TECHNOLOGY USAGE SCENARIOS

Right Device Recommendations for Learning and Teaching

Lower Elementary: Grades K-2 (ages 4-8)

The early elementary grade levels lay an important foundation for learning. Depending on what country you live in, students are learning to read, developing fluency in reading accuracy and speed throughout second grade, and exploring language through books, rhymes, and writing. Students also are beginning to solve simple addition and subtraction problems, and then grasp more abstract mathematical concepts like time, money, units of measure, multiplication, division, and skip counting. They are exploring animals, habitats, and patterns in nature and becoming interested in historical stories about the world around them. It is important to integrate technology at this level in a way that provides purposeful, hands-on activities that not only further understanding of the subject matter, but also encourage interaction with technology and collaboration with peers. The younger the child, the more important authentic interactivity must be to support learning.

During these years, children should demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software and connectivity. Tablets, 2-in-1s, and educational apps inspire learning in young children through interactions that draw attention to content by providing instructions to touch specific points on the screen in response to audio, text, or video prompts. Specifically, many educational apps and educational games now consist of immersive, kinesthetic activities supported by a touch interface that allows an experience of identifying, moving, coloring, or sequencing comparable to that which was once possible only through books, games, and other traditional materials. Some young students are able to use laptops for basic tasks, but some may be challenged by the motor skills needed to operate a keyboard and mouse.

- **Student device choices:** Tablets and 2-in-1s with touch or pen input allow students to collaborate through exploration and investigation of software and applications. These can be used for one-to-one access, pair or small group collaboration, and/or classroom cart mobility.
- **Educator device choices:** Educators need a mobile, full-featured 2-in-1 that enables them to manage their classrooms and communication efficiently, create and prepare curriculum and digital content, and have a reliable connection to their personal learning communities for ongoing professional development. Educators also need to be able to access the school's network and LMSs from anywhere, so they need the ability to store data or applications in the school's cloud.

Upper Elementary: Grades 3-5 (ages 8-12)

In upper elementary grades, teachers utilize a variety of teaching methods. During these years, students increase mastery of basic literacy and writing skills. Children move from being good readers to being avid readers, and they are encouraged to analyze the genre, characters, plot, and settings of what they read. Children also begin to explore and create their own voice through their writing, understand writing processes, and build research skills. In mathematics, students continue to expand their foundations of primary addition, subtraction, multiplication, and division concepts. They also expand their inquiry through explorations of maps and measuring distances, units of measurement, basic fractions, and complex problem solving. Developmentally, students need a supportive, encouraging, and friendly classroom climate that can involve and challenge students through focused, productive learning activities.

Developing cognitive and motor skills at these ages requires instructional strategies with stimulating activities and constructive teacher-student interaction. Teachers may begin to use technology with students to support student-centered learning endeavors. Teachers may integrate digital learning practices in which children take the lead and explore educational apps in small groups and/or whole-group, teacher-led activities, utilizing a mix of traditional and student-centered learning processes.

Although educators may find that tablet computers are exceptionally well suited for student engagement due to the touchscreen, the capability to connect a keyboard enables the device to be integrated across subject areas and digital assessments as well. For this age group, technology is a useful tool to develop and catalog student portfolios, monitor work and provide feedback. Diagnostic applications and platforms allow for regular monitoring of student progress, collecting and analyzing student data, and providing personalized instruction plans. Often, these diagnostic tools provide tutorials and practice activities that require writing sentences, stories, letters, and expository paragraphs.

Children continue to demonstrate a proficiency in the use of computers and applications, as well as a deeper understanding of the concepts underlying hardware, software and connectivity. Students must also now demonstrate a responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society. Additionally, students will be required to use technology for research, critical thinking, decision making, communication and collaboration, creativity, and innovation. Children will begin to get familiar with e-mail, online discussions through social media, and other web-based environments, as well as calculators, probes, and videos for extended learning and problem-solving activities. Children may use the camera feature and substitute original photos with stock photos within subject matter presentations. In addition, videos may replace the traditional book report. As a result, student engagement improves, and the students may become more likely to remember what they learned by representing their knowledge in their chosen format.

- **Student device choices:** Tablets, Chromebooks*, and 2-in-1s are best for this age group.
- **Educator device choices:** Educators need a mobile, full-featured 2-in-1 that enables them to manage their classrooms and communication efficiently. Teachers can create and prepare curriculum and digital content, have access to their personal learning communities, and continue their professional development opportunities. Educators also need to be able to access the school's network and LMSs from anywhere, so they need the ability to store data or applications in the school's cloud.

Middle School: Grades 6-8 (ages 12-14)

Older students in upper elementary and middle schools strive to become more independent thinkers and learners as they grow and build foundations in preparation for high school. At this age, basic classroom management strategies, consistency, organization, and routine become important as students are much more dynamic. Instructional strategies focus on problem solving, computational thinking, exploration of multiple ways to approach issues, and interactive lessons. Middle school students are expected to understand themes from their readings and be able to write an organized answer in response to a question, write position papers using clear reasoning, and find and provide support for their answers with evidence from multiple resources. The students also begin to work with more abstract and complicated math concepts such as fractions,

decimals and ratios, as well as solving real-world problems through the application of algebraic and geometric concepts and variables with mathematical expressions, equations, inequalities, and graphing skills.

As teachers begin to challenge students through independent, collaborative, and inquiry-based problem solving activities, the use of digital resources in a variety of ways to support teaching and learning occurs more frequently. To support this self-directed student learning, the connected classroom becomes increasingly important. Blending traditional classroom instruction with online and digital content provides access to relevant resources that connect learning to the world beyond the school. The continued use of the Internet and adequate connectivity provide a wide range of resources from the complex, such as interactive math activities, to videos and images, to simpler resources such as stories with interactive graphics or audio.

By this age, children have a working proficiency in the use of computers and applications and have developed a deep understanding of the concepts underlying hardware, software, and connectivity. Students also have cultivated their ability to use technology for research, critical thinking, decision making, communication, collaboration, creativity, and innovation. Students can supplement their projects with interesting new material, making papers and presentations dynamic, diverse, and purposeful through robust connectivity, camera features, and graphics. Often, lessons allow students to use chat tools and video conferencing to communicate and collaborate on projects with their classmates and with external experts.

- **Student device choices:** Laptops, Chromebooks, and 2-in-1s are the best devices for this age group.
- **Educator device choices:** Teachers may experience increased efficiency in classroom management through technology integration into an ecosystem of interactive whiteboards, virtual learning platforms, and wireless connectivity. Here, teaching and learning activities combine with multiple resources or applications to form a digital portfolio so parents and teachers can monitor progress. By utilizing a virtual learning platform to place materials directly into each student's folder, teachers may personalize resources to adjust instruction to each student's level as needed.

High School: Grades 9-12 (ages 13-18)

Secondary students spend most of their time cultivating college- and career-readiness skills. Students need to be prepared to compete in a competitive world that demands more than basic knowledge skills. Pathways to college and career readiness incorporate an important focus on 21st century skills: critical thinking, problem solving, collaboration, communication, creativity, and innovation. These are the skills high school students need to be successful in higher education and on the job market. College and career readiness helps students adopt these modern skills and develop a process for lifelong learning.

By now, students should be master readers of multiple, sophisticated sources, from informational and non-fiction text to literature, and they should be able to synthesize what they read in all contexts and subjects (i.e., history, social studies, the sciences, the arts and humanities), write about it, and continue to analyze it as they develop their critical-thinking skills. Students should also have mastered the ability to apply mathematical computation, algebraic and geometric equations, computational thinking, logic, and reasoning skills to real-world situations.

To create an authentic learning environment with innovative technology would be to create a learning environment that consists of a wide array of learning activities, including content creation, productivity, research, collaboration, demonstration of knowledge and access to supplementary resources and Internet materials. As technology begins to transform the classroom, teachers and students use available tools to significantly redesign their learning activities, including high-end computing power for STEM, parallel program operations, and design curriculum. In the most complex format, scientific or engineering models may be developed in ways that are contextually relevant.

By this age, students should have developed firm technology skills and the ability to make and choose the correct technologies they need for required tasks. They should also utilize online resources and have skills for determining their legitimacy. In addition, they should begin to use technology as an adult would for finances, schedules, addresses, purchases, correspondence, and managing their personal and professional lives.

With the right device and continued access to the Internet, the students increase their ability to have more autonomy and control over the direction of their own learning. Through their connected classroom, they can more easily find their assignments and start working faster and more proficiently. Shifting more control over their own pacing and progress through the material onto the students increases the personalization of their learning experience and opens the possibility for them to push themselves harder.

Increased formative assessment and self-reflection are ways technology can modify traditional instruction. A digital device, combined with a virtual learning environment, will allow schools to integrate easy, computer-supported assessment and self-reflection into any lesson where the technology is available. Digital or online assessments provide students and teachers immediate feedback about strengths and weaknesses. Teachers can integrate assessment and self-reflection into lessons reinforcing personalized learning. In addition to assessment, teachers can apply technologies such as wikis, blogs, or even digital post-it notes for younger students to ask for reflection on the lesson and to discuss what they could do to improve the project or scores next time.

By this age, students have mastered the use of computers and applications, as well as developed a deep and lifelong understanding of the concepts underlying hardware, software, and connectivity. Students have also mastered the use of technology and understanding of ethics and safety issues in using electronic media at home, in school, and in society. They are well on their way to becoming model digital citizens. Additionally, they show mastery in their ability to use technology for research, critical thinking, decision making, communication, collaboration, creativity, and innovation in their work.

- **Student device choices:** The best device for this age group is a 2-in-1 or laptop. These devices can empower a learner through a wide variety of education applications, desktop performance with mobile flexibility, a full-sized keyboard with tablet capabilities, and an active stylus for easy annotating, drawing, or note taking. These devices are lightweight, with flexible connectivity, and a long battery life, and they have processor power for audio, video, graphics and data processing.
- **Educator device choices:** Teachers may experience increased efficiency in classroom management through technology integration into an ecosystem of interactive whiteboards, virtual learning platforms, and wireless connectivity. Using a virtual learning platform to place materials directly into each student's folder helps teachers to personalize learning. Educators also need to be able to access the school network from anywhere and access LMSs, data, or applications in the school's cloud. The best devices for teachers are laptops.

Maker

Maker education, closely associated with STEAM (science, technology, engineering, the arts, and math) learning, is a problem-based and project-based approach to education that relies upon hands-on, often collaborative, learning experiences as a method for solving authentic problems. "Making" is the act of making something—it involves attempting to solve a particular problem, creating a physical or digital artifact, and sharing that product with a larger audience to review. It is a way for children of all ages to tinker, construct, and create together.

The maker movement has its roots outside of formal schools, in institutions such as science museums and libraries, and in the informal activities that everyday people have taken part in for years. It began expanding more and more over the past decade through the rise of popular events such as maker faires. With more increased accessibility to open-source software and hardware, digital tools, microcontroller platforms such as Arduino/Genuino, other low-cost electronics, robotics, and rapid-prototyping tools such as 3-D printers, making has become much easier for educators and students to access.

The maker movement also offers a way for students familiar with more traditional shop program classes, such as metalworking and woodworking, and home economics and art activities, such as arts-and-crafts and sewing, to combine their interests to build innovative things and solve complex problems. Maker spaces are creating new learning environments in schools, taking the place of these more traditional programs, which have all but vanished from formal education.

In the maker space, creativity and exploration often take place as independent or small group learning interests but would not be possible without access to technology. Collaboration across digital networks enables interaction with experts beyond a student's classroom or immediate geography through features such as video conferencing or text messaging, communities of practice, or social media.

Today, maker education is redefining teaching and learning spaces. It is promoting broader access to this new type of learning opportunity for diverse interests beyond the formal classroom environment. In addition, it is influencing educational practices through direct experiences that illustrate the value of these exploratory, empirical, and experimental approaches to learning.

Maker education is not something set in stone by grade level or age. For students, it is more about building foundational skills and expanding on these skills over time as they master different techniques. For teachers, the biggest factor is safety—making sure students at specific ages understand what they are doing and why, all in safe yet constructive ways. Teachers of any subject or grade level can integrate maker concepts and activities and maker spaces into their classrooms and schools just as students at any age—as long as they have the correct skills—can be innovative makers.

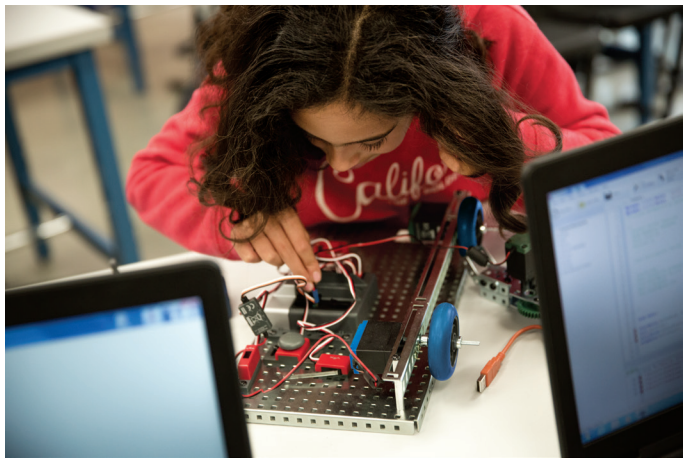
Beginners (early elementary, ages 5-8)

Maker education for students in elementary school focuses on helping students build foundational skills. Teachers strive to teach reasoning and computational thinking skills through basic, hands-on activities, as well as to familiarize the children with the tangible tools needed to build, design, and innovate in the coming years. As students become more aware of the design of the world around them, they begin to see themselves as people who can affect that design and are also empowered to do the work to tinker, hack, and improve it.

Students at this age are introduced to many concepts surrounding engineering, abstract and design thinking, and tangible programming. The idea is to help the children understand the process for why and how to do things with the correct tools and strategy. They may learn about how a circuit works by completing one or play logic-building games to build reasoning insights. They may also build with construction toys, like LEGO*, or sculpt with clay or paper supplies, to learn more about how things fit and work together, the building blocks of engineering and design. Then they may tie together their work—combining simple electronics and simple machines to design new inventions that integrate their new knowledge. Additionally, they may begin to thread in artistic skills through sketching, coloring, and designing and explore math concepts of angles and numbers through coding and design—all to build concrete support for their future exploration.

Intermediate (upper elementary and middle school, ages 8-13)

Once the children have built a firm foundation for both the process and the tools, intermediate maker students are now ready to start to further develop their diagnostic and problem-solving skills and apply their foundation skills to more complex activities. When children at this level enter a makerspace in their school, their frame of reference should shift from finding the right answer to asking the right questions and using the right tools. Intermediate maker students will continue to learn STEAM skills through engineering, programming, design, construction, and logic. But now they will begin to learn how to use and integrate digital software programs such as Scratch*, Blockly*, Turtle Art*, Inkscape*, and Tinker Cad* to enhance their innovations. They will also use additional hardware tools such as laser cutters, 3D printers, digital cameras, vinyl cutters, and needle and thread to explore many new projects that enhance their creativity. Finally, students can begin to integrate microcontrollers, resistors, small motors, capacitors, breadboards, conductive wire, LEDs, copper tape, conductive thread, yarn, and fabric, batteries, buttons, and switches into their projects, along with more analog materials like PVC pipe, wood, metal, and cardboard to build skills in electronics, conductive textiles and fabrication, design, and construction.



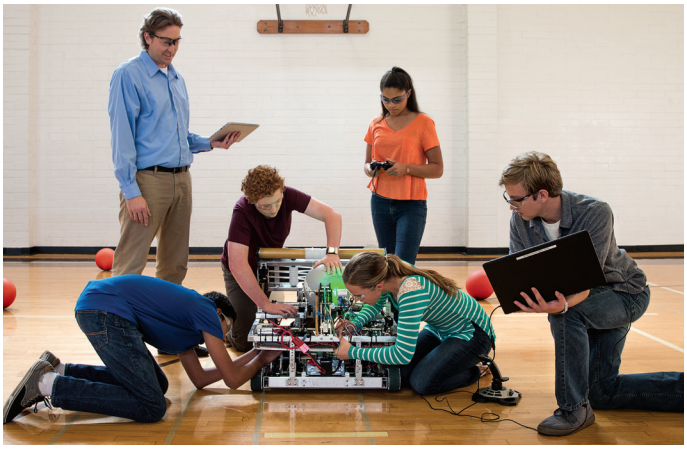
Advanced (middle and high school, ages 13-18)

Advanced makers are makers who have mastered the skills and have the agency and confidence to apply their innovative process and skills to enhance their own learning. Advanced students are ready to use all of the skills and tools they have learned to build, create, hack, and innovate to address real-world problems. As students become more advanced, they can increase their skill sets by using more complex software and hardware and running it by themselves or teaching it to others. Students who had previously worked with Scratch and Blockly visual programming languages might now move onto text-based languages like Arduino or Python*. Additionally, students who originally used programs like Tinker Cad to plan their 3D creations might now move on to AutoCad*. Students at this level will also continue to build, using all the materials and tools they used as intermediate

makers. These tools bring electronics, programming, and computational mathematics together in meaningful, powerful ways. Advanced students can use them more masterfully to begin to create new and innovative projects of their own making and choosing.

Teachers

A successful maker teacher needs to be able to help students diagnose a problem so that the student can create a solution. The teaching process must shift from transmitting knowledge, as with direct instruction, to enabling a student to create their own answers. As there is no way that any one teacher can be a subject matter expert in everything a maker student might need or want to know, teachers should immerse themselves in the maker movement and attend professional development opportunities and maker events to stay up to date and learn how to drive a creative and innovative mindset. These activities will help teachers to both integrate maker into their classrooms and curricula and build the skills to advocate for more dedicated maker, innovation, and creativity spaces within the school.



Designing a 360-degree learning experience

Schools face the challenge of creating personalized and relevant learning experiences for students while preparing them with modern skills to meet the demands of the 21st century workforce. Choosing the right devices for learning and teaching is an important decision on the journey to personalized learning. However, schools must also consider how the devices, classroom technologies and school campus will connect with and be supported by the education IT infrastructure. A robust infrastructure gives students and educators secure access to the Internet, cloud, data, apps, digital content, learning platforms, analytics and more, as they strive toward personalized, meaningful learning experiences enhanced with technology.

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