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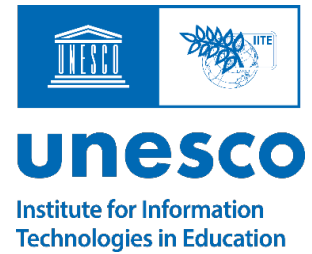
REPORT

Advancing Artificial Intelligence-Supported Global Digital Citizenship Education

Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

SHANGHAI OPEN UNIVERSITY

unesco
Institute for Information Technologies in Education

This work is a co-publication produced by the UNESCO Institute for Information Technologies in Education and Shanghai Open University within the joint project "Promoting ICT Capacity Building and Open Education in the Era of Artificial Intelligence and Digital Technologies".

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CONTENT

TABLES & FIGURES

5

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

EXECUTIVE SUMMARY

The UNESCO Institute for Information Technologies in Education (IITE) was established as an integral part of UNESCO by the General Conference of UNESCO at its 29th session (November 1997) and is located in Moscow, Russian Federation. IITE is the only UNESCO Category 1 Institute that holds a global mandate for ICT in education. In line with the new Education 2030 Agenda, IITE has developed its strategic priority areas to meet new demands and tasks ahead. The mission of IITE in the new era is promoting the innovative use of ICT and serving as facilitator and enabler for achieving Sustainable Development Goal 4 (SDG 4) through ICT-enabled solutions and best practices. This report, supported by the Online Learning Consortium (OLC), is published in partnership with Shanghai Open University (SOU) to help amplify best practices regarding artificial intelligence, digital literacy, and digital citizenship instruction for lifelong learning and success.

In our increasingly interconnected, technology-steeped society, the development of educated, active world citizens through global citizenship education is an essential component of quality education and lifelong learning that transcends time, place, and space. Digital citizenship education allows learners to develop as individuals, to act responsibly according to social norms and practices concerning their uses of technology (Kara, 2018; Ribble, 2008) within and beyond multiple facets of society, including in the personal, professional, and civic life domains (Milenkova and Lenzhova, 2021).

The benefits of global digital citizenship education opportunities deployed at scale for learners from diverse backgrounds, countries, and communities advance society, organizations, and individuals by preparing adaptive workers and citizens who competitively meet evolving workforce demands. To accomplish the scaling of digital citizenship education, educational policymakers, leaders, educators, and researchers are increasingly focusing on overcoming challenges and developing best practices leveraging artificial intelligence (AI) in education to expand the scope of reach to learners across countries and contexts, thereby promoting sustainable development and increasing educational equity.

To promote global citizenship education across a worldwide scale, this analytical review and its corresponding study examine perspectives, insights, and best practices for digital literacy and digital citizenship education. This analytical review reveals a gap in current instructional frameworks, chiefly a lack of lifelong learning focus, and highlights through case studies efforts around the globe to extend and cede continuous learning principles when implemented intentionally and strategically to address macro, meso, and micro-level challenges, through intentional, iterative design and implementation practices. A focus on AI, digital citizenship, and digital literacy proves essential in our 21st century lifelong learning landscape as the interconnection of these concepts has the potential to amplify educational equity, thereby advancing the United Nations Department of Economic and Social Affairs Sustainable Development Goal 4 (SDG 4): "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (UNESCO, n.d.).

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

6

As this analysis of relevant literature reveals, the power inherent in AI-supported global digital citizenship education efforts lies in amplifying broad paths of access for students from diverse backgrounds and geographic regions, closing achievement gaps, and closing gaps in existing educational support services for diverse learners across the globe (Holstein & Doroudi, 2021), and providing opportunities for meeting continuously evolving workforce skill needs (Pedro et al., 2017).

In order to deconstruct the role of AI within digital citizenship education, this review addresses the following key areas:

- A synthesis of advanced digital citizenship education policies and practices
- An analysis of conclusions about the current state of global digital citizenship education policies and practices
- An overview of challenges and demands at the macro, meso, and micro-levels related to the development and implementation of global digital citizenship education through AI-supported educational systems to learners from diverse backgrounds, countries, and communities
- Recommendations for improvements in the development of global digital literacy and global digital citizenship education to better align with and serve society, organizations, and individuals through the cultivation of learners' adaptable and important emerging workforce skills.
- A newly-proposed digital citizenship framework to bridge the global digital skills gap and advance sustainable development by increasing educational equity across the globe. This framework will be expounded upon in a subsequent publication addressing a potential assessment and evaluation tool towards that framework.

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7

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

INTRODUCTION

Global digital citizenship education, situated within the technology-rich facets of personal and professional life domains of learners from diverse backgrounds, countries, and communities, provides the key for government policymakers, Artificial Intelligence (AI)-supported education developers, educational leaders, and educators to amplify success across multiple areas of work and life and advance social equity. The advancement of global digital citizenship education allows stakeholders to promote active citizenship and adaptable lifelong learning opportunities for learners within formal windows of education and across lifespans to nimbly serve continuously changing human and workforce needs.

More specifically, global digital citizenship education refers to the level of training and development of digital competencies within the context of an individual's active engagement in personal, professional, and civic life domains (Milenkova and Lenzhova, 2021). As such, the development of digital citizenship skills fosters inclusivity by preparing individuals to be active contributors to a global society by acting responsibly according to social norms and practices regarding their uses of technology (Kara, 2018; Ribble, 2008).

In this way, an important, intersecting relationship between digital technologies, digital literacy, and digital citizenship converges through learners' digital skill development proficiency in various life domains necessary for social skills, social inclusion, and professional competency (Milenkova and Lenzhova, 2021). Those competencies include digital access, digital commerce, digital communication, digital literacy, digital etiquette, digital law, digital rights and responsibilities, digital health and wellness, and digital security (Ribble, 2004). In essence, as Hollandsworth, Dowdy, and Donovan (2011) noted, digital citizenship allows individuals to be active and effective participants in the electronic realms of traditional society, whereby individuals can buy, trade, socialize, work, entertain, and pursue an education. In these contexts and beyond, digital citizenship competencies are essential for individuals as they navigate as learners, workers, and humans across the interconnected world to emphasize active participation in a global society. The findings of this study and this literature analysis highlight the potential power of AI-supported global digital citizenship education efforts.

The work of educational policymakers, institutional leaders, educators, and researchers working to develop a global system and framework for digital citizenship education provides inclusive paths of access for students from diverse backgrounds, life stages, and geographic regions. Unfortunately, as will be discussed, much of the present effort around digital citizenship is targeted at specific intervals of the formal education program in varying countries and global regions. The benefits of these individual and collective efforts, and an expanded lifelong learning mindset is shown in this analysis with potential to scale and implement across global contexts to leverage benefits to society, organizations, and individuals. This work doubly benefits society in that improvements in digital literacy and citizenship helps close achievement gaps and interconnected gaps in existing educational support services for diverse learners across the globe (Holstein & Doroudi, 2021), providing the chance to better meet evolving workforce skill needs (Pedro et al., 2017).

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

8

DIGITAL LITERACY AND CITIZENSHIP FOUNDATIONS AND POLICIES

Educational Equity: The Foundational Pillars of Digital Literacy

SUSTAINABLE DEVELOPMENT GOAL 4–QUALITY EDUCATION
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (UNESCO, n.d.).

Derived from both the United Nations' (U.N.) Declaration of Human Rights and U.N. Sustainable Development Goals, this analytical literature review and collection of case studies recognizes that equity drives and underpins the goals and outcomes of learners' development of digital literacy and digital citizenship skills. To achieve this focus, Frasier's (2009) concept of social justice provides a fitting positionality from which the assumptions and goals of this project proceed.

Frasier (2009) contended that equity exists on two planes that must converge to make meaningful progress toward social change. On the first plane, equity is a moral imperative essential for achieving progress toward social justice (Frasier, 2009). On the second plane, equity is situated within social theory, recognizing and embracing differences and encompassing the accommodation of the complexity of relationships between culture, identity, economy, class, and status as these features exist and intersect an interconnected global society (Frasier, 2009). Correspondingly, achieving inclusive and quality education for all reaffirms the belief that education is one of the most powerful tools for sustainable development.

Alongside the previously-stated positions and characteristics of equity, the core tenet of UNSDG 4: Quality Education, underpins the ideas represented in this analysis, which are central to the development of AI-supported education, digital literacy, and digital citizenship. The crux of which, when implemented effectively for all learners, especially learners from diverse backgrounds, countries, and communities, catalyzes individual and societal benefits through the development of lifelong learning opportunities and workforce skill development to meet changing regional and global needs.

Analysis of Essential and Foundational Frameworks

Despite the wide use of digital tools for online engagement, there has been a noted lack of research focused on defining digital citizenship (Atif & Chou, 2018). Earlier definitions focused on netiquette, more recent definitions have expanded to include additional areas that focus on digital aspects of access, communication, identity, rights and obligation, safety, literacy and resource evaluation, well-being, social responsibility, and security in service of active social, professional, and civic digital

9

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

participation (Atif & Chou, 2018; Mattson & Lindsey, 2021; Kim & Choi, 2018; Milenkova & Lendzhova, 2021; Ribble 2008). Earlier definitions and these areas of expansion are included in more recent definitions, such as the International Society for Technology in Education's (2021a) description that states that as a digital citizen, it is important to "recognize the rights, responsibilities, and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical" (1.2 Digital Citizen). However, a distinct focus on formal education as opposed to the holistic lifespan of learner development has been noted in almost all existing frameworks.

Thus, it is important that the definition of digital citizenship "goes beyond conversations about personal responsibility," supporting individuals as they become "active citizens who see possibilities instead of problems, and opportunities instead of risks as they curate a positive and effective digital footprint" (International Society for Technology in Education, 2021b, para 2). It is also important to recognize the central goal of digital citizenship – to equip individuals, from an early age, "with the knowledge, skills, and attitude to take advantage of the opportunities and be resilient in the face of risks" (UNESCO Bangkok, 2015, p. 3). These evolutions in thinking help underscore the importance of elevating this component of explicit international education across multiple layers and levels of human development.

With digital citizenship levels being perceived as moderate or low in many areas in conjunction with increased digital tool usage, there is a need for teaching digital citizenship explicitly and early in formal education (Öztürk, 2021). This fact highlights the need for non-private sector partners to support educator training and resource development focused on a comprehensive framework of digital citizenship as educators hold a transformational role in assisting students in developing early digital citizenship competencies (Kim & Choi, 2018; Milenkova & Lendzhova, 2021). To move towards filling this gap, this analysis will first summarize the relevant foundations and policies, which when connected to current best practice case studies, highlight a potential strategy to situate digital literacy and citizenship within the 21st century technological context that we presently find ourselves—one steeped in and increasing dependence on digital tools.

European Union's Digital Competence for Citizens Framework

The European Union's Digital Competence for Citizens Framework provides eight proficiency levels across five competence areas which are foundational considerations in deconstructing the digital citizenship construct (Carretero et al., 2017). Competence areas include information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. These competence areas are measured across the eight proficiency levels, from foundational to intermediate to advanced to highly specialized (Carretero et al., 2017). Each competence area and proficiency level contain clearly-defined learning outcomes based on and aligned with Bloom's taxonomy, as well as examples of use, to clarify specific demonstrable knowledge of students concerning the development of each digital competence skills. This comprehensive framework unpacks, with clear learning outcomes, many key knowledge areas of digital literacy along a developmental continuum, making it a solid framework and applicable resource for use throughout educational institutions (and beyond) and thus worthy of the attention of policymakers, leaders, and educational faculty.

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

10

S.A.F.E. Framework

Among key other frameworks that consider broader definitions than netiquette is the S.A.F.E framework developed to support educators as they work with students to develop their internal knowledge, skills, and capacity for understanding and applying principles of digital citizenship. Influenced by a study of 200 pre-service and in-service teachers, Kim and Choi (2018) developed the S.A.F.E. framework that focuses on students developing self-identity, engaging in positive online activities, advancing their fluency and literacy skills with digital tools demonstrating ethical decision-making in digital environments. This tool is particularly helpful in contextualizing formative instruction and the responsibilities of educators to shape student thinking as they interact with technology locally and ultimately on a global scale.

Figure 1. SAFE Framework for Digital Citizenship Scale of Youth

Edvolve Framework

Mattson & Lindsey (2021), focusing as well on primary and secondary education, identified similar strands to support the notion of explicit and formal digital citizenship development. Their framework strands include digital safety, media and information literacy, digital well-being, and social responsibility. Evolve (2021) advocates for the cultivation of deep technology skills as it is in these technology skills that individuals can "access the limitless possibilities for learning, communicating, and creating in today's digital world" (p. 5). However, Mattson & Lindsey (2021) acknowledged the difficulty in this technology skill cultivation, advocating for continuous learning as new technologies and functionalities are emerging and in a state of constant evolution. A proliferation of advanced technological tools and applications, expanding at an incredibly expeditious rate due to the advent of artificial intelligence and machine learning, further buttress and expound on the need for this area of learner development. Mattson & Lindsey (2021) also advocate for lifelong learning considerations of digital literacy training and development, though their clients and target audience remain K-12-focused.

11

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Figure 2. Edvolve Digital Citizenship At-a-Glance Indicators

DIGITAL CITIZENSHIP
Strands At-A-Glance

edvolve
DIG CIT DOCTORS

DIGITAL SAFETY

Digital Citizens keep themselves and each other safe.

Enduring Understandings:

1. Laws, rules, and social norms govern digital spaces.
2. Digital identities, data, and online activities are commodities.
3. Individuals and organizations may misrepresent themselves online.

MEDIA & INFORMATION LITERACY

Digital Citizens responsibly consume, create, and share digital content.

Enduring Understandings:

1. Effective search strategies help individuals locate information online.
2. Digital information varies in value, quality, and reliability.
3. Media influences individual perceptions and societal actions.
4. Technology can be used to express and amplify ideas.

DIGITAL WELL-BEING

Digital Citizens prioritize their digital well-being and the well-being of others.

Enduring Understandings:

1. Self-awareness and the use of intentional strategies can support a healthy digital diet.
2. Online personas are constructed reflections of an individual's identity.
3. Technology may play a role in both advancing and impeding human connection.

SOCIAL RESPONSIBILITY

Digital Citizens are socially conscious and empowered to influence change.

Enduring Understandings:

1. Digital citizens have a collective responsibility for the ethical design, use, and regulation of new technologies.
2. Technology is a powerful vehicle for civic engagement.
3. Technology both highlights and perpetuates social inequities.

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

12

Correspondingly, the Edvolve Framework: Evolving the Digital Age (Lindsey, 2021) is notable in its organization into three major themes, connecting digital-age literacy with digital citizenship and learner agency. According to the Edvolve Framework, the concept of digital citizenship "refers to the idea that technology users are inhabitants or 'citizens' of a digital society" and have the responsibility to behave appropriately and the opportunity to create digital spaces (Lindsey, 2021, p. 1). According to Lindsey (2021), "digital age citizenship additionally refers to the use of technology to participate in non-digital communities, fair and equitable digital-age practices, and the quality of relationship an individual has with technology" (p. 1). The concept of digital citizenship rests on the development of digital-age literacy skills, which include "consuming, creating, and communicating information and ideas." Additionally, the framework integrates components from information literacy, visual literacy, media literacy, and news literacy (Lindsey, 2021, p. 1).

Most notably, the Edvolve Framework also depicts learner agency as an integral part of digital citizenship education, namely the emphasis of learners taking ownership for their learning due to the availability of digital tools that allow learners to take control of their learning to drive their learning efforts and their motivation to master concepts (Lindsey, 2021). According to the framework, students' mindsets, skill sets, and critical thinking skills also contribute to learner agency (Lindsey, 2021).

Figure 3. Edvolve Framework Integrator Visual

13

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Kim and Choi (2018), Mattson & Lindsey (2021), and Ribble (2008) each align framework elements beyond merely working with technology appropriately, extending into advanced elements that focus on how individuals can work together in a global, digital society. These elements include:

- *Digital Access* that enables all users to participate at acceptable levels in a digital society if they so choose;
- *Digital Commerce* that enables the knowledge, protection, and skills to buy and sell goods electronically;
- *Digital Communication* that enables users to apply appropriate communication methods to exchange information;
- *Digital Literacy* that enables the ability to use digital technology, as well as when and how to use it;
- *Digital Etiquette* that enables users to consider others in a standard of conduct and respect;
- *Digital Law* that enables an awareness of laws and restrictions that govern digital technology use in their region;
- *Digital Rights and Responsibilities* that enables users to understand their privileges and freedoms, as well as how to protect them;
- *Digital Health and Wellness* that enable users to consider the risks and leverage benefits of digital technologies;
- *Digital Security* enables users to protect their information while creating precautions for others to protect data.

Similar to Edvolve (2021), Ribble (2008) acknowledged that having elements like these is not enough and advocates for a continuous cycle of technology integration because there is no end to learning, particularly as it relates to using and reflecting on technology use. Thus, Riddle (2008) proposes a four-stage technology learning framework for teaching digital citizenship that operates in a continuous state of reflection that includes: 1) awareness that goes beyond basic knowledge of hardware and software, expanding to use and misuse of digital technology; 2) guided practice that gives students opportunities to use technology while getting support from educators; 3) modeling and demonstration from educators where they showcase proper use of technologies and digital citizenship; and 4) feedback and analysis that centers school as a place where students use technologies and educators discuss their use with them.

Framework Elements in Practice

When considering both foundational elements as well as holistic digital citizenship and literacy frameworks, which will be summarized following this section, it is also helpful to scan practices from around the globe that contextualize necessary actions, exemplars, and steps which can be leveraged as we explore a recommended and potential evaluation system for deepening digital citizenship instruction within the context of digital literacy and, increasingly, an AI-driven society. Seven global cases gathered in this study align well to digital literacy and digital citizenship fundamentals.

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ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

14

DIGITAL LITERACY AND CITIZENSHIP FOUNDATIONS CASE STUDIES

Informative Global Cases & Practices

1. **CHINA: SHANGHAI OPEN UNIVERSITY**
   Smart Learning Camp Provides Life Skills and Lifelong Learning Opportunities for All Age Groups

2. **CHINA: SHANGHAI UNIVERSITY FOR THE ELDERLY**
   Smart Learning Experience Classroom of Shanghai University for the Elderly Deeply Engages Learners in Technology

3. **SPAIN: NAVARRA UNIVERSITY**
   Envisioning Full Educational Track for Communications Students that Emphasizes Mastery of Digital Literacy Skills

4. **CHINA: DEPARTMENT OF EDUCATION OF ZHEJIANG PROVINCE**
   Digital Learning Immersion Opportunities for Senior Citizens Ensure Lifelong Learning and Access

5. **SAUDI ARABIA: KING KHALID UNIVERSITY**
   Digital Learning Simulations and Dashboard Visibility to Educate At-Scale in a Post-Pandemic Saudi Arabia

6. **CHINA: CHENGDU OPEN UNIVERSITY**
   Digital Experiences Enhance Lifelong Learning and Workforce Development Skills for People with Disabilities

7. **CHINA: SICHUAN DREAM REALIZATION DISABLED PUBLIC WELFARE CENTER**
   Chengdu Province Leverages Digital Solutions to Close the Gap with Disability Employment Efforts

15

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

CASE STUDY # 1

CHINA: SHANGHAI OPEN UNIVERSITY

Smart Learning Camp Provides Life Skills and Lifelong Learning Opportunities for All Age Groups

There is a clear global spectrum needed for learner development in the areas of artificial intelligence, digital citizenship, and digital literacy. Emergent practices that help situate and respond to these challenges can be seen within the Shanghai Province of the People's Republic of China. In fact, multiple innovative practices concerning the development of digital literacy competencies emerge from the world's most populous country. The Shanghai Educational Software Development Co., Ltd. and the Community Education Department of Shanghai Open University in China developed a partnership in which established the Shanghai Smart Learning Camp for the Elderly under the guidance of the Lifelong Education Division of Shanghai Municipal Education Commission. With respect to teaching digital literacy, representatives report:

Through in-depth research on the learning styles and learning interests of the elderly, it has sorted out, integrated, designed and built rich digital learning resources for the elderly, and provided the elderly with an online and offline dual-space learning environment in the form of an online and offline dual-interaction short-term training camp, helping them integrate into digital life.

The camp provides themed learning resources for learners, which are tailored to users who are just beginning to use smart devices including smartphones and tablets.

Once learners are acclimated to the basic operational functions of smart devices, the second term of the camp offers practical real-world applications of technology, including mobile travel, payments, health applications, and voice calls. In the third term, learners learn detailed life skills through the integration of technology, including making medical appointments, placing online

Photo Credit: Shanghai Open University

orders, and purchasing airline tickets online. This effort, in sum, provides a replicable example of how to minimize the digital divide across generations and ensure technological literacy for a segment of the global population who might otherwise be left behind. It is insufficient to merely train students during primary and secondary education or even offer advanced training tied to workforce competencies in university studies. Continuing advances and the prevalence of technology in everyday life warrants life-long engagement, consistent training and retraining, and the expansion of skills in respect of digital citizenship and literacy competencies--however those competencies may evolve over time.

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Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

16

CASE STUDY # 2

CHINA: SHANGHAI UNIVERSITY FOR THE ELDERLY

Smart Learning Experience Classroom of Shanghai University for the Elderly Deeply Engages Learners in Technology

A lifecycle-focused initiative aimed to advance digital citizenship education and provide continuing technology education is the Shanghai University for the Elderly, which to date, has offered more than 600 classes on intelligent technology to more than 22,000 students. According to data submitted for the OLC/UNESCO IITE study, the aim of the Smart Learning Experience classroom (pictured below) is to promote the "engagement, happiness, and security" of senior citizens. A focus on holistic training and competence in digital technologies across the development lifespan is a fundamental consideration for full social engagement and economic well-being, thus elevating the importance of initiatives such as this additional entry out of Shanghai, China. With the overall planning and full support of Shanghai Municipal Education Commission, Shanghai University for the Elderly carefully creates an immersive experience smart learning scene by focusing on the high-frequency needs and service scenes of the elderly, such as transportation, medical treatment, consumption, entertainment, and handling of affairs. The main area includes five islands and one room, namely, "Science and Technology Island", "Health Island", "Transportation and Finance Island", "Life Island", "Happy Island" and the Central Control Room. These classrooms turn smart devices in daily life into teaching aids, introduce them to the campus, and simulate life scenes such as online shopping, online payment, medical treatment appointment, and online hailing for a taxi, to create a ubiquitous digital life experience environment, which narrows the distance between the elderly and smart devices. By combining the courses with the digital equipment of the experience classrooms, the "Smart Learning Experience Classroom" is normally applied, and the elderly can touch, learn, and use it anytime and anywhere. It eliminates the elderly's "fear of use" of intelligent technology, enhances their confidence of "able to use" and increases their "happy use" experience.

快乐岛

健康岛

科技岛

金融岛

生活岛

中控室

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17

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

CASE STUDY # 3

SPAIN: NAVARRA UNIVERSITY

Envisioning Full Educational Track for Communications Students that Emphasizes Mastery of Digital Literacy Skills

Charo Sádaba, Associate Professor and Dean School of Communication at the University of Navarra in Pamplona, Spain, describes his institution-based advocacy to create a full instructional track grounded in digital literacy and citizenship pedagogy. Sádaba seeks to assure his students, who are future communication professionals, have developed mastery of their own digital literacy skills and thus are fully emboldened to engage with and positively impact the global workforce. Responding to an OLC questionnaire transmitted across the globe through this case study analysis,

Photo Credit: Navarra University

Sádaba states that he fundamentally believes "Higher [education's] goal is to prepare the students to think and reflect about their real life/work situations by themselves in order to find their own perspectives and solutions." According to Sádaba, the first step must be an exercise to assure students understand the role digital technologies play in their daily lives. He describes the use of an activity in his own classroom that challenges students to go 24 hours without media, screens, or technology as a means to provide a "valid starting point to help them reflect about their own routines."

Next, a professional track and reflective exercise follows about their responsibility as communication professionals to be aware of the impact of digital media on audiences, noting the significant dependence many generations of global learners have on technology for information access, social engagement, and media processing. Sádaba noted, "We have created an initiative, Think Tech: a group of students that during four semesters work about the role of technology on work, democracy, economy and relationships. The results are incredible as they are able to have a deeper knowledge on the subject, able to address the relevant issues and also to reflect about their own habits." Finally, Sádaba revealed, some kind of course about how professionals can combat misinformation and disinformation is an emergent and essential aspect of the formal and taught curriculum. To measure learning outcomes in connection with digital literacy and 21st century workforce skill development, Sádaba acknowledged that formal measurement and assessment of progress with respect to a maturity or skills spectrum is somewhat of "a pending subject for us." He wrote, "we have not at the moment the capability to identify the right key performance indicators (KPIs) in this scenario. So it would be needed to start with the strategy and the desirable outcomes to identify later on how to measure it in a standard way."

Digital literacy skills mastery can legitimately be developed within a skills-focused academic program of study such as global communications studies–a field increasingly driven and immersed in technology, thus empowering learners through technology applications that are changing and influencing global learning. Additionally, derivative of the aforementioned framework considerations for the explicit modeling and teaching of digital citizenship connected to digital literacy skill-building,

Sádaba's work pinpoints ideas and points for discussion for educators and academic leaders outside even his communication field when looking to infuse the mastery of digital literacy skills within courses and programs at their own institutions. Responsibilities for media literacy, information analysis, and teaching responsible engagement most certainly transcend those who plan to embark on career pathways in the communications field. Further, the fact that these challenges transcend early education through collegiate studies, and in fact are impactful on the global population through their lifespans, highlights the need for formative development as well as continuing education to respond to evolution and trends in technology such as artificial intelligence as it intersects digital citizenship and literacy. The camp provides themed learning resources for learners, which are tailored to users who are just beginning to use smart devices including smartphones and tablets.

Once learners are acclimated to the basic operational functions of smart devices, the second term of the camp offers practical real-world applications of technology, including mobile travel, payments, health applications, and voice calls. In the third term, learners master detailed life skills through the integration of technology, including making medical appointments, placing online orders, and purchasing airline tickets online. This effort, in sum, provides a replicable example of how to minimize the digital divide across generations and ensure technological literacy for a segment of the global population who might otherwise be left behind. It is insufficient to merely train students during primary and secondary education or even offer advanced training and skills tied to workforce competencies in university studies, as continuing advances to technology and the prevalence of technology in everyday life warrants life-long engagement, consistent training and retraining, and the expansion of skills respective of digital citizenship and literacy competencies— however those competencies may evolve over time.

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19

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

CASE STUDY # 4

CHINA: DEPARTMENT OF EDUCATION OF ZHEJIANG PROVINCE

Digital Learning Immersion Opportunities for Senior Citizens Ensure Lifelong Learning and Access

The Department of Education of Zhejiang Province in China launched a special assistance program for its elderly population adapted to trends of smart life via its "Popularization of the Elderly's Daily Application of Intelligent Technology" initiative. This was enacted at the provincial level in order to eliminate the digital divide faced by senior citizens and help them "better integrate into the smart society and enjoy the smart life." Citizens were enrolled in Hangzhou Shangcheng Community College for a course titled "Smart Life with Mobile Phones" which teaches elderly learners the basic

Photo Credit: Hangzhou Shangcheng Community College

functions of smartphones in order to integrate learners into the use of digital technologies and digital devices as part of their daily lives. The course is organized into four class levels: basic, advanced, intensive, and special, which center on teaching learners through a variety of innovative practices.

Statistics show that by giving full play to the joint efforts of the province's community education system for the elderly, from January to September 2021, the province had carried out nearly 23,000 special trainings, serving more than 1 million elderly people, providing more than 1,200 classes with an educational system developed over nine months with the participation of nearly 130,000 students. The volunteer services of "entering homes, communities and old-age care institutions" have reached more than 12,000 times and have been provided to more than 260,000 people.

In 2021, "Zhejiang Education for the Elderly" classroom in the air, a virtual learning experience, became a successfully registered trademark of Zhejiang Senior Citizens Open University. Every semester, the "Zhejiang Education for the Elderly" classroom in the air launches the "Online Education Month for the Elderly" teaching activity, in order to offer a variety of special courses. The classroom in the air featured a special lecture "Prevention of Telecommunication and Internet Fraud for the Elderly," which engaged students from more than 20 open universities for the elderly.

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20

Helping the elderly to cross the "digital divide" is an important project for people's livelihood in Zhejiang Province. The action of assistance for the elderly's smart life "Popularization of the Elderly's Daily Application of Intelligent Technology" is expected to carry out popular science training on intelligent technology application for more than 2 million elderly people in the province within three years, striving to "provide training on intelligent technology as much as possible" to the willing and capable elderly people, so that the elderly can share the development fruits of Zhejiang digital economy.

Photo Credit: Zhejiang Senior Citizens Open University

DEPARTMENT OF EDUCATION OF ZHEJIANG PROVINCE

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21

CASE STUDY # 5

SAUDI ARABIA: KING KHALID UNIVERSITY

Digital Learning Simulations and Dashboard Visibility to Educate At-Scale for Post-Pandemic Saudi Arabia

King Khalid University, one of the largest and fastest growing institutions of higher education in the Kingdom of Saudi Arabia, noted not only significant challenges to learning associated with global COVID-19 pandemic, but also an opportunity to leverage student interest and increasing capacity in digital learning, theorizing that enhanced learning analytics, when applied to increased digital learning experience, might expand educational access, attainment, and student success. Through its ELD project, Dr. Adel Ibrahim Qahmash, Dean of E-Learning Deanship, has led the three-phase development of scaled simulations and expanded distance learning courses paired with a learning analytics dashboard designed to support institutional decision-making and future forecasting for administrative and student support, based on the analytics of learning data extracted from the system. "As the university has shared," Qahash states, "university leaders, faculty members, and students benefit from data about the educational process when impacting so many unique students. We can now improve and customize learning according to the different needs of students".

The first phase of the project added a public-facing dashboard, to share an array of data on the various supports for students and faculty at King Khalid University, along with their trending usage (digital experience and citizenship tutorials, library resources, science and mathematics course lab components). This encourages greater access and use. The second phase of the project added an internal analytics and forecasting dashboard for university leadership, working with data scientists to build AI models for analyzing and forecasting student needs and opportunities for success. The third phase of the project, currently in development, will provide enhanced forecasting tools for faculty and students.

E-Lab Screenshot Credit: King Khalid University

Dr. Qahmash reflected, "we would like to help students and predict their performance during the semester, and decision makers can see the students' anticipated performance. We would love to be able to identify early at-risk, and we would like to leverage learning analytics and AI to support students and help students". Future plans include offering tutoring and content and other sources of support, including counseling and financial support for students. The university is also working to build a chatbot system inside the

LMS that will connect to the dashboard, with natural language processing AI that will leverage machine learning and internal data to support students. "When a student logs in, they can speak to the system to inquire about upcoming projects and deadlines. We want the system to have soul and talk to the students to help keep them on track."

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22

CASE STUDY # 6

CHINA: CHENGDU OPEN UNIVERSITY

Digital Experiences Enhance Lifelong Learning and Workforce Development Skills for People with Disabilities

Centered on the principle of lifelong learning, Chengdu Open University's digital citizenship commitment, designed to enhance the personal and digital social development of people with disabilities, relies on top-level design, high-level promotion, pluralistic governance, clarification of responsibilities, and innovative information management to promote digital citizenship education. Chengdu aims to provide equitable learning opportunities for people with disabilities to foster higher participation in social activities, promote social development, and meaningfully integrate information technology within work, life, and education. The Chengdu Municipal Committee and Chengdu Municipal People's Government's digital citizenship education program launch a comprehensive educational platform and specialized curriculum development resources developed by Chengdu Open University. Educational institutions and private business are provided access to recruitment and employment training materials to promote harmony and inclusion for vulnerable citizen groups.

Photo Credit: Chengdu Open University

Program outcomes flow from "top-level design and high-level promotion" from the CPC Chengdu Municipal Committee and Chengdu Municipal People's Government, which prioritizes the building, development, and support of a special education system centered on digital citizenship education. The Chengdu Municipal Disabled Persons' Federation has set up online and offline service platforms for people with disabilities, including the first Comprehensive Cloud Platform for Special Education Services in China, built by the Chengdu Education Bureau. The platform was launched to provide personalized,

specific professional education services for more than 9,000 children with disabilities, approximately 20,000 parents and over 6,000 special education teachers. The cloud platform provides five types of services: individualized education, today's classroom, call services, quality monitoring, and resource services. The Bureau reports that use of digital technology within special education provides "home-school co-education, individualized learning service, accurate resource supply and real-time information interaction, making parents feel more at ease and home-school interaction smoother."

23

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CASE STUDY # 7

CHINA: SICHUAN DREAM REALIZATION DISABLED PUBLIC WELFARE CENTER

Chengdu Province Leverages Digital Solutions to Close the Gap with Disability Employment Efforts

The Sichuan Province of China has a large population overall and over 6.22 million people with disabilities, ranking the second highest in China. Further, according to research from Sichuan University, the proportion of people with disabilities to the overall population is 7.57 percent in Sichuan, the highest in the People's Republic of China (Zhang, 2015). Recognizing that people with disabilities have difficulties meeting their requirements for public services and without special engagement can withdraw from full society, Chengdu, the Sichuan capital, has focused on personalized support and the use of technology to level the playing field, teach digital citizenship, and close opportunity gaps. The Sichuan Dream Realization Disabled Public Welfare Service Center connects government, business, and people with disabilities in service-focused ways. Services deployed include a set of systematic employment assistance modules for people with disabilities, including employment development, teaching and training services, and recruitment assistance. The distinctive recruitment assistance includes three forms: first, offline recruitment. The Center organizes traditional special job fairs for the [people with disabilities]. Second, online recruitment. The Center has developed a platform "Zhihui Dream Realization" for the employment of [people with disabilities], which publishes and updates the recruitment information of [people with disabilities] of enterprises from time to time. [People with disabilities] can submit resumes and make an appointment for interviews after online registration. Third, recommendation and promotion. It mainly provides guidance and recommendation for disabled people with mature entrepreneurial will.

Photo Credit: Sichuan Dream Realization Disabled Public Welfare Service Center

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24

HOLISTIC DIGITAL CITIZENSHIP FRAMEWORKS AND POLICIES

Ribble Model Framework

Among the first essential holistic digital citizenship frameworks are the Ribble (2008) model on teaching digital citizenship. Ribble emphasizes the role of adults of all types, especially parents, noting educators of this discipline are more than just classroom teachers. Adults of all types are influential guides to children's technological and digital disposition and development. Adults model the proper use of digital technology in society and provide space to engage in discussion and constructive criticism to guide generative technology-based citizen engagement and behaviors.

Figure 4. Ribble's Digital Citizenship Framework

UNESCO Bangkok (2015) acknowledges that children and young people utilize a good deal of technologies outside of school and recommends parental or guardian mediation, which they categorize as being: 1) active where they discuss with children the positive and negative aspects of digital environments and how to protect themselves; and 2) restrictive in which boundaries and rules support appropriate access. Seeking alignment of those boundaries within a community, regional, national, or international context is, of course, a larger challenge.

International Society for Technology in Education (ISTE) Framework

The United States-headquartered International Society for Technology in Education (ISTE) (2021b) brings many of the concepts discussed in Choi and Kim (2018), Lindsey (2021), and Ribble (2008) into a concrete set of standards for students when seeking

25

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to formalize and enact an explicit digital citizenship protocol and curriculum.

ISTE's standards are designed to empower students' voices, ensure learning, and situate digital citizenship as a crucial component with additional key areas (i.e., Empowered Learner, Knowledge Constructor, Innovative Designer, Computational Thinker, Creative Communicator, Global Collaborator) that educators can use to support students thriving in the evolving digital landscape. Speaking to the relative importance of digital citizenship as a technology competency, ISTE was among the first to formalize digital citizenship as one of its holistic competencies, or standards, for learning, behavior, and training within a comprehensive instructional framework.

ISTE DIGITAL CITIZEN STANDARD
Students recognize the rights, responsibilities, and opportunities of living, learning, and working in an interconnected digital world, and they act and model in ways that are safe, legal, and ethical.

As part of the digital citizen standard, the International Society for Technology in Education (2021b) further delineated several specific objectives, or calls to action, including assurance that:

- "Students cultivate and manage their digital identity and reputation and are aware of the permanence" (1.2a)
- "Students engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices" (1.2b)
- "Students demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property" (1.2c)
- "Students manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online" (1.2d)

With a multidimensional focus on digital identity, reputation, behavior across interactions, rights, and obligations related to intellectual property, and data privacy and security, the ISTE framework provides several useful pathways and resources (e.g., their YouTube Playlist) for educators and parents to utilize as they teach children essential digital citizenship skills.

Figure 5. ISTE Standard Resources and Playlists

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26

Figure 5. ISTE Standard Resources and Playlists

Additional Framework Sampling

While there are many related frameworks, programs, and resources to support primary and secondary educators, as well as the general public, there have been relatively "few initiatives that explicitly target very young children, the elderly, and the business sector" (UNESCO Bangkok, 2015, p. 43). Correspondingly, within the limited body of research that does exist, current frameworks and research have provided a less robust focus on developing digital literacy competencies and digital citizenship skills beyond primary and secondary education, thus limiting commonly accepted considerations for the higher education level. Almost no research and standards or frameworks exist outside formalized education structures–a limitation known to be a risk given the development lifecycle considerations mentioned in the aforementioned section, and the needs and responsibilities to educate global citizens at-pace the speed technology changes across their lifetimes.

Framework Connections and Commonalities

The available, researched, and accepted advanced digital citizenship education policies and practices do share a set of common attributes, which provide a unified direction for educational policymakers, educational leaders, and educators aiming to advance global and local digital citizenship education efforts. These common attributes of exemplary digital citizenship frameworks, models, and programs include: showcasing the connection between digital literacy and digital citizenship proficiencies (Atif & Chou, 2018; Mattson & Lindsey, 2021; Lindsey, 2021); reflecting the nuances and complexities inherent in the advancement of digital citizenship education across global contexts (Searson et al., 2015); and inspiring an active commitment within learners to create a just world (Lindsey, 2021; Parekh, 2003).

A number of frameworks, models, and programs maximize the connectedness between digital literacy and digital citizenship skill development, an advanced practice that allows learners to develop foundational skills that can be developmentally built upon throughout their learning lifespan. Within these contexts, digital literacy skills provide learners with baseline knowledge necessary for development as active, global digital citizens by allowing them varied experiences in consuming, creating, communicating through digital technologies within and beyond the digital world (Atif & Chou, 2018; Mattson & Lindsey, 2021; Lindsey, 2021). Six global cases will now be highlighted to connect these principles and lead towards the broadest possible developmental spectrum and an evaluation framework for global adoption.

27

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HOLISTIC DIGITAL CITIZENSHIP FRAMEWORK CASE STUDIES

Informative Global Cases & Practices

8. **TURKEY: BALIKESIR UNIVERSITY**
   Emphasizing Across-the-Board Student-Centered Digital Citizenship Education Design and Practices

9. **UNITED STATES: KENNESAW STATE UNIVERSITY**
   Applying Expertise and Insights for Growing a Common Understanding of Digital Citizenship Education

10. **AUSTRALIA: NATIONAL CYBERSTART INTIATIVE**
    Embracing and Respecting the Challenges and Opportunities in Growing AI and Digital Citizenship Education

11. **SINGAPORE: NATIONAL CYBER WELLNESS PROGRAM**
    Supporting Media Literacy and Digital Citizenship Development in a Media-Rich Nation

12. **MALAYSIA: CYBERSECURITY MALAYSIA INITIATIVE**
    National Strategy for Information Security, Media Literacy, and Digital Citizenship Instruction

13. **SOUTH KOREA: COMMUNITY MEDIA FOUNDATION**
    Community Foundation Supports the Development of Digital Citizenship Through Media Production Training

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28

CASE STUDY # 8

TURKEY: BALIKESIR UNIVERSITY

Emphasizing Across-the-Board Student-Centered Digital Citizenship Education Design and Practices

Gülcan Öztürk, Assistant Professor, Balıkesir University, Necatibey Faculty of Education, believes "artificial intelligence in education learning environments can be created according to the individual needs, interests, and wishes of the student." Öztürk's expert position on digital citizenship education emphasizes the importance of student-centered digital citizenship education design and practices. This is one of the key challenges of integrating artificial intelligence in education, according to Öztürk as expressed in questionnaire responses gathered for the OLC/UNESCO IITE study, as the "needs, interests, and wishes of the student may not be fully determined." In his own teaching practice, as Necatibey Faculty of Education at Balıkesir University, Öztürk is teaching a first-year course called Information Technologies. Within the scope of this course, he focuses on developing learners' basic digital literacy skills by teaching content, including "the use of office software, strategies for searching information on the Internet, designing instructional activities with web 2.0 tools, and digital communication skills." To measure students' digital literacy skills, Öztürk uses tests that include a variety of question types, such as multiple choice, open-ended, matching, and fill-in-the-blank questions for assessment. He also assigns group assignments and relies on peer assessment and self-assessment for group assignments. Öztürk cautions about overlooking the basics of digital literacy before situating those skills in the context of digital citizenship.

Through the intentional design and development of his course, Öztürk's focus on centering digital citizenship education around student needs provides a lens through which educators across the world might model their own students' learning experiences. The "walk first to run" student-centered learning approach values and positions the needs of students alongside the learning outcomes and experiences garnered through digital learning experiences, which serve to advance digital citizenship education at the micro, meso, and macro levels. With certainty, the linkage between digital literacy skills and digital citizenship suggests that a basic mastery of the currently accepted core technology competencies within an academic realm, discipline, or career pathway are pretext to the ethical and evolutionary application of more advanced citizenship and engagement components with technology and through use of digital skills.

Photo Credit: Balikesir University

BALIKESIR UNIVERSITY (ÜNIVERSITESI)

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29

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CASE STUDY # 9

UNITED STATES: KENNESAW STATE UNIVERSITY

Applying Expertise and Insights for Growing a Common Understanding of Digital Citizenship Education

Through honing his expertise and working in digital citizenship for the past 15 years, Kennesaw State University Associate Professor Michael Ribble offers a path forward for expanding digital citizenship education at and beyond his institution. Ribble acknowledged many in the field have worked to contribute resources to holistic digital citizenship education. He has published a number of articles and books, including *The Digital Citizenship Handbook for School Leaders: Fostering Positive Interactions Online* (2019), *Digital Citizenship in Schools: Nine Elements All Students Should Know* (2015), *Digital Citizenship within Schools* (2011), and *Raising a Digital Child: A Digital Citizenship Handbook for Parents* (2009). Ribble said the continued development of digital citizenship resources is necessary to fully advance the field.

According to Ribble, creating a broad scale understanding of digital citizenship and best practices for teaching digital citizenship provides the best way forward. He said: "The concept of digital citizenship is still often new to many users. It would be helpful to users if they were exposed to and had opportunities to learn the skills necessary to be good digital citizens. The issue still continues to be that there is no coordinated idea of what digital citizenship is and how it should be taught." At Kennesaw State University, Ribble sees the mapping of digital citizenship learning experiences and outcomes as a process that could promote students' development of 21st century workforce skills. Ribble suggests first, it would be good to have a [consistent] goal on what is needed when using digital technologies in the classroom. Once this has been completed then there can be data collected on the types of technologies that are being integrated into the classroom and the workforce. Finally, having these base concepts then we could begin collecting information and measuring how effective they are both in the classroom as well as in the larger workforce. There needs to be an [understanding] of what are these technologies and how they are being used before we can determine their effectiveness. These insights are helpful for educational policy makers, researchers, leaders, and educators seeking to grow a common understanding of digital citizenship education and to promote student learning across digital realms.

KENNESAW STATE UNIVERISTY IN GEORGIA

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Photo Credits: Kennesaw State University

CASE STUDY # 10

AUSTRALIA: NATIONAL CYBERSTART INTIATIVE

Embracing and Respecting the Challenges and Opportunities in Growing AI and Digital Citizenship Education

Cybersmart is the national cybersafety and cybersecurity education program of the Australian Communications and Media Authority (ACMA), an entity created by Australian Government to execute its national commitment to cybersafety and digital citizenship. The program is specifically designed to meet the needs of its target audiences of children, young people, parents, teachers and library staff. Cybersmart digital citizenship is about confident and positive engagement with digital technology. A Cybersmart digital citizen is anyone with the skills and knowledge to effectively use digital technologies to participate in society, communicate with others, and create and consume digital content. Everyone online is therefore a digital citizen. Understanding the opportunities presented by the online world and the concept of digital citizenship is crucial to students' learning about technology. However, knowing how to minimize associated risks and developing an awareness of the impact of individual footprints online are also vital.

Evaluation results of initial program execution showed high levels of support of the program by parents, teachers, and students. Yet, the importance of continuing the dialogue about online-safety following the program was emphasized (Griffith Institute for Educational Research for the Australian Communications and Media Authority, 2011). The Cybersmart Detectives online education activity has been a game-based program for 11- to 12-year-olds in Australia since 2004. The evaluation with 28,000 students substantiated the intended changes in online behavior as well as positive actions for students in risk groups (Australian Communications and Media Authority, 2012; Dooley, Thomas, Falconer, Cross, and Waters, 2011). Our findings highlight that many of the issues preteens are negotiating call for more nuanced and sustained educational programs that support the development of critical social media literacies. In particular, with the proliferation of mass user platforms and artificial intelligence, there is a need for schools to educate students around managing and protecting personal data.

Photo Credit: Australian Communications and Media Authority

AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY (ACMA)

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31

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CASE STUDY # 11

SINGAPORE: NATIONAL CYBER WELLNESS PROGRAM

Supporting Media Literacy and Digital Citizenship Development in a Media-Rich Nation

The nation of Singapore has invested consistently in explicit and dynamic cyber wellness training to ensure children develop ethically and positively. The Cyber Wellness program, which promotes character and citizenship education (CCE), focuses on the well-being of secondary students as they navigate cyberspace. As Chan Chun Sing and the Singapore Ministry of Education share, the Cyber Wellness curriculum "aims to equip students with the knowledge and skills to harness the power of ICT [information and communications technologies] for positive purposes, maintain a positive presence in cyberspace and be safe and responsible users of ICT." As Madjid et al first noted (2020), Singapore's 21st Century Competencies "provide holistic education to students and prepare them to face future challenges as well as seize opportunities. In addition to other competencies, this framework puts emphasis on two information literacy competencies: critical and inventive thinking and communication, collaboration and information skills" (p. 383).

Figure 6. Singapore Ministry of Education's Cyber Wellness Framework

As a result of students' skyrocketing social media use, Singapore has recognized an urgency to develop students' recognition of media source credibility for responsible engagement with and on social media platforms and to boost skill in information source analysis, resiliency in responding to misinformation and/or cyber-bullying, and generally promote holistic well-being as a result of media connectedness. Singapore's former education minister and current national Minister for Health, Ong Ye Kung, shared, the country developed plans and has consistently invested in "devot[ing] more time, and develop[ing] more materials to teach to critically evaluate what they read online, be able to tell genuine news from falsehoods, and not rely on social media 'likes' for validation" (Ong in Teng, 2020, para. 7).
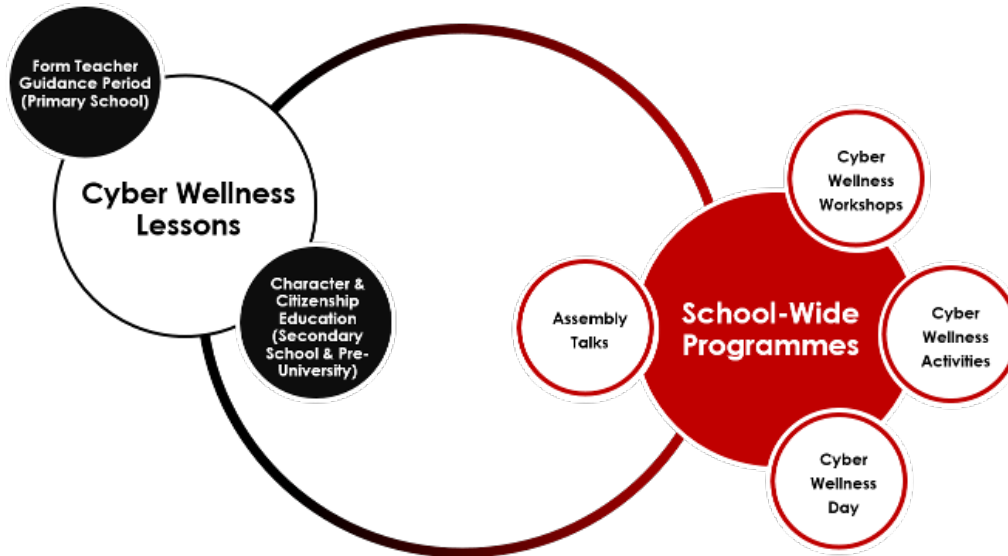
The Singapore Ministry of Education set out to deliver three key messages through the Cyber Wellness Program, likely generalizable to a global audience as part of a summative framework:

1. Embrace the affordances of technology while maintaining a balanced lifestyle of offline and online activities
2. Be a safe and responsible user of technology and maintain a positive online presence
3. Be responsible for personal well-being in cyberspace.

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32

Through these messages, the program aims to support the development of healthy and responsible technology use across its student population. The following table shows the organization of the Cyber Wellness program's curriculum:

Figure 7. Singapore Ministry of Education's Spectrum and Approach

SINGAPORE'S CYBER WELLNESS CURRICULUM	
TOPIC	**SKILLS TAUGHT**
Cyber Use	• Maintaining a healthy balance of online and offline activities
Cyber Identity	• Developing a healthy online identity • Appropriate online expression
Cyber Citizenship	• Understanding the cyber world • Handling online content and behavior • Having a positive presence in the cyber community
Cyber Ethics	• Creating and sharing online content in a responsible manner • Respecting copyright
Cyber Relationships	• Netiquette
Cyber Bullying	• Developing safe, respectful, and meaningful online relationships

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33

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CASE STUDY # 12

MALAYSIA: CYBERSECURITY MALAYSIA INITIATIVE

National Strategy for Information Security, Media Literacy, and Digital Citizenship Instruction

CyberSecurity Malaysia is an initiative launched by the Malaysian Communications and Multimedia Commission that offers its domestic services and programs to support information security, media literacy, digital citizenship resources and training across its citizenry. One of CyberSecurity Malaysia's programs, CyberSafe, exists in partnership with Digi Telecommunications, a Malaysian mobile service provider, "to impart practical knowledge on cyber safety and provide necessary information and resources to a wide spectrum of the community to ensure their online experience is positive and secure" (CyberSecurity Malaysia, para. 2). As Susanty et al (2019) noted, CyberSafe is thought to be one of the pioneering efforts in the region for initiating digital citizenship, particularly for training and developing skills for internet safety and security. The program has also developed various media and materials that include newsletters, videos, and games to be used as training and development aids.

The CyberSafe in Schools program has been lauded as a pioneer for raising awareness, conducting studies, developing content, establishing networks with agencies and global positioning" (Susanty et al, 2019, p. 824). However, CyberSecurity Malaysia has moved to extend its offerings beyond training and education for internet safety and digital literacy. This has included in-person camp and workshop experiences, where students engaged in immersive, social programming to learn about digital citizenship and cyberbullying prevention. Through this programming with the national digital citizenship program in alliance with education agencies, instilling digital citizenship skills through education will, in the long run, yield youths who are civic minded, who will not become victims and will not victimize others when online. Inclusion of the digital citizenship initiative education framework in the CyberSafe Program will certainly contribute to the national sustainability, social well-being and wealth creation of the cyber security ecosystem in Malaysia. The framework is envisioned as the baseline for developing more content, which could help parents and teachers to educate K-12 students as technology users with the appropriate norms and responsible users of technology. In digital citizenship, identifying the solution, developing the resources and teacher and parent development programs, establishing the implementation strategies and the impact assessment will be the key factors for digital citizens to sustain the social well-being in the future.

<table>
<tr><td>

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Photo Credit: CyberSafe in Schools Program

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34

CASE STUDY # 13

SOUTH KOREA: COMMUNITY MEDIA FOUNDATION

Community Foundation Supports the Development of Digital Citizenship Through Media Production Training

In South Korea, the nation's dynamic media ecosystem and culture, which include both the technical and cultural proliferation of digital technologies and media content, have contributed to global phenomena like Korean film and popular music (K-Pop). As such, digital media has impacted almost every aspect of life in South Korea, with the younger generation being the nation's most active cohort in the adoption of these new technologies that in turn are forming their culture (Yoon et al, 2017). As South Korea has a nationwide infrastructure to support some of the fastest Internet connection speed in the world, Yoon et al (2017) have reported that "88.3 percent of the entire population over 3 years of age have Internet access, while 99 percent spend an average of 14.3 hours per week online. Half of the Korean population aged six and older play mobile games on average 12.6 times a week" (p. 1). Within this context, robust programs and support for media literacy and digital citizenship are of great interest for other nations seeking to understand how to support their citizens and strengthen their governmental, economic, and sociocultural institutions as technologies continue to accelerate in their adoption speed and scale.

As a vehicle for promoting media literacy and digital citizenship, The Community Media Foundation (CMF) is a public institution that works to provide media literacy and digital citizenship education in South Korea, and supports the work of government entities. The CMF has offered free media production classes such as recording and editing since 2015. Media literacy education programs of CMF in Korea consist of mainly media production courses, which emphasize skill development for media awareness (MA), media competency (MC), communication and participation (C&P), and responsibilities and rights (R&R). Related to digital citizenship, CMF training also supports development of targeted digital citizenship skills, including internet political activism (IPA), technical skills (TS), critical perspective development (CP), and networking agency (NA). In a recent study, CMF trainings in South Korea yielded significant effects on the population across media literacy subcategories of MC, CT, C&P, R&R (Park et al, 2021). On the digital citizenship front, CMF's work has made impacts on the IPA, TS, and CP. Particularly for internet political activism, the results of the study suggest that CMF's work has contributed to the facilitating of democratic engagement in South Korea. As Park et al (2021) note, "it is encouraging that the CMF's educational effect was confirmed in the IPA, a crucial element of democracy. The CMF is an institution dedicated to media literacy education to spread the base of democracy" (p. 128).

KOREAN COMMUNITY MEDIA FOUNDATION (CMF)
Operating locally throughout the Republic of Korea Foundation for Broadcast Culture (FBC) from Munhwa Broadcasting Corporation (MBC) http://www.fbc.or.kr/

35

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SYSTEM AND PRACTICE CHALLENGES

Call to Action from Existing Digital Citizenship and Literacy Frameworks

Showcase the Connection Between Digital Literacy and Digital Citizenship Proficiencies

A number of frameworks, models, and programs maximize the connectedness between digital literacy and digital citizenship skill development, which allows learners to develop foundational skills that can be developmentally built upon throughout their learning lifespan. Within these contexts, digital literacy skills provide learners with baseline knowledge necessary for development as active, global digital citizens by allowing them varied experiences in consuming, creating, communicating through digital technologies within and beyond the digital world (Atif & Chou, 2018; Mattson & Lindsey, 2021; Lindsey, 2021). An undercurrent of this connection between digital literacy and digital citizenship focuses on teaching learners to ethically operate within and beyond their digital communities and the wider world. Atif and Chou (2018) noted learners are citizens who inherit rights within their digital contexts and must behave responsibly, ethically, and appropriately according to community standards. This ethical dimension serves to bridge the development of learners throughout their learning lifetimes as they progress from developing foundational digital literacy skills to operating as proficient, engaged global digital citizens. As such, the intentional integration of the ethical dimension of the connection between digital literacy and citizenship is a keystone of holistic digital citizenship policies and practices.

*Reflect Nuances and Complexities Inherent in the Advancement of Digital Citizenship
Education Across Global Contexts*

Advancing global digital citizenship education is a complex, nuanced undertaking, according to Searson et al. (2015). In articulating this complexity, Searson contended, "Agreeing upon the universal characteristics, and features that constitute digital citizenship across the globe would challenge notions of a unified ideal" (Searson et al., 2015, p. 730). In an effort to confront this complexity, Searson et al. (2015) recognized that educators across the world are increasingly moving in a positive direction to educate all students by facilitating their learning within and beyond digital environments. Searson et al. (2015) wrote: a universal approach to a digital citizenship is subject to similar complexities when trying to construct any global citizenship model. One might ask, for example, if our digital citizenry is largely an accident of birth? We are born into societies whose technical infrastructures and government policies frame our digital experiences (p. 730). As such, advanced digital citizenship policies and practices should represent globalized and localized contexts to provide learners the proficiencies they need to function within their communities and within the world. In creating a global digital citizenship framework to drive policies and practices, policymakers and educational leaders should consider the answers to a few complex questions:

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Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

36

- To what degree is our development as digital citizens empowered or limited by factors related to nation-state identity, gender, regionalism, religion and religious tolerance, socio-economic status?
- How much do these external factors shape the extent and quality of our digital citizenship?
- Is it even possible, let alone advisable, for all world citizens to achieve the same characteristics of digital citizenship and literacy?

Inspire an Active Commitment within Learners to Create a Just World

Global digital citizenship education should inspire learner agency and drive learners toward an active commitment to improving the world. Parekh (2003) contends global citizenship facilitates learning through action centered around three main components: consistent, reflective questioning of a learner's own country and its policies, active interest in other countries' affairs, and active commitment. Parekh's ideas connect to Lindsey's (2021) incorporation of learner agency into the Edvolve Framework: Evolving in the digital age. The Edvolve Framework is positioned to express that learners must develop mindsets, skill sets, and critical thinking skills, which contribute to learner agency (Lindsey, 2021). In conjunction, these skills and mindsets provide learners the opportunity and the realization that they actively develop their thoughts, voices, and digital identities through digital experiences and that they have the power to use these experiences and this knowledge to interact with the world around them (Lindsey, 2021).

AI-Supported Digital Citizenship Education Systems and Practices

The examination of AI-supported education in connection with global digital citizenship education provides a critical path for expanding educational access and equity across the globe. The Organization for Economic Co-Operation and Development (OECD) defines AI as "a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. AI systems are designed to operate with varying levels of autonomy" (OECD, 2019). Our technology-steeped world is surrounded by AI technologies, which drive computer applications, systems, and processes that humans interact with daily, from smartphone assistants to search engines to systems that evaluate employee candidates (Southgate, 2020).

As Southgate (2020) contended, educators and policymakers face several challenges, including developing a solid understanding of AI's essence and inner workings to raise relevant questions about AI-supported educational systems' design, application, and implications. Educators must also use their foundational understanding of AI to drive questions about decision-making related to AI implementation and governance in higher education (Southgate, 2020). Educators must also use this knowledge to recognize and address the unique challenges AI presents in terms of equity and inclusion to recognize and correct systemic biases to provide equitable, inclusive learning environments and experiences for all students, especially those who have been historically marginalized (Southgate, 2020).

37

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Additional and specific challenges related to developing AI-supported digital citizenship education span macro, meso, and micro-levels. Macro-level challenges encompass global networks and international systems; meso-level challenges address the importance of inclusion and equity in AI systems; and micro-level challenges highlight challenges within the scope of individual educational institutions and classrooms.

International and National Challenges

International and national challenges at the macro-level, include developing a network of national and international systems and policies that support implementing AI-supported ecosystem digital citizenship education that advances sustainable development (Pedro et al., 2019). This macro-level lens highlights an important gap in the literature on global digital citizenship education, which serves as the aim of this analytical review and a study. Our study, titled *UNESCO Institute for Information Technology in Education (IITE) Study on Digital Literacy and Digital Citizenship Education,* examines how existing global educational systems promote information and communication technologies (ICT) capacity building through the use of artificial intelligence (AI) technologies to facilitate learning and to develop the learner toward the acquisition of digital literacy and 21st-century workforce development skill proficiencies to promote educational equity and prepare learners for lives and careers as active digital citizens. The findings of this study, showcased through a model framework and a series of webinars, will provide educational best practices, evaluation criteria, and guidance for educators across the world in creating lifelong learning experiences to develop learners' digital literacy skills, 21st-century workforce skills, and human skills through active digital citizenship.

Regional and State-Level Challenges

Regional and state-level, or meso-level, challenges are also present. These include ensuring equity and inclusion as integral components of AI-supported educational systems (Pedro et al., 2019). Advancing effective solutions to this level provides support for the advancement of the UN's SDG4: "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (UNESCO, n.d.). This goal is especially important in the realm of global digital citizenship education to promote diverse people and perspectives operating in a connected world and avoid magnification of biases or exclusion of learners from a rich array of backgrounds, contexts, countries, and communities. Specifically, SDG4, Target 4.7, centers on global citizenship as a component of sustainable development.

Target 4.7 states:

> "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" (UNESCO, n.d.).

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

38

Importantly, the indicator measures the "Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in (a) national education policies, (b) curricula, (c) teacher education and (d) student assessment" (UNESCO, n.d.).

Local-Level Challenges

The metrics of Target 4.7 manifests as the third level of challenge, which can be examined at the local or micro-level. This exists at the institutional and classroom level, including on-site, online, blended, digital classrooms. This challenge centers on the development of a synergistic relationship between AI-powered education and educators, ensuring educators and educational leaders are equipped with skills and knowledge to facilitate AI-powered pedagogy within their institutions and ensuring AI-supported systems create solutions that are sustainable in real-world classrooms and educational environments (Pedro et al., 2019). Designing, modeling, and measuring effective and cyclical AI systems that promote cyclical interactions between systems, learners, educators, and behaviors should focus on future work implementing and scaling AI in education (Holstein & Dordoudi, 2021), especially through AI-supported digital citizenship education. AI-supported digital citizenship education implemented across various countries, communities, learners, and contexts can be maximized through the scale potential inherent in machine learning. AI-supported education must also be moderated, tempered, and adapted through human interactions to mitigate the magnification of biases (Holstein & Dordoudi, 2021).

Holstein and Dordoudi (2021) emphasized the importance of this synergistic interaction: In cases where deployed AI systems both shape the behaviors of learners and educators (e.g., by presenting particular predictions, recommendations, or behavioral nudges) and are shaped by these evolving behaviors (continuously learning and adjusting based on incoming educational data), the dynamics of the resulting educational system can be challenging to anticipate…If intentionally designed as such, these cycles may potentially serve as positive, regulative loops (cf. VanLehn, 2016)—helping humans mitigate undesirable impacts of algorithmic decision-making and helping machines mitigate undesirable impacts of human decision-making.

Pathways Forward for Addressing Challenges to Equitable AI-Supported Digital Citizenship Education

To address macro-level challenges of equitable AI-supported digital citizenship education, policymakers, educational leaders, and AI developers should ensure technologies are iteratively designed and continuously monitored and improved across geographic, ethnic, language, socioeconomic, and political contexts. At the meso-level, educational leaders and AI developers can maximize inclusivity and equity by ensuring diverse voices and perspectives that represent the educators and students the AI-supported education is designed to serve. Engaging participation from representative stakeholders in the design of AI-supported educational systems provides agency and accountability for the synthesis of perspectives into equitably designed systems that meet the needs of learners, thereby enhancing the operationalization of the system of equity and inclusion throughout the learning system and learning process (Holstein & Dordoudi, 2021).

Finally, at the micro-level, institutional leaders and educators can design and assess their technologies and organizational processes for inherent biases and unintentional negative impacts of their technologies (Holstein & Dordoudi, 2021).

Addressing these multi-level challenges underscores the emphasis on further research and practice needed to address scalability and strategically maximize equitable impacts while minimizing the potential of inequitable impacts of AI-supported digital citizenship education. At the higher education level, government policymakers are increasingly emphasizing AI strategy, which includes AI-supported education and AI competencies to close the country's skills gaps (Pedro et al., 2017). The foci on AI competencies and AI-supported education ensure institutions prepare graduates to meet workforce skill needs upon entering the workforce and encourage lifelong learning by cultivating adaptable, lifelong learners. Lifelong learning, as defined by The International Labor Organisation, is "all learning activities undertaken throughout life for the development of competencies and qualifications," resulting in learners who master lifelong learning, "the appropriate skill formation strategy for the 'new economy'" (ILO, 2004). This principle, as applied to AI-supported global digital citizenship education ensures maximum learning outcomes across an individual's development and maximum societal benefits across an individual's lifespan.

In developing and scaling AI-supported digital citizenship education, leaders must consider the notion of transparency. Holstein and Dordoudi (2021) contended, "Ultimately, the notions of fairness we choose for a particular application depending on what we, and those we include in the design process, find most salient and important. Where fundamental design trade-offs exist, we need to take a stance and make these trade-offs (p. 14). For developers and educational leaders, this means committing to transparency in an attempt to accept responsibility and communicate limitations. Through continuously assessing, communicating, and iteratively responding to inequities, developers and leaders can mitigate the long-term unanticipated effects of biased systems and processes (Holstein & Dordoudi, 2021). In committing to transparency and maintaining human control, carefully designed AI systems, developers' and educators' awareness of how human decision-making and algorithmic decision-making interact, build trust (Lee & Baykal, 2017).

Through their analysis of individuals' perceptions of fairness of algorithmically-based decisions, Lee's and Baykal's (2017) research explored an essential central question related to the design of algorithmic technologies, a valuable perspective for individuals working to develop, implement, or scale AI-supported education: how can the best parts of human and algorithmic technologies be combined to minimize system bias and increase trust? Lee's and Baykal's work suggested the answer to this question is nuanced. The authors' findings suggested even algorithms mathematically proven to be fair may not be perceived as fair from human perspectives (Lee & Baykal, 2017). Lee and Baykal also cautioned that even mathematically-sound systems must incorporate a human element, claiming "algorithmic mediation in group decisions should account for social and altruistic behaviors that may be difficult to define in traditional mathematical or economic terms" (Lee & Baykal, 2017, p. 1046). This fact underscores the importance of implementing the principles of iterative design, continuous monitoring, and continuous improvement processes for creating and maintaining foundational human-machine relationships to create trustworthy, transparent AI-supported educational systems that serve the needs of students. With regard to global digital citizenship education, trust, and transparency as built through fair and equitable systems that rely on the integration of human-centered and machine-centered components, which coalesce to ensure

learners from diverse backgrounds, countries, and communities are equipped to make meaningful gains in their development of digital competencies necessary for full, active participation as global digital citizens. We now conclude this analysis and topical overview with seven global cases that highlight the intersection of AI-enabled technologies and enhanced digital literacy, and digital citizenship framework needs and principles for the global spectrum of needs.

Photo Credit: Charles Deluvio, *Unsplash*

41

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

HOLISTIC DIGITAL CITIZENSHIP FRAMEWORK CASE STUDIES PART 2
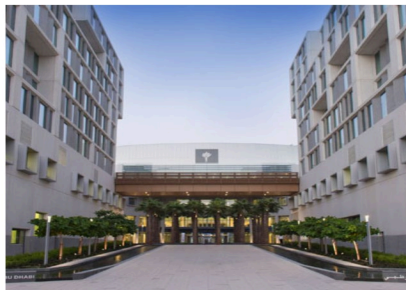
Informative Global Cases & Practices

14. **ECUADOR: UNIVERSIDAD DE LAS AMERICAS AND INTERNACIONAL DEL ECUADOR**
   Adaptive Learning in Practice

15. **KENYA: M-SHULE PLATFORM**
   Adaptive Learning in Practice

16. **URUGUAY: PAM PLATFORM**
   Adaptive Learning in Mathematics Education Contexts

17. **UNITED STATES: UNIVERSITY OF MICHIGAN**
   My Learning Analytics Dashboards

18. **AUSTRALIA: UNIVERSITIES OF SYDNEY AND MELBOURNE**
   Student Relationship Engagement System

19. **UNITED STATES: UNIVERSITIES OF NORTH CAROLINA AND ILLINOIS**
   The da Vinci Surgery System for Medical Sciences

20. **UNITED ARAB EMIRATES: NEW YORK UNIVERSITY ABU DHABI**
   Politics of Code Course Inspires Survival of Best Fit

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

42

CASE STUDY # 14

ECUADOR: UNIVERSIDAD DE LAS AMERICAS AND UNIVERSIDAD INTERNACIONAL DEL ECUADOR

Adaptive Learning in Practice

In Ecuador, researchers from the Universidad de las Americas and Universidad Internacional del Ecuador are leveraging big data and artificial intelligence to respond to the transition to remote learning during the COVID-19 pandemic. In the context of the pandemic, universities have increasingly adopted remote, online, and hybrid solutions. As a way to augment student supports through remote and online instruction, researchers developed a model that leverages and integration of big data and artificial intelligence "as a solution in a technological architecture that supports the remote education model" (Villegas-Ch. et al., 2020, p. 2). Through adoption of their model, researchers found it possible to identify students' learning and task performance needs, and could leverage their system to recommend immediate actions for students. The framework was developed using Apache Hadoop, a collection of open-source software utilities that enables the use of multiple computers in a network to solve problems that require or use large quantities of data and/or computation (Apache Hadoop, https://hadoop.apache.org/, n.d.). As the researchers shared, "this work is marked as a starting point for the inclusion of emerging technologies such as educational assistance, where the needs of the students are identified through the analysis of the grades of the students in each partial or by activity" (Villegas-Ch. et al., 2020, p. 23). Through this framework, the adaptive learning solution gathers a variety of student performance data to clearly identify problems and generate effective solutions that are quickly shared with students to improve their learning. In the long-term, researchers think the ability of the system to understand the learning situation of each student will lead to even more targeted and personalized education models. Researchers highlight the system's ability to recommend a change in the activities or evaluation on the part of instructors "which leads to including in the architecture the management of laboratories and virtual environments where active learning can be applied" (p. 25).

Photo Credits: Universidad de Las Americas and Universidad Internacional del Ecuador

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43

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

CASE STUDY # 15

KENYA: M-SHULE PLATFORM

Adaptive Learning in Practice

M-Shule was launched in Kenya in 2016 as a mobile platform filled with lessons based on national curriculum standards delivered via SMS that adapt to each student's skills and abilities using AI technology. M-Shule is designed to track and analyze student's performance in order to give schools and parents recommendations and guidance. What is particularly unique about this application is the explicit and programmed connection between identifying and communicating learner performance to empower parents and schools with insights and recommendations. As Nyabola (2021) has noted, M-Shule "uses AI to provide an adaptive learning experience to students by continuously assessing their competency and tailoring the lessons to their needs. M-Shule represents the most ambitious, public-facing deployment of AI in Kenya to date" (p. 7). Mulligan (2018) noted that a pilot program implementation of M-Shule with 15 schools and more than 400 students was successful. A broader roll-out of the platform has been affected by the coronavirus pandemic, which shut schools across the country, although the platform has quickly adapted to providing health and safety information to learners during the pandemic. Amos Otunga, the Learning and Projects Supervisor, recently shared that M-Shule seeks to "reach learners in communities that are often forgotten. During the pandemic, we have seen low-income families drastically affected by school closures — and this divide has impacted refugee children most of all. They too deserve a chance to learn academically as well as enhance their socio-emotional development" (M-Shule Learning Team, para. 5). Otunga went on to share that M-Shule is "first learning platform to use SMS to build academic or life skills and collect data in a personalized way" in the East African region, by combining SMS with artificial intelligence to deliver tailored, accessible, and affordable learning that builds skills and knowledge (para. 13).

Photo Credit: M-Shule

M-SHULE PLATFORM

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Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

44

CASE STUDY # 16

URUGUAY: PAM PLATFORM

Adaptive Learning in Mathematics Education Contexts

In Uruguay, Plan Ceibal is a public organization aimed at generating inclusion and equal opportunities with the support of technology, including the provision of computers and free internet. One of its main initiatives is an online adaptive learning solution called "Mathematics Adaptive Platform" (PAM for its Spanish acronym). While first an innovative application to discipline-specific learning, PAM's content has since been adapted to Uruguay's national curriculum and standards, and is a tool that provides personalized feedback according to each student's skill level based on an analysis of student experiences. Several studies have shown how the program has already had a positive impact on learning (Bailón et al, 2015). PAM was developed by the German company Bettermarks and began to be used in 2013 as part of the One Laptop Per Child program, offering students over 100,000 activities to give them personalized assistance according to their level of knowledge. PAM provides students with help through a set of over 25 thousand step-by-step exercises and 2800 feedback patterns to explain the solutions of each exercise. PAM is an adaptive online platform for teaching mathematics, which actively integrates students and teachers in the educational process. It also provides teachers with tools to work with their groups, establish learning goals and propose activities, and it has comprehensive evaluation instruments to provide immediate follow-up and reports. It allows you to create your own series of activities and share them with colleagues.

Photo Credit: Plan Ceibel

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45

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Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

CASE STUDY # 17

UNITED STATES: UNIVERSITY OF MICHIGAN

My Learning Analytics Dashboards

Data visualization and empowerment comes front and center in the My Learning Analytics (MyLA) from the University of Michigan. MyLA is a dashboard that provides students with information about their engagement with course materials and resources, assignments, and grades in a learning management system. A set of three learning analytics data visualizations have been designed to: reveal behavioral patterns associated with good learning skills, guide decisions about actions students can take that may improve their academic outcomes, and provide a transparent view of students' course standing. For ease of use, these visualizations can be accessed directly from the university's learning management system course navigation or from the relevant page view in each course, placing the links where the students already go for course-related information. MyLA was developed as a collaborative project between researchers from the School of Information and School of Education partnering with the Information Technology Division's Teaching & Learning section. Particularly unique about this initiative, students can view interactive dashboards with their progress in the class and the activity of their peers. This can be useful in considering what other students are viewing in the course, or how they are preparing for exams. The MyLA systems help students to set course progress goals and track them, or to identify what resources in a course are being used by other students and visualize their success in the course. This strengthens student awareness and self-reflection and promotes empowerment.
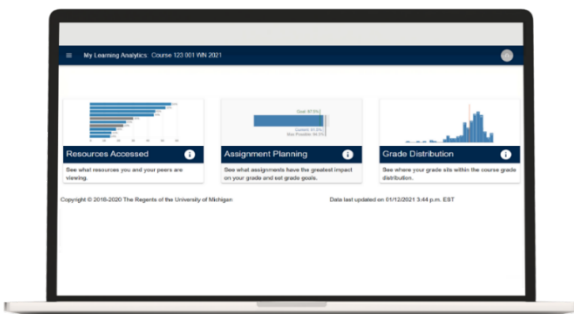
Photo Credits: University of Michigan

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46

CASE STUDY # 18

AUSTRALIA: UNIVERSITIES OF SYDNEY AND MELBOURNE

Student Relationship Engagement System

The system developed collaboratively between the University of Sydney and the University of Melbourne in Australia, is an exemplary case for how universities can empower educators to use learning analytics to support students. Now in use at four universities across Australia, SRES operates with the goal to provide personalized communication and targeted support, especially with large classes of hundreds of students. Scaled across universities with thousands of students, where hundreds of students may be enrolled in one class alone, writing individual email messages to each student may not be possible. The SRES alleviates this challenges system by allowing faculty to filter by grades, student feedback, and other data points to begin responses through email templates designed to feel personalized to many students. Though SRES, faculty can use variables or placeholders for a student's name or grade, and then provide specific, useful feedback for the scenario to which they are responding.

SRES includes a number of features that offer both robust support for faculty who input and engage with the platform to support students, as well as to students themselves. As was highlighted in the 2021 EDUCAUSE Horizon Report, almost "1.8 million 'personalization events' have been delivered by SRES since 2016, reaching more than 100,000 unique students" (EDUCAUSE, 2021, p. 21). Research on the SRES and its relation to learning analytics suggests that not only is the platform effective for capturing and reporting data for personalizing communication strategies with students, but that the platform has created new possibilities for how faculty engage with students holistically, including during in-person meetings and face-to-face classes, as well as implications for students' sense of belonging (Arthars et al, 2019).

Figure 8. SRES At-a-Glance Summary
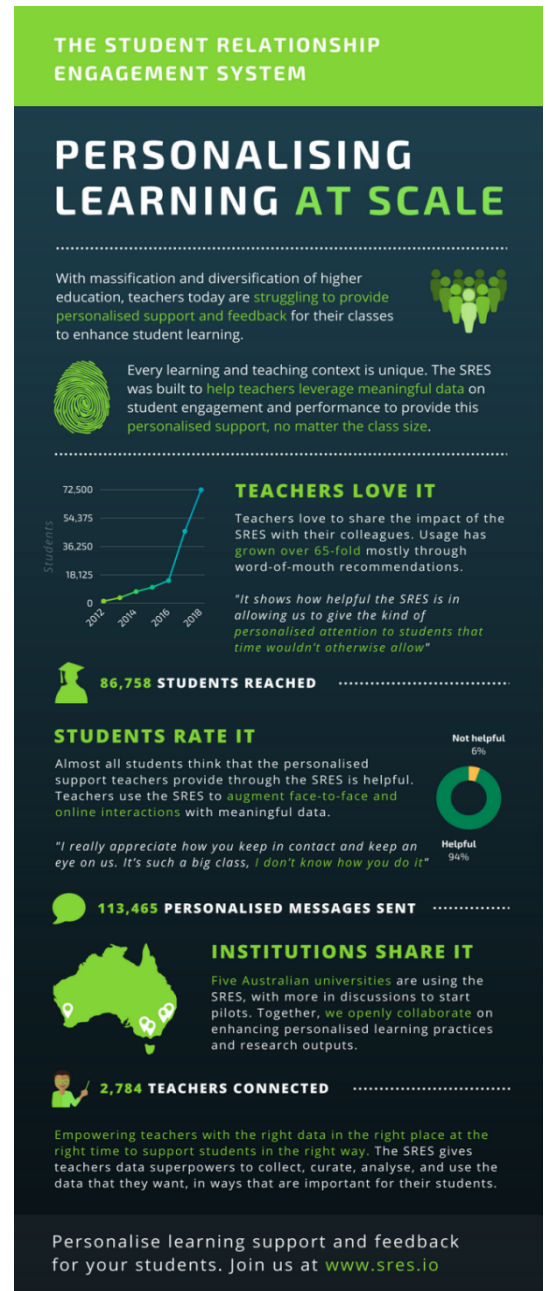
STUDENT RELATIONSHIP ENGAGEMENT SYSTEM (SRES)

University of Sydney: Camperdown NSW 2006, Australia
University of Melbourne: Parkville VIC 3010, Australia
https://www.sres.io/

47

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CASE STUDY # 19

UNITED STATES: UNIVERSITY OF NORTH CAROLINA AND UNIVERSITY OF ILLINOIS-CHICAGO

The da Vinci Surgery System for Medical Sciences

The da Vinci Surgery System has been an approved robotic surgical system in the United States for nearly 20 years. However, recent advances in the manufacturing of simulated anatomy have made it possible for innovations in surgical training in development at two institutions of higher education in the USA. While the da Vinci system can be used in a variety of real surgeries, its use to help surgical students develop and learn is critical because apprenticeships in training new surgical skills can be problematic and ethically complex when it involves human subjects. This is particularly true for areas of the human body that may be difficult to access, or which require particularly invasive operations.

At the University of North Carolina at Chapel Hill, researchers have implemented the use of 3D-printed anatomy to help surgical simulation for transoral robotic surgery (TORS) (Turr et al, 2021). TORS can be particularly challenging and poses challenges for operators in training, with limited robot access on a platform requiring distinct surgical skills. As the authors noted, there are few robotic simulators available and capable to support head and neck simulations, and most VR-based training solutions don't focus on that area of the body. So, the researchers developed a set of 3D-printed oral cavity structures with artificial tissue that could be readily replaced. The simulations asked students to engage in short, hands-on simulations, and the researchers were seeking validity for the simulator compared to lived surgical conditions. In this innovation, the simulator differentiated between novices and more experienced, and robotically trained operators of the system, and the study's findings suggest a positive future direction for the use of robotic medical simulation buoyed by 3D-printing of simulated anatomy.

At the University of Illinois-Chicago, fabrications of the colorectal area have also produced important advancements for the use of the da Vinci Surgery system as a training simulation. As with the TORS study in North Carolina, researchers in Illinois sought construct and content validity through their research to further validate the efficacy of their simulator. Primarily, their research sought to distinguish expertise of trained surgeons versus those of surgical residents. Such simulations, aided by the manufacture of fabricated anatomy, shows great promise for the future of surgical solutions across the globe.

Photo Credit: Melich et al (2018)

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Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

48

CASE STUDY # 20

UNITED ARAB EMIRATES: NEW YORK UNIVERSITY ABU DHABI

Politics of Code Course Inspires Survival of Best Fit

Emerging from a "Politics of Code" course at New York University Abu Dhabi by four computer science students, Survival of the Best Fit is a web-based game simulation to educate the public about the effects of AI bias in hiring. Through the game, players assume the chief executive officer (CEO) role at a rapidly scaling company, where they come to see how their use of machine learning algorithms for automated hiring practices can inadvertently disqualify and omit deserving candidates. This leads to a series of compounded challenges and perceptual risks to the company. As the developer team behind Survival of Best Fit shared, they built the game to "reach an audience that may not be the makers of the very technology that impact them every day. We want to help them better understand how AI works and how it may affect them, so that they can better demand transparency and accountability in systems that make more and more decisions for us" (Survival of Best Fit website, n.d.). Survival of Best Fit is a notable case on several fronts. Primarily, the global nature of its collaboration is remarkable, as it was created by four students from four different countries (Hungary, Egypt, Korea, and Slovenia) and living in four others (UK, UAE, Singapore, and Sweden). Furthermore, Survival of the Best Fit was built as a class project by students, and then received funding to scale through Mozilla's Creative Media Awards, which "supports the development of games, films, and art projects aimed at raising awareness about the unintended consequences of AI" (Dickson, 2019, para. 3). In this way, this case represents more than a best practice outcome related to a playable game and product that serves to educate about the growing role of artificial intelligence and its opportunities and risks for implementation in contemporary life. It is also an exemplar for 21st century pedagogy and learning itself, as its development was fostered through a higher education learning experience, and then supported externally for its continued development.
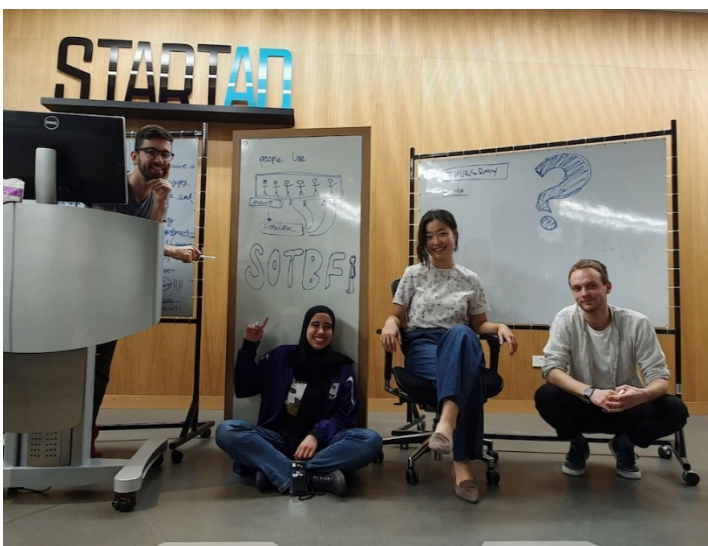

Photo Credit: Survival of Best Fit

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49

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GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

GLOBAL IMPACT AND EMERGING INTERSECTIONAL FRAMEWORK

Situating Needs Within the Global Economy

Considering the international context in which this research is situated, the U.N. Declaration of Human Rights and U.N. Sustainable Development Goals connect and drive the sense of urgency for action in digital literacy to ensure a more just and interconnected global society. In considering the breadth and depth of case studies shared, which sample advances in digital literacy, digital citizenship, and artificial intelligence impact on global and lifelong learning, and the existing research and policy frameworks that call for explicit instruction to advance educational outcomes for each topic, undercurrents of global change, equity and access, necessary technology fluency all contribute to the need for a comprehensive and actionable lifelong learning framework to ensure holistic digital literacy and citizenship.

Further, as the globe embarks on the "Fourth Industrial Revolution," it is important to consider how characteristics of the 21st Century Economy (i.e., automation resulting from artificial intelligence; employer access to global mobile talent increasing job competition; the impact of talent-as-a-service platforms supporting the commonplace of "gig work;" longer life expectancies increasing career lengths; robotics and computers augmenting work tasks; the pace of change shrinking the shelf-life of skills; continual employee learning to adapt to change; and lower job tenure) are disrupting prior and current perceptions of work and career (CareerPrepped, n.d.) and how those trends support or further exacerbate the challenges associated with achieving digital literacy outcomes that we recognize will facilitate a greater and more comprehensive attainment of the U.N. Declaration for Human Rights and Sustainable Development Goals. Not unlike the core finding that digital literacy, citizenship, and artificial intelligence must be taught recurringly with instruction modified across the lifelong learning spectrum, the future of work similarly suggests a realization that career-readiness is no longer something that can be achieved at an early point in one's formal education. Instead, it is an ongoing process of perpetual learning that supports individuals in being equipped with the skills they need to succeed across their lifespan.

Figure 9. Senninger's Learning Zone Model

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

50

The Senninger's Learning Model focuses on a proactive approach to perpetual, lifelong learning, acknowledging that working adults, in particular, often stay far too long in the comfort zone in a false sense of security, missing the opportunity of the learning zone when they are presented with market changes that create possibilities of being laid off or burnt out which then forces them into the panic zone as they may not be equipped to compete in the new reality of current and future labor market (CareerPrepped, n.d.). However, to be proactive in supporting equity and mastery of 21st-century skills across the globe, it is necessary to understand the market through employer needs. Those needs compel on-going engagement with digital literacy and digital citizenship competencies, and so our ensuing charge is clear.

Workforce Preparation and Further Connection Points

As a part of ensuring their workplaces are prepared for the 21st-century, employers are focused on identifying candidates who can showcase problem-solving skills and their ability to work as a part of a team (NACE, 2019). Similar to the National Association of Colleges and Employers (2019) data, the Center for Economic Development (CED) ranks problem-solving as a top-rated essential competency for work with the ability to work with others of diverse backgrounds, critical thinking, teamwork and collaboration, oral communication, organization and the ability to prioritize, written communication, and proficiency with new technology also mentioned as key competencies (CED, 2015).

Figure 10. Attributes Employers Seek on a Candidate's Resume (NACE, 2019)

ATTRIBUTE	% OF RESPONDENTS
Problem-solving skills	91.2%
Ability to work in a team	86.3%
Strong work ethic	80.4%
Analytical/quantitative skills	79.4%
Communication skills (written)	77.5%
Leadership	72.5%
Communication skills (verbal)	69.6%
Initiative	69.6%
Detail-oriented	67.6%
Technical skills	65.7%
Flexibility/adaptability	62.7%
Interpersonal skills (relates well to others)	62.7%
Computer skills	54.9%
Organizational ability	47.1%
Strategic planning skills	45.1%
Friendly/outgoing personality	29.4%
Entrepreneurial skills/risk-taker	24.5%
Tactfulness	24.5%
Creativity	23.5%
Fluency in a foreign language	2.9%

However, not all essential competencies are as easy to hire for, with problem-solving and critical thinking being noted as being essential to hire for and the most difficult to hire. Thus, to support individuals' employability, it is important to focus on supporting them in gaining essential qualities that include problem-solving abilities (e.g., critical thinking, creativity, adaptability), professional strengths (e.g., communication, work ethic, habits of lifelong learning), and people skills (e.g., collaboration, teamwork, cross-cultural competence), which transcend both an individual's education and current work experience while supporting rapid change (Wolff & Booth, 2017). Many of these skills interconnect to the frameworks and components of existing models of digital literacy and digital citizenship instruction and compliment these needs well.

51

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Related, employers also value experiential learning, indicating that learners cannot develop these skills in a vacuum – they need to be applied and practiced – by sharing that when making hiring decisions, employers are influenced by internship experience, as well as work experience (NACE, 2019, p. 14). A key challenge for employers continues to be the career readiness of college graduates, as they report college graduates as being least proficient in the areas they believe to be essential (NACE, 2019). This thinking further aligns to multiple global case studies wherein higher education leaders across disciplines expressed concern about the lack of student preparedness in digital competencies.

Figure 11. Essential Competencies for Hire (CED, 2015)

As 21st-century jobs continue to shift into performing interactive and collaborative tasks focused on problem-solving more frequently and repetitive tasks less frequently due to intelligent technologies that can automate and augment, it will be important for not only individuals to develop new skill sets but for countries to assess the impact of augmentation and automation on their economies (Accenture Research, 2018). Accenture analyzed 14 countries across the globe, identified that more than half of the work time in these economies has the potential to be augmented. Thirty-eight percent has the potential to be automated, with the distribution of this work skewed toward certain role clusters and could leave some economies with greater shares of their populations with jobs in their workforce in highly automatable and augmented fields more apt to negative consequences. For example, physical manual labor represents the largest share of employment in China. By 2028, demand will decrease, but it will remain the dominant form of employment. In fields that have highlighted augmentable and automatable tasks as main parts of job roles, it will be important to analyze how positions will evolve and where action may be needed to upskill to ensure the success of individuals and economies.

Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Figure 12. Skillsets of Growing Importance (Accenture, 2018)

The skillsets that are increasingly important across every role are acquired through practice and experience, not in classrooms.

Importance: ○ High ○ Medium ○ Low	Complex Reasoning		Creativity		Socio-emotional Intelligence		Sensory Perception	
	Importance in 2017	Change since 2004	Importance in 2017	Change since 2004	Importance in 2017	Change since 2004	Importance in 2017	Change since 2004
MANAGEMENT & LEADERSHIP	High	▲	High	▲	High	▲	Low	▲
EMPATHY & SUPPORT	High	▲	High	▲	High	▲	Low	▲
SCIENCE & ENGINEERING	High	▲	Medium	▲	High	▲	Low	▲
ANALYTICAL SUBJECT-MATTER EXPERTISE	High	▲	Medium	▲	High	▼	Low	▲
RELATIONAL SUBJECT-MATTER EXPERTISE	Medium	▲	Medium	▲	High	▲	Low	▲
PROCESS & ANALYSIS	Medium	▲	Medium	▲	High	▲	Low	▲
PHYSICAL SERVICES	Low	▲	Low	▲	Medium	▲	Low	▲
TECHNICAL EQUIPMENT MAINTENANCE	Medium	▲	Medium	▲	Low	▲	High	▲
MACHINE OPERATION & MANOEUVRING	Medium	▲	Low	▲	Low	▲	High	▲
PHYSICAL MANUAL LABOR	Low	▲	Low	▲	Low	▲	Medium	▲

Note:
- Complex Reasoning includes critical thinking, deductive reasoning, active learning and a set of higher-order cognitive capabilities.
- Socio-emotional Intelligence involves active listening, social perceptiveness, persuasion, negotiation and service orientation.
- Sensory Perception incorporates a wide range of sensory capabilities that have been stimulated through our increasingly intimate relationship with digital technologies.

Source: Accenture analysis of data from The Occupational Information Network (O*NET) of the US Department of Labor

Many of these changes are underpinned by technological advancements in robotics, artificial intelligence (AI) and machine learning, virtual reality (VR) and augmented reality (AR), and cloud computing that extend human-machine partnerships (Institute for the Future & Dell, 2017). As countries work to assess technology's impact on job roles, it will be important for them to determine how robotics can complete dangerous and repetitive tasks that do not require human intervention (e.g., related to special cognitive or problem-solving skills), AI and machine learning can assist with processing and applying data, VR and AR can create engaging experiences that support new learnings, and cloud computing can support timely and safe sharing of data (Institute for the Future & Dell, 2017). However, when countries and their workforces leverage emerging technologies to identify and act on information, quickly deploy resources, and deliver services, a change takes place that necessitates new processes, cultural norms, and employee skills are created and fostered (Institute for the Future & Dell, 2017; Wolff & Booth, 2017). This not only means supporting individuals in developing contextualized intelligence (i.e., focusing on a nuanced understanding of culture, society, business, and people), entrepreneurial mindset, personal brand cultivation, automation literacy, and computational sensemaking but also cultivating career adaptability (Institute for the Future & Dell, 2017; Monteiro et al., 2018).

Skills-Mastery Recommendations for Digital Literacy Education

Cultivating career adaptability—the ability for an individual to manage career transition through awareness of the future, self-discipline to shape themselves and their environment during challenges, curiosity to explore situations, and confidence in pursuing and managing career choices – is an imperative in the 21st-century labor market (Monteiro et al., 2018). Unfortunately, due to the shifting global economy related to the Fourth Industrial Revolution and the related skills individuals need across job roles to be successful, "incremental changes to our education and corporate learning systems will not be sufficient." (Accenture Research, 2018, p. 3).

53

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Accenture Research (2018) recommends that education and corporate learning systems adopt three steps for solving the skills crisis:

Three Steps for Solving the Skills Crisis	
1	Speed up experiential learning (e.g., hands-on application) by doing, using technology to push the boundaries of experience, and leveraging apprenticeships
2	Shift focus from institutions to individuals (e.g., by broadening roles and work to grow but also institutions broadening multidisciplinary learning and companies should support lifelong learning
3	Empower vulnerable learners through education and corporate lifelong learning systems that provide learning guidance and flexible access to training.

It will be important for institutions of higher education to acknowledge that "for most students today, getting a job is a primary reason to enroll in a degree or certificate program" and align their programming "with major changes in the workplace – such as technology, data analysis, or global context" (Wolff & Booth, 2017, p. 52). Thus, it is integral that institutional strategy, degrees, and courses continuously and consistently utilize workforce data to understand which new programs and courses may be needed and degrees and courses that should be redesigned to align with employer needs (Rand, 2015). However, merely teaching skills is not enough, as employers often report a disconnection between knowing about skills and applying them in the workplace (Wolff & Booth, 2017).

Thus, institutions of higher education must consider how these skills are taught, providing opportunities to learners to apply work-based problems in "applied projects, team-based problem-solving or entrepreneurial experiments, internships, community-based learning, simulations, and other direct application learning opportunities" in courses, as well as through essential student career service and apprentice programs (Wolff & Booth, 2017. p. 53; Accenture Research, 2018). This means that institutions of higher education must consider models outside of the traditional paradigm, like competency-based education (even meta-competencies as noted by Ustav & Venesaar, 2018) and providing credit for prior learning outside the classroom, which are both finding increased support among Chief Academic Officers (Jaschik & Lederman, 2020). Institutions of higher education must also invest in the quality of design and instruction "to improve student retention, degree completion, and learning" (MacCormack et al., 2019, p. 42). According to Gallup (2014), employed graduates reported higher engagement at work if they had a professor who cared about them, made them excited about learning, or mentored them.

Additionally, employed graduates who felt college prepared them for life outside of it also increased three times, the odds of them feeling engaged at work (Gallup, 2014). Given the depth of the professor-student relationship, it can be argued that the time in courses is a critical place to create the connections between their future careers and what they are learning clear (MacCormack et al., 2019).

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

5 4

Thus, investment in professional development for professors to establish powerful learning outcomes, embed career guidance into their courses, and develop students' career-ready skills is crucial for students gaining the needed 21st-century skills, articulating the transfer to potential employers (e.g., in résumés and interviews), and applying them in the workplace is crucial, particularly as it may require out-of-the-box thinking beyond the classroom walls (Accenture Research, 2018; MacCormack et al., 2019) and interviews.

Workplaces must also invest in their training programs and partner with institutions and other information and formalized educational systems. Investing in training programs will allow workplaces to reskill their workforce to catch up to the skillsets needed for success or face substantial economic risk, with G20 economies potentially losing "up to US$11.5 trillion in cumulative GDP growth in the next ten years." (Accenture Research, 2018, p. 6). For example, "Coorpacademy, a Switzerland-and France-based provider of training solutions, realized the need to help clients lead and communicate more effectively in the world of new technologies. The firm has introduced a blockchain course that is focused less on technology and more on helping managers create a culture that will ease collaboration with blockchain experts as this technology increasingly plays a role in business." (Accenture Research, 2018, p. 24)

No matter where the upskilling is offered, it will require engaging and adaptive techniques that can support more personalized, lifelong learning—especially in older workers and those in low-skill roles, who are often excluded from education and skills programs." (Accenture Research, 2018, p. 3). In support of upskilling in key areas of career adaptability and preparation, CareerPrepped (n.d.) recommends the following high impact practices be on-going:

On-Going Practices for Career Preparation	
1	Cultivate a growth mindset that abilities can be developed to foster a love of learning
2	Engage in continuous, self-directed learning from formal and informal learning opportunities
3	Prioritize continuously building "soft skills" that transfer to success in any career
4	Develop a personal brand from individual values and purpose, separate from the employer
5	Engage and connect in learning communities to exchange knowledge and build social capital
6	Reflect on and document experiences to improve translating their value to the labor market
7	Habitually curate and document evidence of learning, achievement, and skill demonstration
8	Continuously showcase and market personal brand to find, attract, and create opportunities.

55

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

New digital citizenship framework to bridge the global digital skills gap and advance sustainable development by increasing educational equity across the globe

Figure 13. UNESCO IITE Analytical Framework
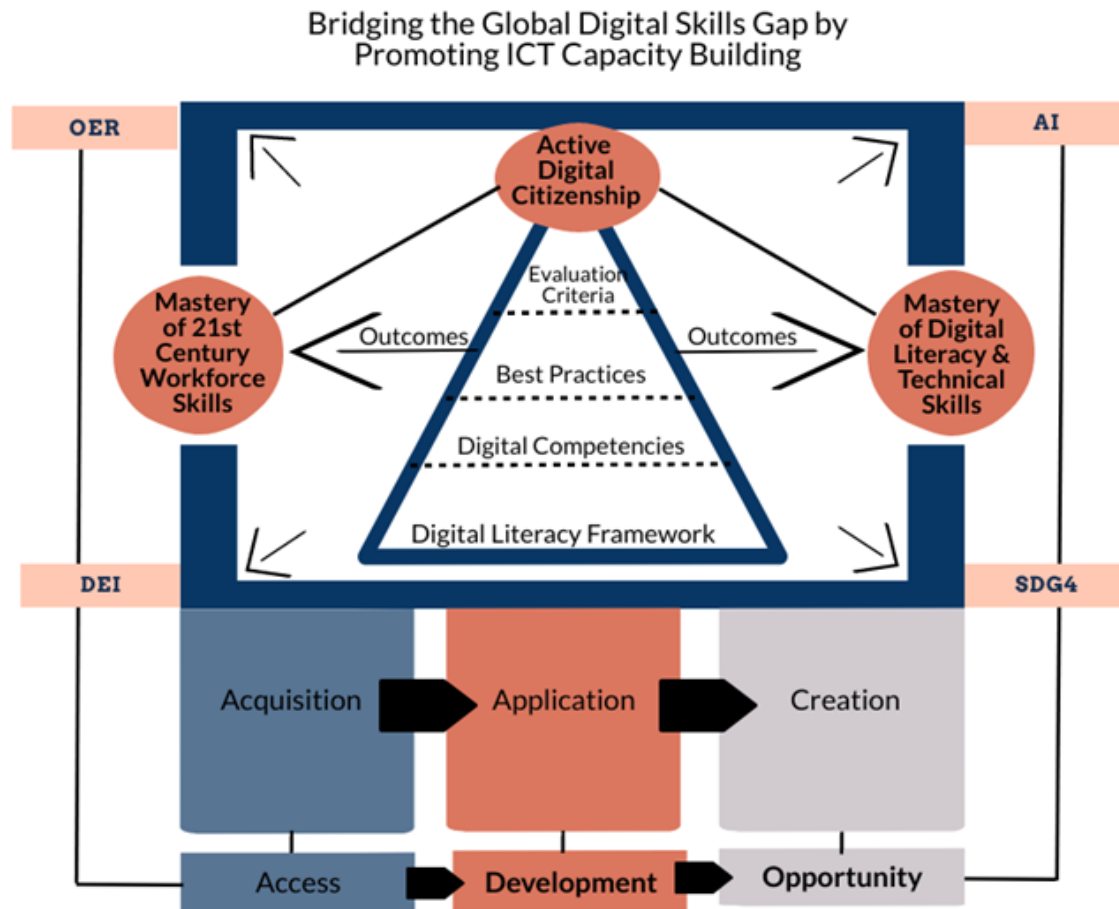
In considering the preceding research and frameworks as well as the emergent practices in the areas of digital citizenship, digital literacy, and artificial intelligence around the globe, an interconnected UNESCO IITE digital citizenship framework emerges to contextualize the interconnectedness and opportunity of approaching these otherwise critical disconnected topics of the taught curriculum in elementary and secondary settings and applying them instead to K-16 and lifelong learning actions. Centered within the equity-focused practices of OER adoption and AI in the pursuit of e-equity through the advancement of DEI and SDG4, this framework construct emphasizes the achievement of equitable, inclusive, quality educational experiences and lifelong learning opportunities for all (United Nations, n.d.). Bridging the global digital skills gap requires promoting ICT capacity building and the foundational pillars supporting, and the corresponding cross-national case studies collected, promote the advancement of DEI through the achievement of SDG4 by developing global educational equity and fostering mastery of 21st-century workforce skills, digital literacy, and digital citizenship.

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

5 6

The lower portion of Figure 13 depicts the developmental learning process for students. This process consists of acquiring skills, applying skills, and creating knowledge in connection with 21st-century workforce skills, digital literacy, and digital citizenship. A second co-process located in the figure below the developmental process provides learners access to digital infrastructure and skills, development of digital literacy skills, and opportunities resulting from the mastery of 21st-century workforce skills, digital literacy and technical skills, and active global digital citizenship.

The core elements of the digital literacy framework, depicted in the pyramid located in the center of Figure 13 are reinforced by the collected data of this analytical review. The digital literacy framework elements include digital competencies, best practices, and evaluation criteria, which may next be aligned in an evaluation and self-assessment tool that can help drive continued reflection on local, national, or international progress at varying levels as well as to promote action-planning of critical growth steps. The linking of these components creates a bounded system to explore cross-national educators' innovative strategies, barriers, and challenges in the development of global digital literacy, 21st-century workforce skill development, digital literacy and technical skills, and digital citizenship for all students.

Conclusions and How to Proceed

A core benefit of fostering global digital citizenship education through AI-supported education for diverse sets of learners across various levels of development, backgrounds, and regions across the globe is the potential for individual and societal advancement. As countries work to develop strategies to support global educational equity, a focus on fostering the mastery of 21st-century workforce skills is imperative. As people spend a great amount of time in the workforce, their work contributes to their self-identity, making having a good job an important factor in one's life (Gallup, 2014). As our globe transitions into a 21st Century Economy, it will be necessary to support individuals in being adaptable for this shift (CareerPrepped, n.d.; Monteiro et al., 2018). In order to do this, it is crucial to explore the shifting global economy, workforce needs, and recommendations for fostering the mastery of 21st-century skills.

This framework was built through the synthesis and expansion of current digital literacy models, including Canada's Center for Digital and Media Literacy Digital Literacy Model (n.d.), the DQ Global Standards Report (2019), the Meta-Framework of Digital Literacy (Martinez-Bravo et al., 2021), and UNESCO's Digital Literacy Global Framework (2018). Other works consulted include Bashay (2020), Broadband Commission Working Group on Education (2017), United Nations Department of Economic and Social Affairs Sustainable Development (n.d.), UNESCO Asia-Pacific Regional Bureau of Education (2015), Rahman & Aziz (2021) and Zucchetti, et al., (2019). In addition, the examined perspectives, insights, and best practices for digital literacy and digital citizenship collected in case studies equally contributed and should be considered in subsequent exploration of how to expand, amplify, and systematize at-scale for global impact.

This research and scholarship will next expand on the framework synthesized in this work and offer an integrated assessment and evaluation tool to help address the varying levels of challenge associated with digital literacy, digital citizenship, and artificial intelligence instruction across the lifelong development span for the benefit of the entire globe.

57

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

Through the efforts of policymakers, institutional leaders, educators, and researchers, AI-supported global digital citizenship education is poised to catalyze the nexus moment created through the increased demand, reach, reliance, and advancement of online, blended, and digital learning due to the global health pandemic. Existing and emerging digital literacy and digital citizenship frameworks provide essential knowledge and skills to determine policy-related, institutional, and educational best practices and assessment strategies regarding digital citizenship education. Through further study, a deeper understanding of the commonalities, nuances, and strengths of existing digital citizenship policies and digital literacy frameworks can provide through research for educational practice a hybrid model that determines an advanced novel framework, learning outcomes, set of best practices, and assessment strategies to advance global digital citizenship education across the world concerning creating, a more sustainable, equitable educational future, especially for learners who have been marginalized, further advancing SDG 4 and ensuring positive global change.

Photo Credit: Ben White, *Unsplash*

ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

5 8

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59

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
GLOBAL DIGITAL CITIZENSHIP EDUCATION**
Promoting Digital Literacy Best Practices Across Global Contexts to Advance Educational Equity

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6 1

**ADVANCING ARTIFICIAL INTELLIGENCE-SUPPORTED
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