural language translation, full accessibility options.
- >99% of technology skills demanded by industry require full software to develop and demonstrate.
- Full online/offline functionality.



- Caters to pen, voice, touch, natural language translation, full accessibility options.
- Provides simplicity for younger learners.
- Full online/offline functionality.

- Predominatly keyboard and mouse.
- Requires connectivity.
- Limitless in content.

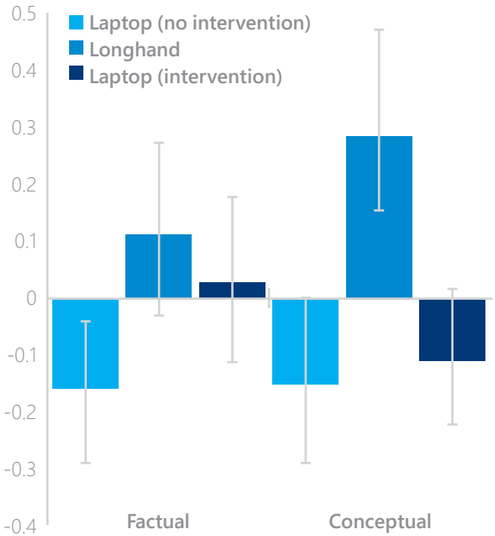
> A digital pen, or stylus, helps smooth the handwriting-to-technology gap. The more content we provide in a digital format for students, the more critical it is that students can annotate and mark up in the digital.
>
> *Sharon Oviatt.*

Make sure your recommended student devices support a digital pen

Recent research has uncovered some new evidence around the cognitive importance of good old-fashioned handwriting.

Princeton University researchers Pam Mueller and Daniel Oppenheimer have discovered that students who handwrite notes in class (rather than type them on a laptop) have significantly better knowledge retention rates and conceptual understanding of ideas, and do better on tests.

Mueller and Oppenheimer's research is now being explored by researchers globally who believe that taking notes by hand requires different types of cognitive processing than taking notes on a laptop, and these different processes have consequences for learning. Because handwriting allows for personal expression, non-linguistic characters, a connection between fine motor skills and concentration, and an often-slower recording, the brain is more engaged. This is true for millennials as much as Gen X, Y or older.



Mean Z-scored performance on factual-recall and conceptual-application questions as a function of note-taking condition (study 2). Error bars indicate standard errors of the mean.

Passive Stylus

Mimics finger painting for limited apps and plug-ins.

Digital Pen

Mimics real pen with precise, pressure sensitive, palm cancelling smart ink, supported at the operating system level.

Don't settle for a smudge tool/stylus

Given the importance for students to be able to take notes, sketch, brainstorm and develop ideas with a digital pen, it's essential not to confuse a basic stylus with a passive stylus. The example above shows the same task completed with a passive stylus compared to a genuine digital pen.

In two different studies in which high school students solved the same mathematics and science problems, the best results came from students using a digital pen, while marking up on the digital content.[70] Using the pen, students produced 56 percent more non-linguistic content (i.e., diagrams, symbols, numbers, etc.), which led to a 9-38 percent improvement in performance.[71] Additionally, research revealed that informal marking of existing content (using a digital pen on top of digital content) helps students to group and organize information, and has been associated with a 24.5 percent higher solution correctness.[72]

The advantages of using a pen interface included improved speed, improved focus, high-level synthetic thinking, more fluent communication and better information recall.[73] Meanwhile, the lower-performing students who had used tablet or keyboard interfaces experienced elevated cognitive load, exacerbating achievement gap between groups.[74]

How to test device capabilities

Before you select devices for school, this simple test will reveal how appropriate they are for deep learning.

Step One

Provide four groups of students with one device each.
Group 1 – smartphone
Group 2 – tablet
Group 3 – laptop
Group 4 – three-on-one device

Step Two

After providing basic guidance on how to use each device, set each group the same open-ended inquiry question. For example, Sharon Oviatt, in her research used an image of a chimpanzee foot, and a homo sapiens foot and tasked students to explain why they differ.

Step Three

Once students have completed their task, use the criteria listed below to evaluate the skills they were able to demonstrate on each device. Then compare the difference in performance against each of the metrics. The differences will reveal themselves very quickly and become more profound as teacher expectations and student capabilities build over time.

Chimpanzee foot

Homo sapiens foot

Observation	Skills Demonstrated
How many sources did they consult for ideas / information?	✔ Consumption
How many diagrams did they draw? How many diagrams were correct? How many ideas / hypotheses did they generate?	✔ Synthesizing ✔ Comparing ✔ Contrasting ✔ Testing ✔ Understanding ✔ Evaluating ✔ Creating
How many ways did they present their information? How much non-linguistic content did they generate (e.g., content that can't be created on a keyboard)? How much linguistic content did they generate (content that CAN be created on a keyboard)?	✔ Creating ✔ Explaining ✔ Applying ✔ Interpreting ✔ Summarizing
What compromises did they have to make to accommodate the technology?	✔ Distractions ✔ Functional stops ✔ Process Fails ✔ Work arounds (e.g., chunking multiple apps to do a simple task)

Make sure school devices are easy to manage

Most schools find it difficult to manage student and staff devices. In today's classrooms, over 90 percent of students use shared devices and educators face more demands than ever before, with nearly 50 percent of teachers serving as their own tech support in their classrooms.

It takes just three steps to set up class notebooks in Windows 10 using the 'Set up School PCs' app. And you can quickly provision them with a wide selection of education apps from the Microsoft Store for Education to suit different students or groups. Each student's settings follow them to whichever notebook they sign into next time. At the end of the school year, one click in Windows Automatic Redeployment returns your student notebooks to their original settings, ready for the next intake.

Specially designed for schools who want to put devices in classrooms and not touch them again for the rest of the school year, Intune for Education makes it easy for either IT admins, or teachers playing the role of IT in the classroom, to get up and running in minutes on Windows 10 devices and easily manage shared devices.

Make it real: device management

Simple Windows 10 Management

The express setup feature in Intune for Education makes it easy to set up default policies for all the devices and users in a class, school or district in a matter of minutes. The management console has been simplified to be friendly to non-professional IT staff, and it contains wizards, default settings, and group types that are appropriate for schools. In addition, it supports shared devices, roaming user settings, and a device lock-down mode for student testing. Schools can customize over 150 granular settings, assign them to a student and apply them to hardware, apps, browsers, the start menu, Windows Defender and more.

Easy application deployment

Set up student devices in minutes. Intune for Education makes it easy to assign and deploy any combination of web apps or education apps from the Windows Store for Business. Once apps are customized, they are available to users at their next sign on and follow them to any device, so students and teachers always see the apps they are supposed to see, and no apps they shouldn't.

Automated setup

By integrating with School Data Sync, Intune for Education automatically creates groups based on school roster data, so apps and settings can be applied to students, teachers, devices, specific schools, or specific classes or sections with no additional work required. Any changes to the roster will be reflected automatically in the group. For example, if a student is added to a photography class in the school roster, they will automatically be added to the group in Intune for Education and get the relevant apps.

Selecting technology for your curriculum

There are two key criteria to consider when selecting digital curriculum. How much can the software or courseware support learning that is collaborative, personalized and problem-based? And has someone done the hard work for you so you can license or freely use material or adapt it easily?

Refer to these guiding questions

The Microsoft Education Transformation Framework features a white paper on curriculum and assessment, authored by Richard E. Ferdig, Summit Professor of Learning Technologies at Kent State University. Ferdig proposes the following guiding questions and research summary for curriculum, content and assessment.

- Does the digital tool or curriculum support constructivist learning through communication and collaboration and how will this be supported and managed?
- How will classroom task/resource management and teacher orchestration/workflow be supported?
- How will future-ready learning skills be structured and integrated?
- What knowledge management is required? How does it link to national curricula internal and external repositories and agencies to ensure compliance with state and safety requirements?
- How balanced is the curriculum for authentic performance-based formative and summative assessment?
- Does the curriculum support collaborative differentiated and game-based experiences?
- Does the digital content from publishers, teachers and students reflect the interactive and collaborative experiences of future-ready learning?
- How easy is it for the community to search, create, collaborate, store and share curriculum content?
- Does the curriculum and assessment enable pedagogy for deep learning?
- How are future-ready skills placed in the context of content standards?
- What are the course management and administration requirements?
- Do you have a system to allow adaptive teaching and learning (authoring, branching?)

Look for technology that encourages collaboration

Researchers agree that collaboration is an important factor in increasing student interest and building their critical thinking[75] through communities of practice where they can try out ideas and challenge each other.[76] Much of this collaboration has been made possible by emerging technologies.[77] Again, it's important to note what constitutes collaboration: There is a big difference between a file-sharing service and a full collaboration suite that allows face-to-face communication and the fluid exchange of myriad file types, all of which can be edited and annotated through typing, digital pens and more.

Use these recommendations for technology-supported collaboration

- Learners need multiple entry points into collaboration around various topics.
- Some learners will engage instantly in synchronous chats; others prefer to reflect and to post more time-intensive asynchronous experiences.
- Model exemplary collaboration within the learning context so that students understand what is expected.

Make it real: collaboration

Available as part of Office 365, Microsoft Teams provides a digital hub that brings together content, conversations, apps, chat, voice, video, even OneNote, into a single continuous experience. It enables students to engage with each other in the way that suits their task and location. Teachers can use Teams to create group discussions around a topic, training, ad hoc news, school events, or notifications.

Microsoft Teams helps to foster deeply engaged classrooms, strengthen professional learning communities, and create more effective school communication.

Look for technology that promotes uncompromised connected learning

The proliferation of digital information and social connection has led to the development of connected learning environments, where everyone and everything is interconnected. These connections magnify the reach and value of not just information but also relationships, creating excellent opportunities for personalized, authentic learning experiences.[79,80] Devices that go home (personal devices) are up to 80 percent more effective than devices that are locked up at school.

In their research, Ito et al. define the opportunity: "Connected learning posits that by connecting and translating between in-school and out-of-school learning, we can guide more young people to engaging, resilient, and useful learning that will help them become effective contributors and participants in adult society. We also believe that networked and digital technologies have an important role to play in building these sites of connection and translation. Our hypothesis is that in order to develop these cross-cutting repertoires of practice, young people need concrete and sustained social networks, relationships, institutional linkages, shared activities and communication infrastructures that connect their social, academic, and interest-driven learning."[81]

Examples of learning environments that integrate peer, interest, and academic pursuits include spelling competitions, debating, hackathons or athletics programs, which feature school recognition and embody values of equity, social belonging, and participation.

An excellent example of connected learning technologies are social networking tools that can be used in conjunction with collaboration apps, like Teams and OneNote, which allow students to collate text, links, images, sketches, audio, video, tables, prototypes, and other multimedia, with the ability to use a stylus to annotate notes. It's important to distinguish this type of software from other online document spaces that don't support many file types or fail to provide rich collaboration options like video conferencing.

Connected learning extends learning opportunities

A typical K-12 student spends just 16 percent of their waking hours in school. Historic emphasis on computer labs or laptop trolleys has confined technology use to this small window. But with a personal device and a connected learning environment, students can learn almost anywhere.

Make it real: Long distance collaboration

This connected learning technology website enables teachers and students to join Skype collaborations with other classes around the world. Popular shared projects include cultural exchange and environmental investigations. Simply sign up to join with your class.

www.education.microsoft.com/skype-in-the-classroom

What constitutes a connected learning environment?

The following summaries are taken from the Connected Learning Research Group's learning and design principles.[82]

Learning principles:

Interest-powered
Interests power the drive to acquire knowledge and expertise. Research shows that learners who are interested in what they are learning achieve higher order learning outcomes.

Peer-supported
Learning in the context of peer interaction is engaging and participatory. Research shows that among friends and peers, young people fluidly contribute, share, and give feedback to one another, producing powerful learning.

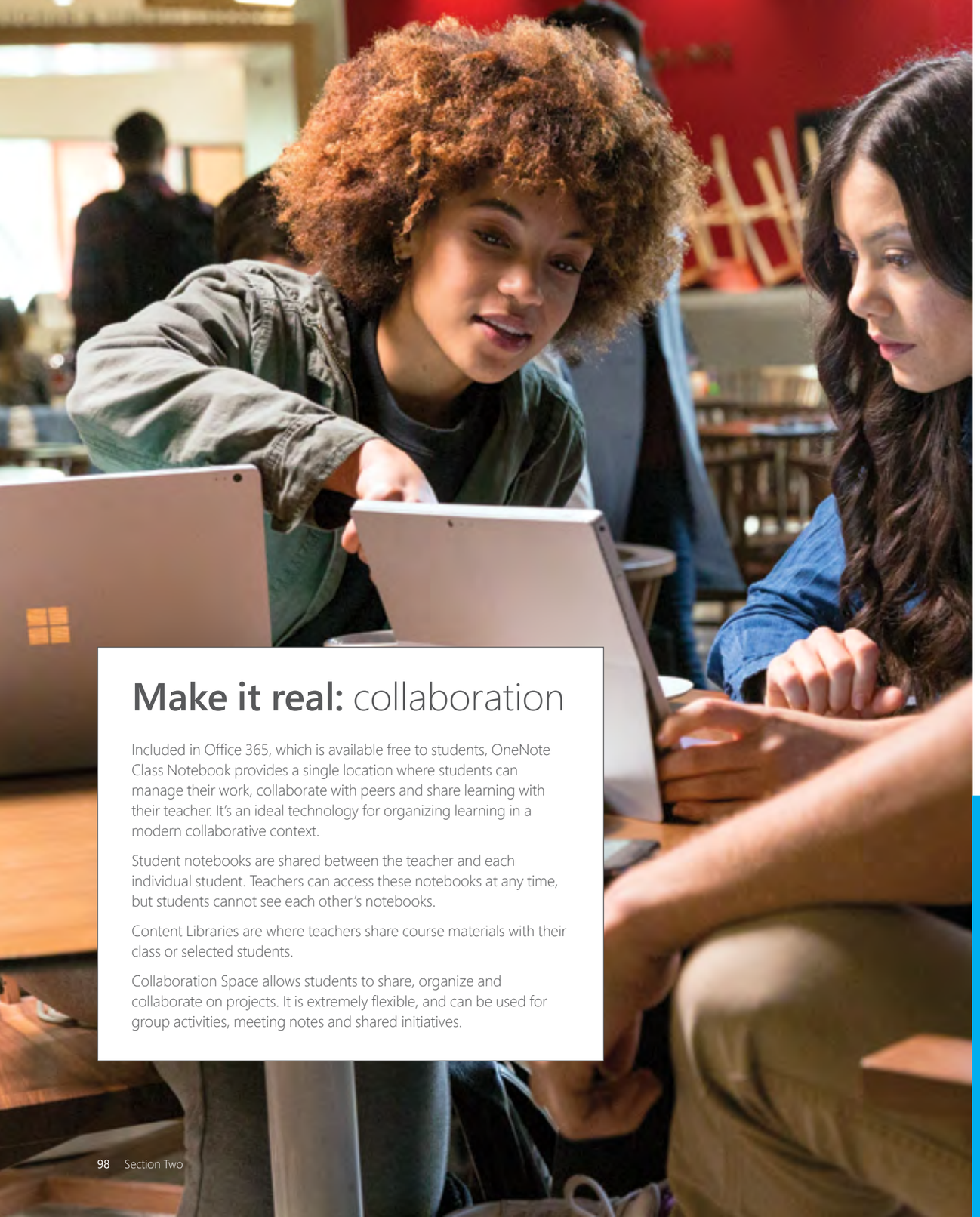
Academically oriented
Connected learning recognizes the importance of academic success for intellectual growth and as an avenue toward economic and political opportunity.

Design principles:

Shared purpose
Today's social media and web-based communities provide exceptional opportunities for learners, parents, caring adults, teachers, and peers in diverse and specialized areas of interest to engage in shared projects and inquiry.

Production-centered
Learning that comes from actively creating, making, producing, experimenting, remixing, decoding, and designing fosters skills and dispositions for lifelong learning and productive contributions to today's rapidly changing work and political conditions.

Openly networked
Learning resources, tools, and materials are abundant, accessible through open, networked platforms and public-interest policies that protect our collective rights to circulate and access knowledge and culture. Learning is most resilient when it is linked and reinforced across settings of home, school, peer culture and community.



Make it real: collaboration

Included in Office 365, which is available free to students, OneNote Class Notebook provides a single location where students can manage their work, collaborate with peers and share learning with their teacher. It's an ideal technology for organizing learning in a modern collaborative context.

Student notebooks are shared between the teacher and each individual student. Teachers can access these notebooks at any time, but students cannot see each other's notebooks.

Content Libraries are where teachers share course materials with their class or selected students.

Collaboration Space allows students to share, organize and collaborate on projects. It is extremely flexible, and can be used for group activities, meeting notes and shared initiatives.

Personalized learning is critical

Every student enters the classroom with different background knowledge, abilities, and levels of interest. Numerous studies confirm that if teachers can personalize students' learning, it improves their outcomes. Consequently, increasing personalization in schools as a strategy for increasing students' academic achievement and social development is a long-standing goal of educational reform.[83] However, without technology—ranging from digital content to adaptive learning software and analytics—it is difficult and resource-intensive for teachers to easily or consistently personalize instruction.

Use the power and potential of new technologies

Fortunately, we're seeing the emergence of adaptive, cloud-based, personalized learning platforms and learning management systems that track student progress across content providers and enable teachers to personalize learning. With modern cloud platforms, analytics and machine learning we now have the technology to provide detailed windows into each student's past learning, their present situation, and their most probable future. Students' static data (for example, demographics; past attainment) and dynamic data (for example, pattern of online sign ins; quantity of discussion posts) can be understood by educators with powerful data visualization tools. These tools can be customized for each user, answer specific questions and update dynamically to provide current information.

Today's advanced analytics tools like machine learning can show the trajectory that students are on (for example, at risk; high achiever; social learner), and hence make more timely interventions possible by offering extra social and academic support, or presenting more challenging tasks.

Move to personalized learning models

An example of analytics being used to personalize student learning is the platform used by the Catholic Education Office of Western Australia. Using integrated Microsoft technologies, this holistic school technology platform enables schools to combine analytics with the use of software tools and content providers to create, manage and analyze individual learning pathways for students.

Teachers can also support personalized learning in their classrooms by using technology to offer choices. For instance, in a history unit, students could choose between just reading, and reading along as they listen to the text. They could take notes on a tablet or record their thoughts verbally as they start to analyze the situation. When they write it doesn't have to be an essay; it could also be a website, a podcast, a video script or speech that they record. Content is also served up based on student achievement and learning requirements.

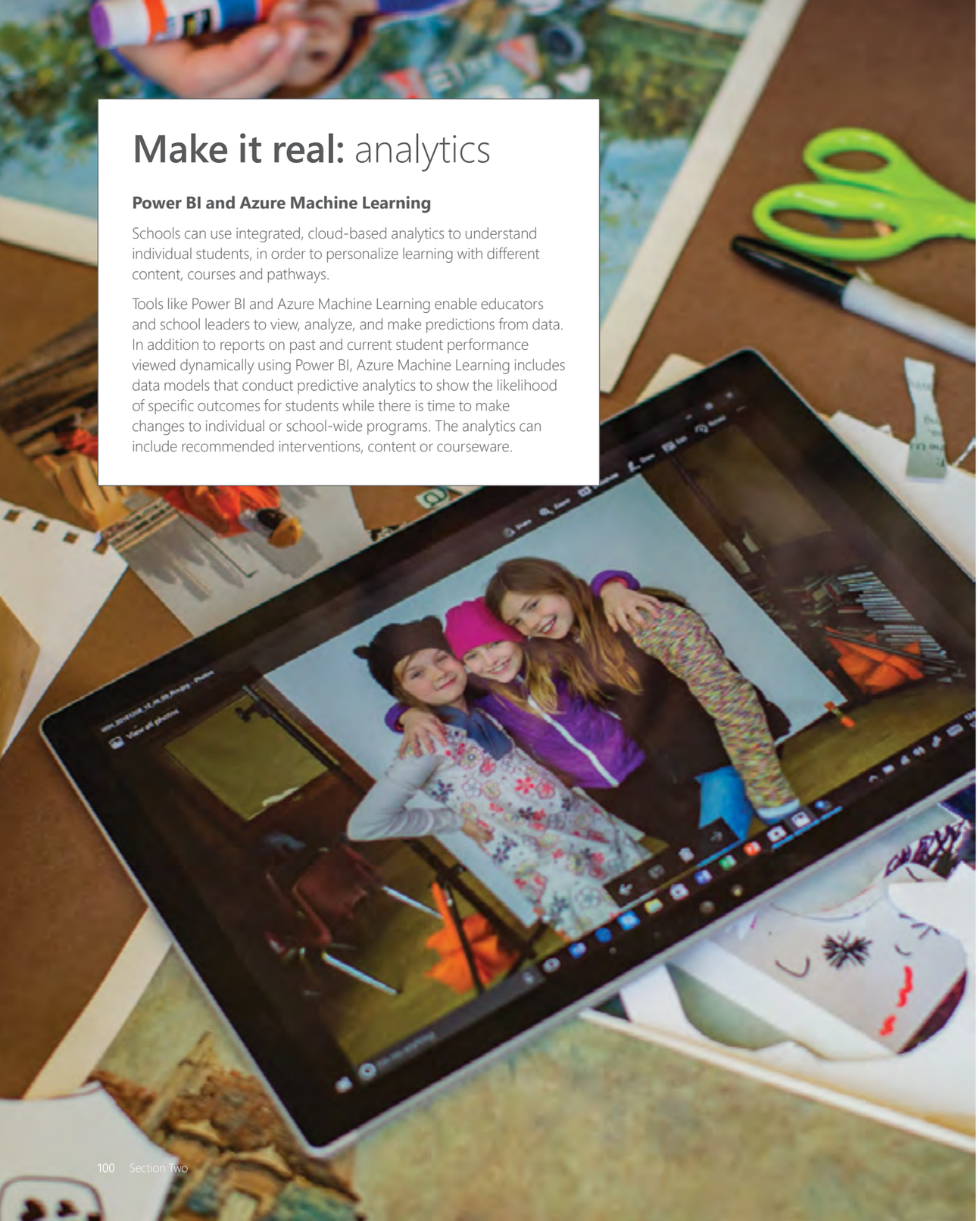
Look for technologies that help you provide choices in:

What students learn
Look for a choice of courses and content.

How they learn
Provide options for interactive, self-paced, audio, video and collaboration technologies.

The pace at which they learn
Offer adaptive and pre-emptive platforms that provide appropriate extension and remediation activities to scaffold learning.

How they demonstrate their learning
Through artifacts like video, audio, digital, spoken or through interactive quizzes and formative assessment.



Make it real: analytics

Power BI and Azure Machine Learning

Schools can use integrated, cloud-based analytics to understand individual students, in order to personalize learning with different content, courses and pathways.

Tools like Power BI and Azure Machine Learning enable educators and school leaders to view, analyze, and make predictions from data. In addition to reports on past and current student performance viewed dynamically using Power BI, Azure Machine Learning includes data models that conduct predictive analytics to show the likelihood of specific outcomes for students while there is time to make changes to individual or school-wide programs. The analytics can include recommended interventions, content or courseware.

What is the Maker Movement doing in education?

The Maker Movement champions open-source learning, contemporary design and powerful personal technology like 3-D printers, microprocessors and robotics. It has settled firmly into the education landscape, inspiring students with hands-on experience, openness, iterative processes, personalization, peer mentorship and ownership.

Use technology to support problem-based learning

Problem- or project-based learning (PBL) is a powerful way to engage students in authentic learning and assessment. As they work to solve an open, broadly defined problem, they will typically conduct research, integrate theory and practice, and apply their knowledge and skills.

Technology can support that complex inquiry at almost every stage. The best learning occurs when real-world problems are paired with real-world tools for problem solving to allow them to go deeper into concepts, deeper with their thinking, and to be more creative with their problem solving. As technology is an integral part of 21st century students' realities, the right tools not only empower deeper thinking, but increase relevance. Studies have found an increase in students' science achievement and self-efficacy for learning science when using computers for PBL,[84] and that these behaviors persist even when students are not using them.[85]

Join the Maker Movement

The Maker Movement is a loose collection of independent inventors, designers and tinkerers, complete with its own Magazine, 'Make, and regular hands-on Maker Fairs.

Dr Gary Stager calls it "a technological and creative revolution," citing the incredible learning opportunities that let students experiment with designing and engineering their own inventions.

Stager has developed a learning strategy he calls Invent to Learn, which posits that the strongest learning experience comes through direct experience.[86] The Maker Movement promotes creativity through digital fabrication, such as 3D printing, and physical computing, such as Arduino, MaKey and Raspberry Pi. Access to this kind of technology may sound expensive, but it's typically quite affordable—and in any case, the strategy is more about nurturing a tinkering mindset and reducing 'chalk and talk' instruction.

Elon Musk famously pulled his children out of private school and created his own school (Ad Astra) based on these principles. He explains, "Let's say you're trying to teach people how engines work. A traditional approach would be to give you courses on screwdrivers and wrenches. A much better way would be, here is an engine, now how are we going to take it apart? Well, you need a screwdriver. And then a very important thing happens, the relevance of the tool becomes apparent."[87]

The Maker Movement

Dr Gary Stager explores the significance of encouraging students to 'make things'.

Piaget teaches us that, "Knowledge is a consequence of experience." There is no substitute for experience and the greatest way to expand the breadth, depth, and range of learning experiences is to use computers and new fabrication technologies to supercharge student projects.

Making things is a way of constructing meaning and concretizing understanding. This isn't just a way of ensuring that students "good with their hands" can experience a bit of academic success, but also a direct challenge to kids who are "good at school" who will be entering an uncertain world in which they will be required to solve problems that their teachers never anticipated. Such confident competent problem solving will often involve the making of something with bits or atoms.

This is the heart of the Maker Movement—a movement where learners are hands on solving problems, building solutions and learning to code in a practical way.

Having run workshops all over the world, it is clear that when teachers engage in a maker approach, they prove:

- Even the least confident teachers realize they are more than competent.
- Knowledge is a consequence of experience.
- Learning best occurs in the absence of instruction.
- Technology supercharges learning and makes us more human, creative, expressive.
- Education can and should be non-coercive.
- Assessment is at best adjacent to learning.
- Constructionism is effective.
- Things need not be as they seem.
- It is possible to create rich productive contexts for learning without fancy architecture, furniture, curriculum, tests.
- Educators are capable of innovation and invention with bleeding-edge tools.
- Learning is natural, playful, intense, whimsical, and deadly serious.
- Age segregation, tracking, and even discrete disciplines are unnecessary and perhaps counterproductive.
- A learning environment should be filled with a great variety of objects-to-think-with.
- Collaboration is great as long as it's natural, interdependent, flexible, mutually beneficial, and desired.
- Computer programming is the new liberal art.

All students should learn to program computers not for vocational reasons, but because it gives them agency over an increasingly complex and technologically sophisticated world.

Democracy depends on being able to answer the question Seymour Papert began asking a half century ago, "Does the computer program the child or the child program the computer?"

Gary S. Stager, Ph.D.
A veteran teacher educator, speaker, journalist, and consultant, Gary Stager has spent the past 36 years helping educators across the globe make constructive use of computers in classrooms. He is a leading expert in teaching programming, making, and learning-by-doing in the classroom, as well as a pioneer in 1:1 computing and online learning. Dr Stager is co-author of 'Invent To Learn – Making, Tinkering, and Engineering in the Classroom' and the founder of the Constructing Modern Knowledge institute.

> "What's excited me the most is that it's given a lot of teachers permission, once again, to be creative, to embrace and respect the ingenuity...of children."
>
> *Dr Gary Stager, world-leading expert and advocate for computer programming, robotics and learning-by-doing in classrooms.*

What is coding doing in education?

Coding is important to today's students because it represents a shift away from computer literacy skills to computer design, science and engineering skills. Young students begin with the concept of algorithms, moving on to logical reasoning skills, until they can begin to learn and use programming languages to create their own websites, games, apps, animations and more.

Provide students with opportunities to learn coding

Computing (logic, coding, algorithm design, etc.) is founded in problem solving. This is being recognized by school systems across the world as they introduce computational thinking into their curriculum and encourage students to design computer games and learn how to code. Coding focuses on developing students' thought processes in order to unravel problems, and then enables them to design and generate digital solutions.

Take advantage of Microsoft coding apps, tools and courses for schools

- **Minecraft, Education Edition:** An open-world game that promotes creativity, collaboration and problem solving.
- **Creative Coding through Games and Apps (CCGA):** Students learn how to code by designing and programming apps and games.
- **CS50x AP (with Harvard):** A year-long computational thinking, computer science and programming course.
- **PXT.IO coding tool:** Students use touch or a keyboard to create apps and games on their devices.
- **Visual Studio Community:** A fully featured integrated development environment (IDE) for any platform.
- **Microsoft Windows & Windows 10 IoT Core:** Helps students and teachers to do great things in STEM.

Make it real: coding

This is a popular game-based learning platform that helps prepare students for the future workplace by building creativity, collaboration and problem-solving skills.

Students can learn coding in Minecraft using tools like Code.org, Tynker, Scratch and Microsoft MakeCode. They can choose between using blocks of code or Javascript to build and create in Minecraft. Minecraft Hour of Code also offers a free one-hour introduction to coding basics.

Minecraft: Education Edition includes special features for teachers such as easy tutorials, classroom management tools, secure sign-in, classroom collaborations and sample lessons, plus a global network of mentors and technology support.

Games and simulations support learning, but you need to be adequately prepared and equipped to teach with them

Simulations and games hold great promise for learning, especially if students can control the pace and content to suit their needs, strengths, and weaknesses. Games and simulations can also put learning in contexts that might otherwise be difficult to experience; for example, underwater, in space, or inside the human body. Studies show that simulations facilitate knowledge integration and a deeper understanding of complex topics such as genetics, environmental science, and physics.[88, 89, 90, 91]

At the same time, research has shown that there are important variables that can significantly affect the extent to which games and simulations support learning. These relate both to the way you teach with them and the way you support the teaching of them.

Students learn better using games, and playing individually

A meta-analysis into the effectiveness of games, simulations and virtual worlds found that while they were all effective, games show higher learning gains than simulations and virtual worlds.[92] The same analysis also revealed that students' performance is enhanced when they conduct game play individually, rather than in a group.

Your school setup and culture can be an obstacle

In his paper on the use of gaming and simulations in science learning, Dede concluded that, "current educational systems pose formidable challenges to implementation at scale."[93] Obstacles can be as simple as not having the technology infrastructure to support a game or simulation, or not supporting teachers with skills and training in how to use games and simulations to best advantage.

Your current assessment method might not be appropriate

It might be time to rethink that pen and paper test. Simulations that use multiple modalities to represent science systems and to elicit student responses present better opportunities for students with diverse learning styles and language backgrounds to demonstrate their knowledge.[94] Your tests may also need adjusting in terms of content. Quellmalz et al. found that in the USA while national 'high stakes' science tests did not accurately measure the complex understandings and skills developed by high-quality simulations and games, student performance was still evaluated largely based on them.[95]

Take advantage of open educational resources

Teaching is a process of continual learning, adaptation, improvisation and instant decision making.[96] This means teachers require access to a variety of resources to meet flexible teaching moments and the remedial and advanced needs of their students.

Open educational resources (OER) can provide a useful supplement. Camilleri et al. suggest that educators can collaboratively improve materials and curricula with OER with less duplication of effort.[97] Students also grow by being introduced to high-quality material that is adaptable and can be remixed for teacher or student purposes. Finally, low- or no-cost access to such materials can improve equity and access issues, although they need localizing or translating from English, which can be expensive or time-consuming.

Look for ready-made digital curriculum

The promise of digital curriculum is tantalizing. Schools can take advantage of ready-to-use online curriculum that integrates assessment, instruction, student activities, remediation and lesson plans. They can also curate and manage resource libraries, including digital textbooks, bringing teacher and student editions to desktop, laptop, and mobile devices to replace bulky print materials.

To support this, some countries (e.g., Australia) have created national digital learning resources networks, making thousands of quality digital learning resources directly linked to the curriculum, available to schools through an online digital curriculum portal. Language translation algorithms are also developing at a formidable pace, which helps reduce the barrier to access.

Is there a MOOC?

Massive open online courses (MOOCs) also provide an opportunity to connect learners to others who share their same interests. Teachers can avoid assessment issues by having students participate in a portion of a MOOC, using content to supplement the needs of the class or the individual student, with current assessment being undertaken by the local teacher.

Benefits include:

- Alternatives for scheduling conflicts.
- Specialist courses, electives, and subjects available where local teachers are not.
- Flexibility for athletes and home-bound students.
- Remediation or credit recovery programs for at-risk students.
- Solutions for emergency shortfalls in teachers.

Make it real: sharing

If you're looking for ready-made curriculum materials, the Microsoft Educator Network contains a huge range that you can use right away. There are lessons on STEM, reading and writing, social studies, languages, fine arts, digital literacy, the environment and much more. You can also find training in Microsoft technologies, as well as video tutorials.
www.education.microsoft.com

> “Data can help point to where a student is headed rather than a summative assessment of where a student has been.”

Selecting technology for assessment

Technology can bring powerful new capabilities to assessment. Traditional assessment, which often takes the form of tests or quizzes, can be enhanced through the use of digital platforms. At a more sophisticated level, analytics can quickly reveal student and class performance.

Start by digitizing your testing process

Starting with Microsoft Forms in OneNote, for example, teachers can design a variety of quizzes and tests, share them with students and see real-time analytics for individual students, as well as summary data, which can be exported to Microsoft Excel for more in-depth analysis. They can also provide personalized feedback directly into students’ work using a digital pen and inking, record their voice and annotate particular points, or record a video of their own screen to demonstrate a solution to a particular challenge.

This kind of assessment is tied to the curriculum in the sense that it tests facts, knowledge, skills or attitudes. It’s an ideal way to get a quick understanding of student capabilities at the end of, or prior to commencing, a unit of work. Standardized tests are better suited for those with average abilities, compared to adaptive tests (see below) that can be used for most learners.[98]

Use data to show where students are headed

One of the advantages of 21st century technologies is the amount of data that is generated with its use. Enhanced data systems can provide opportunities for data-driven decision-making at any point throughout the learning process, rather than waiting until a student has passed or failed a unit or, worse yet, a course. Data can be used to help assessment become a learning tool; it becomes a formative approach to improving curriculum. It can help point to where a student is headed rather than a summative assessment of where a student has been.

Work toward adaptive and embedded assessment

When you have a solid transformation platform as described in Section One of this guide, you can put in place the technologies to support adaptive and embedded assessment.

Studies show that adaptive assessment offers key advantages in K-12 education.[99,100] It has been found to be as accurate as fixed-form tests that are twice as long, that by drawing from large item pools it provides much more information, and more precise information about students who are struggling and those who are excelling.

Because they are administered by computer, adaptive assessments provide immediate feedback to students and teachers. These instantaneous results help teachers to adjust instruction in real time.

Students still complete assessments, but the opportunity to assess their learning is embedded within the content being offered, and it occurs frequently. This helps teachers deliver adapted and dynamic content so that as students progress through the curriculum (now defined broadly as a combination of content and embedded assessment), they are presented with materials that map to their learning styles, remedial or extension needs.

Shute, in discussing stealth assessment, adds: “We now can more accurately and efficiently diagnose student competencies at various levels during the course of learning. With regard to low-level diagnoses (i.e., at the problem or task level, addressing how the person handled a given problem), new technologies allow us to embed assessments into the learning process; extract

ongoing, multifaceted information (evidence) from a learner; and react in immediate and helpful ways. On a more general level, we can support learning by using automated scoring and machine-based reasoning techniques to infer things that would be too hard for humans (e.g., estimating competency levels across a network of skills, addressing what the person knows and can do, and to what degree). These competency-level diagnoses then provide the basis for improved instruction, self-reflection, and so on."[101]

Use digital portfolios to support alternative assessments

There are many ways to assess learning outcomes. However, if you're looking for a more holistic understanding of your students' abilities, digital portfolios have many advantages. Not only do they allow students to demonstrate their strengths and accomplishments, studies show that they can enhance both student engagement and self-assessment.[102] And because digital portfolios enable students to share their work digitally with a broader audience, they have the added benefit of supporting peer feedback and self-reflection. In fact, a study into the use of digital portfolios by fourth graders found that both student writing performance and peer feedback skills also improved.[103] The leading portfolio software is OneNote and there are a multitude of OneNote lesson plans available online.

Could a Microsoft Stream video channel work for self-reflection and evaluation in your class?

Don't forget the possibility of creating a video channel that is private to your class, where students can annotate each other's and their own work. Other options include student websites and dedicated portfolio sites. Teachers can also use familiar desktop and publishing software, social networking tools, and Microsoft Stream to implement broader concepts such as digital storytelling and online presence.

Look for these three essential elements when choosing technologies

When choosing technology for digital portfolios you'll need to balance the institution's needs for an assessment management system with the need for a reflective portfolio that supports deep learning. Barrett and Wilkerson[104] proposed that an electronic portfolio system could achieve this with three linked elements:

- A digital archive of learners' work.
- A learner-centered electronic portfolio using the learner's authentic voice.
- An institution-centered database, or assessment management system, to collect assessment data based on tasks and rubrics.

Make it real: personalized learning

- Based on Artificial Intelligence models and machine adaptive learning capabilities, this engine "listens to and observes" each student's interactions with learning activities from curricular activities.
- Claned personalizes learning to each individual, optimizing study motivation and learning results. It is being used globally by the most innovative education systems for both students and teachers.
- Founded in Finland, Claned takes the best ideas from Finnish Education and combines them with the most powerful cloud technologies to become a clear pack leader in what technology makes possible.
- In February 2018, Claned was named the Best E-Learning Company of the year at the EdTechReview Summit and Expo in New Delhi.
- The platform maximizes learning outcomes by combining artificial intelligence, collaborative learning and world-class pedagogy.

How technology is changing the nature of assessment[105]

Traditional Assessment	Emerging Assessment
Assessment is external to learning processes; the challenge of 'validity' or alignment of the test with what has been taught.	Assessment is embedded in learning; 'validity' is no longer a challenge.
Limited opportunities for assessment, restricted data sets (select and supply response assessments).	Data are big because there can be many small data points during the learning process (structured and unstructured data).
Conventional focus on summative assessment.	Renewed focus on formative assessment.
Summative assessment is an outcome or end view of learning.	Summative assessment is a progress view, using data that were at first formative to trace learning progressions; feedback is recursive.
Expert or teacher assessors.	Crowd-sourced, moderated assessments from multiple perspectives, including peers and self.
Focus on individual memory and deductions leading to correct or incorrect answers.	Focus on knowledge representations and artifacts that acknowledge textual provenance and trace peer collaborations.
Assessment of fact and correct application.	Assessment of complex epistemic performance, disciplinary practice.
Assessment experts as report grades.	Learners and teachers as data analysts, with the support of analytics dashboards and visualizations.

Ensure students can input their own opinions

The ability for students to input their own opinions is important because the artifacts in a digital portfolio are assessed on both their merit and the student's rationale as to how their selected artifacts achieve the required outcomes, or standards. And the ability to link it to your institution's assessment management system is key because evidence needs to be validated by a trained reviewer, using a well-developed rubric with identifiable and specific criteria.

Technology can help students and teachers to reflect on learning

Reflection is essential to learning. John Dewey made the famous claim that we learn from reflecting on our experiences. Reflection, for Dewey, was an "active, persistent and careful consideration of any belief or practice in light of reasons that support it and the further consequences to which it leads."[106]

Without reflection, students spend time in class only focusing on the present and the future; the learning that just occurred becomes isolated and thus easy to discard.[107] Reflection can occur through discussion, questioning, and journaling.

One stand-out technology for reflective learning is blogging. Studies have found that it affords opportunities for self-expression and self-reflection[108] and that is not confined to words alone. Bloggers can also express themselves by integrating pictures, audio or video, supporting multi-modal expression.[109] Video presentations (recorded on student smartphones or tablets) can be very effective in documenting student progress by recording and commenting on specific projects.

Collin & Karsenti conducted a literature review of the use of online learning to support reflective practice.[110] They found that the time and space flexibility of online learning gave people the opportunity to reflect and become metacognitive about their posts. Forums were also the most beneficial form of online practice to promote reflection. Finally, their own research provided evidence that online interaction encouraged "both individual and groups to exercise a range of reflective functions. Furthermore, online interaction was positively and significantly correlated with cognitive engagement."

Make it real: reflection

- Use blogs to reflect on learning or other experiences.
- Use social media (e.g., a subject page in Yammer—a safe, secure social network) to post and then comment on the posts of others.
- Contribute to wikis.
- Encourage students to use e-portfolios to build a curated selection of their work, which they can then evaluate and reflect on as they progress.

> “There is an immediate sense of 'the future, now' about the HoloLens experience, and, as an educator, I instantly felt that the device, and the way in which it offers an ‘enhanced’ view of one’s surroundings, has almost limitless potential as a teaching tool. Its main benefit to teaching is not so much expanding on what we can teach but on how we can teach—that is a much more profound leap forward.”
>
> *Chris Barry, Head of Digital Strategy at Harrow School .*

Mixed reality

Picture this. Your students dissecting a frog or examining the bones in a human arm—without any of it being real. Imagine picking up a priceless vase from Ancient Greece to study its inscription. Assembling a motor from scratch. Or taking a stroll around Machu Picchu as it was in 1200 AD.

HoloLens and Windows Mixed Reality look set to transform learning. By creating mixed reality visual and tactile experiences that enable students to engage hands-on in their subject, HoloLens has the power to make challenging topics more accessible and take students to new dimensions of understanding.

How does it work?

HoloLens is a holographic computer that students wear. Using high-definition lenses and spatial sound technology, it immerses students in the holographic experience while rooting them in the physical world. It does this by projecting holograms, overlaying objects and places, even people, directly onto the environment so students can see, hear and manipulate them. When they wear the headset they can interact with holograms; for example, pinching the thumb and index finger to make things smaller, expanding it to make things bigger, gesturing to cover a wall with specific objects and so on. The device is self-contained, requiring no connection to a PC.

Will it transform learning?

Microsoft is working closely with a wide range of partners to create powerful experiential learning opportunities, where students can interact with holograms as if they were in their space with them. Whether this be exploring a volcano, taking apart a Boeing jet engine, understanding anatomy, or walking with the dinosaurs, this technology will change the way we think about learning experiences.

Teachers have been excited try this technology in their classrooms to understand how it can enhance teaching and learning. Recently, Microsoft partnered with Lifeliqe—the visual education company that creates digital science curriculum for students by using the latest Mixed Reality (MR) and Augmented reality (AR) technology—to bring augmented learning to prep schools in California.

In 2016 the University of Washington hosted the world's first HoloLens class. There, computer science students got to experiment with the headset for ten weeks, testing out different apps from making spring rolls to destroying giant eyeballs.

Microsoft has also demonstrated how it can be used to play games like Minecraft, put together 3D models and power a robot. With these kinds of applications, teachers can incorporate HoloLens into STEM education curriculum and provide a more interactive learning environment. It can also be used to support technical education. Having an interactive, 3D model of, for example, a jet engine could supplement manuals and help when the actual equipment is unavailable.

Adaptive and personalized learning

While the opportunities for what HoloLens can teach seem limitless, the real excitement is in how HoloLens will change the nature of teaching by making it more adaptive and personalized. Students can study and investigate a holographic 3D model in the way they prefer, and take ownership of their learning experience. HoloLens can also bring tremendous fidelity to learning in a way that a photograph or diagram cannot. Augmented realities point out components, and offer step-by-step instruction to support learning.

Experiential assessment

The cameras on the HoloLens can also change the way teachers provide feedback to students by enabling them to see through their students' eyes, even from far away, so they could provide real-time support during hands-on exercises. This kind of experiential assessment allows for far more immerse and comprehensive "in context" assessment that was either not possible, unaffordable or unscalable.

Flexible learning

With more and more classes being taken online, HoloLens offers the potential of quality learning to extend schooling or provide students who live in remote settings or who cannot attend an institution with high-quality experiences. By providing simulated environments for students to learn in, and giving teachers the means to offer hands-on instruction from afar, it provides a rich learning experience.

Reality Check

Virtual reality (VR)
Provides a completely new visual environment by artificially rendering sights and sounds. Because they seem real to the user it creates an illusion of the subject being somewhere else.

Augmented Reality (AR)
Allows you to see what's actually in front of you with a virtual layer on top. In the past, these were commonly viewed through a smartphone.

Mixed Reality (MR)
Takes Augmented Reality a step further, allowing virtual objects to actually interact with the physical environment and behave subject to the laws of physics set by the physical world.

It's already happening

Immersive learning through Mixed Reality is a game-changer in education, and has many more possible applications that are still being developed.

Training medical students

A team of experts from the University of Leiden and the Leiden UMC has added a new feature to the Microsoft HoloLens, which connects the human body movements and the virtual anatomical model. Students can learn from their own physical movements while studying the virtual model. This provides a real-time, three-dimensional model for students to study, using their own bodies as learning tools.

Training pilots

Using Microsoft HoloLens, Japan Airlines (JAL) has developed two proof-of-concept programs to provide supplemental training for engine mechanics, and for flight crew trainees who want to be promoted to co-pilot status. Engine mechanics can study and be trained just as if they were working on the actual engine or cockpit, placing their hands on virtual engines and parts.

Training astronauts

NASA is using HoloLens technology for Project Sidekick, which lets space station crews get the assistance they need, on demand, to reduce the amount of training they require.

Red Flags

Here are some of the most common stumbling blocks to a successful technology deployment.

Common reasons for underwhelming outcomes

- Making technology, instead of learning goals, the starting point for digital transformation.
- Having a platform that is a cobbled together set of apps or applications unable to provide high-quality data to empower learning transformation.
- Failing to support or skill teachers in emerging technologies. For example, recently introduced policy in the UK encourages primary schools to teach coding but schools report that most teachers have no experience.
- Assuming that knowledge-based curriculum keeps student options open, while technical curriculum narrows them. Technical curriculum; for example, coding, has been shown to expand future-ready skills, mathematical and scientific thinking, and to improve general problem solving.
- Using digital curriculum that simply replicates a printed book. E-readers can be useful when they allow students to annotate text, but they can also lead to less-focused reading and can reduce the likelihood that students will learn to love reading for pleasure.
- Using apps which 'dumb down' learning. Many apps only provide students with opportunities to react or select from options, rather than create, imagine, collaborate and showcase their work. Be rigorous in evaluating their learning potential (and don't mistake distraction or entertainment for meaningful engagement).
- Failing to spot the cultural implications of digital curriculum, which may only present "western stereotypes" that do not fit every culture or context.
- Being lured by one-size-fits-all propositions, instead of ensuring technology caters for different students and contexts. Online learning, for example, may suit certain students, but may be less effective for students with different learning preferences or learning styles.

Evidence and Further Reading

To delve deeper into some of the topics in this chapter, here is a selection of recommended reading and relevant case studies to serve as a useful starting point.

Ito, M.; Gutiérrez, K.; Livingstone, S.; Penuel, B.; Rhodes, J.; Salen, K.; Schor, J.; Sefton-Green, J.; Watkins, S.G. (2013) Connected learning: An agenda for research and design. Irvine, CA: Digital Media and Learning Research Hub.

Zahira Merchanta, Ernest T. Goetzb, Lauren Cifuentesc, Wendy Keeney-Kennicuttd, Trina J. Davis (2014) Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis.

Cope B., Kalantzis M. (2016) Big Data Comes to School: Implications for Learning, Assessment, and Research AERA Open Vol. 2, No. 2, pp. 1–19.

Liu, M., Hsieh, P.(.H., Cho, Y. & Schallert, D. (2006) Middle School Students' Self-Efficacy, Attitudes, and Achievement in a Computer-Enhanced Problem-Based Learning Environment. Journal of Interactive Learning Research, 17(3), 225-242. Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Critical Concepts

Choose technology for maximum pedagogical potential.

Essential steps to success

Learn from the mistakes of the past

Investigate technology deployments that have not succeeded and learn from them. Schools that claim that "technology failed them" often share a common theme: minimally spec'd devices rushed into classrooms with insufficient staff training and no leadership policies, change management or pedagogical innovation.

Today's bargain. Tomorrow's expensive mistake.

Restricting students to low-cost, but under-performing, technology can seriously undermine their thinking and performance. Education is a critical determinant of student success in life. Don't compromise.

Key selection criteria

Ensure the technology you choose supports:

- **Multi-modal learning—**touch, pen, type, voice, video.
- **Personalized learning**—via integrated learning analytics and digital curriculum
- **Rich assessment and feedback**—ideally with the potential for analytics.
- **Powerful communication and collaboration—**with multichannel tools that enable schools to use the medium that suits the situation, including: text, video, real-time document collaboration, social media, blogs, etc.
- **Connected learning**—on and offline opportunities.
- **Problem-based learning**—software and apps that allow students to investigate, ideate, create and present.

Make sure your recommended student devices support a digital pen

All the evidence points to the cognitive importance of students being able to sketch, annotate, brainstorm and ideate with digital pen.

Make sure school devices are easy to manage

Look for practical software tools (such as the Windows 10 set-up app) that let teachers with limited IT skills quickly set up student devices and load them with relevant software and apps.

Embrace a modern curriculum

Join the Maker Movement and inspire students to start re-imagining solutions and creating their own designs.

Teach coding

Coding is important because it represents a shift away from computer literacy skills to computer design, science and engineering skills, which are so vital for tomorrow's world.

Powerful Questions

Why are we introducing new technology? Is it to impress parents, keep up with another school, keep students happy, or is it to fundamentally improve learning? Ask these essential questions.

1. How well do the proposed student devices support multi-modal learning for every student, subject and situation?
2. Will our devices entertain or educate students?
3. How will we investigate how effective the proposed technology is for learning before we deploy it?
4. How can we make sure we use the proposed technology to transform pedagogical practice and not simply 'digitize' what we already do?
5. Is there an individual or group of teachers who we could nominate to 're-imagine teaching at our school', giving them carte blanche to come back with ideas on how we could use technology to transform learning?
6. What could we change to ensure that our current curriculum and teaching practice reflect modern society and the skills students need today?
7. How can we introduce coding and exploit the maker movement?
8. How can we move toward embedded assessment?

Physical Learning Spaces

Stop building your grandparents' school

Prakash Nair shares his wisdom on what it takes to build modern, inspirational learning spaces.

The traditional classroom is obsolete

What do the thousands of schools around the world have in common? The classroom! That's a huge problem because classrooms actively prevent our children from receiving the education they need. The World Economic Forum's "Future of Jobs" report identified complex problem solving, critical thinking and creativity as the top three skills needed for success in 2020 and beyond. Classrooms are not designed to deliver these skills.

A new kind of school

We need a new kind of school where students are not sorted by age and trapped with one adult for most of the day. This new kind of school is not just about learning spaces, but about learning itself. Imagine a school that welcomes students and the community, showcasing its unique culture and ethos. A place where students are actively engaged in various tasks and display their work-products. Teachers connect with students one-on-one or in small groups. They also have their own professional work area. Every student works on tasks based on their own individualized learning plan. Collaboration and social skills are nurtured.

Qualities of learning spaces

There is ample daylight, places for students to reflect and work independently and to build and give form to their own creations. The acoustics are excellent, colors are cheerful and tasteful and furnishings are varied and comfortable. Technology is everywhere, available when and where students need it. There are cafés where students eat on demand, connections to the outdoors and nature are plentiful, and the whole campus is an exemplar of green, sustainable design.

This kind of school is not only essential but is already working across the globe, and in many cases costs significantly less than traditional buildings or learning spaces. The evidence is irrefutable. You can create great places for learning whether you are constructing new buildings or renovating an old one. Stop building your grandparents' school! Our children deserve better. Let us give them schools to prepare them fully for their future and not our past.

Prakash Nair

Prakash Nair is the Founding President and CEO of Fielding Nair International, a firm that has worked on innovative schools in 47 countries on six continents. Prakash has written two highly regarded books including one published by Harvard University. He has won numerous design awards including the MacConnell Award, which is the highest honor worldwide for school design. Prakash's signature talent lies in his ability to communicate his passion for a new approach to education across the globe. He has consistently built strong partnerships with local communities by helping them visualize their future, built consensus for uniquely tailored solutions, and helped execute them successfully.

The Opportunity

Schools can improve the positive impact of digital technology with physical learning spaces that are more flexible, collaborative, equitable, healthy and inspiring. Teachers can now let their lesson plans drive the classroom setup, instead of the other way around.

As digital technology revolutionizes nearly every aspect of the developing world, we are now seeing its influence on our schools. In taking up digital tools, teachers and students have naturally begun to seek out more comfortable, more flexible, and more connected environments that can support their 21st century learning.

We know from research done in office work environments that physical design can have both positive and negative effects on health, satisfaction and productivity.[111] It is clear we need to be wary of this dilemma when importing new design ideas into the classroom. If students are going to spend more and more time using digital screens and other technologies, we must clearly identify and accentuate the positive effects, while flagging and minimizing any negatives.

Oddly enough, the move toward developing more flexible, comfortable and inspiring learning environments isn't wholly different from the Montessori method developed in the early 1900s, which encourages students to learn through cooperative and self-directed learning in a carefully considered environment. But unfortunately, the inclusion of ICT has generally not been planned around any specific pedagogy like this, and instead has been assumed to be integrated into any and all instructional settings.[112] It's clear that this laissez-faire approach isn't delivering results.

This chapter looks at the process of understanding, designing and implementing new physical learning spaces—not just as a solution to immediate digital needs, but as a way to completely re-engineer the idea of classrooms, so they can continue to adapt well into the future.

> "In the one-to-one classrooms in which we work... we have seen attendance go up, behavior problems go down, and test scores jump by 30 percent."
>
> *Professor Norris and Professor Soloway, University of Texas and University of Michigan.*

The Challenge

The basic structure of teaching spaces has not evolved over the past century; it's time to bridge the gap between architecture and education. If new ideas about physical learning spaces continue to be introduced ad hoc, they are merely whizzbang upgrades to teacher-centric practice with peripheral student engagement.

Give classroom design the same weight as pedagogy and curriculum design

Around the world, easily millions of hours have been dedicated to discussing who, what, why and how we should teach our children. So it's strange that the 'where' is often an afterthought, especially when the classroom is often famously referred to as "the third teacher."[113] Ironically, it's the virtual and digital world that is finally bringing the importance of physical learning environments to the fore.

Learning is becoming more cooperative, which turns teachers into learners too. In response, the concept of a physical learning environment has evolved into a complex structure that includes equipment, data, and events, where students can take part in the learning process both directly and virtually. [114]

To plan an effective physical learning environment, technical and digital specifications must be developed alongside qualitative considerations.[115] This is what the OECD calls Quality Design, which begins with defining a quality physical learning environment—in terms of student requirements, age groups, societal needs and usability/safety regulations[116]—then continually measuring and analyzing the results.[117]

The OECD defines a quality learning environment as "a physical space that supports multiple and diverse teaching and learning programs and pedagogies, including current technologies; one that demonstrates optimal, cost-effective building performance and operation over time; one that respects and is in harmony with the environment; and one that encourages social participation, providing a healthy, comfortable, safe, secure and stimulating setting for its occupants."[118]

Experts agree that the overall aim of Quality Design is to 'bridge the gap' between architecture and education, addressing the fundamental question: How do the facilities contribute to educational goals, policy, effectiveness and quality?

> "Think of today's top rating for environmental school design as tomorrow's last-place rating, and design to be better than the current best practices."
>
> *The Third Teacher, 2010.*

Built with purpose

OECD experts identified criteria for assessing school building quality along with six universal principles. Facilities should be:

- **Fit for purpose**
- **Inspirational and symbolic**
- **Environmentally sustainable**
- **Healthy and comfortable**
- **Safe and secure**
- **Cost-effective**

Use ergonomics to improve learning outcomes

Classroom ergonomics is in a sorry state. Zandvliet and Straker found that, while schools tend to put a lot of effort into choosing technology, they put inadequate consideration into the adjustability of student workstations and the suitability of lighting. Worse, many schools see the design of the environment, lighting, and air quality as potentially distracting to learners, even though Zandvliet and Straker effectively proved the opposite. They found that an adequate working environment is more than a comfort or safety issue—it's a learning issue. Inadequate physical learning environments create psychosocial disharmony, which can actually distract or disrupt intended learning goals.[119]

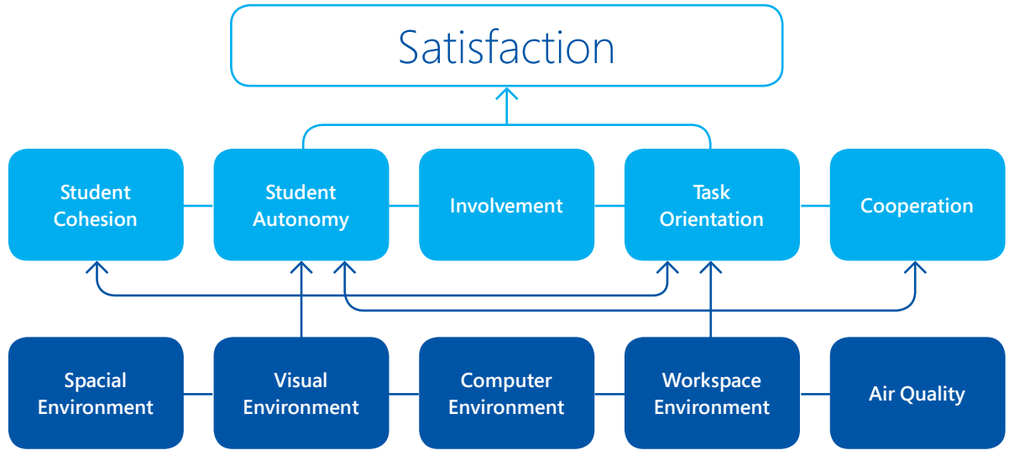
To help combat this, Zandvliet and Straker developed a new model through which to design a physical learning environment. They propose that careful consideration of the spacial environment, visual environment, computer environment, workspace environment and air quality has various impacts on psychosocial factors, which in turn contribute to overall satisfaction. The physical factors with the greatest impact on psychosocial factors are the visual environment and the workspace environment.[120]

Essentially, this model is a way to link pedagogy to space and modalities–in other words, find the right space for the lesson. Using five principal modalities, Delivering, Applying, Creating, Communicating and Decision-Making, the Director of Learning Futures, Dr Kenn Fisher, was able to explore the most appropriate space for each task, as illustrated in the diagram to the right.[121]

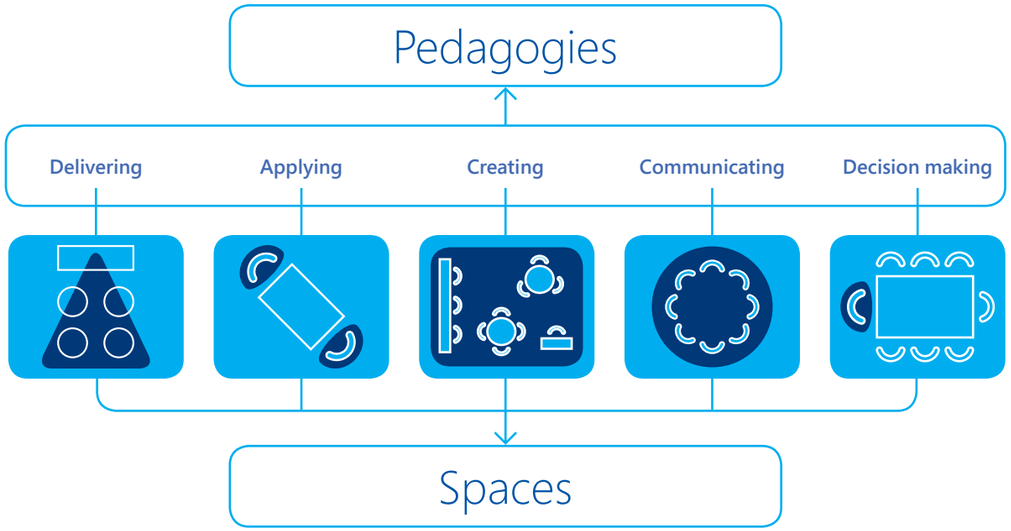
Once implemented, a physical learning environment also needs a constant cycle of evaluation and analysis. The effective evaluation of learning spaces requires a rigorous and action-oriented approach, and one that fits with institutional requirements and outputs.[122]

> "Manipulation of physical factors (such as lighting and workspace) can be considered as a positive and practical method of influencing the overall learning environment."
>
> *David Zandvliet and Leon Straker, Physical and Psychosocial Aspects of the Learning Environment in Information Technology Rich Classrooms.*

Zandvliet & Straker's Model for Educational Productivity



Scott-Webber's Linking pedagogy to space/modalities



Encourage good posture with adjustable workstations

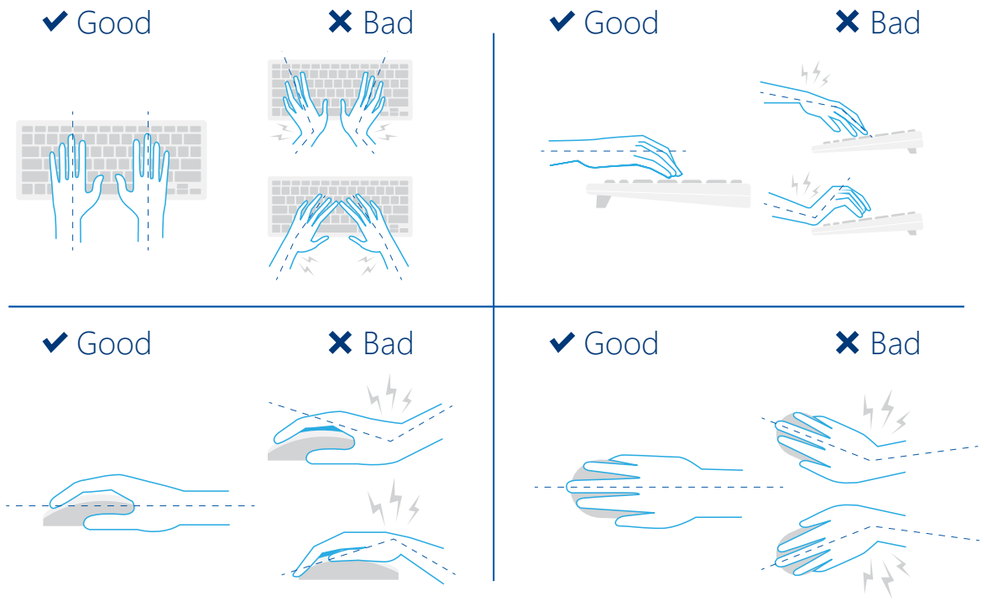
Computers, like heavy backpacks, are associated with spinal distortions. When students are given laptops and tablets but not their own workstations, they can end up slumped over school desks that weren't designed for computing–or worse, curled up in a beanbag. When the spine is continually hunched, the thoracic and cervical spine begins to deform, creating serious concerns that go beyond back pain. Occupational Health & Safety researcher Steve Marshal observes, 'We do not as a whole, sit with proper posture when using our computers... We slouch, we hunch over and perhaps we sit cross-legged or curl our legs under our seats."[123]

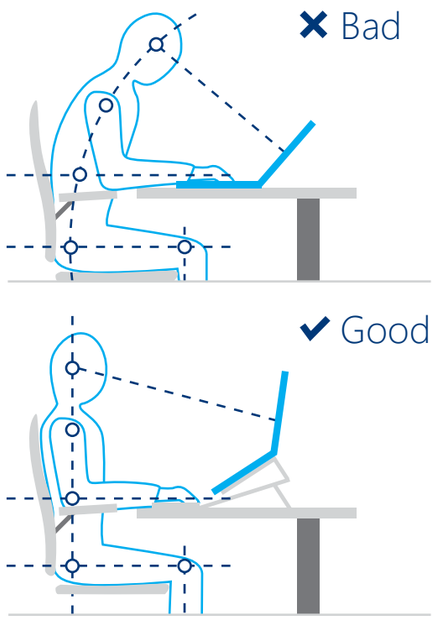
In a study of 314 middle and high school students engaging in "moderate" amounts of computer use (calculated as a mean of 3.2 hours per day), 60 percent of students reported discomfort associated with laptop use. The time spent using laptops was positively related to the discomfort experienced,[124] suggesting that the more students use laptops, the more discomfort developed.

Even when special workstations are provided, they must be adjustable. Another study of 95 middle school children using computer workstations found that none of the workstations were adjustable, all exceeded the recommended dimensions, and fully 100 percent of student postures fell in the unacceptable range,[125] according to RULA guidelines.[126]

Picking up on this, another study tested the postures of 58 middle and high school students using a typical unadjusted workstation and workstations individually adjusted to each student. Their results proved that adjustable workstations can provide "significant improvements" in posture.[127]

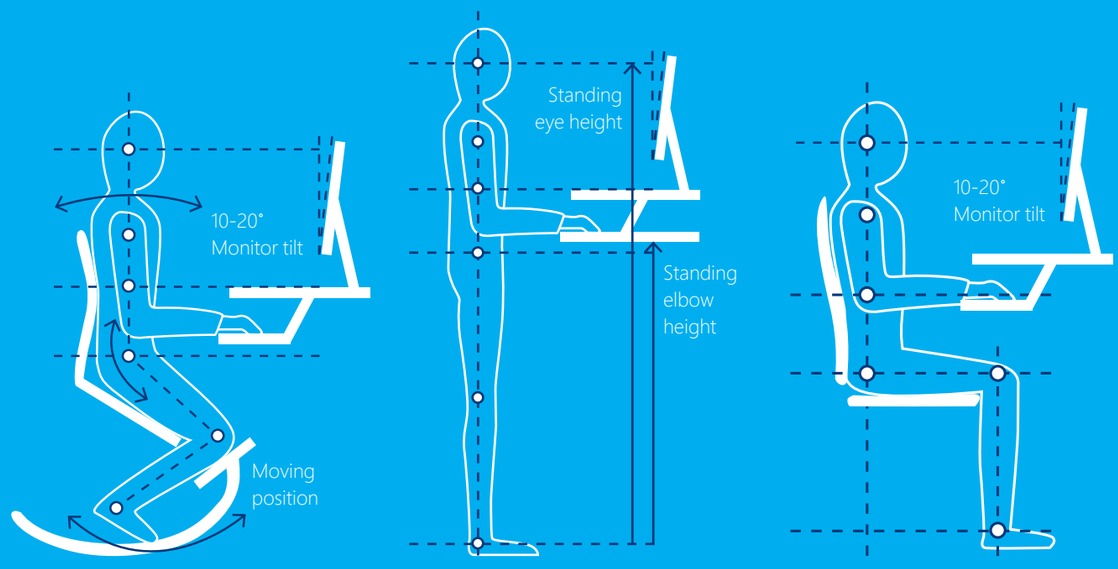
A good workstation adjusts not only to the students' height, eye level and arm level, but choice of device. Adjustable stands with peripheral keyboards and mice help students maintain the right posture and wrist flexion when using laptops, tablets and hybrid devices. Adjustable, ergonomic chairs with optional footstools also help maintain the correct positioning of the spine. Alternatively, standing desks or kneeling chairs can be provided.





Tips for workstation design

- ✔ Adjustable desks specially designed for use with computers.
- ✔ Screens positioned at eye level or slightly lower.
- ✔ Keyboard set at a height that lets your elbows rest comfortably at your sides. Forearms should be roughly parallel with the floor and level with the keyboard.
- ✔ Adjustable, ergonomic chairs that are specially designed so the spine holds its natural curve, and allow the feet to rest flat on the floor or a footstool.
- ✔ Ergonomic keyboard that ensures the hands and wrists are in a natural position.
- ✔ Regular breaks to keep students' bodies moving, perhaps switching from sitting desks to standing desks each lesson.



Protect student eyesight from blue light

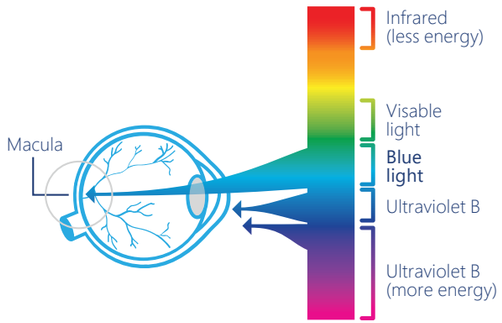
All digital devices emit blue wavelength light, which we are beginning to understand may have detrimental long-term effects on the eye. Blue light is, of course, naturally occurring as daylight from the sun. But artificial blue light from digital screens is different, mostly because we tend to stare right into it. Blue light reaches deeper into the eye than UV light and, with continued exposure over time, can cause retinal damage.[128,129,130]

The eye's natural defense mechanisms against blue light are melanin and ocular lens pigment (OLP), which both selectively limit the amount of blue light that reaches the retina. Unfortunately, humans are born without any OLP in the eye–it only begins to develop in later teenage years. A study by the French Agency for Food, Environmental and Occupational Health & Safety confirmed that children absorb more blue light from devices than adults,[131] so they will need to be especially protected.

Extensive screen use can also cause vision fatigue, dry eye and headaches. Moreover, if screens are used right before bedtime, blue light exposure can reduce the production of melatonin, which causes difficulty sleeping. Poor sleep often has a negative effect on diet, concentration levels, and academic performance.

There has also been a dramatic increase in the incidence of myopia (short-sightedness), occurring when too much time is spent focusing close up to a screen and there are not enough opportunities to exercise long-distance vision. This is especially prevalent in Asian countries like China,[132] but has also increased in the United States, up from 25 percent to 41.6 percent of the population, in just 30 years.[133]

Blue light spectrum



Signs that may indicate a child has a vision problem according to the American Optometric Association

- Frequent eye rubbing or blinking
- Short attention span
- Frequent headaches
- Covering one eye
- Tilting the head to one side
- An eye turning in or out
- Seeing double
- Losing place when reading
- Difficulty remembering what he or she read
- Holding reading materials close to the face
- Avoiding reading and other close activities

Fortunately, there are now some ways to minimize the effects of digital screens, as well as some promising new innovations that aren't particularly expensive to implement.

Awareness

Educating students and parents on the dangers of extensive screen usage, especially late at night, will go a long way to improving eye health and sleep patterns.

Ambient light

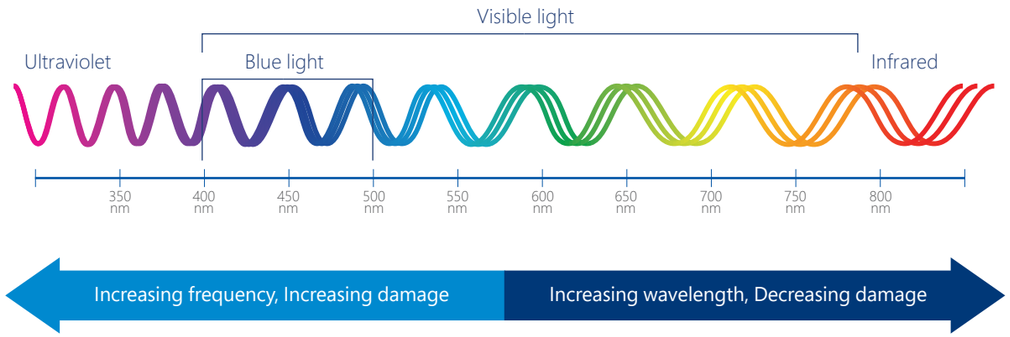
When using a computer, ambient light should only be about half as bright as what you'd expect in an office. Avoid using fluorescent lighting that is positioned directly overhead, or switch to 'full spectrum' fluorescent lighting.

Access to eye exams

To detect and help manage eye conditions like myopia, macular degeneration and astigmatisms, it is good practice to help students access professional eye examinations at least once every two years. This also helps ensure vision problems are not misattributed as learning difficulties, such as ADHD.

Time management

With coordinated awareness of classes in which a student will need to use a digital screen each day, teachers and staff can work together to keep screen time at an acceptable level. Teachers could also help implement the 20-20-20 rule, which suggests that every 20 minutes, take a break for 20 seconds and look at something at least 20 feet away.



400-450nm
HEV-induced retina damage and cell death.

460+10nm
Glare caused by LCD displays, mobile displays, LED lights. Melatonin suppression increased alertness, increased heart rate, etc.

470nm
"Good" blue light useful for various treatments (sleep disorder, seasonal depression, etc.).

Helpful Products

Melanopic Light Apps

This software (often free) continually works to adapt the screen color to match the time of day, gradually becoming warmer like a sunset in the evenings. This minimizes overall blue light exposure, discourages late-night computer usage and helps reduce the impact on melatonin production.

Screen Stickers

Blue light filtering stickers are available in a range of sizes, and can be placed directly on the screens of PCs, laptops, tablets and smartphones. They have the added benefit of protecting from dust and scratches.

Computer Glasses

These yellow-tinted lenses filter out blue light to reduce digital eye strain, headaches and dry eye.

Anti-Reflective Glasses

Prescription glasses can be purchased with a special coating that reduces screen glare and increases contrast.

Educate students and parents on other health concerns

On top of awareness of proper workstation setup and eye health as outlined in previous sections, students can benefit from additional tips on protecting their health when it comes to using ICT.

Protecting hearing

The MRC Institute of Hearing Research says that one in six adults has enough hearing loss to cause problems in social situations, and the World Health Organization reports that the single biggest cause of preventable hearing loss is loud music.[134] Most cases of deafness are caused by noise damage to the tiny hair cells in the inner ear–damage that is permanent and irreversible. Experts agree that continued exposure to noise at or above 80-85dB can cause hearing loss. For comparison, an iPod playing on the loudest setting is about 112dB and a chainsaw is about 115dB. Students should be encouraged to abide by the 60:60 rule, by listening to music at 60 percent of the maximum volume for no more than 60 minutes a day. Larger, higher-quality, noise-cancelling headphones are also more effective at minimizing background noise, and can better transmit bass sounds, preventing reliance on the more dangerous higher frequency sounds.[135]

Protecting skin

It may sound far-fetched, but there are many incidences of burns and lesions caused by positioning a laptop on the thighs,[136,137] a condition that is known as "toasted skin syndrome" or "hot water bottle rash". If the user isn't wearing clothing on the legs and is running CPU-intensive applications, some devices can heat up to levels over 47˚C (116˚F), which is enough to cause burns. Children's skin is especially susceptible to heat, so it is important to ensure they do not place laptops on the bare skin of their thighs, preferably keeping their laptop on a workstation or a heat shield at all times. For schools in particularly warm climates, specially ventilated laptop stands can help keep devices running at a cooler temperature.

Excessive screen time at night causes strain on the skin and muscles around the eye, often resulting in dark circles or puffiness. Maintaining an appropriate schedule of technology use, staying hydrated and getting the right amount of sleep helps keep skin healthy and students happy.

Protecting joints

Repetitive Strain Injuries (RSI) in the fingers, wrist, elbow and shoulder can develop due to excessive repetitive keyboard, mouse, trackpad and/or touch screen use. Students who also spend large amounts of time gaming can experience twitching and swelling of the fingers. These conditions are best treated by reducing the amount of time using the body in this repetitive way, but if the RSI is already entrenched, students should be referred to specialists for treatments such as physiotherapy or massage.

Protecting fitness

Activity involving ICT should never replace fitness, sport or outdoor play. Students should be made aware of the lifelong habits that can form if they become too reliant on devices for entertainment, which in extreme incidences can lead to poor nutrition, poor hygiene and obesity. For situations where access to sport, fitness or outdoor play options is limited, some promising results can be achieved using physical or motion-activated interfaces like the Xbox Kinect.

Although studies are in their infancy, one meta-analysis of multiple trials using "health video games" to combat childhood obesity found positive outcomes at least 40 percent of the time.[138]

Encourage mental health and work/life balance

In the United Kingdom, around one in 10 children aged five to 16 are suffering from a "diagnosable mental health disorder," according to the Association for Young People's Health. This can lead to a variety of social and emotional difficulties, such as violence and self-harm.[139]

Technology is rapidly soaking into this landscape and, without appropriate measures, is poised to make a delicate mental health situation worse.

Numerous studies have linked technology to poor mental health.[140] A recent survey of 3,500 adults by the American Psychological Association found that 20 percent identified technology as a source of their stress,[141] and the British Psychological Society warns that the constant in-flood of notifications are a "toxic source of stress."[142] Another Swedish study of 4,100 young adults showed that heavy technology usage increases sleep disorders, stress and symptoms of depression.[143]

Just because technology gives us the option to be "always on" doesn't mean we have to be. Educating and encouraging the importance of robust mental health and work/life balance in students is crucial to ensuring they enter higher education and the workforce with a balanced perspective on technology use.

> "Just because technology gives us the option to be 'always on' doesn't mean we have to be."

Helpful Policies

Yoga

By training students to learn how to relax and calm their minds through physical movement, yoga can reduce anger and increase focus, while helping to minimize the physical effects of technology overuse. In a study of over 800 students aged 14-15 years old, students who practiced yoga went on to perform better in academic testing.[144]

Meditation

When used in an education context, meditation improves student wellbeing and aids the development of empathy skills. Many schools are establishing a 'quiet time' during the school day, usually just 10-15 minutes, in which students are encouraged to sit quietly and meditate.[145] Sessions can be theory-led, teacher-led or completely open to interpretation.

Mindfulness

Effective for both students and teachers, mindfulness encourages practicing self-awareness of 'moment to moment' experiences, to help mitigate negative thoughts, emotions and behaviors.

Therapy and Counseling

It's important to train or re-train counselors in digital wellbeing, so they can help identify and sensitively treat students who may be suffering the effects of technology overuse or addiction.

Create flexible layouts with technical support for teachers

A flexible learning environment enables multiple layouts and usages, supported by fully integrated technologies. This kind of setup increases collaboration and the number of teaching and learning activities that take place.

In a large experiment at Warwick University, UK, a group of researchers designed and road-tested what they call the Teaching Grid. It is two physical spaces: A collaboration area for teachers to develop ideas; and an experimental, customizable teaching space with a 'rich collection of technologies'. A wide range of university teachers from different subject areas tried out new lesson plans in the Teaching Grid and reported their findings over the first three years, resulting in 119 case studies.[146] Analysis of these case studies revealed several useful insights. Analysis of these case studies revealed the four key insights shown below.

These findings are reinforced by a 2007 investigation into the future design of learning spaces, which concluded "that relatively small improvements may be amply rewarded in learning benefits".[147] The flexibility of the space allowed teachers to adopt multiple pedagogies for all learning styles,[148] and the range of technologies allowed them to create multiple opportunities for individual learning needs.[149]

1

Flexible use of space correlates with an increase in the number of teaching and learning activities taking place within a single session.

Out of the 119 case studies, 59 used the flexibility of the space to set up more than one layout during a session. Within these 59 flexible approaches, there was a significant increase in the mean number of teaching and learning activities used.

2

Flexible use of space correlates with collaborative use of space.

When the Teaching Grid was used flexibly, it was also more likely to be used collaboratively. One case study explained that, 'Groups with a predominantly egalitarian and informal style could use "soft" areas and those who were more formal could use desks. Interestingly, when "soft" areas were available, groups used them for more creative and balanced tasks."

3

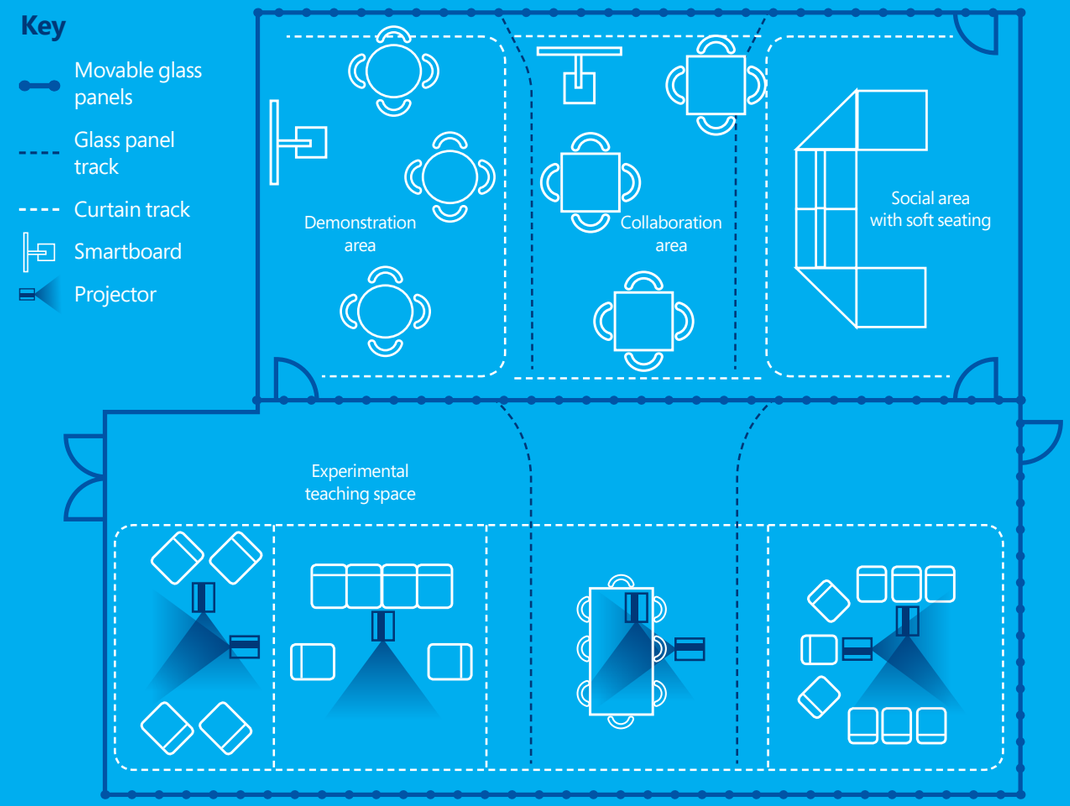
Collaborative use of space correlates with an increase in the number of teaching and learning activities.

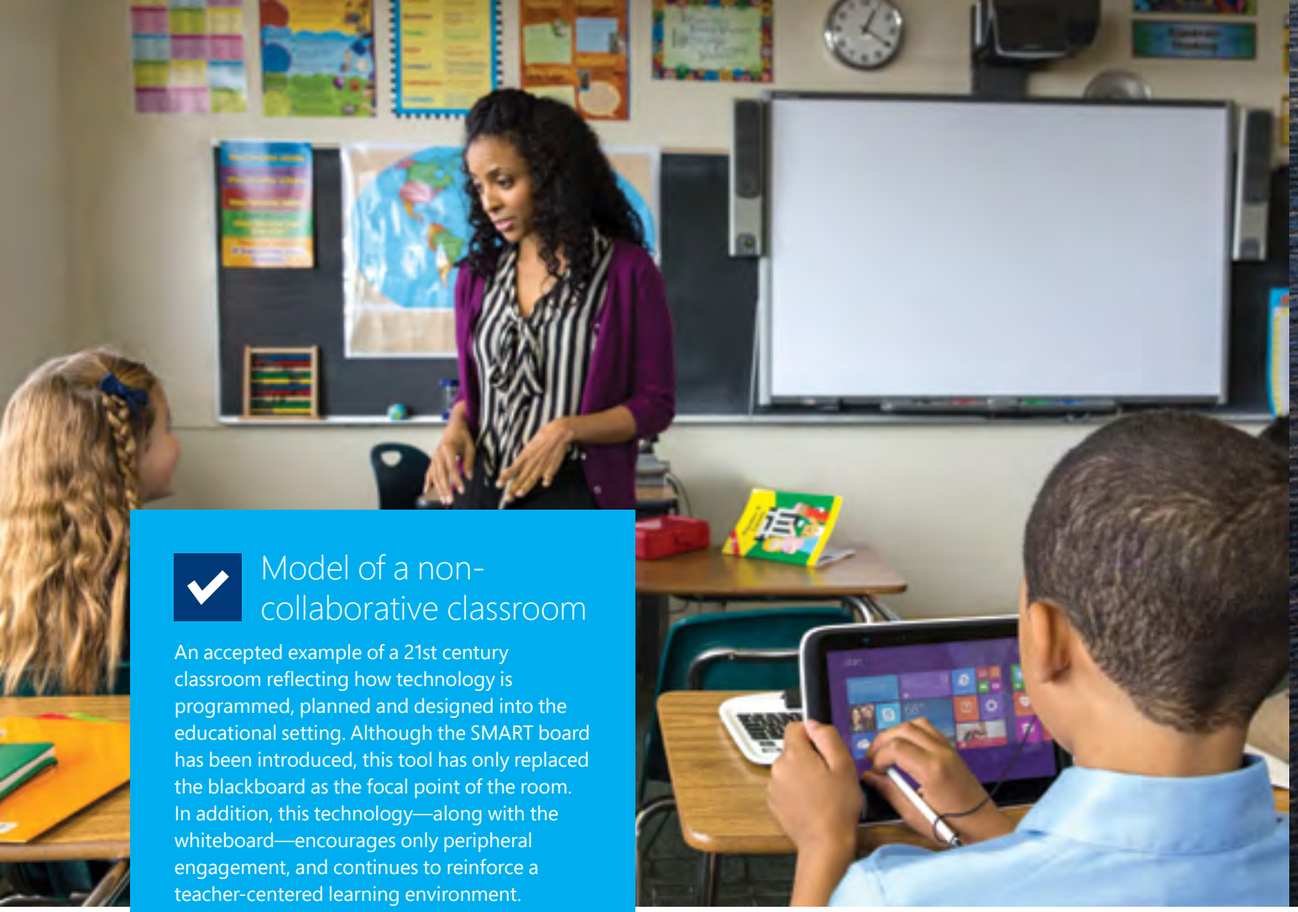
Activities were more successful when teachers could configure the space to support student groups, so much so that there was often an immediate positive impact on the activity. One case study reported, "The room layout with its various activity zones had an energizing effect on the session."

4

The number of technologies used correlates with the number of teaching and learning activities.

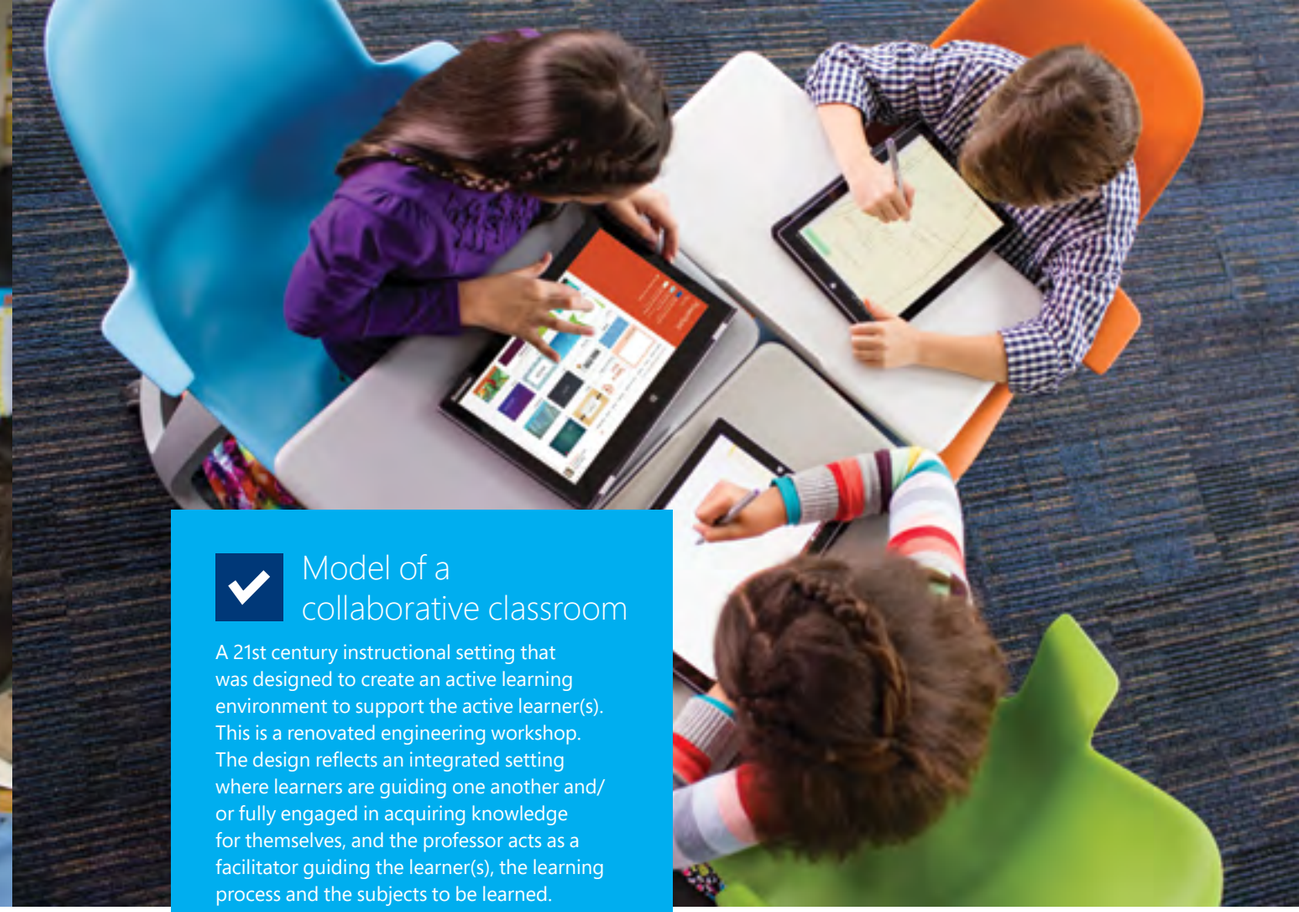
The Teaching Grid allowed teachers to explore technologies in a well-equipped environment supported by technical staff. The study found strong support for this setup, with one Systems Biology teacher saying, "I would definitely alter my structure of the session so as to maximize the uses of all the technologies."





Model of a non-collaborative classroom

An accepted example of a 21st century classroom reflecting how technology is programmed, planned and designed into the educational setting. Although the SMART board has been introduced, this tool has only replaced the blackboard as the focal point of the room. In addition, this technology—along with the whiteboard—encourages only peripheral engagement, and continues to reinforce a teacher-centered learning environment.



Model of a collaborative classroom

A 21st century instructional setting that was designed to create an active learning environment to support the active learner(s). This is a renovated engineering workshop. The design reflects an integrated setting where learners are guiding one another and/or fully engaged in acquiring knowledge for themselves, and the professor acts as a facilitator guiding the learner(s), the learning process and the subjects to be learned.

Increase access with long-distance online learning

What's a physical learning environment to the students who are too distant, too ill, or otherwise unable to attend regular school? There's been an incredible surge in the interest in distance K-12 education. Between 2001 and 2011, the United States saw a tenfold increase in the number of K-12 students taking online courses, from about 200,000 to almost 2 million.

Online courses are already available on a broad scale in other countries, such as Singapore and South Korea. These countries use online courses to expand learning time, which is attributed as one of the reasons why they outperform American students in Program for International Student Assessment and Trends in Mathematics and Science tests.[150]

Online distance learning also increases equitable access to education by introducing a flexible course calendar, an expanded course catalog, and individualized instruction. Self-paced courses also allow both fast-learning and slow-learning students to complete courses at a pace that suits their needs. Distance education, as a learner-centered approach to education, is an efficient learning environment that focuses the teacher's attention on the specific performance of individual students, guiding them as needed to achieve success.[151] The student teacher relationship is immediate and personal.

Some of the most promising K-12 distance education methods include:

- Blended learning models and practices.
- One-to-one computing models and practices.
- School administration and leadership practices.
- Funding and cost models.
- Matching students with the optimal learning environment.
- Professional development and teacher education programs.
- Systems for analysis and display of data to school staff, parents, and students in order to answer questions about what is happening in the school and why.

Red Flags

Though it is inspiring to focus on best practice, it's useful to also be aware of the common stumbling blocks in a designing a physical learning environment. Keeping an eye out for red flags can help your team identify problems earlier and work quickly to correct them.

Common reasons for underwhelming outcomes

Technology is chosen before the environment is

Skipping ahead to choosing technology and gadgets leaves schools to backfill policy and design.

The reason for change isn't clear enough

Ultimately, the people who will both spend the most time in the space and have the most to say about what works are the teachers and their students. Including their ideas and concerns in the design process can bring hugely beneficial insights, as well as boost inclusion and morale.

Furniture and equipment is not adjustable

Every student is different. And so is every teacher. One size doesn't fit all when it comes to the space in which we need to spend many hours working.

Technology is shoe-horned into old pedagogy

Installing a smart whiteboard in the place of a blackboard and carrying on as usual will not revolutionize teaching and learning practice.

Teachers have inadequate technical support

Let teachers do what they do best: Teach. Having a dedicated team on hand to support and advise teachers on best practice relieves the burden of change.

Students spend too long staring at screens

A positive transformation cannot be expected if the basic needs for technology access are not met.

The digital shift is not supported by mental and physical health

Protect physical health with ergonomics, and raise awareness about the mental health problems associated with excessive, addictive technology use.

The environment is not evaluated and adjusted

Implementing a cycle of constant review and adjustment is the best way to ensure your physical learning environment continues to meet its needs and evolve into the future.

Evidence and Further Reading

To delve deeper into some of the topics in this chapter, here is a selection of recommended reading and relevant case studies to serve as a useful starting point.

King, E., et al. (2015)
Exploring the Impact of a Flexible, Technology-Enhanced Teaching Space on Pedagogy, Innovations in Education and Teaching International, 52:5, 522-535.

Kuuskorpi, M. & González, N. (2011)
The Future of the Physical Learning Environment: School Facilities That Support the User. CELE Exchange, OECD Publishing.

Schleicher, A. (2015)
Schools for 21st-Century Learners; Strong Leaders, Confident Teachers, Innovative Approaches. International Summit on the Teaching Profession, OECD Publishing.

Zandlivet, D. & Straker, L. (2001)
Physical and Psychosocial Aspects of the Learning Environment in Information Technology Rich Classrooms. Ergonomics.

Critical Concepts

Give classroom design the same weight as pedagogy and curriculum design. Start by defining a quality physical learning environment– in terms of student requirements, age groups, societal needs and usability/safety regulations.

Essential steps to success

Put adequate consideration into the adjustability of student workstations and the suitability of lighting

Create flexible layouts with technical support for teachers

A flexible learning environment enables multiple layouts and usages, supported by fully integrated technologies. This kind of setup increases collaboration and the number of teaching and learning activities that take place.

Match pedagogy to space and modalities

Find the right space for the lesson according to which of the five principal modalities you are using: delivering, applying, creating, communicating or decision-making.

Encourage good posture with adjustable workstations

A good workstation adjusts not only to the student's height, eye level and arm level, but choice of device. Adjustable stands with peripheral keyboards and mice help students maintain the right posture and wrist flexion when using laptops, tablets and hybrid devices.

Protect student eyesight from blue light

All digital devices emit blue wavelength light, which may have detrimental long-term effects on the eye. Children absorb more blue light from devices than adults, so install blue light filtering stickers directly on the screens of school devices. They have the added benefit of protecting from dust and scratches.

Protect students hearing by minimizing headphone usage

Students should be encouraged to abide by the 60:60 rule, by listening to music at 60 percent of the maximum volume for no more than 60 minutes a day.

Protect students from RSI

Repetitive Strain Injuries (RSI) in the fingers, wrist, elbow and shoulder can develop due to excessive repetitive keyboard, mouse, trackpad and/or touch screen use. Monitor students and make sure they have a variety of activities so that they can reduce the amount of time using the body in this repetitive way.

Promote fitness

Activity involving technology should never replace fitness, sport or outdoor play. Students should be made aware of the lifelong habits that can form if they become too reliant on devices for entertainment, which in extreme incidences can lead to poor nutrition, poor hygiene and obesity.

Encourage balance

Just because technology gives us the option to be "always on" doesn't mean we have to be. Educating and encouraging the importance of robust mental health and work/life balance in students is crucial.

Increase access with long-distance online learning

Online distance learning increases equitable access to education by introducing a flexible course calendar, an expanded course catalog, and individualized instruction.

Powerful Questions

Challenge your assumptions by asking the following questions:

1. How does our classroom layout contribute to our educational goals, policy, effectiveness and quality?
2. Are we corralling our students into 20th century teaching and learning practice by the way our school and classrooms are designed?
3. How do we support the different physical needs of our students—is there anything that students can adjust to suit them?
4. How do we support collaborative learning, quiet study, group and pair work?
5. How effective are we in our duty of care when it comes to protecting students' eyesight and hearing?
6. Do we have any guidelines to help students avoid physical strain due to using computers?

Creating an Inclusive Classroom

The Opportunity

With the right technology, teaching practice and classroom setting, today's schools have a real opportunity to provide special needs students with an education that is more equitable and engaging. But they are not the only ones to benefit. When such an environment is created, all students have the opportunity learn in ways that are more personalized and diverse.

The number of children with special education needs has grown over the past 20 years due to increased diversity in communities and better diagnostic tools. According to the Organization of Economic Cooperation and Development (OECD), as many as 35 percent of school-age students need some kind of special support or have been diagnosed as having special needs.

At the same time, technology advances have introduced new ways for teachers to create classrooms where children with disabilities have equal opportunities to learn and thrive. The effects have been felt in two key areas. Firstly, input and control methods, including voice, touch, keyboard, pen, as well as eye trackers and head pointers, have enabled more students to acquire digital literacy and develop skills like creativity, collaboration and problem solving that they need to thrive in today's world. Secondly, the ability to customize the way they use technology to suit their individual needs has enabled more students to confidently join in with class activities.

Creating an inclusive classroom requires more than the technology. In order for the advantages to be felt, educators need to make subtle adjustments to their teaching, classroom settings, and assessments. And to make the most of the opportunities new technologies offer, they need to take advantage of evidence-based tools that support the delivery of inclusive, high-quality instruction to a diverse range of students.

In this chapter we take a look at policies and practical steps you can take to create a classroom that promotes equal learning opportunities for all. Much of the content has been summarized from the white paper on accessibility by Robert A. Stodden, Ph.D., Founding Director & Professor Emeritus, and Norma Jean Stodden, Ph.D., Training Director & Associate Professor (retired), Center on Disability Studies, University of Hawaii at Manoa.

To read the white paper in full, visit:
www.aka.ms/leaders

> "As a special education teacher, I am constantly on the hunt for technology and tools that give students with disabilities an environment that is personalized, differentiated and yet as close to their peers' experience as possible. With Windows 10 and Office 365, I have been able to find and use many of the accommodations that I have been looking for."
>
> *Robin Lowell, Special Education, Science and Mathematics teacher.*

The Challenge

With a much more diverse range of students entering the mainstream classroom, it can be challenging to provide personalized learning that pays attention to the unique needs of every child—particularly those with learning or physical disabilities. To do so takes knowledge and skills. And staying up to speed with new developments is important, especially given the rapid advancements in assistive technologies.

Conduct a student audit and assess your environment

Students enter classrooms with different interests, learning styles, and levels of readiness to learn and progress. Conducting an audit or interview with all of your students can yield helpful insights into what support mechanisms are needed. It's also helpful to understand what kinds of accessibility your students require. In general, student challenges fall into four categories:

- Learning and/or physical disabilities, sensory, cognitive and/or mental health impairments.
- Cultural and language differences.
- Economical or environmental disadvantages.
- Differing learning preferences and interests.

Check how effective your classrooms and school are by asking the following questions

Physical access: Is the seating or organization of the setting designed so that all students can participate?

Programmatic access: How accessible is your learning program, including the educational content, the instructional method(s), the materials or software programs used to relay new knowledge, and the methods of evaluation?

Attitudinal access: What is the level of expectation established and maintained by everyone in the school community? Is every student expected to participate to the full and not miss out, or is compromise ingrained?

Technology access: Are you using accessible technology that enables individuals to adjust a computer to meet their vision, hearing, dexterity, cognitive, and speech needs? Can all students see, hear, and use a computer? Are they able to personalize settings to meet their own needs and preferences?

While these questions can be challenging, they can also become a catalyst for change. By setting the benchmark of accessibility for all, you can free teachers and students up to re-imagine learning experiences.

Policy guidelines

Rather than ignoring or second guessing the diverse learning needs of your students, focus upon proven inclusive practices that ensure equal access and equitable opportunity for every student.

There are four evidence-based tools at your disposal:

1. Universal Design for Learning.
2. Differentiated Instruction.
3. Gradual Release of Responsibility (GRR).
4. Instructional strategies that have high impact and require low preparation to integrate into instruction.

> "Can all students see, hear and use a computer? Are they able to personalize settings to meet their own needs and preferences?"

Universal Design for Learning

Universal Design for Learning (UDL) is a conceptual framework and the practice of preparing and presenting lessons that are usable for the widest range of learners without preparing special or separate programming efforts.[152]

Learners differ in the ways in which they are motivated, how they comprehend information, and how they express what they know. To cater for this, UDL emphasizes the need for multiple educational approaches and provides a proactive way of recognizing and designing a learning environment that accepts, respects, and values all students.

UDL offers an educational approach to teaching, learning, and assessment, which draws on new brain research and new media technologies to respond to individual learner differences. It centers on three principles of design: multiple means of engagement, multiple means of expression and multiple means of respresentation.

Multiple means of engagement

Provide varied ways to actively involve learners in the learning process.

Multiple means of expression[153]

Provide options for physical action, expressive skills and fluency, and executive functions. There are many ways in which learners might reveal their understanding of concepts or skills besides a written test or handout. Students may create a slide show, game, short play, or web page, plan a Web Quest, draw a picture or chart, develop a PowerPoint presentation, or write a children's book.

For a comprehensive review of pedagogical, neuroscientific, and practical underpinnings of UDL see www.cast.org, several books that discuss UDL at greater length[154] and international projects and partnerships.[155]

Multiple means of representation

When creating course materials and implementing content, provide options for perception, language and symbols, and comprehension. For example, use a combination of:

Visual representaton

Video, graphs, a presentation, or mind mapping.

Auditory representation

Voice - podcast.

Touch-based apps

Skeletal notes, physical or computer models, or written transcript of a video.

Differentiated instruction

Differentiated instruction is a way of thinking about teaching and learning that seeks to recognize, learn about, and address the different learning abilities and needs in the same classroom. There are four things to consider when designing accessible learning.

1. Content

Differentiating content is about providing alternative ways for how students gain access to core learning based on individual student differences. Content can be differentiated by using diverse delivery formats, such as video, readings, taped lectures, or audio. It can be enhanced for depth, complexity, and novelty by tiering, compacting, accelerating and chunking information. You can also provide materials at varying readability levels, offer the use of technology to access text materials and provide manipulative and graphic organizers.

2. Process

The process can be differentiated by how a teacher teaches. This could include use of explicit instruction, modeling, manipulative use of multimedia, and classroom practice. How students engage in learning can be differentiated by the use of flexible grouping, questioning for critical thinking, contracting, learning centers, problem-based learning, note-taking organizers, and options to express learning. You can also vary the amount of teacher and student support for a task.

3. Product

The product involves students communicating what they have learned after an extended period of study. A product can be varied by offering options; e.g., an e-portfolio of student work, authentic/real-world solutions, end-of unit project or challenging paper and pencil test.

4. Learning Environment

To create an inclusive classroom you need to make sure you establish a learning environment in which students are comfortable with differences, skilled at confronting and working on challenging issues, and aware of their interconnectedness. This means building a community of learners who can work together with a sense of trust, caring and support. To do this takes ongoing explicit instruction. It also requires a space that allows flexible movement for individual and group work and access to digital tools and varied resources, as well as materials and artifacts that reflect a variety of cultures.

How do you differentiate?

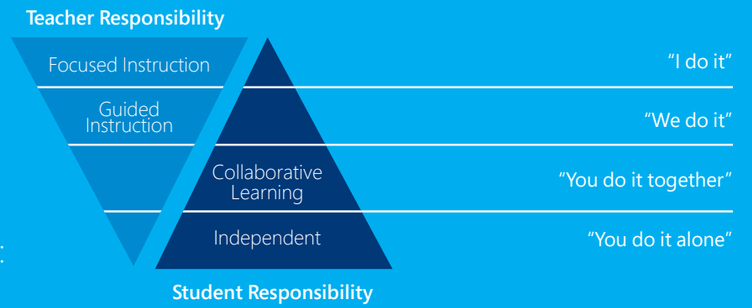
Be proactive in determining what instructional and pedagogical strategies a student needs to reach a specific learning goal.

- Differentiating in response to student readiness might require adjusting the initial degree of difficulty of a task, readability of instructional materials, scaffolding, manipulative, or a different instructional strategy.[156]
- Differentiating for interests might include giving students a choice of topic or product related to a learning task, a range of materials and digital tools, and authentic learning opportunities to differentiate for interests.
- Differentiating for students' learning profiles include presenting information through auditory, visual, and kinesthetic modes, allowing students to work alone or with peers, or providing a choice of competitive, cooperative or independent learning experiences.

The Gradual Release of Responsibility

This model of instruction provides one way to introduce and scaffold new information to support learning for a wide range of learners.[157] It offers an instructional process for shifting from the teacher assuming all responsibility of the learning task to the learner taking all the responsibility.[158]

A visual representation by Fisher & Frey (2007) depicts the four phases of the GRR instructional process:



1. Focused Instruction (I do it)

The teacher establishes learning objectives and provides direct instruction, modeling and thinking aloud, while students actively listen, take notes, and ask for clarification.

Focused instruction provides different ways to represent and present content (visual, auditory, and kinesthetic) that fit students' learning profiles. Instructional strategies might include:

Advance organizers

These can be expository, narrative, skimming and graphic. The principle is to introduce big ideas prior to the actual presentation to help students think about content before they experience it.

Chunking

Organizing new content into small chunks and presenting it in sequential steps makes it easier for students to comprehend. The working memory can only hold a few bits of information at one time.

Examples/non-examples

Comparing and contrasting helps students readily make connections to new information. It takes students beyond merely associating a key idea with a definition. It also promotes higher order thinking.

2. Guided Instruction (We do it)

This is when teachers prompt and provide additional modeling, while students ask and respond to questions or work with teacher and classmates.

To support different learning needs and styles, offer students varied ways to interact with the content (PowerPoint, poster, digital format or handout) or differentiate the content by tiering or varying readability levels. Instructional strategies might also include:

Questioning

Teach students to generate questions, rather than solely answering them. This promotes deeper understanding and higher order thinking, increases comprehension and improves memory, accuracy and integration of main ideas.

Summarizing

Encourage students to summarize after each new chunk of information is introduced. This helps them create a personalized understanding, especially if it is done in collaboration with peers.

3. Collaborative Learning (You do it together)

This is when students practice in small groups on a shared outcome to consolidate their thinking and understanding. The learning task might be differentiated by providing a choice of tasks or how students express what they are learning.

Cooperative learning

When students interact with one another they are able to apply, process, and synthesize newly acquired information. Grouping students in pairs and threes promotes the most time on task and achieves the highest rates of student engagement.

Graphic organizers

Creating visual displays of information, in strategic ways, helps students to process newly acquired information in varied and unique ways by using several different styles of learning. Graphic organizers are said to be one of the most powerful ways to enhance understanding.

4. Independent Learning (You do it independently)

Students practice independently using and applying information, ideas, content, skills, and strategies to further solidify their understanding. The teacher provides feedback, assesses learning, and determines the level of understanding.

Differentiate for varying levels of readability or difficulty or allow students to use digital tools to express their understanding of what they learned.

Word mapping

Visually mapping out new words, in various interconnected ways, allows students to expand their initial knowledge through various learning styles and thinking processes. Word maps help students understand and internalize concepts, rather than passively copying a word from the dictionary.

Manipulation

By providing physical objects that students interact with, you can help them make abstract concepts more concrete and teachers can view and assess, first hand, the cognitive processing taking place.

Error analysis

When teachers carefully look at students' mistakes, they are able to identify error patterns, across individual performances or the entire group. This allows them to reteach and/or differentiate instruction (by tiering) before moving on to a new concept or skill.

Meeting diverse learners' needs to amplify ability and extend opportunity

Dr Fiona Forbes discusses assistive technologies.

Technology and amplifying ability

When I started teaching, technology was breaking ground to provide opportunities for learners with diverse needs in a variety of ways. I recall the first PC in my classroom being used mainly for word processing and educational games.

I remember a particular student discovering his potential as a writer when he used a keyboard to write. In his previous years at school he labored over pen and paper with little reward, inevitably developing a negative attitude to writing. By using the computer in writing sessions without first handwriting this unlocked his inner writer. He changed his self-belief in this in turn had a profound effect on his learning potential.

Technology and opportunity

Move forward to today's classrooms where we have 1:1 and multiple opportunities to interact through technology. Now as a school principal I have students who can let their computer be their writer through voice-to-text software.

Equally I have students who can let their computers be their voice with text-to-voice software. We now have the ability to connect with students who are absent from school for extended periods of time by having virtual students in classrooms learning via Skype from their homes.

Touch screen technology and digital pens allow greater access for those with some physical disabilities. The ability to customize displays on individual devices also creates more opportunity to personalize learning. The use of Virtual Reality technology can provide learning opportunities that are only just emerging in our schools for those with diverse needs. We have come such a long way in such a short time; the future of learning through technology holds the key to more accessibility for learners with diverse needs in our schools. We need to ensure that teachers and leaders are embracing this potential.

Dr Fiona Forbes
has worked in early childhood, primary, secondary, tertiary and special education fields for 27 years, for the past 16 as the principal of a unique special school catering for early childhood students with language disorders. She has numerous publications in the area of special education and leads a state-wide service for teacher development in supporting students with speech, language and communication difficulties in mainstream schools.

Fiona holds an Honorary Doctorate with the Australian Catholic University. She is the current President of the International Confederation of Principals and Board Chair of the Australian Special Education Principals' Association.

Make it real: accessibility

Accessibility features are not just for students with disabilities. Most students benefit from the option to personalize their computers and learning environments; for example, by changing colors, font style and size, background images, and computer sounds. Microsoft® Windows®,

Microsoft® Office, and Microsoft® Edge® include many accessibility features and settings that make the computer easier to see, hear, and use. Take the course now: **www.aka.ms/accessiblecontenttraining**

Creating accessible content: 8 things you could do to make a difference

Office 365 enables you to communicate information to your students in a variety of ways to meet their diverse needs. This includes documents, presentations, spreadsheets, emails, chats, sways, notes, videos and more. It also enables you to ensure the content you create is accessible so that it can be used by students with varying levels of vision, hearing, cognition and mobility.

1 Use accessibility templates

Office 365 has templates in Word, Excel and PowerPoint that prompt you to create content that is structured to ensure ease of navigation with a screen reader and keyboard, and to use fonts and colors that are easy to read with low vision or color blindness. Watch the video: **www.youtube.com/watch?v=BAhB_umpQzM**

2 Check accessibility

In the Review tab in Office 365, simply click on the Check Accessibility button to see if your document—test, assignment, teaching notes—can be read aloud. It not only finds accessibility errors and tells you how and why to fix them, but also links to detailed support articles on creating accessible documents. The key is to use styles and avoid using the return key to create space on the page, which can be done in the paragraph styles. That way when your document is being read it can alert the reader—"Heading: Year 5 test". "Subheading: Answer any two questions". "Subheading. Question One". You can immediately grasp the difference this makes to vision impaired students or those who respond better to the spoken word. Plus, by applying styles, you'll be learning some good writing habits yourself!

3 Use image description controls

When you use visual objects to communicate information, you need to add alternative text descriptions (alt-text) to ensure they can be understood by people with visual impairments. Through machine learning, this service will keep improving as more people use it, saving you significant time to make media-rich presentations accessible.

4 Use link display name controls

When you include links to web pages or documents, you need to add meaningful display names to ensure screen reader users find it easy to understand the purpose of the links. To make this process easier, there are controls to add display names for links in Office and several Office mobile applications. Microsoft is also introducing new control called Link Gallery, which will show you your most recently used files from SharePoint and OneDrive, as well as any web page from your clipboard. When you insert a link by selecting it from this gallery, the file or web page name will automatically be added as the display text, and you can build on this to make it more meaningful.

5 Use Learning Tools

Learning Tools gives students new ways to approach learning tasks in Word, OneNote, Outlook, Office Lens or ePubs. The Immersive Reader is a standout. It enables students to have a text read to them, giving vision-impaired students learning independence and putting them on an equal footing with their peers. The Dictation tool allows students for whom writing is an impossibility to record their thoughts without writing. And the contrast tool is a powerful decoding aid for dyslexic students. Learning Tools don't just make a huge difference to students with learning difficulties, they can help all students.

6 Use digital and non-digital interchangeably

Thie Office Lens app is a game changer. A free download, it enables students to snap a photo of, for example, the class whiteboard, a printed page or rough sketch on paper. They can then import it into OneNote, OneDrive, Word, PowerPoint, Outlook or Immersive Reader where it appears as editable text. Just from a research perspective it's a huge time-saver, enabling every student to collate information quickly.

For students with reading difficulties it means that text can then be enlarged or given different fonts or color backgrounds to make it more accessible. Now even the school canteen pricelist can be quickly scanned and read back to a vision-impaired student. Plus, teachers can save a lot of time after team brainstorming meetings by simply photographing the whiteboard ready to take the next step—from sharing to editing.

7 Use advanced features of Edge

Edge, the browser in Windows 10, comes with e-reading capabilities, which means students can read ePub books directly in the browser without needing a special app. It features a progress bar, the ability to resume where you left off, bookmarks, and a customizable reading view. The accessibility advantage comes from the ability to use Learning Tools with ePubs in Edge, opening up all the customization opportunities described above.

8 Translate presentations in real time

Presentation Translator, a new add-in to PowerPoint, translates and subtitles live presentations, displaying subtitles directly on a presentation in any one of more than 60 languages. By unmuting the mic, teachers can also allow students to ask questions by typing or speaking, which are displayed for all to see. This enables hearing-impaired students to follow along with the class on their phone, tablet or computer and participate in the discussion without needing help.

Red Flags

Though it is inspiring to focus on best practice, it's useful also to be aware of the common stumbling blocks in creating an accessible learning environment. Keeping an eye out for red flags can help your team identify problems earlier and work quickly to correct your trajectory.

Common reasons for underwhelming outcomes

Guesswork instead of detailed investigation

It's easy to see that you have a diverse range of students in your class. But it's harder to discover exactly what learning difficulties they have. You might think accessible learning isn't required in your class right now, because no student has requested an accommodation, but this could be because students don't like to stand out. Disabilities can be invisible, can occur at any time, and for varying durations, so it is likely that you will have a student or parent who will benefit from accessible content.

Grandiose, visible changes to one or two things

It's more constructive to look at subtle changes to every aspect of your teaching rather than making one or two very visible efforts such as. for providing your core competency lessons as videos.This might help many students, but not all of them.

One-off initiatives for a particular student instead of a wholesale change in practice

Accessibility is not just about 'helping Hans hear better by moving him closer to the front of the class'. It's about a wholesale change in the way you prepare and deliver your teaching so that it is always more accessible to every student, all of the time. It takes time to get it right, so set yourself a goal with milestones and work at your own pace to adjust and refine practices as you progress toward creating an accessible classroom.

Lack of knowledge of assistive technologies

There are so many opportunities for teachers to improve the life of a student in positive ways these days. By relying on the tips you'll see in Office 365 and this course you can transform your curriculum easily as you move forward.

Take the course now at:
www.aka.ms/accessiblecontenttraining

Teachers bravely working alone

Encourage your peers to collaborate with you and share best practice. Use this handy poster to remind educators and students about simple accessible practices they can adopt:
www.aka.ms/reimagineaccessiblecontent

Lack of policy communication to the class or parents

Talk openly about accessibility with your students and how you all need to work together to create a classroom and an atmosphere of friendship and cooperation. Set behavioral guidelines and make parents aware of your inclusive classroom practice.

Evidence and Further Reading

To delve deeper into some of the topics in this chapter, here is a selection of recommended reading and relevant case studies to serve as a useful starting point.

Tomlinson, C.A. (2014)
The Differentiated Classroom: Responding to the Needs of All Learners, 2nd Edition. Alexandria, VA: ASCD.

Anderson, K. M. (2007).
Differentiating instruction to include all students. Preventing School Failure.

Meyer, A., Rose, D.H., & Gordon, D. (2014)
Universal Design for Learning: Theory and Practice. Wakefield, MA: CAST.

Sousa, D., & Tomlinson, C.A. (2011)
Differentiation and the Brain: How Neuroscience supports the learner-friendly classroom. Bloomington, IN: Solution Tree Press.

Valiandes, S. (2015).
Evaluating the impact of differentiated instruction on literacy and reading in mixed ability classrooms: Quality and equity dimensions of education effectiveness. Studies in Educational Evaluation.

West, C.S., & Marzano, R.J. (2015).
Examining similarities and differences: Classroom techniques to help students deepen their understanding. West Palm Beach, FL: Learning Science Center.

Critical Concepts

When you create an environment that supports accessibility, all students benefit from the opportunity to learn in ways that are more personalized and diverse.

Essential steps for success

Creating an inclusive classroom requires more than technology

In order for the advantages to be felt, educators need to make subtle adjustments to their teaching, classroom settings, and assessments.

Start by auditing your students

It's important to understand the diversity of students. In general, they fall into four categories:

1. Learning and/or physical disabilities, sensory, cognitive and/or mental health impairments.
2. Cultural and language differences.
3. Economical or environmental disadvantages.
4. Differing learning preferences and interests.

Review the accessibility of your learning environment

Consider four key aspects: physical access to learning spaces, the accessibility of educational content and instruction, your attitudes and expectations to student participation, and finally, technology accessiblity.

Use these evidence-based tools to effect change

1. **Universal Design for Learning**—a conceptual framework and the practice of preparing and presenting lessons that are usable for the widest range of learners without special or separate programming efforts.
2. **Differentiated Instruction**—a way of thinking about teaching and learning that seeks to recognize, learn about, and address the different learning abilities and needs in the same classroom.
3. **Gradual Release of Responsibility (GRR)**—an instructional process for shifting from the teacher assuming all responsibility of the learning task to the learner taking all the responsibility.
4. **Instructional strategies** that have high impact and require low preparation to integrate into instruction. These include Focused Instruction, Guided Instruction, Collaborative Learning and Independent Practice.

Familiarize yourself with the technology tools at your disposal

Microsoft® Windows®, Microsoft® Office, and Microsoft® Edge® include many accessibility features and settings that make the computer easier to see, hear, and use. See Section Four for a detailed overview. The Microsoft accessibility website also contains more resources, information and case studies to inspire you. Visit **www.microsoft.com/en-us/accessibility/default.aspx**

Learn to make every communication and lesson accessible

In the Review tab in Office 365, simply click on the Check Accessibility button to see if your document—test, assignment, teaching notes – can be read aloud. It not only finds accessibility errors and tells you how and why to fix them, but also links to detailed support articles on creating accessible documents.

Powerful Questions

Challenge your assumptions by asking the following eight questions:

1. How accessible is our school? What if we surveyed the students and parents; would they agree with us?
2. What is our current attitude to students with disabilities. Is it written into policy and expressed in our daily practice?
3. Do we reflect today's best practice in regard to accessibility? Or are we a little out of date?
4. Is accessibility something we think of in terms of addressing one-off needs instead of embracing it holistically into all our teaching?
5. Are there new technologies that we know nothing about that could enhance the learning opportunities of our students?
6. Is anyone charged specifically with looking after accessibility in our school?
7. Who do teachers turn to for help?
8. Do we have a central repository of best practice accessible learning content to inspire us?

Section 3

Future-Ready Skills

According to the World Economic Forum, we are on the verge of a technological revolution that is predicted to "fundamentally alter the way we live, work, and relate to one another." Analysts predict that by 2030 up to 375 million people across the world will need to switch the type of work they are doing.[159]

To successfully compete in this highly dynamic global economy, nations will require a flexible workforce that can adapt rapidly.

Education systems must be oriented toward producing youth with future-ready skills. This section reflects on what they are and how technology can be used to develop them.

- The Importance of Future-Ready Skills
- Problem Solving
- Future-Ready Learning Design for Problem Solving
- Collaboration
- Creativity
- Communication
- Science, Technology, Engineering & Math (STEM)
- Social and Emotional Skills
- Entrepreneurship

> "People will create the jobs of the future, not simply train for them, and technology is already central. It will undoubtedly play a greater role in the years ahead."
>
> *Jonathan Grudin, Principal Researcher, Microsoft.*

The Importance of Future-Ready Skills

The road to 21st century competencies

Dr Kirsti Lonka, Professor of Educational Psychology, University of Helsinki, and Dr Topi Litmanen, Chief Educational Scientist, Claned Group discuss curriculum.

As Finland is celebrating its 100th Independence Day, we are also celebrating our marvellous school system. It would not be as excellent without continuing efforts to renew it. The latest reform took place in 2016 when Finland introduced its new national curriculum. With the support of Microsoft, our team and Claned were able to give a gift to our schools and teachers. "Road to 21st Century Competences" is an assessment framework that supports teachers in evaluating how well they teach the competencies necessary to provide students with tools for their future life.

The assessment tool helps whole school communities by evaluating the opportunities students are offered to master 21st century skills. This framework is based initially on the Finnish national curriculum and supports its implementation, pedagogy, and learning concept. The 21st century skill themes, which are taught alongside subject-matter-based content, are:

- Thinking and Learning to Learn.
- Cultural Competence, Interaction and Self-Expression.
- Self-Care and Managing Everyday Life.
- Multi-literacy.
- Information and Communication Technology (ICT) Competence.
- Working Life Skills and Entrepreneurship.
- Participating, Influencing, and Building a Sustainable Future.

The evaluation framework and the accompanied interactive questionnaires give a teacher or a school analysis about their strengths and areas for improvement. Materials include ideas for improving teaching, project templates and a platform for sharing best practices. Educators provide blended professional development opportunities with face-to-face education aiming to aid schools with transforming their practices to support learning.

So, what are the main changes in Finnish schools?

We want to equip students with a stronger entrepreneurship mindset, self-directed orientation and high-level collaboration skills. At the same time, the learning environment expands. Learning takes place both formally and informally, both inside and outside schools. In addition to the broad 21st century skills, new phenomenon-based projects were introduced, intending to bridge across school subjects. The projects start with a larger phenomenon and pupils may collaboratively define the phenomenon at hand. Also scientific and technical innovations were integrated in these phenomenon-based projects.

During the school years, the cognitive activity should deepen, and repetition is replaced with deep, holistic and analytical thought. The motivation and emotion in learning are both critical in this process. The assessment practices are changing as well, and as a result of this project, essential 21st century competencies are assessed more systematically.

> “In one of the largest ever global studies into future-ready skills and how to teach them, researchers found that 90 percent of schools surveyed mentioned future-ready skills in their public messaging, yet less than 1 percent had a common language or agreed definition for what they mean. Fewer still had adopted a deliberate strategy for how to teach or assess these skills.”

How do you teach future-ready skills?

Research suggests that teachers are the strongest influence on whether or not students develop future-ready skills. And that this is determined by the nature of the assignments they set their students.

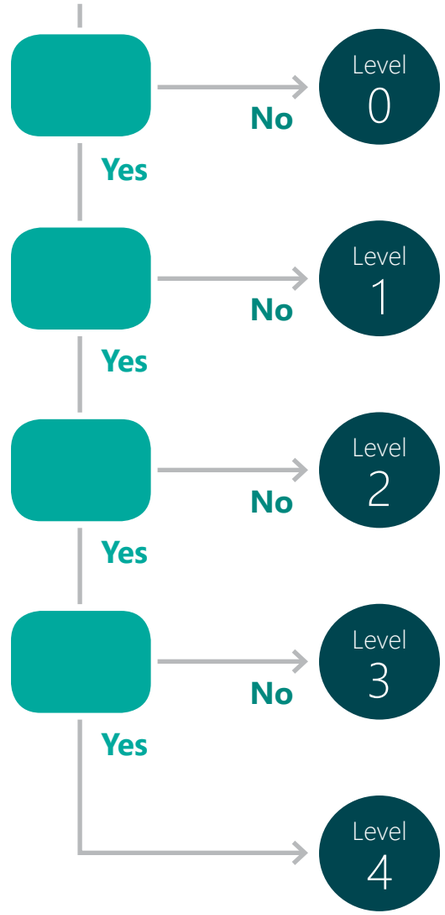
The ITL research, which spanned seven countries and tens of thousands of cases, revealed that the quality of a teacher's assignment strongly predicts the level to which a student demonstrates future-ready skills in their response. The data suggested a 'ceiling effect' imposed by teacher assignments: while it is possible for students to build and exhibit a greater level of future-ready skills than their learning activities call for, they rarely do so.

To empower teachers to design learning activities that develop future-ready skills, Microsoft partnered with SRI to create the future-ready learning design tool suite. The concept is simple. What decisions does a teacher need to make in order to create learning activities that require students to demonstrate or develop future-ready skills? Each skill is supported by a decision tree, where an assessment item or learning activity can be coded against a focus skill (where 0 represents no chance to develop or demonstrate, 4 represents the best possible chance).

At the end of each chapter in this section we include a summary of the future-ready learning design decision tree.

For details and comprehensive training resources, visit: **www.microsoft.com/education**

Decision steps



Source: Screenshot taken from the 21st Century Design app, available for all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

Using technology to develop future-ready skills

Information and Communications Technology (ICT) is a powerful tool to support the development of future-ready skills. It enables students to build relevant connections to new, authentic audiences and contributors, and it empowers them to collaborate, create, solve problems and develop higher order thinking skills.

While student devices, software and other communications technology are commonly used for learning, they are often employed to present or passively consume information instead of to construct knowledge. The following questions taken from the 21st Century Learning Design app are designed to guide teachers and schools to plan learning activities that use technology in the most effective way.

Do students have opportunities to use ICT?

Consider the opportunities your students have to use ICT directly to complete all or part of the planned learning activity.

While teacher use of ICT can significantly enhance teaching, the focus should be solely on how the learning activity requires students to use ICT in their learning.

NB: The use of ICT to present information does not count as learner use.

Does ICT use support knowledge construction and add value to learning?

Real knowledge construction happens when students generate, construct, and actively create ideas and understandings that are new to them.

This requires them to engage in complex, productive and intentional thinking, use critical and creative thinking skills and processes to support deep understanding, and apply or use their learning in other contexts.

The knowledge construction supported by ICT must connect to the learning goals of the activity and it must add value to the learning work.

NB: The use of ICT as an end in itself does not qualify.

Do students use ICT to design and create multi-modal ideas, products and solutions for authentic audiences and users?

Learning is more powerful when students use ICT to design and create new knowledge, understandings, solutions, ideas or products for authentic audiences and users.

This challenges students to think, learn and use ICT in more complex ways. When students have to teach or demonstrate learning to others in some way, they achieve deeper understanding themselves.

> “If we want students to become smarter than a smartphone, we need to think harder about the pedagogies we are using to teach them. Technology can amplify great teaching but great technology cannot replace poor teaching.”
>
> *OECD 2015, Students, Computers and Learning: Making the Connection, PISA, OECD Publishing.*

When they act as designers to create new products or solutions to real-world issues, problems or opportunities that others can use, they develop a sense of efficacy and empowerment that comes from learning they can make a difference to others and to their world.

Does student use of ICT demonstrate ethics, social-ethical protocols and one or more additional 21st century capabilities?

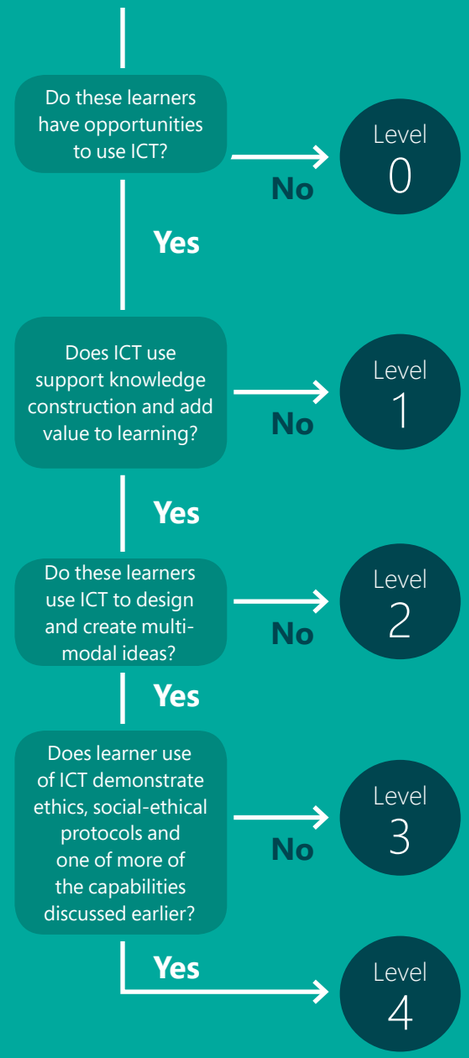
The ethical use of ICT is an integral and critical part of student development.

This requires students to learn about ethical use of ICT, and to demonstrate strong application of social-ethical protocols in their work.

ICT is used most powerfully when it enables students to develop the develop 21st century capabilities for deeper and richer learning than was previously possible. Look for activities that enable students to be designers and producers of knowledge.

Encourage them to use ICT to collaborate, communicate, innovate and solve problems as they address real-life issues and projects that make a positive difference to learning and the world.

Decision tree for the use of ICT for learning



Source: 21st Century Design app, available from all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

Problem Solving

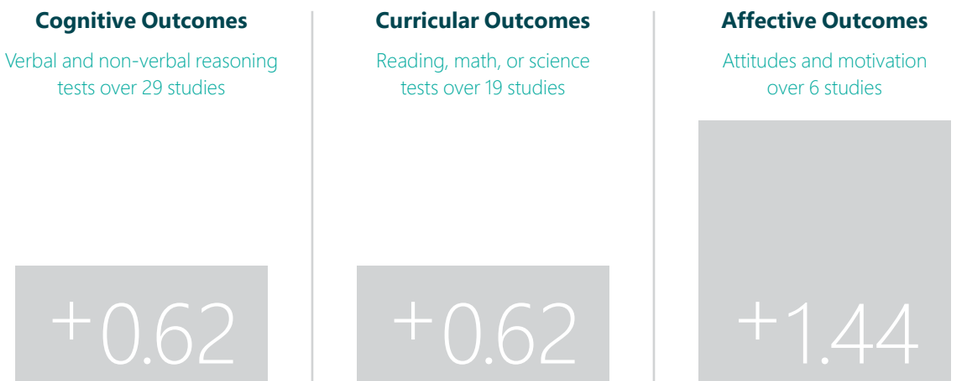
The Opportunity

Problem-solving skills are in high demand in today's workplace. They are essential if students are to develop the creativity and confidence to re-imagine solutions and devise better ones.

As students learn to apply critical thinking methodologies to identify and solve real-world problems, they also develop essential life skills. They become more flexible in their thinking, they learn how to assess the value of ideas and become skilled in making informed decisions.

Teaching real-world problem solving is about more than skilling tomorrow's workforce. An analysis of 29 studies found that when students learn thinking skills, their verbal and non-verbal reasoning improves, they're more motivated to learn, and their achievements improve significantly across the curriculum.[160]

The average effect of thinking skills instruction



NOTE: 0.62 is a large effect for an educational intervention, equivalent to moving an "average" class of students from the 50th percentile to the 73rd percentile on a standardized measure.

The Approach

Starting from the early grades, educators should all teach with an eye toward critical thinking and problem solving. But these skills can be hard to isolate and define. Here are some recommendations on defining and then incorporating higher order thinking skills into teaching.

Focus on teaching students how to think, not what to think

To become capable critical thinkers, students need to forget the notion that there are answers to everything and that they are constant. Instead they need to accept that knowledge is evolving and contestable and they need to cite evidence to support their arguments. This means questioning everything: their research, their assumptions, other people's and their own conclusions.

They need to become competent in the way they:

- Explore, annotate, outline and summarize.
- Synthesize, contextualize and identify patterns.
- Evaluate the logic of arguments and adjust their perspectives.
- Manipulate information to create a new solution or verify a hypothesis.

Ask authentic learning, searching questions

The most practical approach is to set authentic learning challenges as part of your course. These can be anything from why the Titanic sank to what's the best resource in the world, to what's the easiest way to explain quadratic equations to a new student. Guide students by posing searching questions, encourage independent research, and question and challenge their assertions so that they learn how to present positions that are supported by facts.

Provide students with a structure

Bransford and Stein[161] classified problem solving into a five-stage process called the IDEAL problem solver. It can form the basis of a handy assessment rubric.

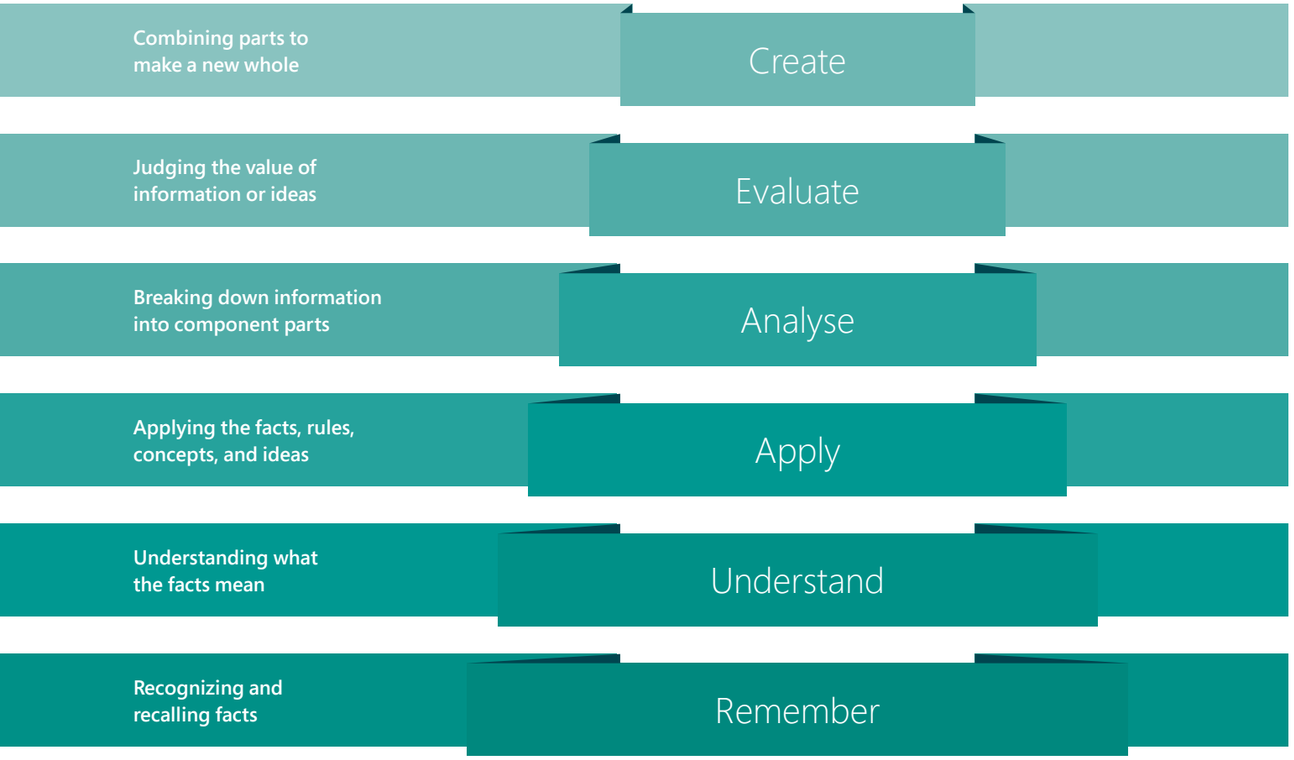
1. Identify the problem.
2. Define and represent the problem.
3. Explore possible strategies.
4. Act on the strategies.
5. Look back and evaluate the effects of your activities.

Bloom's taxonomy

This helpful framework enables educators to classify their teaching objectives, activities, and assessments in order to scrutinize the relative emphasis, curriculum alignment, and missed opportunities of a course or unit. Higher Order Thinking Skills (HOTS) increase from "understand" to "create", so make sure your planned activities fall into these higher classifications.

Define and map a framework

Bloom's taxonomy provides a useful framework of the six major cognitive processes listing skills from simple to complex use his help plan activities that align with higher order thinking skills (HOTS).



Recommended techniques

Focusing on the higher order thinking skills in categories 2-5 taken from Bloom's taxonomy, here are some practical suggestions on how technology can be used to support the development of critical thinking and problem-solving skills.

Category 2: Understand

Interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining

Build active reading skills

Simply reading and re-reading a text isn't an effective way to understand and learn. Instead, students need to actively and critically engage with reference books, which is quite different from reading a novel for passive enjoyment.

According to the McGraw Center for teaching and learning at Princeton University, basic highlighting is not enough.[162] Students need to make notes in the margin, adding asterisks, circling words, connecting arrows and underlining to increase depth of processing and freely illustrate their thinking as they go. Although some e-readers make provision for note taking, with many, these marks fold away as you move so you can't exploit spatial memory in the brain. Tablets with digital inking tools are a better option.

Techniques:

- Ask questions. Tell students to imagine they are talking to the author as they go.
- Write down key words to remind them when topics were discussed.
- Make outlines, flow charts or diagrams that help them understand.
- Summarize the text or a paragraph in two or three words.
- Write down what they have read in their own words as if they were teaching someone else.
- Dispute an idea or point of view.

> "Critical thinking is best taught on a versatile device that can support the full range of tasks and learning styles."

> “The single most powerful thing a school or school system can do to improve how 21st century skills are taught is to agree on a common language and set of definitions. This alone can lead to profound and measurable improvements in teacher and student capability.”
>
> *Dr Maria Langworthy, Microsoft.*

Encourage active web research

The Internet is an overwhelming place for students. As well as refining their search techniques to target accurate sources, it’s important they avoid mindlessly scrolling through websites without understanding their content. The best way to do this is to ask them to annotate sites as they go.

Techniques:

- Circle or highlight key words as you explore.
- Make notes as you go.
- Sketch diagrams or flowcharts if it helps you understand better.
- Create a reading list of relevant sites.

Teach active note-taking

- A study conducted by Princeton’s Pam Mueller and UCLA’s Dan Oppenheimer[163] found that when students only use an on-screen or physical keyboard to take notes they don’t absorb new materials as well, mainly because typing notes encourages verbatim, mindless transcription.
- Although students with keyboards made more notes, those who used digital or physical pens scored higher when questioned on the concepts they were learning.
- Even when instructed not to mindlessly transcribe what was being said, students who used a keyboard continued to do so, while those with a pen were better able to reflect and summarize as they went.
- It seems that with a digital pen, students are freed up to listen to what is being said and understand it better. And this helps them construct and retain knowledge.
- That’s because note-taking with a stylus encourages processing, elaborate thinking, connecting and summarizing ideas. And it’s also because we can’t transcribe rapidly when we write, so we have to summarize, which makes our brain process information more deeply, leading to better recall and understanding.

Techniques:

- Listen and summarize what is said.
- Organize notes under clear headings.
- Jot down diagrams if it helps.
- Note down questions, and make a point of asking them later.

Make it real: understanding

- The Microsoft Edge browser lets students write directly on web pages using a digital pen, and share their comments with teachers or classmates.
- Add notes with a pen, a highlighter, an eraser, a typed note, and a clipper tool.
- Choose from different colors and brush sizes.
- Use the integrated Share Panel to annotate and circle items and then share them with others.
- Add ordered text notes to a web page save it to a OneNote account to share.
- Save web notes to a reading list folder in the “Reading List” tab.
- Pin important web pages to the Start menu to save them as live tiles on the start screen.
- Use Learning Tools in Edge.

Make it real: problem solving

Digital pens are available for most Windows 10 devices. Students simply use the Windows Ink workspace to jot down notes using Word, Excel, PowerPoint, or they can compose sticky notes, and use the screen sketch and sketch pad.

- Make notes intuitively, focusing on what is being said, rather than concentrating on typing.
- Brainstorm with different pen sizes, colors, connecting lines, and intuitive ways to move graphics, words and ideas.
- Write freely, jot down ideas, cross them out, experiment with workings to clarify thinking.

Category 3: Apply
Executing and implementing

Encourage students to sketch when problem solving with numbers and symbols

Visual thinking is especially important in subjects like science and math where students have to solve problems using diagrams and symbols. A keyboard is particularly ill suited to problem solving because deep thinking is not a linear or linguistic process. A digital pen on the other hand is ideal.

That's because problem solving often involves reiterating ideas and thinking as a solution is developed. This is more effective with a stylus, especially as diagramming is important.

The more difficult thinking becomes, the more likely we are to switch to multi-modal thinking—and use a pen. In fact, Professor Sharon Oviatt[164] found that when students solved science problems using a digital pen, their ability to write numbers, symbols and diagrams helped increase the number of hypotheses they generated by 35 percent. Not just that, they also solved more 24.5 percent problems correctly.

Oviatt's research reveals that when students annotate problem visuals informally they're able to group and organize information, which helps them clarify meaning to solve problems. Encouraging students to make informal markings on problem visuals is key to helping their thinking process. In studies where students made diagrams before solving a problem their science score were 25-36 percent higher than when they did not.

Techniques:

- Use symbols, numbers, diagrams to apply your understanding.
- Create a reading list of relevant sites.

> "The traditional skills many schools still focus on are precisely the ones that algorithms can perform much quicker, more profoundly and reliably than humans."
>
> *Professor David Deming, Harvard Graduate School of Education.*[165]

Category 4: Analyze
Differentiating, organizing and attributing

Create mind maps and flow charts

Studies show that graphic organizers help students assemble their thoughts more logically and clearly. After investigating a number of meta-analyses into the effectiveness of concept mapping and graphic organizers John Hattie[166] reported an overall effect size of 0.57, which translates to a percentile gain of 22 points.

Techniques:

- Create a mind map to organize and prioritize your ideas.
- Link ideas with lines to show relationships, hierarchies.

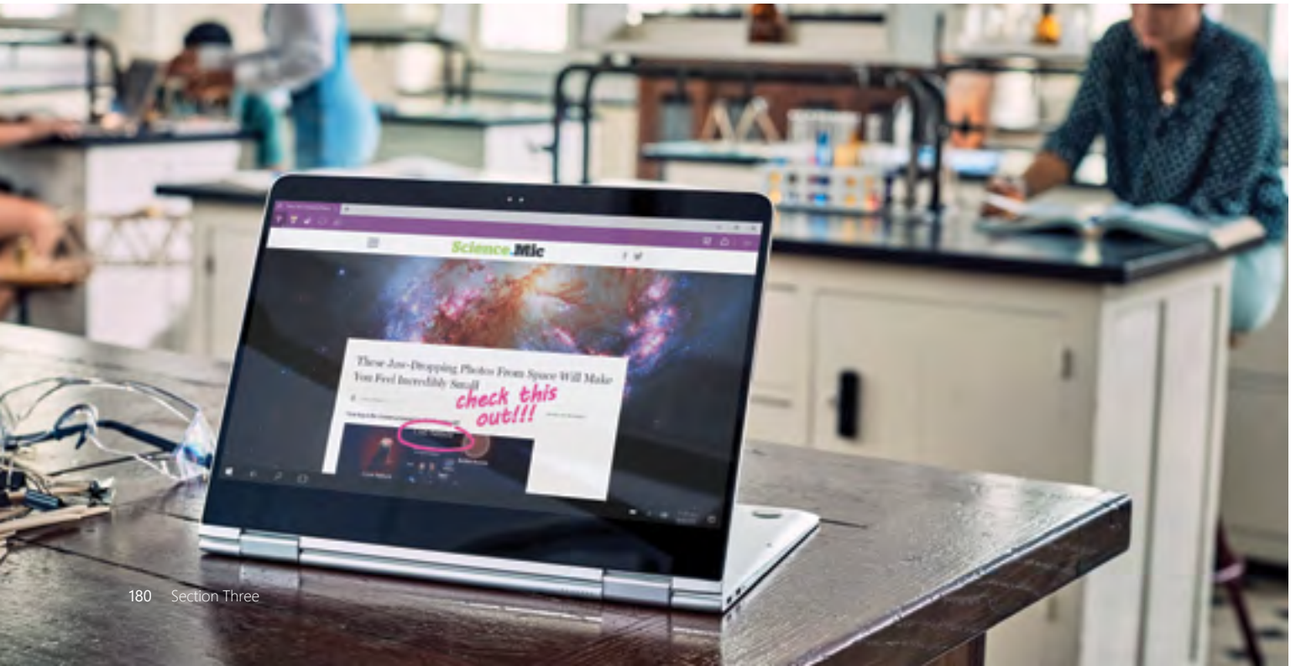
Create graphs and charts

Don't tell students how to organize information. Simply ask them to organize it in the way that makes the most sense. This makes them think through the most effective way to respresent data from STEM experiments or mathematical or survey data, developing analytical skills as they do so.

Make it real: analysis

Graphing in Excel is a great way to develop higher order thinking skills, especially when students have to reason: What data is relevant? How it should be recorded? How often and where? How should it be presented most clearly—bar graph, chart, plotted line, etc.?

- Excel is included in Office 365 - free for students and teachers.
- Students can save spreadsheets in OneDrive, share them with others.
- Students can work together in the same Excel sheet at the same time.
- A wide range of templates kick-start ideas and model best practice.



Category 5: Evaluate
Checking, critiquing

In her research, Professor Sharon Oviatt found that when they're brainstorming with a digital pen, students come up with 56 percent more ideas than they do with a keyboard. It's because outlining an idea with a keyboard puts more cognitive load on our brains as we cope with the skill of typing, leaving us less free to imagine and invent. A digital pen is a far easier way to come up with ideas because using a pen is already automated in our brains and ideas are often sketched out, not typed or written. So, with a digital pen you're not compromising your students' thinking. It works better than plain paper because they can bring in references from the web, as well as photos or video to stimulate ideas. And they can be far more creative. There's a huge choice of sketching apps for Surface. OneNote is free for students and perfect for brainstorming.

Techniques:

- Bring all of your research together in one place to evaluate it.
- Then use divergent thinking to categorize and understand options.
- And finally, use convergent thinking to prioritize thoughts or narrow down options.

Category 6: Create
Generating, planning, producing

Creativity needs to be limitless and open-ended. And for that to occur students need full programs, not apps. Complexity is seldom an issue. Students usually peer tutor and are very adept at learning new features and capabilities as and when they need them–by going online and reviewing video tutorials, for example.

Techniques:

- Come up with a sustainable solution for the problem we are investigating.
- Reinvent or re-imagine an outdated process or business model.
- Propose a new way of managing a situation or event.
- Suggest a smarter way of drawing attention to an issue or injustice we are studying.
- Design a product or innovation for your contemporaries and show how you would produce and market it.
- Demonstrate what you have understood about this topic in a way that would help others understand it more easily.

Make it real: evaluation

OneNote provides a convenient digital place for students to bring all their research together in one place to evaluate it. It works across all devices and saves automatically.

- OneNote is included in Office 365 free for students and teachers.
- Enter text using a digital pen or via a keyboard, create tables and insert web links and pictures to compare.
- Write anywhere with no enforced page layout or structure.
- More than one student can work in one page at the same time.

Future-Ready Learning Design for Problem Solving

Use these questions to guide the planning of activities that develop skills in problem solving.

Do students work with real-world issues, opportunities, challenges and problems for authentic audiences and real-life benefits?

When students see what they are doing as useful and relevant they are more motivated and empowered to learn. When students make a positive contribution to their own and other's lives they develop personal and social responsibility. This helps to shape their learning, their thinking, and their world in ways that make a real difference.

Do students actively enquire and pose questions?

Real-world innovation and problem solving requires students to actively inquire, post and pursue questions in order to understand and accurately identify authentic needs, issues, opportunities, challenges and problems.

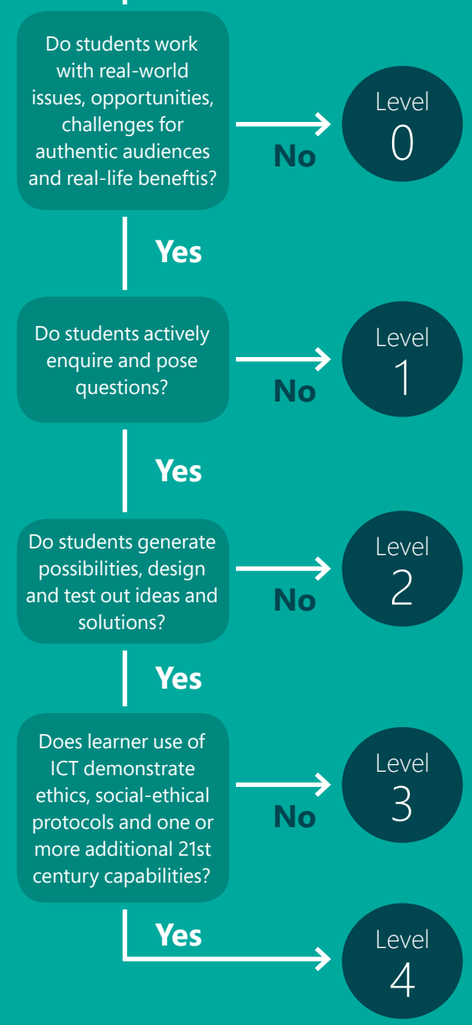
Do students generate possibilities, design and test out ideas and solutions?

When students work as innovators, problem solvers and designers, structure and process are both necessary and invaluable for learning. The process used will depend on the type of innovation or problem at hand; e.g., design-thinking process vs brainstorming scaffold.

Do students evaluate, reflect and take action?

Real-world innovation and problem solving is driven by authentic purpose. The aim is to make a difference that results in real benefits for specific audiences and situations. To achieve this, students must evolve their plans to action in some way. This requires them to reflect and make key decisions related to implementation and action. Implementation requires learners to put their ideas and solutions into practice in the real world. For example, it does count as taking action if learners design and build a community garden in the grounds of their school: simply designing the garden does not.

Decision tree for real-world problem solving and innovation



Source: 21st Century Design app, available for all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

Collaboration

The Opportunity

Encouraging students to reach out to each other to solve problems and share knowledge not only builds their collaboration skills, it leads to deeper understanding as they learn to see others' perspectives and evaluate their own.

Studies have found that working collaboratively on projects also helps students develop their argumentative and cognitive skills[167] and, that cooperative experiences encourage them to use higher level cognitive and moral reasoning strategies more than they do when working competitively or alone.[168] Further, research reveals that collaborative writing increases the accuracy of student writing.[169] Also group processing increases the achievement of high- , medium- and low-achieving individuals' problem-solving success and motivation.[170]

The Approach

In an increasingly trans-disciplinary world, learning to collaborate is crucial for students. But encouraging them to do so can be easier said than done. Educators should focus their teaching on helping students to share, accept, mediate and have shared accountability for their ideas.

Incorporate collaboration into teaching

Make sure you distinguish between cooperation and collaboration. Cooperation is when you divide up tasks and each student completes their requirements separately. Collaboration is when students work together to share ideas, task switch, review their work, and co-create their solutions.

Construct groups with opposing views to help students rethink their approach and understand the viewpoints of others as they work together. And design tasks to be harder than individual homework because students will quickly discover that they can solve things as a group that they might not be able to figure out on their own.

To become effective at collaborative work practices, students need to learn how to listen to others, express their own views and validate them through research. They also need to recognize their own strengths and those of others, to take turns, to strive for a better solution that uses everyone's abilities.

How technology helps

Technology has the power to extend a student's brainstorming power from something that might only happen in person, to something that can occur between schools, across a city or the world. Here are some practical tools to help educators teach collaboration.

Opportunities include using digital pens to sketch and share ideas, annotate them, add images and move text and images around quickly–whether students are side by side or sharing their screen across vast distances.

Encourage collaborative brainstorming

When they're brainstorming with a digital pen, students come up with 56 percent more ideas than they do with a keyboard.[171] Outlining an idea with a keyboard puts more cognitive load on our brains as we cope with the skill of typing, leaving students less free to imagine and invent. A digital pen is a far easier way to come up with ideas because using a pen is already automated in our brains and ideas are often sketched out—not typed or written. It also works better than plain paper because students can bring in references from the web, as well as photos or videos to stimulate ideas.

With face-to-face communication via video conferencing, they can communicate quickly and get immediate feedback on their ideas. They can also record their debate to reflect on them later. Students who are shy often respond well to brainstorming ideas online or via text. They reflect more when they write down ideas and have time to think through their responses. Studies have found that, for large groups, anonymous, synchronous brainstorming via computer worked better than in person.[172]

Techniques:

- Create team mind maps to organize and prioritize ideas.
- Bring in references to stimulate creativity.
- Sketch diagrams or flow charts.
- Move headings around quickly.
- Make provocative 'what if' statements and ask difficult questions.
- Brainstorm with another student, group or class anywhere in the world.

Make it real: collaboration

Teachers can create collaborative classrooms and communicate with students all from a single experience in Office 365 for Education. It's free for students and includes powerful learning software like Word, Excel, PowerPoint, OneNote, Microsoft Teams and much more.

- Students can collaborate on documents in real time.
- OneNote helps every student organize and share their learning in a digital workspace where teachers can post assessments, assignments, comments and resources, as well as monitor and manage schoolwork.
- Teams is a digital hub that brings conversations, content, and apps together in one place.

Set collaborative assessment and reviews

Technology can introduce contemporary ways to assess student work that allows for peer review and collective commentary. Today social media is almost a de facto platform for assessing individual and company values, initiatives and projects, so it is helpful to introduce safe social media into schools so that students have an opportunity to learn 'netiquette' on how to constructively evaluate the work of others, and give feedback without being personal or negative.

Techniques:

- Publish project work—videos, artwork, photos or presentations—on safe social media to obtain peer feedback.
- Have students post their final assessment on your class or school video channel for others to provide feedback.

Make it real: student collaboration

Skype in the Classroom

A free online community that promotes knowledge sharing, cultural exchange, and collaboration in K-12 schools across the world. Join a project or propose one.

Teams

Microsoft Teams lets students communicate around their learning, via a text-like interface. Simply set up a "team" and invite students, groups or teachers to join. It's a great way of tuning in to your students' voices and encouraging reticent speakers to communicate.

Ensure productive collaborative processes can continue after school

As Dan Roam points out in his book, *The Back of the Napkin*, research has shown there is no more powerful way to communicate the idea that's in my head into your head than by talking and drawing a simple picture about it at the same time. The concept of gathering around a whiteboard, or large piece of paper, sketching ideas, crossing out prototypes and improving concepts is familiar to every great collaborator. With few exceptions, the greatest inventions, creations and innovations began with sketches, drawings and concepts done by hand. The right modern technology allows these highly productive conversations to continue beyond a single physical space.

Techniques:

- Set students collaborative tasks for homework.
- Encourage students to collaborate with peers across the world.

Teach collaborative online research

Students can research topics individually and share their findings later with the team or they can work together to research and refine results.

Techniques:

- Share and edit research.
- Look for joint research projects on real-world topics that you can undertake with other schools.

Encourage collaboration on projects online and in real time

Technology presents great opportunities for students to work together on projects, sharing thoughts, feedback and inspiration as they go. Co-authoring in PowerPoint and Word enables students to work in the same document at the same time and see what others are writing, drawing or adding as they go.

Technology can also introduce your students to new collaboration teams across the world. Skype in the classroom enables teachers create a Skype collaboration in order to find another class for shared project-based shared learning.

Techniques:

- Collaborate internationally on project-based learning with other students.
- Co-create, co-edit and co-design in the same document where students can share ideas, contributions and arrive at sound decisions.
- Quickly collaborate between group members by creating a Yammer Group for the project.
- Use a wider class, special interest group or subject Yammer page to allow students to showcase and debate work in progress.
- Seek and share ideas, advice and evaluation across the community.
- Share assignments and photos.
- Collaborate on a single document or projects in a secure, online space.
- Work on projects together and update work centrally for all to share.

Make it real: online collaboration

SharePoint

This password-protected online platform allows students to share and collaborate on any type of project—from a document to a website—using any device. They use the same familiar Office tools to create and share content with 'who's who' cards to identify team members and 'what's new' cards to alert them to updates.

OneDrive

OneDrive is pre-installed into Windows 10 with 1TB free storage for students. Students can use it to collaborate using Word, Excel, PowerPoint and OneNote from the desktop, mobile device or online.

Future-ready learning: Design for Collaboration

Use these questions to guide the planning of activities that develop future-ready skills in collaboration.

Do students collaborate informally?

Students collaborate informally when one seeks assistance or information from another to benefit their learning work.

Teachers can use these opportunities to scaffold student understandings, reflections and collaborative skills.

At times, informal collaboration may be part of a more formal collaboration; for example, a student might informally seek information online from an expert to fulfill their individual role and task responsibilities as part of a team project. The immediate goal, however, is to help their individual learning.

Is there shared responsibility for a joint outcome or product?

Students have shared responsibility when they work together to develop a common or joint outcome, product, design, response or decision. This gives them a reason and shared purpose for working together.

Shared responsibility is more than simply helping each other: students must collectively own the work and be mutually responsible for its outcome. This might, for example, involve a partner or team conversation and joint decision about an important issue, investigating an authentic problem and developing a team solution, or creating a joint design and product.

Is there substantive decision making?

It is one thing for students to have or be given 'shared responsibility' by teachers, and quite another to be actively engaged in working out and making decisions about what that looks and sounds like in practice.

Learning and collaboration are both strengthened considerably when students must make substantive decisions and resolve important issues that will guide their work together.

Substantive decisions are decisions that shape the goals, content, process, outcome or product of learners' work.

Is student work interdependent?

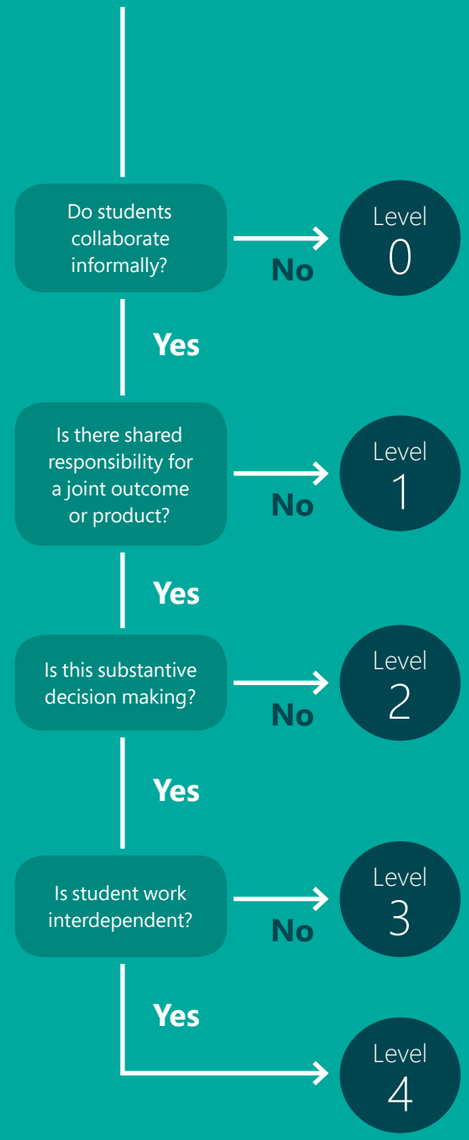
Learning work is interdependent when all students must participate equitably in order for the team to succeed. Too often, a group of students may have shared responsibility for an outcome, but in practice the decisions made result in one or two doing most of the work for the team, or the work is not divided fairly.

It is important that collaborative learning work is structured to require a coherent outcome to which all members have contributed. It must take the work of all team members into account so that their outcome or product is complete and fits together.

Red Flag

Don't confuse the use of collaborative tools with a high-level expression of collaboration as a skill. While it's time-saving to have students type together in real time using Microsoft Word, it is unlikely to require or develop deeper collaboration skills without meaningful learning design.

Decision tree for collaboration



Source: 21st Century Design app, available from all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

I Creativity

> “Schools themselves need to be changed, to foster the creativity that humans will need to set them apart from computers.”
>
> *The Economist, 2014.*

The Opportunity

Do schools kill creativity? It’s been over ten years since Sir Ken Robinson’s provocative challenge to the education system.[173] While there’s now widespread agreement about the importance of creativity and knowledge construction, there is still debate about how best to teach it.

Technology, and especially digital technology, is only increasing the importance of engaging in meaningful knowledge creation and creativity, as a greater number of jobs that require either merely technical or procedural knowledge–including disciplines like diagnostic medicine and law–will be able to be performed by artificial intelligence.[174] So ensuring that the teaching of what Bloom calls ‘synthesis’–the combining of elements ‘in such a way as to constitute a pattern or structure not clearly there before’[175] –has a huge role to play in the classroom.

The Approach

Children are born with innate creativity, curiosity and imagination. But these traits are often seen as disruptive or distracting in a classroom setting. How can educators help to harness their students’ creative powers, and channel them into more productive activities? Here are a few approaches.

The art of creativity

Before we can begin to teach creativity, it makes sense to have some shared way to define it; or at least describe the broad umbrella under which creativity falls. Robinson proposed a simple description–“the process of having original ideas that have value” [176] –while Daniel Pink suggests that the “right brain” qualities of inventiveness, empathy, joyfulness, and meaning–increasingly will determine who flourishes and who flounders.[177] Creativity, of course, plays a role not just in the arts but across all fields of discovery. So while at the practical, classroom level, STEM and disciplines like economics often emphasize the understanding and application of existing rules, when students reach the tertiary level and beyond, creativity will play an increasingly critical role.

Bringing it to life in a learning environment

Strangely, the starting point for classroom creativity may not be teaching students but teaching teachers:[178] Teachers who demonstrate creativity tend to encourage the same tendency in their own students.[179] But once teachers have adopted that mindset, there are a surprising number of ways in which creativity might find its way into a structured curriculum. At the highest level, it becomes important to value subjective answers to questions and place less importance on the one “right” answer.[180] At the more granular level of classroom activities, students are given the opportunity to start notebooks for ideas, follow their curiosity, learn mindfulness, brainstorm collectively and investigate the lives, work and methods of other creative individuals.[181]

Learning modes and objectives

Phase	Research	Ideate	Develop	Implement
Mode	Open	Open	Open	Closed
Objective	Take in as much information from as wide a range of sources as possible.	'Brainstorm', accepting that any of that information might be the (start of the) solution to the problem.	Take the best ideas and see where they'll go, with no fixed conclusion in mind.	Settle on a winner and focus on making it as strong as possible, putting aside rival ideas.

Overcome the assessment hurdle

Henriksen, Mishra and Fisser note that, "Creativity, due to its open-ended nature, is difficult to evaluate and assess."[182] But there is light at the end of the creative tunnel: Grant Wiggins of Authentic Education talks about assessing the impact of creativity, with questions as simple as, was it boring or engaging?[183] Robinson, meanwhile, suggests evaluating creative work by its practical contribution, as well as recognizing that assessment involves two criteria: description (what was done) and comparison (in relation to other achievements in the field).[184] In the next section of this chapter, we'll look at some ways the digital realm can play a role in assessing creativity.

Encourage creative problem solving

John Cleese–who might know a thing or two about creativity–talks about two modes of thinking: open and closed.[185] Put simply, the open mode is where there's no pressure finding the "right" answer, and ideas can come from any source. But we still need the closed mode for when we've decided on a direction, and now have to put those ideas into action.

Combine digital literacy with creativity, curiosity and imagination

Teaching creativity can be separated into two equally important parts. Firstly, giving students room to accept, express and embrace creativity. Secondly, helping them direct that creativity toward problem solving. Let's take a look at how digital tools and digital literacy can help students do both so that they might take creativity for granted as part of their learning, with a view, eventually, to solving problems and meeting challenges we, as a society, are not even aware of yet.

How technology helps

Technology, if used effectively, can be a fantastic way to stimulate individual or collaborative creativity in the classroom. Here are some helpful tips and tricks to help educators integrate technology into their lessons.

Keep creative notebooks

The trouble with a traditional notebook is that it can run out of pages. Even the fact that it has a number of pages can leave you feeling hemmed in and rule-bound. A digital notebook, on the other hand, feels limitless–whether it's kept on a laptop or a tablet. But just like a pencil and paper, it shouldn't corral the way students keep notes. Some will be visual, some will be verbal, and some might completely surprise you in how they express themselves.

Techniques:

- Assign times for free writing in notebooks on a specific topic. Encourage students both to explore their own train of thought, and look for inspiration from a variety of outside sources.
- Similarly, allow students time to write about no specific topic, jotting down things that have caught their attention in the last 24 hours or week.
- Give students even more freedom to express themselves in idiosyncratic ways through art diaries.

Master the art of brainstorming

When students first start to brainstorm, their inner critics may be holding them back from participating fully and getting the most out of the exercise. That's why it's essential to create a supportive atmosphere where students feel free to express themselves without the fear of criticism.[186] It may be wise to remind students that the goal of brainstorming is quantity, not quality, and that much of what seems to separate creative individuals from their apparently less creative counterparts is divergent thinking: coming up with "a theoretically limitless number of sometimes even unrelated solutions" [187] to problems.

Techniques:

- A great approach to brainstorming that helps overcome anxiety is to work in groups of four to six. One student suggests a solution to an open-ended problem, the next suggests an idea that that idea sparks, and so on. Write all these iterations down for review later.
- Cross-class or cross-school brainstorm to help students learn to collaborate collaboratively in an online environment.

> “When they start work, students will be expected to ideate at high speed. So while it’s usually important to study a topic deeply, ask them to solve a problem quickly and creatively, starting at a common website and following a trail of links to compile information and devise a solution.”
>
> *Sean Tierney, Microsoft.*

Foster free association

Creativity is often about thinking in a cross-disciplinary manner, seeing the way different subject areas and modes of thinking can bear upon a problem. And, strangely enough, the Internet is perfect for this sort of exercise. Normally we might frown on students being distracted by link after link, but it’s great for unleashing creativity and coming to understand a problem or a piece of subject matter from a variety of perspectives, while drawing unexpected connections of your own. Authors like Malcolm Gladwell (Blink) and Steven R. Levitt and Stephen J. Dubner (Freakonomics) have made careers out of this kind of free-associative thinking.

Techniques:

- Ask students to ‘follow a trail’ of information, starting at a common website and searching through links to compile information and design a solution.
- Have students practice creating search strings to see who can uncover the best answer to an open-ended question.
- Use image search to help students build visual association.

Look at how creative professionals do their thing

“Where do you get your ideas from?” is the most common question asked of writers, artists, composers, entrepreneurs and the myriad types that make up the creative fields. Here’s an opportunity for your students to find out not just what inspires creativity, but how that inspiration is turned into the perspiration of actual creative achievement: having original ideas that have value, in Robinson’s words. Students could even reach out to creative figures they respect and admire, with the possibility of starting long-lasting creative relationships.

Techniques:

- Have students choose either a figure they admire, or a subject that interests them and find a luminary within it, remembering that in this context, Einstein was every bit as creative as Picasso.
- If a student’s creative hero is still alive, you might even encourage them to make contact, perhaps for an interview on the creative process.
- Have the student keep a free-form diary of her or his achievements.

Set problems with open-ended solutions

“Open-ended problems are those which have many solutions… and usually involves the use of all the skills discussed in Bloom’s Taxonomy”.[188] On top of that, open-ended problems often involve multiple steps and require judgement about how to best balance competing interests.

Open-ended problems might be tackled in groups or by individuals. For example, you might challenge groups of students to tackle challenges they find in the news, like figuring out a solution to the problem of climate change. For younger students, a simple problem might involve finishing a story in which two characters have to cooperate to achieve a common goal; for example, getting from one side of a river to another.

Techniques:

- This is really the synthesis of all the techniques above, which makes it great for exploring group, or co-, creativity. So while you might ask a single student how many uses they can find for a paper clip, students in groups can tackle much bigger challenges. For example, how could we confront climate change or address the Syrian refugee crisis?

Make it real: creativity

No longer the realm of sci-fi movies, 3D visualization is fast becoming an essential skill for understanding our world and mastering new skills. It’s already used in medicine, engineering, architecture, mining, aviation, manufacturing and construction to simulate environments, design prototypes and train people in the use of sensitive, costly or dangerous equipment.

The following Windows 10 tools make it easy to introduce your students to 3D so they can start developing valuable future-ready skills and use emerging technologies, like 3D printers.

Paint 3D

- Construct 3D objects, placing them within a scene to create dioramas quickly and easily.
- Select objects, stickers or use 3D doodle to draw free-form.
- Use a library of textures.
- Paint 3D’s Magic Select tool functions like a Photoshop-like editing tool for 2D and 3D.

Mixed Reality Viewer

- This companion app allows any 3D creation to be viewed in the real world.

3D Builder

- Students can quickly build custom prints for 3D printing without CAD skills.
- Select from a customizable catalogue of 3D prints or bring in your own images.
- Windows has native drivers for 3D printers; build or follow the prompts to send your file to a 3D printing company.

Remix 3D

- Remix 3D is an online home for 3D content.
- Students and teachers can peruse the catalog, select 3D objects and make them their own.
- Work on 3D projects collaboratively, or be inspired by the work of others.
- Share back to the community and see how others build on your models.

PowerPoint

- Easily insert 3D into PowerPoint in Office 365—free for students and teachers.
- PowerPoint accepts a range of 3D formats that are easy to import.
- The Morph transition lets you resize, move, and rotate your 3D model from one slide to the next.

Creativity and knowledge construction

Use these questions to guide the planning of activities that develop future-ready skills in creativity.

Do students engage in meaningful knowledge construction?

- Students are more likely to see meaning and make sense of learning when they understand its relevance and purpose. This is enhanced when learning intentions and topics are explicitly connected to their lives and experiences, and real-world contexts.
- When students understand why the learning is important, and how this will help them now or in the future, they are more likely to commit to the learning work.
- When we activate, assess, and build on students' existing knowledge and beliefs, and use this as the starting point for new learning, they are more able to acquire coherent and thorough understanding because they can make meaningful connections between new ideas and their prior knowledge.

Do students work with significant ideas, topics, questions and thinking?

- In today's complex, ever-changing world, a focus on conceptual and deep understanding is central to effective knowledge construction. 'Covering the curriculum' for breadth or addressing too many topics works against understanding because it is difficult for students to make connections. What these are more likely to acquire is a set of disconnected facts. Even young students benefit from and can grasp important conceptual ideas when they are presented in developmentally appropriate ways.

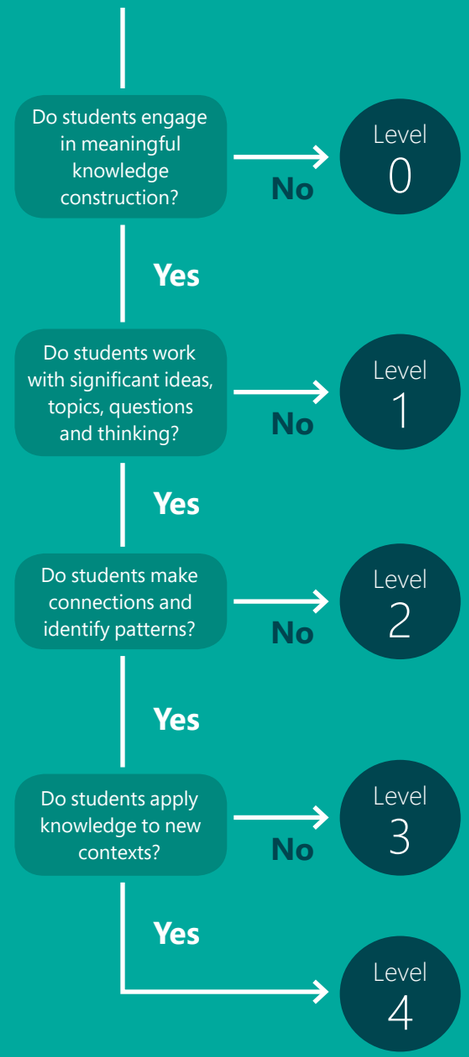
Do students make connections and identify patterns?

- Making connections, identifying patterns and seeing relationships among these is essential for construction of deep understanding and for navigating a massive sea of knowledge effectively in an inter-connected global word. This is too important to be left to chance, and students need pattern-recognition experiences from an early age.
- While our brains are biologically designed to seek patterns, students do not automatically realize that a concept, a learning process, or one curriculum area is connected to another in any shape or form. Learning activity design must assist learners to make connections, helping them to see the whole, not just the parts, and our teaching must actively scaffold learners' understandings and skills to do this effectively.

Do students apply knowledge to new contexts?

- While all learning involves transfer from previous experiences, a true test of effective knowledge construction is the extent to which students can transfer or apply their new knowledge appropriately to new and authentic situations and settings.
- Understanding is demonstrated when students use their new knowledge to adapt, extend or customize their new knowledge for new, specific situations/ contexts, apply what they have learned to real-world challenges or problems, and apply what they have learned to their own lives, both inside and outside of school.

Decision tree for creativity and knowledge construction



Source: 21st Century Design app, available from all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

Communication

The Opportunity

Amid the concerns about what computers will do better than people in 20 years' time, it's still considered highly unlikely that an artificial intelligence will communicate as well as we do anytime soon.[189]

At the same time, communication is becoming more and more essential to the type of collaborative innovation sought after in the business world, in the sciences and in government.[190] And as communication in the workplace shifts in emphasis from face-to-face to digital channels, flexible communication skills will become more important than ever.

The Approach

If communication is one human ability that AI will struggle to become more competent in, how can we ensure that our students are equipped to succeed in this category to the best of their ability? Here are some things for educators to focus on when teaching communication.

Master structure through written communication

According to John Bean, "Writing instruction goes sour whenever writing is conceived as primarily a communication skill, rather than as a process and product of critical thought".[191] Expert communicators have clear thoughts to express—and this comes from a deep understanding of structure. At the same time, today's main source of written communication, the web, encourages students to take in information in an unstructured fashion. So how do we bridge the two and benefit from the best of both worlds?

Overcome the anxiety of oral communication

Erik Palmer, educational consultant and author, suggests that some schools and teachers struggle to systematically teach speaking in schools.[192] The growing importance of delivering a message through podcasts, videos, video conferences or webinars calls for a renewed focus on this set of skills.[193] Students practicing and improving their oral communication skills will also be developing their faculty for practical empathy by learning active listening and active speaking,[194] as well as mastering techniques for overcoming the anxiety of speaking in a public forum.[195]

Explain both sides of the communications coin

Speaking of empathy, teaching communication is as much about teaching listening and understanding–that is, taking in information–as it is about speaking and writing. Anyone who's read a message board or comments feed will have seen the way we often fail to consider the 'other side's' point of view. Indeed, the web has been seen as a source of increasing polarization.[196] This means teachers have a tremendous opportunity to influence the standard of online discourse.

Robert J. Marzano writes that, "Active speaking involves using one's words to encourage another person toward possible solutions. This might involve using a certain tone of voice, actively summarizing the conversation, or conveying empathy through gestures and facial expressions".[197] But what are the online equivalents of gestures and facial expressions, used to express empathy? Is it all about emoticons and emojis, or can our students do better than we've managed thus far?

Understand the effect of communication on the brain of listeners

When listeners are paying attention to engaging communication, their brains literally 'sync up'. This phenomenon is known as entrainment.[198]

Combine digital literacy with oral and written communication

As digital possibilities grow and evolve, it seems that the basics of communication are changing every six months. But whether it's a video call, a podcast or writing a blog, the fundamentals of interaction remain largely the same. Instead, we can ask ourselves where new media are intuitive, and where they're less so. What do students take for granted, and where do we need to focus our attention to account for gaps in their understanding?

When listeners are paying attention to engaging communication, their brains literally 'sync up'.

Listener 1
Listener 2
Listener 3

Source: Yuri Hasson, "This is your brain on communication".

How technology helps

Good communication skills come naturally for some students, while others struggle to convey meaning. Here are a few practical tips to help educators draw insights out of their class.

Encourage listening deeply

More commonly called "active listening", this communicates to the listener: "I'm interested in you as a person, and I think that what you feel is important. I respect your thoughts, and even if I don't agree with them, I know that they are valid for you. I feel sure that you have a contribution to make. I'm not trying to change you or evaluate you. I just want to understand you. I think you're worth listening to, and I want you to know that I'm the kind of a person you can talk to."[199] And it works both ways: students are more likely to find themselves being listened to if they develop these skills.[200]

One of the challenges for active listening is that we often assume we're listening actively, when in fact we're waiting for a gap in the conversation where we can jump in. Here, digital tools that record students' communications can provide greater self-awareness, showing them where they're succeeding and failing to listen deeply.

Techniques:

- Set a topic or scenario, then pair students up to video conference via laptops or tablets. Record the conversation, and ask each participant to self-assess their own performance based on the criteria of active listening.

Teach students to speak actively

This might be best thought of as active listening, stage two. As Marzano notes, active speaking is exceptionally valuable because it creates an atmosphere of cooperation.[201] Just as importantly, these skills need to be developed for increasingly important virtual or blended forums, like Skype and web conferencing, which come with the freedom to bring more diverse participants into the conversation, but require greater skill to express empathy and encourage the participation of everyone involved. Learning to ask open-ended questions and summarize the other parties' points of view as you go are great starts.

Techniques:

- Try a variation of the above exercise, but in this version, only one of the participants knows the topic of conversation. Have that 'knowing' student interview the other using active speaking skills.
- Reverse the roles so that the interviewer doesn't know the topic, but the interviewee does, and see how much interviewer can find out about the topic (without being able to ask directly what the topic is).
- Now have an interviewer encourage active speaking from a group of two or three interviewees.

Chair digital conversations

With regard to those virtual or blended collaboration environments, 'it can be tempting to assume that virtual meeting room software replaces active facilitation, but it really doesn't. Virtual or blended meetings require as much advance preparation and active facilitation as face-to-face meetings, and sometimes more'.[202] Students can gain a valuable collaboration (and leadership) advantage by learning the skills of active facilitation in a digital communications context.

Techniques:

- After mastering active listening and speaking, it's time to use those skills in a more real-world context, with students taking turns to facilitate at first virtual, then blended collaboration sessions.
- Set objectives for the sessions, such as coming to an agreement on how to approach a particular problem. This can easily be combined with creative problem solving from the previous section.

Maximise your listeners' attention

As it turns out, speakers aren't the only ones who get nervous at the prospect of public speaking. Influential communication scholar Dr Paul King has found that the accumulation of information creates a "cognitive backlog" and attendant anxiety as listeners are expected to remember more and more information.[203] It's also important to bring the audience into the conversation with "invitations", such as: 'Right now I would like to take a few minutes and ask you about...' [204]

Presentation applications are important tools in the battle to keep your audience engaged and interested. Students can learn to focus their arguments and make sure they hit key beats, without overloading their audience with superfluous information.

Techniques:

- Begin by letting students work from a presentation developed for them, to get used to the idea of following a set structure.
- Next, provide them with a long presentation (say, 20 slides), which they're tasked to cut down to 10 slides and present.
- Finally, have students prepare their own presentations from scratch.
- Recording all presentations will provide invaluable self-evaluation material.

Red Flag

Don't mistake connectivity for communication

Some 87% of millennials admitted to missing out on a conversation because they were distracted by their phone, while 51% of teens would rather communicate digitally than in person (even with friends). And 43% of 18- to 24-year-olds say that texting is just as meaningful as an actual conversation with someone over the phone.

www.attentiv.com/we-dont-speak

Make it real: communication

Microsoft Teams lets students communicate around their learning, via a text-like interface. Simply set up a "team" and invite students, groups or teachers to join. It's a great way of tuning in to your students' voices and encouraging reticent speakers to communicate.

- Teams is included in Office 365 – free to students and teachers.
- Share video, apps or other content that is relevant to the course or class.
- Students can access the 'feed' on their smartphone, tablet or laptop.

Make it real: video, the new voice

Encourage students to communicate in new ways, by writing voice-over, commentary or dialogue for video and then producing their work.

Office 365 Word – template for script writing

If you want to develop future skills in writing, video scripts are an important part of communication. Video is fast becoming one of the most popular ways to explain or advertise things on the web. Students use the script writing template that's included in Word.

Windows 10

Download the free Photos app that enables students to join, trim, rearrange clips, add background sound track music and apply effects and text titles.

Office 365 Stream

Office 365 Video provides an easy place to share your class videos and encourage students to communicate about them through Yammer conversations.

Explore video

From a written or, increasingly these days, a visual point of view, clear expression is largely about structure. There are of course thousands of resources available for structuring written essays–but what about a video essay? As visual storytelling becomes even more common on the web, simple editing software will provide a great tool for thinking laterally about the way students impart information with real impact.

Techniques:

- Have students get up to speed by creating short (say, 30-second) videos that express an idea, like "the secrets of a healthy diet" or "how to cook a stir fry".
- From there, move onto larger, more complicated structures–mini-documentaries of three minutes. These would express the student's understanding of a personally assigned topic.
- Test the effectiveness of the communication by having other students write down what they thought the mini-docs were trying to say.

Future-ready Learning Design for Communication

Use these questions to guide the planning of activities that develop 21st century skills in communication.

Does this learning activity require coherent communication?

The links between language and thinking are significant; each develops the other.

When students are able to listen, read, view, write, record, and interact to express, exchange, explore and develop ideas with others, not only do they learn important communication skills, but also, their thinking, comprehension and understanding is deepened.

This dimension requires that students understand, select and use a range of communication modes and tools to produce coherent communication; i.e., communication that makes sense and reflects coherent and connected ideas, not a single simple thought.

Are students required to design their communication for a particular audience?

When students compose and produce communication for a particular audience, they must ensure that their communication is appropriately designed to achieve maximum understanding, relevance and meaning for that audience.

This requires them to carefully select the content, communication style, language, modes and tools they will use to tailor their communication to the needs, preferences and context of that specific audience.

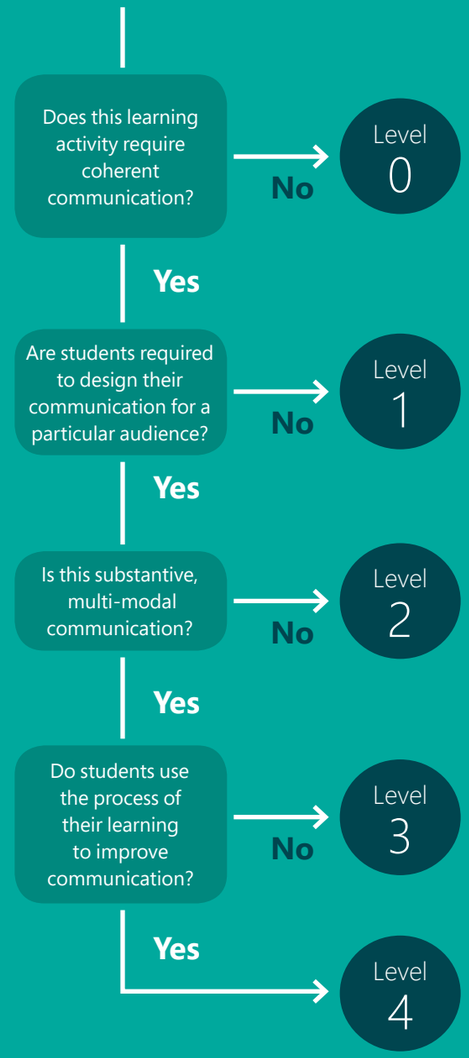
Is this substantive, multi-modal communication?

Communication is multi-modal when it includes the use of more than one type of communication mode or tool to produce a coherent message. For example, students might create a presentation that integrates video and text, or embed a photograph into a blog post. The communication is considered multi-modal only if the elements work together to produce a stronger message than any one element alone.

Do students use the process of their learning to improve communication?

What occurs during the process of learning–the interactions, processes, communication modes, language and skills used–are key to monitoring, assessing and explicitly developing students' communication skills. While capturing this in the past has not been easy, current and emerging technologies are making this possible in powerful ways because students can be more actively involved in reflecting and monitoring their own development and learning.

Decision Tree for Skillful Communication



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Science, Technology, Engineering & Math

The Opportunity

From genetics to robotics, from neuroscience to climate science, the opportunities in the science, technology, engineering and mathematics (STEM) fields have never been greater. Talented STEM students are the lifeblood of a strong economy. But while 75 percent of the world's fastest-growing occupations call for STEM skills, a far lower percentage of high school students plan to pursue STEM at university.

This is detrimental because STEM is more than a series of connected disciplines. Rather, it represents a way of thinking about the world that is valuable in any profession, whether solving equations or wearing a white coat. Going back at least to the Enlightenment, STEM has represented our human curiosity, industriousness and thirst for new knowledge.

Encouraging students to embrace and enjoy STEM is therefore a key priority for education systems across the world. So, what can you do to make STEM more attractive in schools to help your students select promising career paths and support the national interest?

The Approach

Microsoft focuses firmly on the T (Technology) aspect of STEM. However, with the Internet of Things, mobile apps, automation and robotics opening up so many exciting career opportunities, we see computational thinking as a vital skill to develop in students. Further, technology is an essential part of interdisciplinary STEM projects, as shown in activities such as Chemistry virtual labs or creating virtual worlds in Minecraft.

Teach computational thinking

Across the world computational thinking is coming to the fore as a key future-ready learning skill. Computational thinking is how software engineers solve problems. It includes elements of problem solving and critical thinking, combining mathematics, logic and algorithms. It teaches students how to approach problems in a structured way by breaking them down into a sequence of smaller, more manageable problems, developing the skill to analyze different situations in order to make the connections. It also introduces a new way to think about the world by developing the ability to use abstractions to represent certain concepts.

Start young

Students are often more receptive to computer science when the topic is introduced early through a hands-on approach. UK schools, for example, have introduced it for children from age five upwards. Initially children will play abstract games and complete puzzles to familiarize themselves with the concept of algorithms without the complexity. By the time students are 14 years old, teachers will guide them on how to use two or more programming languages. All of this is compulsory. That makes the UK the first G20 nation to put computer science at the heart of its curriculum.

Make it real: coding

MakeCode

Microsoft MakeCode (makecode.com) brings computer science to life for all students with fun projects, immediate results, and both block and text editors for learners at different levels.

- Learn and teach courses, books and guides for teachers ensure exciting and empowering learning design is simple, for beginners to advanced programmers.
- Includes tools and resources like Minecraft code, developer documentation, etc.
- Works with hardware like Micro:bit, Circuit Playground Express, Chibi Chip, Grove Zero, Wonder Workshop and many more.
- Children can develop advanced game design concepts in a simple, direct, and intuitive manner.
- In-game camera and student portfolio to capture evidence of learning.
- Safe game environment.
- Guide projects with Classroom Mode for Minecraft.
- Promote computational thinking and creative coding.

Minecraft Education Edition

An open-world game that helps prepare students for the future workplace by building creativity, collaboration and problem-solving skills. Using Code Builder students can learn coding in Minecraft using tools like Code.org, Tynker, Scratch and Microsoft MakeCode. They can choose between using blocks of code or Javascript to build and create in Minecraft. Minecraft Hour of Code also offers a free one-hour introduction to coding basics.

- Minecraft: Education Edition includes tutorials, classroom management tools, secure sign-in, classroom collaborations and sample lessons, plus a global network of mentors and technology support.
- Create and share lessons across STEM, Humanities, and the Arts.

Make it real and relevant

There are now toys and games that students can learn to make and program, which teaches them the basics of coding—how to break down problems into components that computers can solve. You can also make computational thinking fun by offering opportunities to design and create games from scratch, then publish them on anything from an Xbox to Kinect or a smartphone.

Encourage girls to participate

Roughly half the population of the world is female, but women are vastly under-represented in the technology industry. For example, in 2015 in the USA, women held only 25 percent of professional computing jobs. It's vital to dispel gender stereotypes associated with careers in technology. Draw inspiration from websites like www.techgirlsaresuperheroes.org and www.womenintechcampaign.com. Consider a girls' computer club or set projects with topics or objects that specifically engage girls. Computing companies like Microsoft offer programs, such as DigiGirlz, which connects young students with women at Microsoft to learn about careers in technologies.

Support and skill your teachers

Teachers are the most important influence on student achievement. However, many countries are facing both a shortage of STEM teachers and the challenge of keeping those in the profession up to date, especially with fast-moving disciplines like technology. Technology companies are helping to address this by offering training courses, certification, and support in keeping the computer science curriculum topical, engaging and relevant. For example, Microsoft has partnered to offer CS50xAP, a year-long secondary course built by Harvard University, to all schools at no cost, providing valuable tuition in computational thinking, coding and computer science. Recognizing that every class and student is different, courses are flexible so that teachers can easily adapt them to their needs.

Build a community for STEM educators

There are some fantastic trailblazers in classrooms, forging ahead to create engaging and interactive learning experiences for their digitally savvy students; for example, by integrating technologies such as Minecraft into their lesson plans.

To make this the norm, not the exception, nurture teachers to exchange best practices and increase their digital confidence using public forums such as the Microsoft Educator Community. Through the resources, certification programs and peer engagement provided here, you can help train teachers to become digital pioneers and inspire new ways of teaching and learning.

Measure performance to drive continual improvement

Keeping momentum and energy behind STEM programs for change—and driving improvement—requires monitoring and measurement. Microsoft is working with school systems worldwide to provide the education analytics they need to benchmark performance and uncover critical insights.

While relatively new to education, predictive analytics offers ways to predict student outcomes in STEM subjects so support can be better targeted. It's also possible to home in on STEM dropout rates, so educators can intervene early and get students back on track. Microsoft has developed a Data Science Design Pattern for Education Analytics and made it available to education data scientists. In Australia, for example, it was used with an anonymized data set of 83,000 students across almost 140 schools to develop a model that predicts student performance based on national test scores, student demographics, school records and school attributes.

> "Many countries are facing both a shortage of STEM teachers and the challenge of keeping those in the profession up to date."

STEM tools for your classroom

Hardware	Class quantity	Grade
Lego WeDo: A Lego kit that can connect to Scratch via USB port.	1	K-3
Makey Makey: Create your own input devices such as controllers and musical instruments.	3	3-8
Finch Robot: This programmable robot is a great intro to Java programming and more.	3	2-12
Hummingbird Duo: Learn to program and set up hardware and create simple robots and machines.	1 for G & T	4-8
Arduino: Develop your own robotics and electronics projects.	1 each	6-12
LilyPad: Hardware to create wearable technology and more.	1	7-12
Raspberry Pi: Create your own Internet of Things on this computer that can run Windows 10 and Linux.	1	7-12
micro:bit/Adafruit: Small microcontroller to develop your own hardware projects using makecode.com.	1 each	5-12

Software	Class quantity	Grade
Minecraft: Education Edition of the popular sandpit game with redstone, pistons and more to create complex machines.	–	K-12
Windows 10 and IoT core Operating System: This gives you a platform to create apps, software and more across all operating systems.	–	K-12
Microsoft Office: Use OneNote, Planner, Sway and other tools to problem-solve and organize, collaborate and present your STEM projects.	–	K-12
3D Builder, 3D Paint and Story Remix: Powerful 3D creation tools built into Windows 10 Creators Update, allowing you to make and print 3D and embed 3D objects in mixed reality.	–	3-12
Unity 3D: Software to create games and even holographic apps for Microsoft HoloLens, Xbox and more.	–	6-12
Visual Studio: A real industry tool to code apps and software in any language and for any device.	–	7-12
Microsoft Azure: Use the latest cloud technology to develop apps, set up servers, create machine learning tools and more.	–	10-12

Social and Emotional Skills

> Technology is an excellent servant, but a very dangerous master."
>
> *Kati Tiainen,*
> *-Education Transformation Lead, Microsoft.*

The Opportunity

Imagine a classroom where groupwork isn't just about mastering academic material, but how well students communicate and collaborate. This kind of Social and Emotional Learning (SEL) is becoming increasingly popular, as it has huge short-term and long-term benefits for today's students. Not only does SEL help students improve their academic performance, it reduces emotional distress and increases the likelihood of success in the future.

From building global or local business teams, through to successful international relations and diplomacy, self-awareness is essential if we are to cooperate, collaborate and interact socially in positive ways. It's not just the economy that benefits from self-aware team players and leaders. Research indicates that self-aware and reflective students think more strategically and have better academic and social performance than less reflective learners.[205]

What are social and emotional skills?

'Social and emotional skills' is a phrase that is easily understood in general, but is difficult to define specifically. They are sometimes referred to as 'soft skills,' 'people skills' or 'emotional intelligence,' or characterized as traits like perseverance, trust, attentiveness, self-esteem, empathy, humility, tolerance, cooperation, collaboration, creativity and problem solving.

> It's not your IQ. It's not even a number. But emotional intelligence may be the best predictor of success in life, redefining what it means to be smart."
>
> *Time, 1995.*

Unfortunately, every country has its own way of defining SEL. However, a report produced by the British Cabinet Office, the Early Intervention Foundation and the Social Mobility and Child Poverty Commission defined social and emotional skills in five key areas:

1. **Self-awareness:** A student's perception of themselves and their value; confidence in their current abilities, and belief in their potential to achieve future goals.
2. **Motivation:** A student's own reasons for striving toward goals, such as the belief that effort leads to achievement, and the attaching of value to a goal, aspiration or ambition.
3. **Self-control:** A student's ability to manage and express emotions, and the extent to which they overcome short-term impulsivity in order to prioritize higher pursuits. (High self-control is associated with 'conscientiousness', one of the 'Big Five' dimensions of personality.)
4. **Social skills:** A student's ability to interact with others, forge and maintain relationships, and avoid socially unacceptable responses. (High social skill is associated with communication, empathy, kindness, sharing and cooperation.)
5. **Resilience:** A student's ability to adapt positively and purposefully in the face of stress and otherwise difficult circumstances.

Preparing students for jobs that do not exist

Students starting school in 2018 will graduate around 2030. Given the remarkable acceleration of technology today, 2030 is a world that is difficult for us to anticipate.

Cathy N. Davidson, Professor and Founding Director of the Futures Institute, estimates that 65 percent of children entering grade school today will go on to work in jobs that don't yet exist.[206] And as for the jobs that do exist? Harvard University academic David Deming found that only the ones requiring strong social skills have significantly grown since 1980.[207] The McKinsey Global Institute projects that by 2030, there will be a 30–40 percent growth in work that will require explicit social and emotional skills.[208]

Helping students to the top of the résumé pile

We are starting to square up to algorithms, automation and even artificial intelligence, and finding the ace up our sleeve is social and emotional skills.

In this light, the emphasis on teaching Science, Technology, Engineering & Mathematics (STEM) isn't enough on its own. It needs to be combined with social and emotional skills.

Many employers already recognize this. The most effective managers are 'good coaches' who are skilled at listening, sharing and translating the relevance of information. So the employees being promoted to manager level (and beyond) are the ones with strong social and emotional skills.

Ensuring all-around success in later life

On top of helping your students secure a fulfilling role in an unknown future economy, SEL has been shown to deliver other long-term benefits.

The Perry Preschool Study tracked two groups of at-risk students for almost 40 years: One group taught with a traditional curriculum, and another taught with a curriculum that incorporated SEL. On average, the group exposed to social and emotional skills training had higher earnings, were more likely to be employed, committed fewer crimes and were more likely to have completed high school.[209]

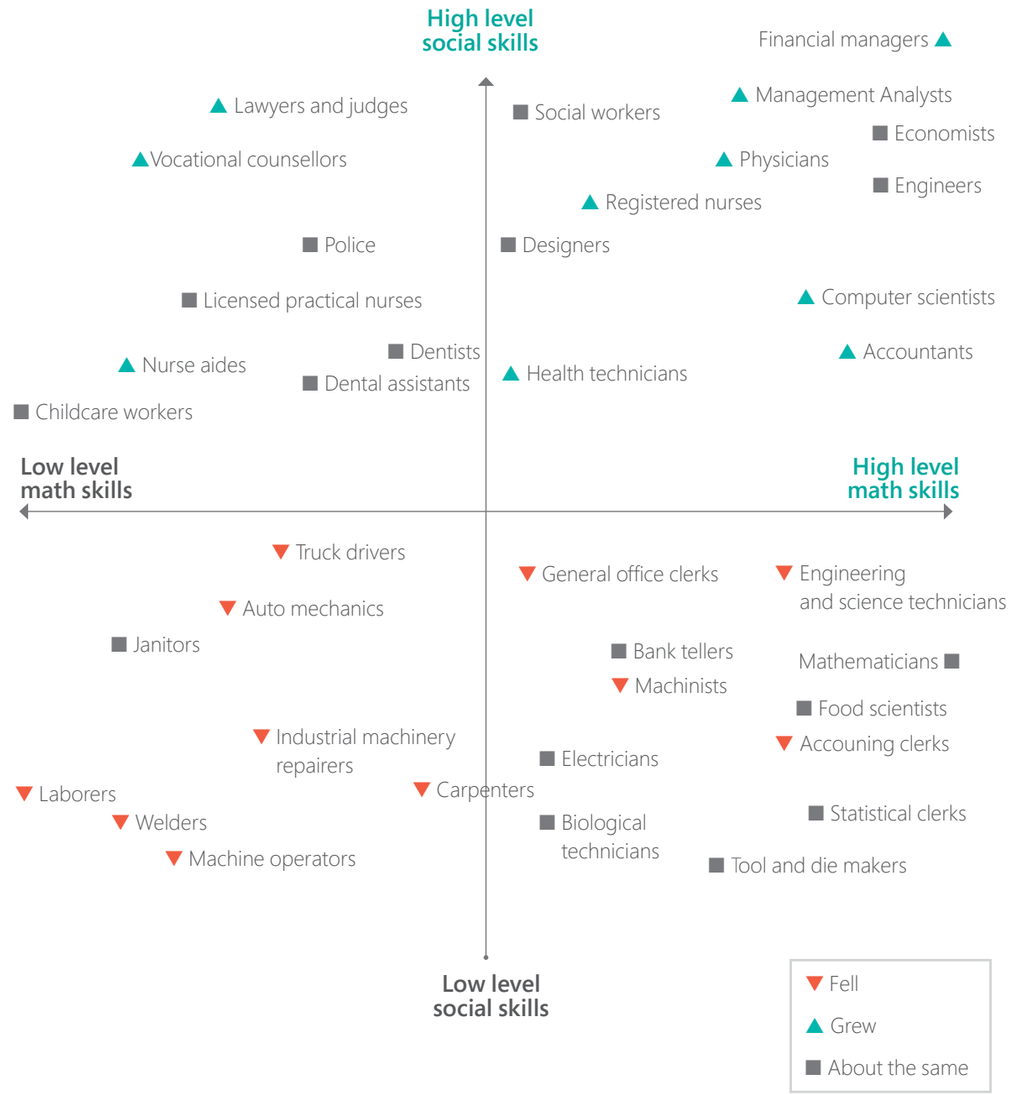
Improving student performance and wellbeing now

SEL has positive short-term effects, too. A meta-analysis of 213 studies of over 27,000 students found that those who were trained in social and emotional skills scored 11 percentile points higher, on average, than those who did not.[210] SEL was also shown to reduce emotional distress, through building confidence, resilience, perseverance, self-esteem, and other core qualities.

> "The World Economic Forum predicts by 2020 emotional intelligence, coordinating with others, and cognitive flexibility will be included in the top 10 skills employers look for."

Change in share of jobs 1980-2012

Harvard University academic David Deming shows that only the jobs requiring strong social skills have significantly grown since 1980.



The Approach

In a world with increasingly blurred lines between personal and digital interaction, schools need to respond to the social changes technology create, with an increased focus on human interaction, behavior and emotional intelligence. Microsoft CEO Satya Nadella commented that in a world with increased AI and machine learning, "human values such as common sense and empathy will be scarce."

Three Approaches to SEL

1. Building a curriculum based on social and emotional skills

By starting with the specific skills, vocabulary and outcomes your students will need to master, your school can reorient its curricula to embrace social and emotional development.

Example: Lions Quest, a K-12 initiative run in more than 90 countries by the Lions Club International Foundation, works to develop positive behavior through SEL. Lions Quest offers a diverse set of learning practices, such as group discussion, peer-to-peer teaching, problem solving, and the "think-pair-share" technique.

2. Embedding social and emotional development into specific programs

Academic programs that focus on foundational skills can benefit from the inclusion of SEL content and vocabulary.

Example: The Facing History and Ourselves program embeds activities about identity and community within a traditional history curriculum, in order to cultivate dialogue, empathy and reflection.

3. Specific teaching practices for social and emotional development

Promote teaching practices that require students to use social and emotional skills, such as discussing topics in a group, listening to peers, solving a problem together or making learning choices.

Example: The Buck Institute for Education offers various teaching models, such as a project-based learning model that champions SEL and makes learning more engaging for high school students.

With social and emotional skills comes self-awareness

When students are self-aware of their own learning they are able to assess and understand their strengths and limitations, which in turn supports their personal development.[211]

Self-reflection is often triggered by a problem, a new situation or the student learning about a new concept that challenges their perception of themselves and their place in the world. Therefore, teachers can encourage self-reflection by setting challenges that put students outside their comfort zone by encouraging them to think anew.

Self-awareness can be defined as combining what a student knows with how they feel, and deciding what action to take in light of both.[212] It's important to learning, because students must be self-aware if they are to recognize their own capabilities, get the most out of their schooling, and take corrective action if they are not.

Teaching self-awareness and self-expression enhances problem-solving skills and decreases student anxiety, depression, stress, violence and drug abuse.[213]

Studies also show that self-control in students can create a task performance improvement of 0.38–an impressive 28 percent gain.[214]

There are three broad topics you can apply to learning tasks

1 Meta-cognitive reflection

Reflecting upon the processes and knowledge a student currently holds. This helps students to recognize their own strength, biases and gaps in knowledge.

2 Critical reflection

Helping students to bridge the gap between understanding themselves and understanding others. This develops multicultural awareness and the ability to collaborate with different perspectives.

3 Process reflection

Helping students reflect when they are problem solving, so that they learn to question their knowledge and experience. This "active thinking" helps students innovate, rationalize and explain their ideas.

How technology helps

Social and emotional skills revolve around the ability to communicate, collaborate and solve problems in a modern context. This makes technology a crucial part of authentic skills development. If students are to succeed both in the classroom today and in the workplace tomorrow, they will need strong social and emotional skills to navigate our emerging digital, virtual, augmented and mixed-reality worlds.

Using technology to build social and emotional skills

In a survey of more than 2,000 educators, parents and technology experts worldwide, the World Economic Forum have analysed the best ways to use technology in SEL. The result is three key strategies: Leveraging existing technology products that already support SEL, embedding SEL features into the development of new technology products, and innovating new technologies to extend the possibilities of SEL.[215]

1. Leverage what already works

There are huge opportunities to teach SEL using existing products, such as games. Not only do games incorporate play, (which is important to childhood development), they allow for continued practice and personalization. Of course, not all games are appropriate. There are three genres, however, that present enormous potential:

Role-playing games

These are single-player, highly narrative experiences that are driven by strategy, decision making and problem solving. One example is the US learning platform iCivics, which includes role-playing games like 'being president for a day' or arguing a case in front of the Supreme Court. Tufts University researchers found that these games helped students hone their persuasive-writing skills, conduct proper research and compose complex arguments, as well as improve their communication, problem-solving and self-directed learning skills.[216]

Strategy games

These are single- or multi-player challenges in planning, strategy and resource management. Sid Meier's Civilization V lets players build their own civilization (with a leader chosen from a pantheon of real historical figures), and through time, attempt to rule the world. A study by the New York Teachers College found that students playing the game not only learned important historical facts but, to their surprise, also took away a deep understanding of the human relationships, economic systems, culture, diplomacy and warfare that has shaped real civilizations.

Sandbox games

These focus on open-ended exploration. Minecraft offers several opportunities to build SEL, as players can work alone or cooperatively to discover how to build, secure resources, manage resources and design their own objects and worlds. Researchers at the University of Wisconsin-Madison found that Minecraft helped improve results in academic subjects like reading, biology, ecology and physics.[217]

How to choose a game or technology for your class

To identify appropriate games and educational technologies for your students, the World Economic Forum put together a research-based list of ideal product features. These are designed to correlate with core "competencies and character qualities."[218]

2. Embed SEL into new games and technologies

Teachers and schools can approach developers to help them better embed SEL features into their educational technology products. Some of the results of this process include:

The Web-based Inquiry Science Environment

Also known as WISE, this free online platform offers customizable curricula and activities for students in grades 6-8 in a number of languages. It enables students to conduct science experiments, practice using the scientific method and collaborate to explore standards-aligned science concepts. Teachers guide and evaluate the process through a suite of classroom tools.

ThinkCERCA

CERCA stands for Claim, Evidence, Reasoning, Counterarguments and Audience. This popular framework offers students rounds of feedback as they construct and refine effective arguments.

> "SAP now have a 'Empathy to action' program for their sales teams, Facebook have an Empathy Lab, Johnson & Johnson have a new business direction with empathy at the heart of it. These initiatives recognize the fundamental shifts that society is undergoing and the need to prepare for the changes that are still to come."
>
> *Belinda Parmar, CEO and Author, The Empathy Business.*

3. Innovate and expand what is possible

Looking to the avant garde of technological innovation reveals many surprising and exciting opportunities to support SEL. The five most promising areas include:

Wearable devices

Think wristbands, smart watches, headsets and smart clothing. For example, Starling is a small clip-on tag that can track the "child-directed" words a child hears each day, which helps support language development. The Embrace watch, meanwhile, tracks physiological stress and vibrates when that stress is too high, in order to provide an opportunity for intervention or emotion management.

Educational Apps

Consider smartphone and tablet apps designed for learning. For example, Learner Mosaic provides parents with personalized insights into how well their children are progressing toward behavior and activity goals. And Bloxels is a video game design platform that fits into the maker movement.

Virtual and Augmented Reality

Use a smart device to view the world overlaid with digital information, or use a headset to simulate one's physical presence in a virtual space. For example, EON Reality uses virtual reality tools to enable collaboration.

Not just any old game

Choosing technology for social and emotional learning.

Structure of interactions

- Allow for turn taking.
- Allow play over multiple sessions with breaks.
- Allow verbal and non-verbal responses.
- Create safe environments to explore and experiment.
- Enable game customization and modification.
- Include engaging characters.
- Include virtual characters that are able to interact with players (embodied conversational agents).

Elements of play

- Allow for management of complex systems.
- Encourage players to apply knowledge learned in games (action domain link).
- Facilitate resource management.
- Increase difficulty level as play progresses.
- Make play adaptive to performance.
- Offer non-linear narratives.
- Provide direct SEL skill instruction.
- Reveal hidden information through players' actions.

Assessment and reinforcement

- Allow for writing notes and journal entries.
- Encourage players to narrate plans and actions taken in game.
- Include aids for teachers and parents.
- Include stealth assessment.
- Offer immediate feedback about performance.
- Offer meta-cognition strategies.

Critical thinking/ problem solving

- Allow players to share proposals.
- Allow players to debrief and reflect on their performance.
- Offer help, hints and instructional supports.
- Connect game to players' interests.
- Award players with prizes.
- Allow for open-ended exploration.
- Embed subject-matter tutoring.

Communication

- Create complementary roles for different players.
- Build in written ways to communicate.
- Encourage interaction with other players.
- Allow communication over social media.
- Allow for voice communication.
- Allow players to share proposals.

Creativity

- Create complementary roles for different players.
- Offer augmented reality and simulation.
- Embed fantasy-like themes.
- Encourage role-playing and perspective shifting.
- Facilitate offline group activity and quests.
- Combine multiple parts of game into a new form.
- Offer opportunities to make choices.
- Create characters and build virtual products.

Collaboration

- Create complementary roles.
- Build in written ways to communicate.

Encourage interaction

- Offer incentives to mentor other players.
- Encourage work with others toward common goals.
- Allow multiple players.
- Allow communication over social media.
- Allow for voice communication.
- Allow players to share virtual products.

Curiosity

- Facilitate offline group activity and quests.
- Combine multiple parts of game into a new form.
- Offer opportunities to make choices.
- Allow for open-ended exploration.
- Embed subject-matter tutoring.
- Make uncertainty salient.
- Reward partial steps.
- Create characters and build virtual products.
- Provide multi-sensory learning materials.
- Provide puzzles that are solvable with effort.
- Reward guessing with feedback on correct answers.

Initiative

- Facilitate offline group activity and quests.
- Combine multiple parts of game into a new form.
- Offer opportunities to make choices.
- Create characters and build virtual products.
- Encourage the completion of goals.
- Provide long-form play.
- Manage multiple goals.
- Allow practice without penalty.

Leadership

- Offer incentives to mentor other players.
- Encourage work with others toward common goals.
- Encourage negotiation through the exchange of virtual goods.

Persistence/Grit

- Award players with prizes.
- Feature conflict or competition with others.
- Feature rankings and leader.

Adaptability

- Allow practice without penalty.
- Create characters and build virtual products.
- Encourage negotiation through the exchange of virtual goods.
- Encourage role-playing and perspective shifting
- Manage multiple goals.

Social and cultural awareness

- Offer incentives to mentor other players.
- Encourage work with others toward common goals.
- Allow communication over social media.
- Encourage negotiation through the exchange of virtual goods.

Awareness of self and others

Joan Cole Duffell explores the potential for using technology to revolutionize social and emotional learning.

Using technology to build new social and emotional skills

At first glance, the idea of tech-based social and emotional learning flies in the face of common sense. Don't humans best learn social and emotional skills in the social milieu? The answer, of course, is yes. Children need social inputs: modeling of positive social emotional competencies, group skill rehearsal (role play), as well as consistent cueing and coaching of SEL skills in everyday situations that occur in the classroom and on the playground. These key strategies are critical for making newfound social-emotional skills adherent or "sticky". However, technology solutions have enabled us to take smarter, more effective SEL solutions to scale in ways we could not have imagined ten years ago.

Finding the right technology

With SEL, the trick is employing technology in the right ways: the best products are making optimal use of technology to scale effective teaching and learning, while also keeping the "social and emotional" aspects of SEL pedagogy front and center. Lessons are streamed into the classroom, enabling teachers and students to learn and practice SEL skills in live sessions. Teacher, administrator and family trainings are delivered online, making it easy for educators to undergo basic professional development while using simple turnkey tools to engage parents.

The future of technology in SEL

Data dashboards allow teachers to track their place in lessons by class grouping, and help administrators observe program use. New assessments are coming online to help educators track students' progress in key SEL competencies. Apps and other tools support teachers in coaching students to practice their skills beyond the lessons. In the background, developers use analytics to observe product use patterns and make iterative improvements over time.

It's an exciting time in ed-tech and the best SEL programs are jumping on the bandwagon, albeit thoughtfully, with a keen eye on effective pedagogy and a laser focus on how technology can truly advance and improve outcomes for students, teachers and families.

Joan Cole Duffell

Joan Cole Duffell is an educator, writer, advocate, and board member for several non-profits focused on education, early learning and childhood wellbeing. The Committee for Children is a global non-profit that has spent 35 years improving children's lives through social-emotional learning. Duffell currently serves on the Council of Distinguished Educators for The Aspen Institute's National Commission on Social, Emotional and Academic Development.

Future-ready learning design for SEL

Use these questions to guide the planning of activities that develop future-ready skills in self-regulation.

Does this activity offer substantive time and opportunity to develop self-regulation?

Length of time is a basic prerequisite for learning opportunities to develop self-regulation skills.

Learning activities must offer students ongoing opportunities to work on and make progress with self-regulation skills over a substantive period of time.

For example, teachers might initially establish learning goals or intentions for learning activities: over time, this would show movement to co-construction and negotiation of goals with students, through to students being able to effectively set and monitor their own learning goals. This kind of learning cannot be achieved in a single lesson or class period, or taught without multiple and ongoing opportunities for students to practice and develop self-regulation skills.

Do students understand learning intentions and success criteria in advance of the learning activity?

Student understanding of the goals or learning intentions and associated success criteria in advance of the learning work to be done markedly enhances self-regulation by providing guidance that enables students to plan, monitor, reflect on and improve the progress and quality of their work as they do it.

Self-regulation is further enhanced when students co-construct learning intentions and associated success criteria with their teachers and/or peers, and when they are involved in self-assessment. If students do not know or understand the learning intentions and assessment or success criteria in advance of the learning work, they are NOT able to plan effectively to achieve desired outcomes.

Is feedback being used to improve learning?

Feedback, used effectively, is one of the most significant influences on improving learning.

When students receive feedback on their learning and use that feedback explicitly to improve their learning work, they can reflect on successes and mistakes made, build on successes, plan improvement, set new goals and plan their next steps for learning.

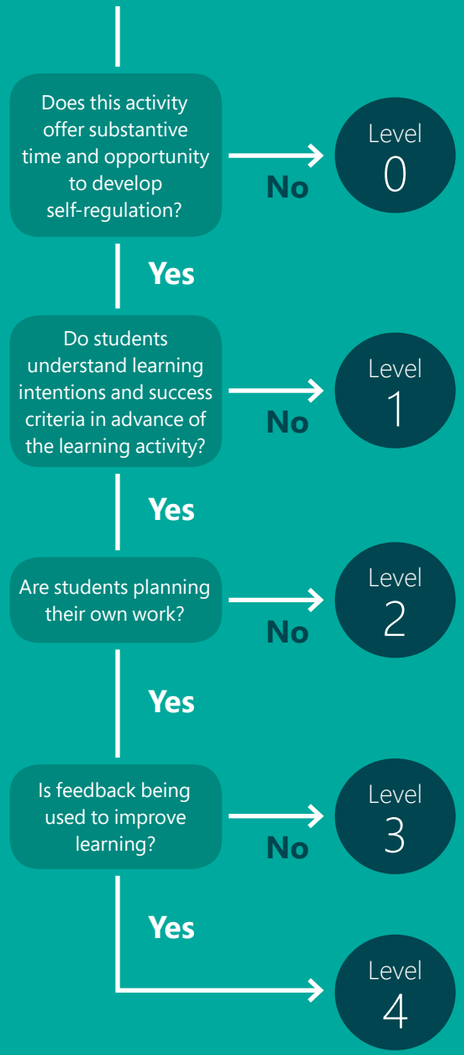
Feedback may come from teachers, peers or relevant others. Students can also engage in self-feedback through a deliberate process of self-reflection.

Feedback is not the same as praise. Comments such as 'good job' or 'great work' do little to help the student know what constitutes great work.

Effective feedback:

- Tells the student specifically what they are doing well and offers specific guidance to help improve future learning.
- Connects directly to the learning intentions or goals and success criteria.
- Acknowledges and raises awareness of progress and improvements needed.
- Leads to reflection and planning of next steps.

Decision tree for SEL learning activities



Source: 21st Century Design app, available from all Windows 10 devices ©2017, Lucas Moffitt, Teacher Collection

Entrepreneurship

The Opportunity

Nurturing young people's entrepreneurial spirit is seen as a critical skill because it stimulates the economy. As a result, many countries already have established programs that encourage school students to start their own business.

Entrepreneurship is not simply about running a business. It's about having new ideas and taking the initiative to create positive change–from coming up with a better way to do something, to solving a global challenge or devising an entirely new venture. It's relevant to every school topic–from science to art–and it's something that many children do naturally as they experiment, imagine and learn.

However, by encouraging entrepreneurial thinking in every topic, you can also lay the foundations for more confident learners who are adept at thinking outside the box, able to spot opportunities, and act on them. Students will also start to act as champions of diversity who recognize the value of unconventional skills and talents in themselves and others. Studies have also found that entrepreneurship promotes social and emotional wellbeing, and that graduates who start their own business are "significantly happier" than others due to perceived greater control over their own destiny.[219]

The Approach

How can you instill entrepreneurial patterns in your students' thought processes? Here are some simple reframing exercises educators can use to encourage initiatives and entrepreneurship in students.

Build networking skills

One of the key skills in modern entrepreneurship is networking. Helping students to work with peers and seek expert advice on any topic is important. Encourage cultural exchange as it opens up fresh perspectives.

Encourage collaboration

Collaboration is vital for successful entrepreneurship. Often the originator of an idea is not the person with the technical, business, finance or marketing skills to carry it forward. That's why start-up incubators and innovation think tanks place so much emphasis on teamwork. In a school situation, students have opportunities to play to their strengths and work on their weaknesses on teams, according to the role they choose.

Develop digital skills

Today's start-ups tend to be mobile, cloud-based and technology-centric. From harnessing the power of robotics to using sensors and the Internet of Things, technology is a powerful driver of innovation. Students also need to understand the capabilities and potential of modern technology and realize how it works so they can brief others and innovate. Learning computational thinking is the simplest way to do this.

Extend project-based learning by adding 'innovate'

The simplest way to encourage entrepreneurial thinking is to add "innovate" as the final step to project-based learning by re-framing your initial questions.

Research	Analyse	Evaluate	**Innovate**

How did the Titanic sink?

Based on your investigation into the Titanic and three other 20th century disasters, **how can we avoid shipping disasters?**

How technology helps

Technology plays a crucial role in nurturing initiative and an entrepreneurial nature in students. It can inspire them, and enable them to experiment and develop concepts, as well as showcase them for peer feedback and review.

Inspire and challenge

Enthuse students about what can be achieved.

Techniques:

- Inspire your students. Join an educator community to see what others are doing and come up with ideas for projects.
- What's the next big thing entrepreneurs could use?
- Check out what students are doing and dream up something better.

Experiment and develop concepts

Make sure every student has the digital skills to succeed.

Techniques:

- If any students are struggling with basic computer literacy, there are free courses that can help.
- Get your students into coding. It's the quickest route to becoming an entrepreneur in the digital economy.
- Why not build something for Kinect or Xbox?
- How about developing a prototype in 3D?
- Interested in connecting the Internet of Things?
- How about a mobile app?
- Something even more professional?

Showcase to the world

Link your budding entrepreneurs with their global peers.

Techniques:

- Take your innovation to the global community.
- Network with like-minded students.

Make it real: entrepreneurship

Microsoft Imagine Academy

Imagine Academy is a complete technology education program that leads to official Microsoft certification recognized by industry.

Schools and educational institutions can license full curriculum and learning tools, giving them access to structured, proven courses that prepare students for further education and careers.

Imagine Cup

- Imagine Cup is a chance for your student entrepreneurs to showcase their biggest, boldest software solution. They'll join tens of thousands of students from across the globe, competing for cash, travel and prizes and for the honor of taking home the Imagine Cup.
- Your students' mission is to create applications that shape how we live, work and play.
- The first step is to come up with a great idea and assemble a great team to make it a reality.
- Students could experience the thrill of seeing their project come to life right before their eyes on devices all over the world, changing lives.

Teachers can get started with a five-hour course at App Studio Education

- Xbox and Kinect developer tools.
- Student developers can create games that work on all Windows 10 devices—everything from phones to PCs and Xbox One consoles.
- Add rich scenes, objects, effects and make the most of modern graphics hardware to bring their creative ideas to life.
- The Kinect for Windows sensor and SDK allow students to develop applications that recognize speech and human motion, letting them build even more interactive games and experiences.

Section 4

Practical Templates and Guides

We've made it easy to undertake some of the key IT administration tasks in your school, from defining an Internet usage agreement with your students through to choosing devices with our suite of practical templates.

Photocopy, share and use any of these pages at will.
Or download digital versions: **microsoft.com/education**

- Phasing your Transformation
- Digital Transformation Journey Map for Institutions
- Checklist: Choosing student devices
- Checklist: Choosing devices for deep learning
- Keeping Your Child Safe Online: Parental policy guidelines
- Sample Internet Acceptable Use Policy: Staying safe online guidelines for students
- Assistive Technology for Vision Impairment
- Assistive Technology for Hearing Impairment
- Assistive Technology for Mobility/Dexterity Impairment
- Assistive Technology for Learning Impairment

> "If you nail down the IT details early with students and parents, things go more smoothly later."
>
> *Andrea Richardson, classroom teacher.*

Phasing your Transformation

Microsoft's Digital Transformation in Education approach is typically implemented in five phases. Each has independent benefits, which are realised along the way when users start to engage. The adoption journey culminates in a fully integrated platform delivering long-lasting and compelling outcomes.

Phase 1: Credentials

What is it?

A single, secure sign-in ID to a central digital learning ecosystem spanning each school and community. Hosted in a sophisticated cloud environment, users can have peace of mind that their personal data is secure. In addition, there's no need to maintain multiple environments or face complex licensing arrangements and data synchronization issues.

What could our rollout process look like?

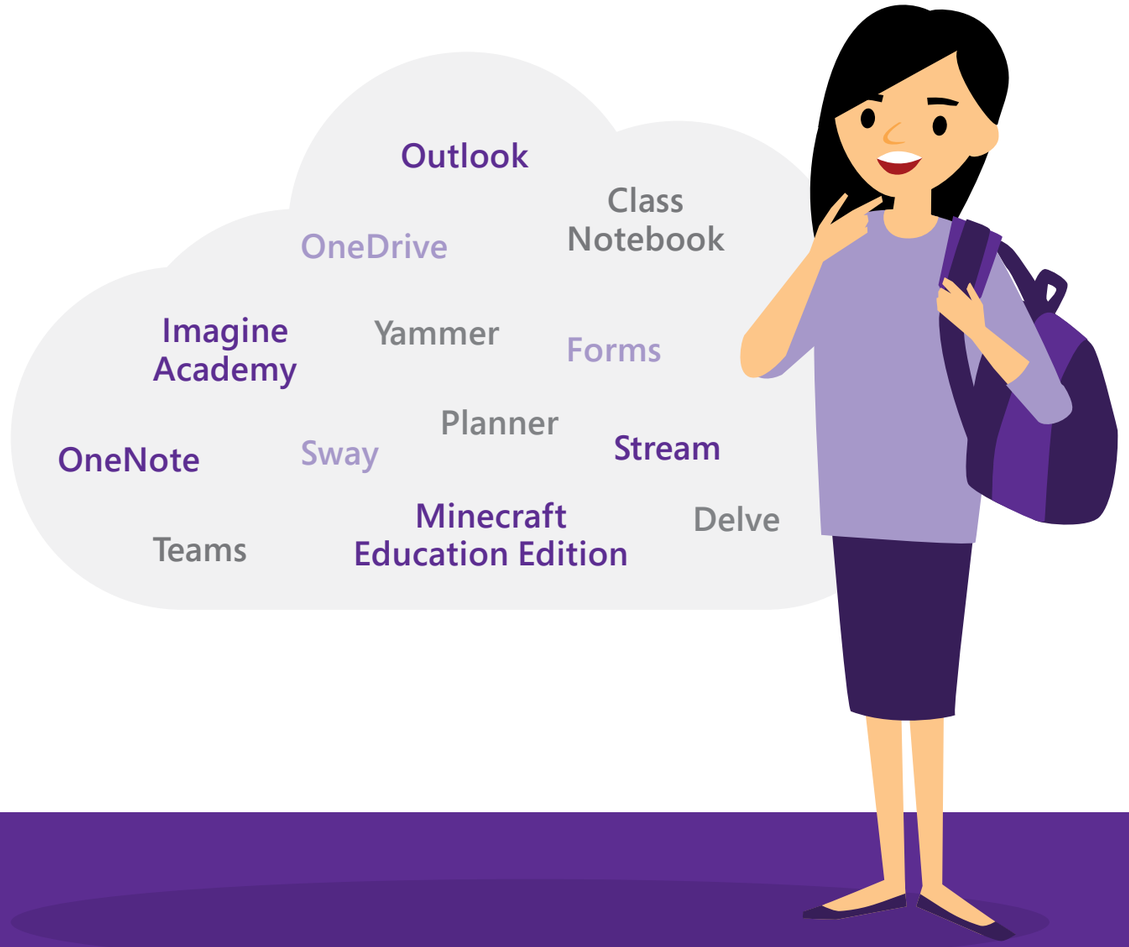
- Firstly, a school's IT team (or a designated IT support resource) will setup and distribute the new sign-on details, generally starting with leaders and key staff members. All users will have the same online experience whether they have a Windows, Mac or iPad, so all these tools will be accessible online or via an app—no matter what device they're using.
- Student credentials can be released in the way that best suits the individual school. Some schools will choose to conduct a staggered rollout by year group, others will elect to activate these all at once. An IT lead should support school leaders here, liaising with their Microsoft partner to devise a solution that fits their needs.
- A series of online resources and technical support services will be available to leaders and IT teams at this time.

Phase 2: Office 365

What is it?

A suite of teaching and learning tools with customized education features designed for every leader, teacher and student. This will enable students and staff to collaborate across multiple channels. Office 365 provides access to old favorites such as Word and PowerPoint, alongside new learning and productivity tools like Teams, Class Notebook, Sway and Stream.

Each sign in will allow all users access to a core set of tools and applications for learning, communications and collaboration.



What could the rollout process look like?

Activation of three key steps has enabled schools like yours to successfully implement phases two and three.

Familiarize

Users can start to test, learn and explore their new suite of tools. They are all designed to be intuitive and user-friendly, so everyone should be able to get started right away.

Plan

In collaboration with IT support (whether an internal department or an external technology partner) leaders will need to plan how their school will implement Office 365.

Things to consider in planning are:

- How leaders will support staff to engage with the new platform and tools.
- How to help teachers best understand the benefits of using the new platform and tools with their students.
- How the school will facilitate the migration of your data to each new system.

It's really important to plan this stage carefully. Leaders need to gain an understanding of the time and resources required for training, teaching applications, internal process changes and the impact of data migration.

Also, the migration process may affect key resources and the running of the school, so thorough planning can mitigate any potential issues and delays that may arise during the implementation and data migration stage.

SharePoint & OneDrive

Once the preparation phase is complete, each school is ready to migrate their data to the new systems. For most schools, their IT lead will be responsible for the migration of school data and information together with individual staff files and folders (including the schools' shared drives or existing teaching and learning assets such as curriculum information or lesson plans) to a school SharePoint site or OneDrive.

Because data is housed in the cloud (and can be replicated locally), there will always be an automatic backup that provides you with peace of mind that your data is always secure and available. Files will be accessible anywhere, anytime, on any device.

The current file structure will be the same, so all files will still be easy to find.

OneDrive allows multiple users access at the same time, so users can collaborate on all applications from their desktop or mobile device. It's a more intelligent way of working – data is more secure, sharing is enabled, documents are saved automatically, everyone has access to the same version and work practices are streamlined.

Once users are familiar with Office 365 and data has been migrated, it's time to get key stakeholders involved. We recommended that schools commence training and engagement initiatives as soon as possible to avoid working across two different systems and encountering duplicate information, gaps and inefficiencies. If additional training is required, some schools might use internal teams while others might engage external trainers if there is no dedicated resource in-house.

Also, getting teachers on board sooner rather than later means they too will start seeing the benefits of these new systems in their teaching.

Remember, to get the most out of your new intelligent platform, it's important to have as many staff and students as possible engaging with the tools.

Phase 3: Administration of Schools

What is it?

A single, integrated system for finance, student administration, academic management, attendance, wellbeing, reporting, staff management and more.

This new platform will provide a holistic picture of staff and student administration in real time, saving time and resources, and helping schools focus on the things that matter.

School Data

Administration
Capture applications, enrollments and alumni information

Finance
Perform key accounting, invoicing and reporting tasks

Analytics
View trends and benchmark performance

Student Data

Marksbook
Record and report on academic performance

Attendance
Record and report on attendance history

Academic Reporting
Generate comprehensive academic reports for students and cohorts

Assessment Feedback and Reporting
Evaluate and reflect on student assessments in real time

Student Wellbeing
View and comment on student behaviors and wellbeing

Timetable
Create and share an integrated timetable solution

Calendar
Coordinate classes and events in a centralized calendar

Curriculum Planning
Create online lesson plans and develop curriculum content

What could our rollout process look like?

Preparation for the Administration of Schools (AoS) implementation will involve planning and familiarization sessions for key administration and finance staff. Typically, this planning will focus on three streams—administration, finance and technical activities—each appointed with a dedicated leader.

It's also an ideal time to cleanse existing data (filing, deleting obsolete information, etc.) in preparation for the migration, so each school is getting started on their new systems with accurate information.

Each school's migration process will vary, but for most, the data will be extracted from current systems through an automated process. This will then be uploaded into the new AoS platform with robust quality control checks and oversight along the way.

Once migration has occurred, each school's administration, finance, and IT departments will need to complete a series of checks and sign-offs before full deployment.

Now it's time for leaders to engage their teams.

Each school is now able to leverage a new suite of services and tools for finance and administration that will deliver increasing benefits over time.

Training and how-to resources will be available for users to help them get started and get the most out of their systems.

Phase 4: Insights and Empowerment

What is it?

Leveraging Administration of Schools, Office 365 and external education resources, the Insights functionality provides data driven visuals and information, powered by sophisticated analytics. Schools can start to track, analyze, benchmark and predict educational outcomes.

For leaders, the analytics dashboard will empower them to drive improvement for students, staff and the school. By visualizing data, leaders can start to use insights to monitor and guide their school's continuous improvement.

A single integrated platform will enable schools to see real-time data on everything from student performance to attendance, wellbeing and more, enabling benchmarking against other schools, past years, system averages or broader assessment trends. Analytics will mean that leaders can see how their school's tracking, investigate the impact of new initiatives, quickly gauge their success and allow for proactive planning. They can then make decisions and predict problems before they happen.

Furthermore, proactive notifications of alerts and trends can be sent directly to principals, teachers, parents or students. As the information in each school's database begins to expand, insights become richer and personalized recommendations for each student's learning will become available—empowering leaders to make better decisions for the entire school community.

The possibilities are almost endless.

Phase 5: Portal

What is it?

The portal can be tailored for each school and community. It provides a personalized window to all the integrated tools and technologies based on individual roles within your school. Each user will have a view into key information that is relevant to them, along with personalized updates and recommendations.

For teachers, it will streamline everyday responsibilities such as attendance, curriculum and program plans, feedback and wellbeing notes for students, formative assessments and reporting. The portal will also be a springboard to class resources, files and student data. Depending on a school's needs, mobile apps can be leveraged to make activities such as recording attendance quicker and easier.

A student portal will provide one-stop access to classes, timetables, files and documents, notifications and recommendations. Parents will also have a single place to access their childrens' reports, enrollment capabilities, fees, and school news.

For leaders, their portal provides a single view of school, staff and student performance by surfacing powerful analytics. Streamlined administration tasks and customized financial reporting allows visibility into budgets, invoices, salaries and more.

Digital Transformation Journey Map for Institutions

Microsoft's Digital Transformation in Education (MDTE) is an approach that unites advanced technical capabilities with powerful educational tools. Founded on Catholic Education Western Australia's LEADing Lights program, Microsoft works with partners to deliver an integrated digital education solution designed to bring users together. Underpinned by powerful analytics, this intelligent platform provides a collaborative and engaging environment for users to share knowledge, skills and resources - enriching the education journey for all.

	Outcome	Benefits
Credentials Universal access for every leader, teacher, student and parent to their digital teaching and learning environment, unlocking the platform's potential with a single sign on.	**Single Identity**	A single sign on to all systems and services—without the need for multiple passwords. This saves schools time, offers more control, less downtime and reduces the burden on IT teams.
	Learning Equity	Optimized for universal access across multiple schools; now everyone can start to benefit from market-leading technology, tools and resources.
	Centralized Hosting	Hosted in a sophisticated cloud environment, all data is highly secure. There's no need to maintain multiple environments with complex licensing arrangements and data synchronization issues.
	Governance and Reporting	Permission-controlled visibility is enabled for all users within the system, along with improved reporting and analytical capabilities. This allows greater transparency between stakeholders.
	User Mobility	Users can transition seamlessly between devices and schools without redirecting their records, resources and credentials.
	Access	Unlock all the tools, resources and functionality at your fingertips.
Office 365 A suite of educational tools that empower schools to engage, collaborate and communicate with the latest technology.	**Best-In-Class Tools**	Leverage the most powerful suite of educational tools including the latest apps like Teams, OneNote, Class Notebook, Delve - as well as old favorites like Word, Powerpoint and Excel.
	Manageable Technology	With a single platform supporting many schools, there's no need for individual schools to manage their own applications. Everyone benefits from "build once, available everywhere" system-wide updates.
	Collaboration	Improve productivity and share resources through collaborative working spaces within the school network and beyond. Foster meaningful interactions between users with real-time communications.
	Data Visualization	Review and gather insights from rich, system-wide data through PowerBI and other analytics tools.
	Storage and Security	Unlimited cloud storage is backed by best-in-class security and privacy standards.

	Outcome	Benefits
Administration of Schools A new, improved system for finance, student administration, academic management, attendance and reporting.	**Central Administration and Finance**	Critical administration tasks such as applications and enrollments are housed in a single, easy-to-use system. Coupled with sophisticated finance management and reporting capabilities, these important functions are streamlined across all schools.
	Simplified Student Profiles	A single location for student data - from demographics and wellbeing through to attendance and academic reporting—enabling a holistic view of the student for all users. All student insights move with them if they transition between schools.
	Informed Planning and Forecasting	Integrated calendar and timetable functionality is augmented by real-time analytics to enable improved curriculum and lesson planning.
Insights & Empowerment An analytics hub powered by multiple data sources to drive continuous educational improvement.	**Student Progress Insights**	A unified view of real-time data gives a clearer picture of what critical factors may affect student performance over time. Insights create an invaluable picture of the 'whole child'.
	Predictive Analytics	Visualization of data trends allows you to undertake more informed planning, with the ability to anticipate and proactively resolve potential issues.
	Benchmarking and Trend Analysis	Map performance at a system-wide and individual school level. Realise trends over time periods, school communities or entire networks to understand the impact of specific initiatives and improve outcomes.
Portal An audience-specific dashboard that brings systems and common tasks into a single place.	**Personalized digital hub**	Each user benefits from a central gateway for all their new tools and resources, at any time, on any device. The portal view is customized for the individual, surfacing information and tools relevant to them, along with personalized updates and recommendations.

This resource was developed in partnership with Catholic Education Western Australia's (CEWA) LEADing Lights program. Microsoft would like to acknowledge this collaboration with their digital transformation team. Learn more at leadinglights.cewa.edu.au Enabled by: Azure Active Directory, Office 365, Dynamics 365 CRM, Cortana Intelligence Suite, PowerBI and Dynamics AX.

Checklist: Choosing student devices

Learning requirement	Recommended
Does it run touch friendly apps and is the screen big enough for reading? Touch friendly apps are particularly useful for lower grades, but add richness and content choices for older grades.	**Touch screen** Minimum 10"—larger for creative or technical work.
Does it enable students to think? Research shows students who can take notes, sketch, diagram, write math equations, science formulae and character-based languages build and retain more knowledge, create more ideas, generate more hypotheses, and show better outcomes in general. Inking is critical to thinking.	**Digital Pen** Empower students to take notes, sketch, write math equations, create, ideate, diagram, input science formulae and other essential non-linguistic content.
Does it allow students to type up professional assignments? On-screen keyboards can slow students down as they obscure much of the working space on the screen and often don't support special characters for math or science.	**Full keyboard** (detachable is fine) so students can type assignments and see a full screen.
Will it run full software and prepare students for the knowledge economies of tomorrow? There are millions of software applications available through Microsoft and its partner ecosystem including Microsoft Office and Adobe Photoshop. There are 680,000 apps in the Microsoft store, including Office 365, and tools for both content consumption and creation.	**Ability to run full software** Over 70 percent of job listings globally specifically require skills in full software—as opposed to "apps".
Does it connect to a school network? Often overlooked, it is critical that student devices can connect to share assignments, tasks and resources.	**Dual-band Wi-Fi** (2.4Ghz and 5Ghz) for fast access.
Is it light enough for the backpack? It's important to consider student posture and welfare.	**Aim for under 1.6kg**
Can you connect peripherals for classwork? It's important that students connect to a wide range of printers, graphics tablets, digital microscopes, etc.	**USB port**
Is it school tough? Drops and knocks are inevitable. Look for a device built to sustain rigorous student use, including tough screen, cover and impact protection.	**Robust case and screen** Solid State Drive (SSD).
Will the battery last a school day? It's important that students and classes are not continually interrupted because devices have run out of charge.	**Battery life** Minimum 6 hours that will last over 3 years (1,000 cycles).
Is the device well managed, updated and secure? It's important that students are secured and protected throughout the device life cycle so that they can stay up to date with innovations and manage any threats.	**Always up to date** Regular Operating System and Security Upgrades throughout the supported lifetime of the device.

Checklist: Choosing devices for deep learning

A guide for school systems implementing anytime, anywhere learning.

When selecting educational devices, consider how they will support learning. A low-cost device quickly becomes a high-cost limitation if it restricts students to the bare minimum. Students need to be able to brainstorm, develop ideas, think independently, and skill up on the technology that will take them through school and beyond. Windows devices are designed for deep learning and offer parents and schools a choice in price and capabilities.

Which category of device is right for your students?

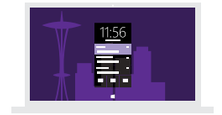
2-in-1, touch and pen Grades 3-12

Digital pen is critical to support multi-modal learning.

Physical keyboard is essential for reporting and assignments.

Full software is critical for unleashing students' creative potential and providing access to uncompromised applications and touch-based apps, allowing learning to continue with or without Internet connectivity.

- ✔ Apps
- ✔ Voice
- ✔ Touch
- ✔ Full software
- ✔ Keyboard
- ✔ Mouse
- ✔ Digitized pen



Laptop Grades 3-12

They can use a full keyboard, write code, edit videos, use full versions of software and create games. Minimum for developing job-ready skills, and carrying our meaningful STEM activities.

- ✔ Apps
- ✔ Voice
- ✔ Touch
- ✔ Full software
- ✔ Keyboard
- ✔ Mouse
- ✖ Digitized pen

Basic Tablet Grades K-2 or as an ancillary consumption device for older students

Basic tablets have significant pedagogical and learning limitations, industry irrelevance, and inability to run full software necessary for employability and deep learning.

- ✔ Apps
- ✔ Voice
- ✔ Touch
- ✖ Full software
- ✖ Keyboard
- ✖ Mouse
- ✖ Digitized pen

Keeping Your Child Safe Online: Parental policy guidelines

Parents or guardians are in the best position to make decisions about what is appropriate for children and to talk to them about online safety. Children may know the technology better than parents do, but you have the wisdom to show them how to make smart choices and to help them use it safely.

Set clear and age-appropriate rules for Internet use

- Make online safety a family effort, a mix of guidance and monitoring.
- Negotiate clear guidelines for using the web and online games that fit your child's maturity and your family's values. Discuss what sites are appropriate, what information can and can't be shared, and the boundaries for communicating with others through gaming, IM, mobile phones, and on social sites.
- For the younger ones, keep the gaming consoles and computers (especially those with webcams) in a central location at home and use net filtering tools to restrict access to websites with offensive content.
- Teach children to keep personal information private. Help all children choose email addresses and account names that are not suggestive. Teach them how to create strong passwords and not to share them with anyone but you.
- Remind children to treat others as they would like to be treated—to be kind and honest online.
- Teach children safe and responsible computer use – to be careful about accepting new friends and not to open attachments or click links with so-called "free offers."

Keep communication open

- Have regular discussions with children about their online activities—who their friends are, the games they play, and the sites they visit. This is also a great way to stay involved in their lives and learn about their interests.
- If there's a problem, teach children to trust their instincts. Ask them to come to you and you'll do what you can to help solve it. It's important to make sure children know that you won't punish them or take away their privileges or devices if they come to you.

Additional recommendations

- Manage and monitor your child's computer use.
- Never let your child have an Internet-connected device that can not be monitored.
- Get reports of your child's computer use.
- Control online access time.
- Don't allow your child to take computers into their bedroom or other places where you can't supervise usage.

Sample Internet Acceptable Use Policy: Staying safe online guidelines for students

Take these steps to guard Internet-connected devices against someone who tries to break in and impersonate or spy on you, scam you, or use malicious software to destroy or steal your photos, games, contact lists, and other information.

The basics

- Keep all software (including your web browser) current with automatic updating.
- Install legitimate antivirus and anti-spyware software.
- Never turn off your firewall.
- Protect your wireless router with a password, and use flash drives cautiously. Microsoft can help you do this: **microsoft.com/security/pypc.aspx**
- Think twice (even if you know the sender) before you open attachments or click links in email, IM, or on a social site.
- Use strong passwords, and DO NOT SHARE THEM— not even with your best friend. Learn how: **aka.ms/ passwords-create**
- Lock your phone with a PIN to keep anyone from making calls, texting, or accessing your personal information.

Share with care

- Information you share online about yourself or comments you post can become public. Plus, they may remain in search results for years to come, potentially visible to a future employer or college admissions officer. Follow this advice to guard against someone turning your information against you to bully or impersonate you, steal your identity, or scam you.
- Don't share suggestive photos or videos. You lose control of where they go.
- If you wouldn't wear it (say, on a T-shirt), don't share it.
- Make your social network pages private. One way is to look for Settings or Options on the social site to manage who can see your profile or photos tagged with your name, how people can search for you, who can make comments, and how to block people.
- Create profile pages and email addresses that reveal nothing personal and aren't suggestive.
- Be choosy about adding new friends on phones or social sites, or in games.

Be a real friend

- Stand up for your friends. Cyberbullies are less likely to target someone who has a strong group of friends, and usually stop when a victim's friends rally around him or her. (Cyberbullies may be surprised to learn that their actions might be crimes.)
- Don't share online personal details of friends and family members without their permission.

Connect honestly and carefully

- Don't download copyrighted music, video games, etc.—it's illegal. Plus, pirated files are often used to distribute viruses and spyware without the user's knowledge.
- Don't be an Internet cheater. Don't copy text from the web or buy finished essays or reports.
- Use only social networks that are right for your age, so you'll benefit from their age-based privacy protections.
- Meeting an online "friend" in person can be risky. Protect yourself: always bring a parent, trusted adult, or friend and meet in a busy public place.

Assistive Technology for Vision Impairment

There are many options for individuals with vision difficulties to modify their computer displays and appearance to make them easier to see or, alternatively, to receive information through sound or touch.

Narrator	**Make your device easier to use without a screen** Describes Windows and apps so that students with vision impairments can interact with them without viewing a screen. It supports 27 languages, with the ability to install more. For Braille readers, Narrator also supports displays from more than 35 manufacturers using more than 40 languages and multiple braille variants, including Contracted (grade 2) Braille.
Read Aloud for Edge	The powerful new Read Aloud feature in Microsoft Edge will read all text from any website, PODF or ePub file.
Magnifier	**Enlarge part—or all—of the screen** This enables students to see words and images better. It comes with a choice of settings.
Cursor and pointer size	**Adjust the pointer color and size to follow the mouse more easily** You can even add trails and touch feedback for students.
Cortana	**Use a digital assistant** Cortana can respond to voice commands to set reminders, open apps, find facts, send emails and texts and more.
Speech recognition	**Enable students to dictate documents, email or surf the web using voice commands** With a little training, it understands individuals. And because it runs locally, no network is required and privacy is protected.
Customization	**Customize your display** Students can alter the text and screen icon sizes and increase the color contrast of text and images so they are easier to see. You can also reduce animations and turn off background images and transparency.
Built-in learning tools	**Improve readability for students with vision impairment** Students can read content in Word documents more effectively by turning on settings in the View > Read Mode. These can read text aloud with simultaneous highlighting, increase text spacing and break words into syllables to promote concentration and comprehension.

Seeing AI app	**Narrates the world around you** Designed for the low vision community, this research project harnesses the power of AI to describe people, text and objects.
Office Lens	**Capture images and make them editable** Using Office Lens students can capture images with real-time voice guidance through VoiceOver. It's easy to snap a photo of the class whiteboard, a printed page or rough sketch on paper and import into OneNote, OneDrive, Word, PowerPoint, Outlook or Immersive Reader where it appears as editable text.
Skype for Business	**Enable screen readers to give automatic announcements** These include conversation invitations, and incoming instant messages and alerts, as well as changes to mute, video and screen sharing states. It's also possible to navigate through the main regions of the application using "F6" and take quick actions after selecting a contact by pressing "Enter."
Notification timing	**Keep alerts up longer** Extend the time a notification will be displayed by up to five minutes, giving students enough time to notice them.
OneNote	**Easier navigation for screen readers** Microsoft is introducing an entirely new design to provide screen reader users a better navigation experience across notebooks, sections and pages.
Office Online	**Use access keys to navigate through the ribbon efficiently without a mouse** It's also possible for screen reader users to work effectively in documents with math equations, comments and real-time co-authoring in Office 365.
Visio	**Screen reader and keyboard users can work with shapes and navigate diagrams** And diagram authors can define the keyboard navigation order of the diagram and include alt-text for shapes, illustrations, pages, masters, hyperlinks and data graphics.
Project	**Enhanced accessibility** Students will find it easier to comprehend and work with the following views: Gantt Chart, sheet views, time line, team planner, usage and form views.

Assistive Technology for Hearing Impairment

Students who have hearing loss or are hard of hearing may be able to hear some sound, but might not be able to distinguish words.

On the computer, adjusting sounds, using alternatives for sounds such as visual indicators and captions, and headphones to eliminate background noise can be helpful options. Accessibility features for those with hearing impairments include changing notifications from sound to visual notifications, volume control, and captioning. These features are available in Windows.

Skype Translator	**Instantly transcribes voice to text** Students won't miss what's being said. They can even type a response and have it read to someone who can't see it. Skype Translator uses machine learning, so the more you use it, the better it gets.
Skype video calling	Use sign language to communicate one on one or in group video calls.
Skype Messaging	**Texting** An easy way for students to communicate via type, while sharing their screens or sending photos, files and videos of any size.
Visual notifications	**Replace audible alerts with visible alerts** Rather than sound cues, the active window or entire screen can flash when a notification arrives.
Closed captioning	**Customize closed caption settings for movies and TV** Windows lets you customize color, size, and background transparency to suit different students.
Mono audio	By default, most stereo audio experiences send sounds to the right and left channel. Windows supports mono audio, so that you can send all sounds to both channels, so students don't miss anything if they have partial hearing loss or deafness in one ear.

Assistive Technology for Mobility/Dexterity Impairment

Mobility and dexterity impairments need to be individually addressed to choose the right mix of accessibility features and assistive technology hardware and software solutions.

Accessibility features built into Windows include keyboard filters that compensate somewhat for erratic motion, tremors, slow response time, and similar conditions. For example, Sticky Keys allows the user to enter key combinations without having to hold one key down while depressing a second. Other options allow users to adjust how quickly a letter appears on the screen when they hold down a key. In addition, Windows allows users to adjust mouse options such as button configuration, double-click speed, pointer size, and how quickly the mouse pointer responds to movements of the mouse. Students can also increase the size of screen elements to provide a larger target, which can benefit people who have disabilities related to fine motor skills.

Cortana	**Use a digital assistant** Cortana helps you get things done, such as setting reminders, opening apps, finding facts, and sending emails and texts.
Speech recognition	**Use voice commands** Dictate documents and email or surf the web just by saying what you see.
The On-Screen Keyboard (OSK)	**Use the On-screen Keyboard** Instead of using a physical keyboard, students select keys using a mouse or any other pointing device like a joystick or trackball. The OSK also helps student author text with word completion and word prediction, saving time for those with mobility limitations.
Sticky, Filter, and Toggle keys	**If students have limited control of their hands** Windows enables them to personalize the keyboard so they can type one command at a time or ignore repeated keys.
Numeric keypad	This can be used instead of the mouse to move the pointer

Assistive Technology for Learning Impairment

The simplified interface in Windows benefits people with learning impairments, as well as people with language impairments, because it helps reduce the number of competing elements on the screen.

Complicated user interfaces can interfere with learning. User interface engineers found that an emphasis on a consistent user experience had the greatest positive impact on individuals with processing problems. Additional computer settings such as adjustable text and screen element sizes, speech capabilities, choice of visual or sound warnings for system events, and Internet display options can benefit those with learning impairments.

Simplify Windows	**Reduce distractions** Windows makes it easy to minimize distractions by reducing animations and turning off background images and transparency.
Edge, Cortana and Start suggestions	**Put suggestions on hold** Start Edge with a blank page and turn off Cortana and Start suggestions when you need to focus. They'll be there when you turn them back on.
Edge Reading View	**Limit distractions** Clears distracting content from web pages so you can stay focused on what you really want to read. You can even change the style to suit your preferences. This also includes options to increase text space and contrast to assist reader requirements.
Fluent Fonts	**Try reading-friendly fonts that avoid visual crowding** Some fonts have been proven to make it easier to read. Fluent Sitka Small and Fluent Calibri are fonts that add character and enhance word and line spacing.
Speech recognition	**Enable dictation** Some students can work more successfully if they can dictate rather than type.
Word prediction and completion	**Help students choose words** The OSK keyboard in Windows help students with a learning disability or cognitive impairment choose the best next word.
Microsoft Edge Read Aloud feature	The powerful new Read Aloud feature in Microsoft Edge will read all text from any website, PDF or ePub file.

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Notes:

> Education is our deepest source of hope—we must plant the seeds now for a better tomorrow."
>
> *World Economic Forum.*

Digital transformation is an indisputable force revolutionizing our industries, reinventing our products, redefining our services and reshaping the way we work. The impact is so dramatic that Klaus Schwab, founder of the World Economic Forum, has dubbed it the Fourth Industrial Revolution. Today's students will enter this very different world. So how do we prepare them for it?

This guide provides an inspiration and a vision for school leaders. It draws on two decades of global research, data, and experiences, taking an unflinching look at what works, and what doesn't in learning transformation.

The result is a short-cut to success. Key concepts, red flags, and powerful questions designed to support transformation at systemic and school level. With insights from thought leaders to align school stakeholders with modern educational thinking.

You'll also find practical help in the form of roadmaps and checklists, as well as recommendations on using technology to teach the future-ready skills that are so vital to today's young people and the success of nations in a global economy.

Every school leader should take time to look through this book before attempting transformational change. It is startling, uncomfortable at times, but it rewards you with a solid foundation on which to move forward.

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