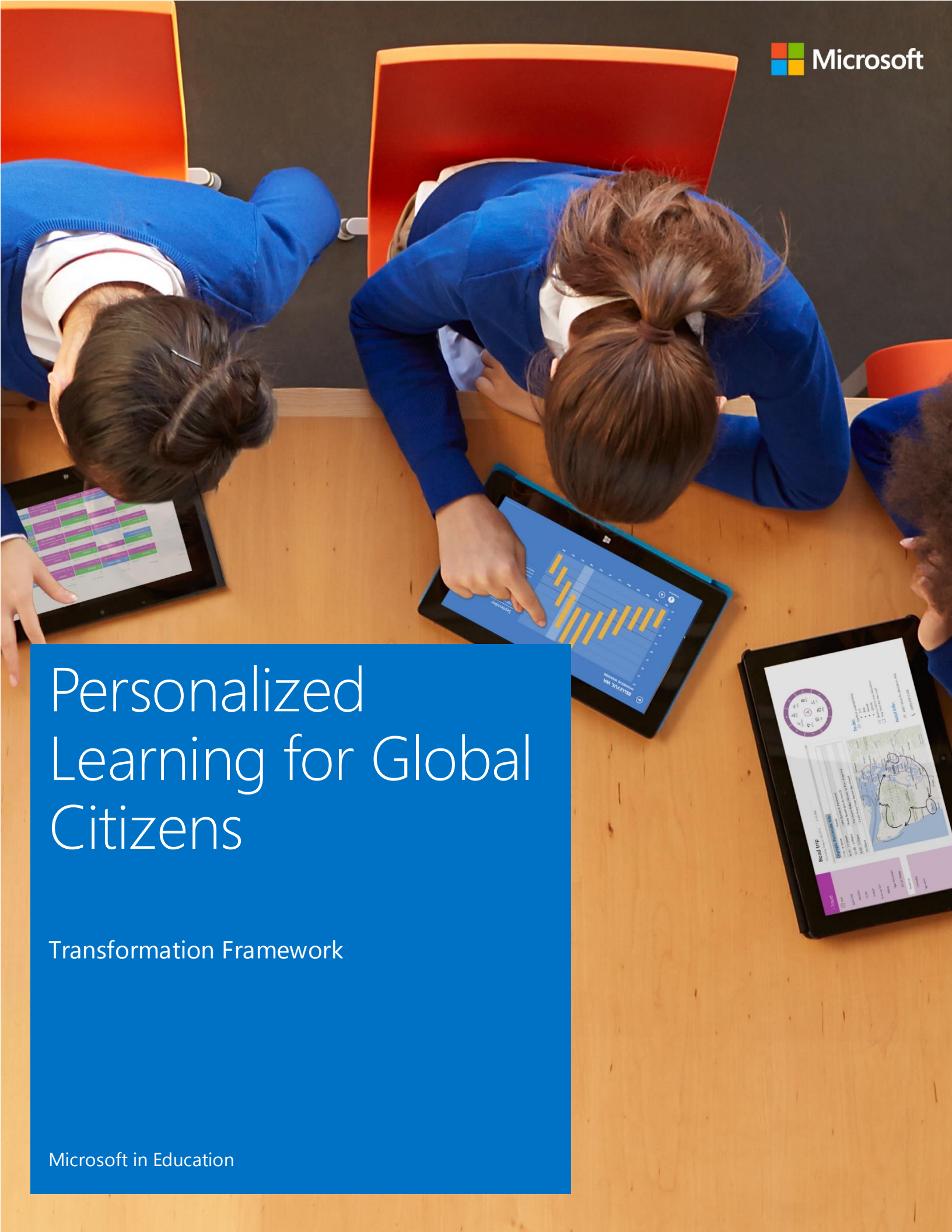

Microsoft

Personalized Learning for Global Citizens

Transformation Framework

Microsoft in Education

About this series

The Microsoft in Education Transformation Framework is a guide for educators and leaders engaged in holistic education transformation. The critical conversations needed for effective transformation of education systems are the focus of this paper series. Each expert author presents a global perspective on the topic through the current thinking and evidence from research and practice, as well as showcase examples. Specifically, the papers document the contributions of anytime anywhere approaches to K-12 learning and explore the potential of new technology for transforming learning outcomes for students and their communities.

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- Curriculum, Content, and Assessment for the Real World
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- Learning Communities and Support
- Building Leader and Educator Capacity for Transformation
- Transforming Learning Environments for Anytime, Anywhere Learning for All
- Designing Technology for Efficient and Effective Schools

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Personalizing learning means students choosing courses, goals, and pathways to achieve those goals, enabled by technologies that customize learning paths for students by way of data dashboards that help students navigate through their learning. Personalized learning is made scalable as a result of the capabilities that technology has reached in recent years. In this paper, we highlight the research on personalized learning, provide examples of personalized learning facilitated by technology, and offer guiding principles for leaders and educators who are planning personalized learning programs.

UNESCO's Information and Communications Technology (ICT) Competency Framework for Teachers also include personalized learning by asking that teachers "identify a personal professional learning goal and create a plan for the use of various ICT tools to accomplish this goal…" (p. 25), preparing them for the work that they will do with personalizing learning for their own learners. OECD (2006) describes the imperative for personalized education to overcome socio-economic, time, and space limitations through educational policy and practice whereby every student matters and education opportunities are maximized through fostering learning skills and motivation.

Personalized learning has resurged in recent years as educators have recognized the merits of technology's role in facilitating cost-effective personalized learning and bringing it to scale. Around the world, technology is allowing schools to design customizable learning pathways for individual students and provide data-rich feedback cycles for teachers and students (Patrick, Kennedy, & Powell, 2013). Personalized learning is neither a new concept, nor a complete departure from established education practice. Today, when educators think of personalized learning, they think of students choosing courses, goals, and pathways to achieve those goals. They think about the use of technologies that will allow for the customization of personalized learning paths for students by way of data dashboards that help students navigate through their learning. Personalized learning is made scalable as a result of the capabilities that technology has reached in recent years. In this paper, we highlight the research on personalized learning, provide examples of personalized learning facilitated by technology, and offer guiding principles for leaders and educators who are planning personalized learning programs.

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Personalized education has the potential to help overcome socio-economic, time, and space limitations through educational policy and practice whereby every student matters and education opportunities are maximized through fostering learning skills and motivation.

- OECD, 2006

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Personalized Learning

Personalized Learning: History, Theory, and Meaning

In the last few years, personalized learning has become a popular topic in education circles around the world. Major theories and hypotheses including cognitivism (Piaget, 1985), constructivism (Piaget, 1950), universal design for learning (Orkwis & McLane, 1998), situated learning (Lave & Wenger, 1991), connectivism (Siemens, 2014), differentiation (Tomlinson, 1999), revised Bloom's taxonomy (Anderson & Krathwohl, 2001), and recently Depth of Knowledge levels (Webb, 2005) are often associated with personalized learning. Many organizations have created their own definitions of personalized learning. In 2010, the U.S. Department of Education published the following definition in the *National Educational Technology Plan*: "Personalization refers to instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary" (p. 38). The International Association for K-12 Online Learning envisions personalized learning as "tailoring learning for each student's strengths, needs, and interests – including enabling student voice and choice in what, how, when, and where they learn – to provide flexibility and supports to ensure mastery of the highest standards possible" (Patrick, Kennedy, & Powell, 2013, p. 4).

In the early 20th century, two educational movements in the United States helped to set the stage for personalized learning. The first was the Winnetka Plan of 1919, which focused on the "whole child" and his/her physical, emotional, social, and intellectual education. The Winnetka Plan used mastery learning and required the student to become competent in the content before moving onto the next concept (Butts & Cremin, 1953; Cubberley, 1947; Gutek, 1986). In 1920, the Dalton Plan introduced the need for balance between a child's individual needs and those of the community. The Dalton Plan provided the opportunity for students to manage their learning time and incorporated the teacher as a resource rather than a lecturer. Additionally, the Dalton Plan tailored learning to each student's needs, interests, and abilities, promoting their independence and dependability, while enhancing their social skills as well as their responsibility toward others (Dewey, 1922). At a similar period in Europe, Montessori education was first initiated, offering students a choice of learning activities tailored to their needs and freedom of movement within the classroom.

Learn more about the Dalton Plan and how it influenced Montessori education.

Dalton Plan by Helen Parkhurst

In 1970, the term *personalization* was coined by Victor Garcia Hoz in his work "Personalized Education" (Hoz, 1982; Hoz, 1997). According to Hoz, personalization is the learner's journey to developing their freedom of choice. Hoz believed that the learner should be in control of his/her life experiences. Similar to the Winnetka and Dalton Plans, Hoz felt that the learning environment should be cognizant of the learner's cognitive, affective, and social-emotional development. Based on Hoz's work, personalized education had two objectives:

Learning goals should be created with input from the learner and should be based on the following personal developmental characteristics, including learner preferences, creativity, freedom, originality, autonomy, socialization, and communication; and

Learning environment and activities should be organized around the learner, and the work should be designed to allow for student control of learning where the student can create and discover by using a variety of learning resources. Teachers guide the autonomous learning of the student.

Research on Personalized Learning

Having laid the historical, theoretical, and semantic groundwork for personalized learning, we next take a look at the important practical evidence base that exists to support it. A large part of the research that has been done for personalized learning was compiled by the UNESCO International Academy of Education's International Bureau of Education in their publication on "How Children Learn" (Vosniadou, 2001). Within this publication is a list of 12 elements of personalized learning, each of which was supported by research. The 12 elements include (1) active involvement; (2) social participation; (3) meaningful activities; (4) relating new information to prior knowledge; (5) being strategic; (6) engaging in self-regulation and being reflective; (7) restructuring prior knowledge; (8) aiming towards understanding rather than memorization; (9) helping students learn to transfer; (10) taking time to practice; (11) developmental and individual differences; and (12) creating motivated learners. The 12 elements are discussed below in conjunction with their research base. A few of the elements are combined due to their close relationship with one another. Also included, where available, are examples of current practices in schools.

Active Involvement and Aiming Towards Understanding Rather than Memorization

At its foundation learning requires the active and constructive involvement of the learner in applied learning situations (Elmore, Peterson, & McCarthy, 1996; Piaget, 1978; Scardamalia & Bereiter, 1991). The maker movement[1], a trending topic around the world that is inspired by Dewey's learning by doing (1916) and Papert's learning by making (or constructionism) (Papert & Harel, 1991), is an example of a learner's active involvement in their educational experience. From the Homebrew Computer Lab of the 1970s to Code.org's Hour of Code and student events like Imagine Cup, the idea of active involvement is key to inspiring creativity, self-reliance, problem-solving, and decision-making in learners (Robinson, 2011). Another current theme in education that promotes active learning in K-12 learning environments is project-based learning, which encourages students to explore real-world problems that they are interested in with the goal of working through possible solutions to help solve the problems.

For example, a group of seventh graders at King Middle School in Portland, Maine, worked with science experts to understand what bacteria exist in the environment and how the bacteria impacts the students' lives. As an end product, the students reported their findings to the community at large in an e-pamphlet on the beneficial aspects of bacteria (Edutopia.org). The project also incorporated multiple disciplines, including science, math, language arts, social studies, art, and multimedia. Interdisciplinary education is profoundly important and contributes to active learning as well (Torp & Sage, 1998). Just as with active learning, learning is more authentic when material is organized around general principles and explanations, rather than when it is based on the memorization of isolated facts and procedures (Halpern, 1992; Resnick & Klopfer, 1989; Perkins, 1992). Project based learning and other applied learning strategies move beyond the standardized testing assessment structure that focuses on memorization and emphasizes the learners' need to come to understand what they are learning. Assessment companies and consortia such as Pacific Metrics, Smarter Balanced Assessment Consortium (SBAC), and the Partnership for Assessment of Readiness for College and Careers (PARCC) are using

[1] See makerfaire.com or diy.org

what is known about assessment and cognition research and through the deployment of technology, developing new technology-enabled items that allow for better information about students' understanding (Winter, Burkhardt, Freidhoff, Stimson & Leslie, 2013).

Social Participation

Learning is primarily a social activity and participation in the social life of the school is central for learning to occur (Brown, Collins, & Duguid, 1989; Collins, Brown, & Newman, 1989; Rogoff, 1990; Vygotsky, 1978). According to learning theory, negotiation in learning helps students make meaning of what they are learning. Put simply, learning becomes a dialogue between multiple learners attempting to come to a shared understanding. Social participation in the classroom/learning environment, in the school as a whole, and even outside of school has been strongly related to self-efficacy, respect for diversity, self-confidence, collaborative skills, avoidance of risk behaviors, and resilience (Billig, 2000). Today, forward-thinking schools are engaging their students as stakeholders in the school and providing them a chance to have a voice in systemic improvement (Holcomb, 2007). Additionally, in some schools, students are also getting more involved in service learning at the community level to take part in their civic role as citizens. Service learning is a way for students to be involved in their community and to make meaningful contributions to society.

An example of this type of service learning is a group of visually-impaired elementary and middle schools students in West Virginia who worked together to raise money for a local animal shelter; to do this, they produced, packaged, and marketed dog biscuits with all proceeds going to the Humane Society (West Virginia Department of Education, 2000). A 3rd/4th grade classroom in Okemos, MI are using online and community-based social strategies in their efforts to get the Northern Spring Peeper frog adopted as Michigan's state amphibian. What began as a basic classroom lesson on state symbols exploded to a multi-faceted learning immersion project that, thus far, has included content in government, language arts, visual arts, interviewing, communications, and social media. In students' "Peeper Promotion" efforts, they have written formal letters, lobbied their local Representative (who subsequently sponsored a bill), held radio interviews, drafted fliers and engaged local businesses, campaigned at events, created T-shirts, and developed a Facebook page.[2]

[2] https://www.facebook.com/MIspringpeeper

Additionally, and more recently, serious games, a type of game designed for purposes other than purely entertainment, are providing a way for students to engage in both meaningful learning and collaboration with others (Connolly, Boyle, MacArthur, Hainey & Boyle, 2012). Robotics clubs have also risen in popularity. Robotics clubs are typically a course or an after-school activity where groups of students work together to build a single robot. Once their robot is completed, they travel and represent their communities in competitions across the country and around the world. In addition, online learning in general helps to expand students' social circles, providing them additional peers beyond those who attend their face-to-face school. Another example is the Deeper Learning MOOC where students at High Tech High built an energy efficient house.[3] For the activity, students had to work with experts in the area of green housing, energy efficiency, and construction in order to build the house. In this capacity, students were working together to learn more about the topic and then applying their knowledge to a true-to-life learning situation. In computer science, pair programming is another situation where social participation helps to further learning. Paired programming is where students work together to create computer programs (Cockburn & Williams, 2011). Kodu Game Lab, a simple visual programming language is used by students working in teams to create games[4]. Students decide on a game concept, and produce the game together, with students taking on specific roles whether training peers in how to use the tools, creating graphic elements, programming game mechanics, or creating a pitch to explain the game to other students in the class.

Learn more about High Tech high.

Meaningful Activities and Helping Students Learn to Transfer

People learn best when they participate in activities that are perceived to be useful in real life and are culturally relevant (Brown, Collins, & Duguid, 1989; Heath, 1983). This element helps to bridge the gap between what students are doing in school and what they do at home and in their life as a whole. Bridging the gap between school and home life allows for more authentic learning and better transfer of knowledge to future learning situations. Learning becomes more meaningful when the lessons are applied to real-life situations and are easier to transfer to other learning situations (Bruer, 1993; Bransford, Brown, & Cocking, 1999; Bereiter, 1997). An example of

[3] https://www.teachingchannel.org/videos/tiny-house-collaborative-project-hth
[4] http://www.kodugamelab.com/

authentic learning is a Global Issues course that was designed by Michigan Virtual School (MVS) to bring American students together with students in England. Within the course, there were co-teachers, one from MVS and the other from England. By exposing the students to global issues, such as global warming and hunger, illustrating the differences in perspectives on how each defined the problem and the scale of the problem, and examining how it was culturally tied to where they were located, a deepened conversation between the two student groups brought the course to life, expanding their learning beyond the typical textbook. Students at the end of the course had to create a local impact plan to bring what they learned to the attention of their community in an active way.

In addition to authentic learning, learning also needs to be culturally relevant (Ladson-Billings, 1994). The term culturally relevant has also been labeled culturally appropriate (Au & Jordan, 1981), culturally congruent (Mohatt & Erickson, 1981), culturally responsive (Au & Jordan, 1981), and culturally compatible (Jordan, 1985). Within culturally relevant learning environments, students have access and equity to learning environments that help them to attain academic success, are engaged in activities that help them learn about and develop their understanding of their own culture, and are encouraged to be critically conscious and question cultural norms, institutions, and values. Culturally relevant education can and should be incorporated into all disciplines; an example of this in physical education courses would be to introduce culturally-based games including *Mulambilwa*, an African bowling and running game, *Kho-Kho*, a chase game originating in India, *Yemari*, a Japanese handball game, and *La Pelota*, a Mexican ball game (Harbin, 1964).

These examples illustrate how schools are embedding 21st century skills into teaching and learning. Learn more about the assessment and teaching of 21st century skills from the Assessment and Teaching of 21st-Century Skills (ATC21S).

Relating New Information to Prior Knowledge and Restructuring Prior Knowledge

Learning is in part the acquisition and construction of knowledge built on the foundation of what is already understood and believed by the learner (Bransford, 1979; Bransford, Brown, & Cocking, 1999). This is critical for students because it is key to comprehension, requiring students to make sense of their learning experiences in the context of what they already know (Kujawa & Huske, 1995) and recognizing how each of these experiences builds on one another. When this

understanding and recognition does not happen, prior knowledge can stand in the way of learning something new. To overcome this, students must learn how to solve internal inconsistencies and restructure existing conceptions when necessary (Piaget, 1978; Carretero & Voss, 1994; Driver, Guesne, & Tiberghien, 1985; Schnotz, Vosniadou, & Carretero, 1999; Vosniadou & Brewer, 1992). An activity often used to engage students' prior knowledge is "think-pair-share" in which students have to think about the topic-at-hand silently, then pair up with a partner to talk about what they thought about, and then share out their thinking with the rest of the class (Lyman, 1981).

An example of this for a technology skills course would be for students to talk to each other about their prior knowledge of website design before they design a website, asking such questions as "When you look at a website, what are some key design features that you like or dislike? If you could design an ideal website, what features would you include?" Another example would be students learning a new coding language. While the specific commands and structures may be different, many coding languages are based on basic logical equations (if/then statements) and follow the same logical principles, meaning that students may draw on the prior knowledge learned from one coding language to understand the basics and provide a foundation for learning the new language. Another place where students can work to build on knowledge is through Minecraft, which helps students use the knowledge that they have acquired in their life and use that to take care of themselves in the game, to see to their basic needs, including food, water, sleep, security, shelter, and homeostasis. During this practice, their prior knowledge is sometimes questioned, and they have to restructure it with the new information they learn from their interaction with the game. Anytime anywhere access to powerful personal computing environments affords these engagements when students are ready to build their knowledge and skill.

Learn more about how Minecraft is being used in education: MinecraftEDU

Being Strategic

People learn by employing effective and flexible strategies that help them to understand, reason, memorize, and solve problems (Mayer, 1987; Palincsar & Brown, 1984; White & Frederickson, 1998). One of the keys to being strategic is thinking critically. Critical thinking is required for questions that do not have simple answers; in asking such questions educators can promote critical thinking in learners. Some learning programs are taking it one step further and preparing students to be strategic by teaching them computational thinking (Papert, 1996). Computational thinking for K-12 provides learners the chance to analyze and logically order data; model data; create data abstracts and simulations; formulate problems for computer assistance; identify, test, and implement possible solutions; automate solutions via algorithmic thinking; and generalize and apply this process to other problems (Stephenson & Barr, 2011). Several programs have been developed to foster computational thinking including (but not limited to) MIT's *Scratch*, Carnegie Mellon's *Alice*, Microsoft's ***Kodu*** and University of Kent's *Greenfoot*. Code.org, a non-profit is working to provide widespread and easily accessible opportunities to learn coding as well. Additional examples of fostering strategic thinking in schools around the world also includes mindmapping with technology tools, such as *NovaMind Mind Mapper* and online journaling in ***OneNote***. These types of activities have come to fruition within blended learning spaces around the world (Ferdig, Cavanaugh, & Freidhoff, 2012).

Engaging in Self-Regulation and Being Reflective

Learners must know how to plan and monitor their learning, how to set their own learning goals, and how to correct errors (Brown, 1975; Boekaerts, Pintrich, & Zeidner, 2000; Marton & Booth, 1997). Self-regulation is a set of knowledge and skills that allows learners to appropriately reflect upon and respond to their surroundings based on what they see, hear, touch, taste, and smell, and to compare that perception with what they already know (Bronson, 2000). This practice of self-regulating allows learners to figure out how to react via their thoughts, emotions, and behaviors. Research has shown that increasing students' self-regulation results in increased

comprehension and achievement in their learning (Mace, Belifior, & Hutchinson, 2001). Such self-regulation processes include self-monitoring, self-instruction, self-evaluation, self-reflection, self-correction, and self-reinforcement. There are a few common strands across self-regulated learning theories. The first is that learners must have an active role in developing their skills and knowledge towards the attainment of their learning goals. The second is that self-regulation is an iterative process where the learner sets goals, decides how to achieve those goals, monitors to see how the process is going, and then changes the course of action if something is not working effectively. The third idea is that motivation plays a key role in learning, specifically for self-regulated learning, and external motivators may need to be used until intrinsic motivation can develop. As Cavanaugh (2014) points out, "Blended programs are most effective when they use technology to increase individualization and opportunity for reflection on learning" (p. 59).

An example of this is within an AP Macroeconomics course at *MVS*, students in the course were asked to use various resources in a shared virtual space or open educational resource (OER) area. The instructor added resources that presented the content in a variety of ways and allowed the students to negotiate which resource was most useful to them.[5] A teacher in Zeeland, Michigan, Tara Maynard, was featured on the *MyBlend* website[6] talking about how she personalizes learning for her students. She uses a flipped classroom model in her 8th grade math class where students learn content and take notes outside of the course via videos and other resources, and then when they get to class, they do assignments, such as projects, to put their learning to practice. When students have questions, Ms. Maynard is there to respond and personalize based on the needs of the students. Ms. Maynard emphasizes that students self-check their understanding and ask peers and their teacher for help along the way.

[5] http://media.mivu.org/mivhs/apmicroecon/APEconomicsOverview/player.html
[6] http://myBlend.org

Taking Time to Practice

Learning is a complex activity that cannot be constrained to a specific time limit. It requires considerable and variable time and periods of deliberate practice to start building expertise in an area (Bransford, 1979; Chase & Simon, 1973; Coles, 1970). Some research emphasizes that it takes 10,000 hours to become an expert on something (Ericsson, Krampe, & Tesch-Romer, 1993). Other researchers emphasize that there are other factors involved beyond deliberate practice that need to be taken into account (Hambrick, Altmann, Oswald, Meinz, Gobet, & Campitelli, 2014). Two key factors are time spent in deliberate practice and the spacing between practice sessions (to avoid burnout). A key piece to personalized learning is creating personalized pathways for learners and going beyond the seat-based time that is allotted in traditional school days. In practice, this takes the form of students designing their own learning plan based on their current knowledge, learning needs, and future goals, allotting the time they need for each content area. Instead, some states are looking more at competency, mastery, or proficiency-based paths so that learners can learn at their own pace (Patrick, Kennedy, & Powell, 2013). A few examples of technologies that could help students with practicing could be collaborative projects with peers and mentors in cloud-based conferencing tools. Simulations, which have a long history in medicine (Cooper & Taqueti, 2004) and business (Keys & Wolfe, 1990) training, are also excellent examples that offer unlimited practice on many tasks that are difficult with physical materials, continuous advances in digital technology also afford more realistic, complex, and socially connected simulations. Online learning also allows students mobile access to learning content 24-7, provides students the opportunity to go at their own pace, and specifically, asynchronous learning gives them the chance to practice and repractice, which is something that we have not been able to replicate in the traditional classroom (Cavanaugh, 2009).

Developmental and Individual Differences

Children learn best when their individual differences are taken into consideration (Case, 1978; Chen et al., 1998; Gardner, 1991; Gardner, 1993). There is a need for learning to be designed to meet the developmental and individual differences and needs of all students. One way in which many schools are approaching this is to use Universal Design for Learning (UDL) which is a framework designed to meet the needs of all students. There are three principles of UDL and their subsequent guidelines and checkpoints are detailed below. The research evidence for all Checkpoints can be found on the UDL Center website[7]:

"Children learn best when their individual differences are taken into consideration."

(Case, 1978; Chen et al., 1998; Gardner, 1991; Gardner, 1993).

Table. Universal Design for Learning: Principles, Guidelines, and Checkpoints

Principle	Guideline	Checkpoints
Provide multiple means of representation	Provide options for perception	1.1: Offer ways of customizing the display of information 1.2: Offer alternatives for auditory information 1.3: Offer alternatives for visual information
	Provide options for language, mathematical expressions, and symbols	2.1: Clarify vocabulary and symbols 2.2: Clarify syntax and structure 2.3: Support decoding of text, mathematical notation, and symbols 2.4: Promote understanding across languages 2.5: Illustrates through multiple media
	Provide options for comp	3.1: Activate or supply background knowledge 3.2: Highlight patters, critical features, big ideas, and relationships 3.3: Guide information processing, visualization, and manipulation

Microsoft education products and partners facilitate the decoding of mathematical notation and symbols.

- Microsoft Mathematics
- Equation Editor
- FluidMath

[7] http://www.udlcenter.org/research/researchevidence

Principle	Guideline	Checkpoints
Provide multiple means of action and expression	Provide options for physical actions	4.1: Vary the methods for response and navigation 4.2: Optimize access to tools and assistive technologies
	Provide options for expression and communications	5.1: Use multiple media for communication 5.2: Use multiple tools for construction and composition 5.3: Build fluencies with graduated levels of support for practice and performance
	Provide options for executive functions	6.1: Guide appropriate goal-setting 6.2: Support planning and strategy development 6.3: Facilitate managing information and resources 6.4: Enhance capacity for monitoring progress

Principle	Guideline	Checkpoints
Provide multiple means of engagement	Provide options for recruiting interest	7.1: Optimize individual choice and autonomy 7.2: Optimize relevance, value, and authenticity 7.3: Minimize threats and distractions
	Provide options for sustaining effort and persistence	8.1: Heighten salience of goals and objectives 8.2: Vary demands and resources to optimize challenge 8.3: Foster collaboration and community 8.4: Increase mastery-oriented feedback
	Provide options for self-regulation	9.1: Promote expectations and beliefs that optimize motivation 9.2: Facilitate personal coping skills and strategies 9.3: Develop self-assessment and reflection

New within the last year at Khan Academy is their Learning Dashboard that allows students to identify their areas of strength and where they need improvement, as well as see their progress and customize their learning path.[8] At Summit Public Schools, students create their own playlists that include courses, course content, and resources for learning in order to master content knowledge.[9] At Michigan Virtual Learning Research Institute (MVLRI), the researchers are looking at ways to visualize student data to help teachers identify and help those students who are struggling.

Microsoft tools help teachers visualize student data in different ways.

Read about Microsoft's Power BI tool. (via TechCrunch)

How can *Power Bi* be used in education?

[8] https://www.khanacademy.org/about/blog/post/58354379257/introducing-the-learning-dashboard

[9] http://www.activateinstruction.org/story/activate-helps-summit-public-schools-prepare-self-directed-college-ready-students/

Creating Motivated Learners

Learning is critically influenced by learner motivation. Teachers can help students become more motivated learners by their behavior and the statements they make (Deci & Ryan, 1985; Dweck, 1989; Lepper & Hodell, 1989; Spaulding, 1992). Some research based strategies for motivating learners include becoming a role model for student interest; getting to know students; using examples freely; using a variety of student-active teaching activities; setting realistic performance goals; placing appropriate positive emphasis on testing and grading; being free with praise and constructive criticism; and giving students as much control over their own learning as possible (Bain, 2004; Nilson, 2003; DeLong & Winter, 2002). This element is also important when thinking about authenticity. If students are able to learn ideas that are connected to their lives and produce representations of their knowledge in ways that matter, they are more motivated.

Another way students are personalizing their learning is by creating paths that works for them. An example of this is Personalized Learning Environments (PLEs), investigated as an application of Drexler's networked learner, and effective for complex collaborative learning (Drexler, in press). In a PLE, the student selects the tools and communities that will best meet his or her learning objectives. Allowing students to choose their own path or have choice in their learning motivates them to continue learning. The following section is intended to help practitioners realize personalized learning in their classrooms and schools based on the research base and examples presented above.

Realizing Personal Learning

Using the research base discussed above, the following provides components for creating personalized learning environments for K-12 students.

- **Create learning environments that allow students to be actively involved in their learning process. Incorporating project-based learning (PBL) is just one example of this.**
- **Assess students in meaningful ways where they can apply their understanding.**
- **Encourage students' social participation in both classroom/learning environment spaces, school communities, as well as the community at large outside of the students' learning space.**
- **Engage students in meaningful activities that are culturally relevant and true-to-life.**
- **Scaffold students to support the transfer of knowledge from one context to another.**
- **Foster students' use of their prior knowledge to build an understanding for new knowledge.**
- **Urge students to think critically about prior knowledge that does not fit a new concept, and inspire them to restructure their thinking to arrive at a new understanding.**
- **Nurture and promote students' use of strategic, critical thinking skills for solving problems with creative solutions.**
- **Support students' self-regulative and self-reflective activities.**
- **Compel students to practice when they want to become experts in a given area.**
- **Give students multiple opportunities for representing, acting, expressing, and engaging in their learning.**
- **Motivate learners by allowing them to take control of their learning, using enthusiasm, setting realistic goals, and providing praise and constructive criticism.**
- **Teach teachers how to use student data to modify learning to meet the needs of each student.**
- **Integrate technology in seamless ways that will allow for customizable learning for each student's individual path.**

Microsoft programs support personalized learning environments. Two examples are Skype in the Classroom and the 21st Century Learning Design.

This summary provides context to personalized learning as seen by Microsoft's Transformation Framework for Education:

Personalized learning is a promising path to differentiate learning for all students and prepare them for college, career and community in the 21st century (Weber, 2014). In today's mobile and cloud enabled personalized learning environments, the technology is adaptive so students get individually flexible and responsive path, pace, and pedagogy according to their needs, interests, and choices. The technology provides data used by teachers in crafting learning plans for each student. Effective personalized learning environments provide tools and learning resources that students use in self-directed and self-paced learning (Patrick, Kennedy, & Powell, 2013). Learner engagement and independence are core goals. Integrated and engaging technology tools can amplify knowledge acquisition, skill development, and application of learning in comprehensive tasks. Adapting the pace and pedagogy require access to content and tools for learning anytime, anywhere, and on any device. Because learning is deepest with guidance and interaction, the content and tools should be collaborative (Jonassen, 2012).

> "Personalized learning is a promising path to differentiate learning for all students and prepare them for college, career and community in the 21st century."
>
> - Weber, 2014

The U.S. Department of Education's Race to the Top District-level grant (RTT-D) awardees provide numerous examples of school districts making the switch to personalized learning (see Oliver, et al., 2014). The winning districts had six key strategies that they used to implement personalized learning, including (1) data and data systems that allow for longitudinal/historical student data and formative data for teachers to use to differentiate for each student; (2) curriculum and teaching that were not time-based and that allowed students to interact with content in multiple ways; (3) learning materials that allowed for digital books, Open Educational Resources (OER), virtual manipulatives, and adaptive tools for personal paths; (4) repurposed learning facilities that would allow for more flexible learning in changeable environments; (5) human capital to understand what personnel is needed and how they are most effectively utilized; and (6) professional development to arrive at a place together as a learning team to make learning student-centered and personalized. Many more schools districts like the RTT-D winners are out there, moving towards personalized education for each student. Despite these districts' major efforts and the efforts of others, personalization

of learning is not as pervasive as we would hope it to be. Given the practical advances and research base, why hasn't personalized learning been realized? One of the greatest challenges for personalization in schools is that it is not implemented in a way that it can be brought to scale, typically due to such issues as human capital limitations, lack of access to necessary resources, and resistance to change, to name a few. Ultimately, personalized learning can be wholly realized when there is a systemic change made within schools, districts, and education-at-large; it is our responsibility as educators to work to put these research-based elements into motion in our early, middle, and secondary schools so our students' true potential can be realized.

Guiding Questions for personalized learning:

- **Does the complete learning experience prepare school leavers for college, career, and community?**
- **Does the learning environment drive students and teachers to be expert learners for life?**
- **How adaptive learning is supported with data analytics?**
- **What software accessibility requirements are needed?**
- **What personalized learning requirements are needed for staff/students?**
- **How are students and teachers enabled with collaborative, creative, and productive learning?**
- **How is differentiated instruction supported and enabled?**
- **How well are we prepared to mix school or workstyle with lifestyle? What does School@home mean for students?**
- **How can you manage personal identity, safety and integrate workstyle with lifestyle?**
- **What is the role of a cloud social environment at home, at school?**
- **How do you facilitate online/blended/mobile Learning?**
- **Roaming and mobility – how do you enable all/specific devices?**
- **Peer to Peer interactions – where do they fit into the learning process?**
- **Edutainment – what are the roles of class work and games based learning?**
- **What lifestyle assets should/can be leveraged?**
- **Are our assumptions on student access, ownership, connectivity and lifestyle correct?**

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