TeachME PROFESSIONAL DEVELOPMENT
CEUs for Teachers and Educators

Infrastructure for High-Quality Digital Learning

Introduction

As educators, it is crucial to stay ahead of the ever-evolving landscape of technology and its impact on teaching and learning. This course is specifically designed to empower teachers with the knowledge and skills necessary to create and maintain a robust digital infrastructure that supports personalized learning, high-quality instruction, collaboration, increased engagement, and creativity. Throughout this course, you will explore a range of topics, including the role of technology in education, understanding digital infrastructure, addressing access gaps and equity issues, planning and leadership demands associated with technological upgrades, considerations for student access to digital tools, and best practices for digital learning. By the end of this course, you will be equipped with the essential tools and insights needed to leverage technology effectively in your classroom, ensuring that all students have equitable access to transformative digital learning experiences.

Section 1: The Role of Technology in High-Quality Digital Learning

In today's fast-paced and interconnected world, technology plays an increasingly vital role in transforming education and enhancing the learning experiences of students. As educators, understanding how technology can support high-quality digital learning is essential for fostering personalized instruction, promoting collaboration, increasing student engagement, and unleashing creativity. This section of the course, "The Role of Technology in High-Quality Digital Learning," delves into the myriad ways in which technology can revolutionize the educational landscape. By exploring the integration of technology in personalized learning, instruction, collaboration, and creativity, we will uncover powerful strategies and tools that empower teachers to create dynamic and student-centered learning

environments. This section will uncover the limitless possibilities that technology presents for transforming education and preparing our students for success in the digital age.

The Need for Technology in Education

Digital innovation in education is important due to its role in ensuring education as a basic human right, particularly in a world facing frequent crises and conflicts (UNESCO, 2023). The COVID-19 pandemic highlighted the significance of digital technology in education, as countries lacking adequate information and communication technology infrastructure and digital learning systems experienced the most severe disruptions and learning losses; this resulted in approximately one third of students worldwide being deprived of learning opportunities for over a year during school closures (UNESCO).

The education disruptions caused by COVID-19 underscored the immediate need to combine technology and human resources to transform schooling models and establish inclusive, open, and resilient learning systems (UNESCO, 2023). The United Nations Educational, Scientific and Cultural Organization (UNESCO) recognizes the value of digital innovation in expanding access to education, promoting inclusion, improving the relevance and quality of learning, creating lifelong learning pathways enhanced by information and communication technology (ICT), strengthening education and learning management systems, and monitoring learning processes.

To aid in achieving these objectives, UNESCO focuses on developing digital literacy and digital competencies among teachers and students. By embracing digital technology, UNESCO aims to bridge the educational gap, empower learners, and ensure that education remains accessible and relevant even in times of crises.

How Technology Supports Personalized Learning

According to Vanbecelaere and Benton (2021), personalized learning with the aid of technology has a significant historical background. In the late 2000s, the concept of personalized learning emerged, emphasizing reduced face-to-face instruction and increased utilization of adaptive learning tools tailored to individual needs (as cited in Vanbecelaere & Benton). There are various forms of personalized learning, and the integration of educational technology has made many of these approaches more accessible. The International Society for Technology in Education (ISTE) defines personalized learning as "the purposeful design of blended instruction to combine face-to-face teaching, technology-assisted instruction, and student-to-student collaboration to leverage each student's interests for deeper learning" (as cited in Brereton, 2023).

By incorporating technology and fostering collaboration among students, personalized learning aims to deepen the learning experience and cater to individual interests. Personalized learning commonly involves considering learner characteristics such as prior knowledge, interests, and preferences, as well as incorporating design components like pace, sequence, technology, and choice, while targeting outcomes such as agency, motivation, and performance (as cited in Vanbecelaere & Benton, 2021). In a classroom setting where it is not feasible to have a one-to-one teacher-student ratio, the use of devices becomes crucial in ensuring that student learning is truly personalized. Lindsey Blass, an education specialist at Adobe, emphasizes that personalized learning goes beyond students simply using devices and following self-guided playlists; she believes that true personalized learning occurs when students have agency and ownership over their learning experience (Hooker, 2023).

Considering the current state of education, personalized learning becomes even more critical. Implementing personalized learning practices may pose challenges,

particularly for teachers who feel overwhelmed by district and state mandates. Experts such as Zareen Poonen Levien, the director of digital learning at San Francisco Unified School District (SFUSD), have witnessed the struggles of teaching and learning during and after the COVID-19 pandemic, including interrupted classes and student absenteeism, which reflect the trauma and uncertainty experienced by many students (Hooker, 2023). Furthermore, the influx of new teachers and the departure of experienced teachers present additional obstacles. Without sufficient support staff to provide interventions and extensions of learning, it becomes essential to create an environment where students have a sense of agency and belonging (Hooker).

What Personalized Learning Looks Like

The availability of devices and advancements in recommendation engines have opened up new possibilities for personalized learning. By leveraging digital tools, teachers can save time and engage students through intrinsic motivation (Dempsey, 2022). Dempsey identifies key components that are common across most (if not all) personalized learning programs:

- **Student experiences:** Often gamified, students can engage in activities that offer formative assessments and practice exercises to determine their proficiency levels. These programs often allow for independent practice, giving students the opportunity to work autonomously with minimal intervention from teachers.

- **Reporting:** For efficient orchestration, teachers are provided with reporting that groups students based on their similar needs. This helps educators organize and manage students' learning experiences more effectively.

- **Personalized recommendations:** Technology-enabled personalized learning offers tailored recommendations for instructional support or additional practice based on individual or group needs. Algorithms and learning

models can accurately identify students' knowledge gaps and suggest specific content or skills to address those gaps.

When these components work in harmony, personalized learning programs can diagnose students' needs through assessments and activities (Dempsey, 2022). The reporting system helps teachers understand students' strengths and areas for improvement, while personalized recommendations guide students toward targeted learning materials (Dempsey).

Benefits of Personalized Learning

Personalized learning technology offers a range of benefits for both students and teachers, with a focus on student engagement, teacher efficiency, and skill mastery (Dempsey, 2022). One of the key advantages is the ability to tap into students' intrinsic motivation by incorporating elements such as competitions, games, and avatars into the learning experience. These motivational factors can ignite students' excitement and enthusiasm for learning, ensuring that they actively engage with the content.

Research by Reynvoet et al. suggests that when we acknowledge the diverse learning environments of children, it leads to benefits in terms of learning outcomes, experience, and attitudes toward specific subjects (as cited in Vanbecelaere & Benton, 2021). With the availability of digital technologies, teachers now have greater access to personalized learning environments, leading to an accelerated adoption of such approaches (Vanbecelaere & Benton). Researchers conducted a systematic review that revealed the benefits for children when using interactive apps, such as engaging in interactive and game-like activities, utilizing adaptive learning technologies, and receiving immediate individual feedback (Vanbecelaere & Benton, 2021). These features encourage repeated and diverse practice of academic skills. Teachers also benefit from digital

technologies by gaining actionable data and learner feedback, which inform their instructional strategies (Vanbecelaere & Benton).

Choice and Engagement

When students have access to appropriate technology, they gain the ability to adapt their learning experience to suit their individual needs. Much like creating a customized playlist on platforms like Spotify, students can construct their own learning playlist, selecting resources and activities that align with their interests, strengths, and learning preferences (K12DIVE, 2022). This level of autonomy and personalization promotes flexibility in the learning process, allowing students to progress at their own pace and delve into topics that genuinely engage them. By tailoring their learning experience, students are more likely to remain motivated and actively participate, ultimately leading to improved learning outcomes (K12DIVE). The capacity to adapt through technology not only fosters a sense of individuality but also empowers students to take ownership of their education, promoting a more personalized and effective learning journey (K12DIVE).

Technology plays a vital role in increasing engagement and fostering excitement about learning. With vast experience in a large urban district, Zareen Poonen Levien suggests that technology can be utilized to fully engage students and provide them with choices and opportunities for creativity (Hooker, 2023). Furthermore, Levien emphasizes the importance of creating an inclusive classroom environment where students feel like they belong and have a place. Research indicates that deeper learning occurs when students feel understood (Hooker). Student agency also plays a significant role in personalized learning. As students are given the opportunity to choose what they learn and how they engage with the content, they thrive. Rebecca Hare, a community engagement manager at Adobe, adds that personalized learning involves providing students with ways to demonstrate their learning that make the most sense for them

(Hooker). Offering different pathways for students to showcase their learning is a fundamental aspect of high-quality personalized learning (Hooker).

Addresses Different Learning Styles & Differentiation

Technology supports personalized learning, particularly in supporting differOntiation to cater to the diverse learning needs of students (Bolden, 2019). One effective approach is the use of learning stations, where educators can integrate iPads or laptops into their daily lessons. These stations enable students to engage with subject content at their own pace and skill level, providing scaffolded supports for mastery. Additionally, software apps can be employed to aid students in solving math problems, comprehending complex texts, and exploring real-life simulations in science and social studies (Bolden).

Technology can also effectively address the diverse learning styles of students by offering various modalities for content exploration (Bolden, 2019). Auditory learners can benefit from text-to-speech services and audio-based resources, while visual learners can utilize graphic organizers and visual supports like highlighted and bold text. Interactive whiteboards are particularly useful in engaging students who require visual and tactile supports. Furthermore, kinesthetic learners can actively participate through websites and platforms that incorporate movement-based activities, such as YouTube dance videos and GoNoodle exercise videos.

Supports Students of Special Populations. According to Bolden (2019), personalized learning technology offers valuable support for various populations of students, including special education students, English language learners (ELLs), and at-risk students. For special education students with disabilities related to sight, hearing, or physical abilities, assistive technology can play a crucial role in their learning process (Bolden). Through the use of software platforms and robotic tools, these students can engage with educational content at a pace and level that

aligns with their general education peers. This technology provides them with opportunities to explore content more deeply, create new products, and provide valuable feedback to teachers, enriching their overall learning experiences (Bolden).

In the case of ELLs, who often need to navigate content in multiple languages within dual language programs, technology can be instrumental. Auditory devices and other technological tools enable ELLs to explore cognates and gain a better understanding of print context across different languages (Bolden, 2019). By leveraging technology, ELLs can enhance their language acquisition skills and develop a deeper comprehension of academic content (Bolden).

Moreover, technology plays a significant role in supporting at-risk students by providing them with opportunities to explore parts of the world that may otherwise be inaccessible due to economic limitations (Bolden, 2019). Through virtual field trips, these students can connect with content beyond the boundaries of their communities, broadening their horizons and fostering a sense of equity in learning experiences. To ensure all students have equal access to educational content, educators must maximize the use of technology in the classroom and leverage its potential to create inclusive and equitable learning environments for all students, regardless of their unique needs and circumstances (Bolden).

Skill Mastery

Personalized learning technology facilitates skill mastery and the exploration of more sophisticated learning concepts (Dempsey, 2022). The system can automatically assess students' abilities and knowledge levels, and then assign them appropriately challenging or scaffolded content. This ensures that students are constantly engaged in learning activities that are aligned with their specific needs and abilities, promoting their growth and development.

Teacher Efficiency & Learning Analytics

While technology offers customized lesson plans and personalized learning playlists, it should not be seen as a replacement for human educators. On the contrary, the right technology serves to enhance the role of teachers in the classroom (K12DIVE, 2022). By leveraging technology, teachers can deliver content in various forms that suit the individual needs of each student. This personalized approach allows teachers to move away from traditional lecturing at the front of the class and instead focus on supporting students in their learning journeys.

Rather than solely being content providers, teachers become facilitators and guides, offering valuable guidance, feedback, and individualized assistance to students (K12DIVE). With technology handling the delivery of content, teachers have the opportunity to engage with students on a deeper level, addressing their specific challenges, providing additional resources, and fostering a supportive learning environment. This shift in role enables teachers to establish stronger connections with their students, understand their unique learning styles, and tailor their instructional approaches accordingly. By embracing technology as a complement to their teaching practice, educators can leverage its capabilities to amplify their impact and better meet the diverse needs of students. The integration of technology in the classroom empowers teachers to be more responsive and adaptive, providing targeted support and personalized guidance to students, ultimately enhancing the overall learning experience and promoting student success.

Another significant benefit to personalized technology is the improvement in teacher efficiency. With personalized learning technology, students can work independently, while the system continuously collects data and generates alerts to indicate when intervention may be required (Dempsey, 2022). This allows

teachers to allocate their valuable time and attention where it is most needed, providing targeted support and guidance to students who require additional assistance. By automating certain aspects of the learning process, teachers can devote more time to personalized instruction and individualized feedback (Dempsey).

To implement technology-mediated personalized learning, intelligent tutoring systems and exploratory learning environments are commonly employed (Vanbecelaere & Benton, 2021). Additionally, the use of learning analytics, involving the analysis of large datasets, has further enhanced the optimization and personalization of learning environments (Vanbecelaere & Benton). Notably, in the context of the global pandemic's disruption to children's education, technology-mediated personalized learning has gained significant attention as a pertinent and beneficial topic for research, particularly in enabling remote teaching (Vanbecelaere & Benton).

Additional Benefits of Educational Technology

Technology has brought about numerous benefits in the field of education, revolutionizing the way students learn and interact with information (Bay Atlantic University, 2022). By incorporating technology into classrooms, schools are equipping students with the skills they need to thrive in a technologically advanced world. Bay Atlantic University discusses additional advantages of educational technology:

1. Applying Knowledge through Technology: Technology in schools enables students to put their knowledge and skills into practical use. While students acquire valuable knowledge through online classes and interactions with teachers and peers, it is crucial to provide opportunities for them to apply these newfound skills in real-world scenarios (Bay

Atlantic University). Technology facilitates this by allowing teachers to assign diverse tasks and assignments that require students to apply their knowledge, develop problem-solving abilities, and create solutions for various situations and events (Bay Atlantic).

2. Enhancing Critical Thinking: Technology has the potential to enhance critical thinking skills by engaging students in interactive and multi-sensory learning experiences (Bay Atlantic University). It makes learning more engaging, boosts academic achievement, self-confidence, and motivation, and facilitates the transition from passive listening to hands-on learning (Bay Atlantic). Students can apply what they've learned to real-life scenarios, fostering problem-solving skills and critical thinking abilities.

3. Fostering Collaboration: Educational technology plays a crucial role in facilitating collaboration among students. It enables effective communication between teachers and students, as well as peer-to-peer interaction (Bay Atlantic University). Students can collaborate on projects, solve problems together, and share ideas through online classes and educational games. Technology also allows for one-on-one interactions with teachers, providing additional support and assistance when needed. Numerous studies highlight the positive impact of instructional technology on student engagement and communication, with tools such as web-conferencing software, blogs, wikis, social networking sites, and digital games enhancing student engagement and interaction (Bay Atlantic).

4. Improving Communication: Technology enables students to connect and collaborate with others, both within their classrooms and globally. Digital tools facilitate project collaboration, fostering cultural learning and preparing students for future careers (Bay Atlantic University). Classroom websites serve as platforms for students to share work, collaborate on

projects, and establish a sense of community. Improved communication through technology enhances engagement, motivation, and overall learning experience (Bay Atlantic).

5. Impact of Technology on Student Learning: Students benefit from improved comprehension, practical learning experiences, efficient time management, and the integration of various learning methodologies (Bay Atlantic University). The positive impact of technology on student learning is evident in heightened motivation, engagement, and communication. Through technology, students and teachers can collaborate, access resources, and engage in interactive learning experiences that enhance their overall educational journey (Bay Atlantic). Technology also supports effective time management and enables a combination of different learning approaches, resulting in a more holistic and comprehensive learning experience for students. The integration of technology in education has a profound impact on student learning, empowering them to acquire knowledge, develop skills, and thrive in an ever-evolving digital world. By embracing educational technology, schools can create dynamic and accessible learning environments that support student growth and success.

Section 1 Key Terms

Assistive technology - Devices, tools, and software designed to support individuals with disabilities in their learning and daily activities.

Digital Competencies - The skills, knowledge, and attitudes required to use digital technology effectively and responsibly in various contexts.

Digital Learning - The use of digital technology and resources to enhance and transform the learning process.

Digital Literacy - The ability to use digital tools and resources effectively to find, evaluate, create, and communicate information.

Gamified - The use of game elements, such as competition, challenges, and rewards, to enhance the engagement and motivation of students in learning activities.

ICT infrastructure - Information and Communication Technology infrastructure refers to the hardware, software, networks, and services that support the use of technology in education.

Learning analytics - The analysis of large datasets generated by educational technology to gain insights into student learning behaviors, patterns, and outcomes.

Personalized learning - The purposeful design of instruction that combines face-to-face teaching, technology-assisted instruction, and student-to-student collaboration to leverage each student's interests and needs for deeper learning.

Section 1 Discussion Questions

1. Reflect on your experience with personalized learning practices. What challenges have you faced in implementing them, and how have you addressed or overcome these challenges?

2. How can teachers empower students to take ownership of their learning experiences through the use of technology?

3. Besides the benefits already mentioned, what other advantages do you see in incorporating educational technology into your classroom? How can technology enhance critical thinking, foster collaboration, improve communication, and impact student learning in diverse ways?

4. How can learning analytics and intelligent tutoring systems be utilized to optimize and personalize learning environments? What opportunities and limitations do you see in leveraging large datasets to inform instructional decisions?

5. How can technology enhance the role of teachers in the classroom and improve teacher efficiency? How do you envision your role shifting from content provider to facilitator and guide when leveraging technology?

6. Share your thoughts on how technology can support students with special needs, English language learners, and at-risk students. What are some effective ways you have utilized technology to meet their unique learning needs?

Section 1 Activities

1. Conduct a technology audit in your classroom: Take an inventory of the technology tools and resources currently available in your classroom.

    a. Evaluate their effectiveness, how often you use them, and consider whether there are any gaps or areas for improvement.

    b. Research and propose new technology resources that could enhance personalized learning in your classroom.

2. Explore open educational resources (OER): Research and explore open educational resources that align with your curriculum and can support personalized learning.

    a. Look for OER platforms that offer a wide range of free and accessible resources, such as textbooks, lesson plans, and multimedia materials.

b. Create a curated list of OER that you can integrate into your instruction.

3. Create a digital portfolio for student work: Explore different digital portfolio platforms and select one that suits your needs.

    a. Create a sample digital portfolio for a subject or project of your choice.

    b. Include examples of student work, reflections, and assessments.

    c. Reflect on how digital portfolios can enhance student engagement, self-reflection, and parent communication.

4. Reflect and Update: Reflect on your current teaching practices and identify areas where technology can be integrated to enhance student engagement, differentiation, or collaboration.

    a. Update an existing lesson plan to integrate technology into it

    b. Write a reflective journal or blog post discussing your findings and ideas for implementing technology in those areas.

    c. Consider sharing your reflections with colleagues or on professional learning networks to promote discussions and exchange of ideas.

Section 2: Digital Infrastructures for Schools

What is a Digital Infrastructure?

Digital infrastructure in the context of educational institutions refers to the tools and technologies that form the foundation of their information technology and operations; it encompasses the necessary resources for schools to establish their

presence in the digital realm of the internet, enabling them to continue their operations smoothly while also improving their overall efficiency and effectiveness in the short and long term (Bordia, 2022). Having a robust digital infrastructure is fundamental when considering the expansion of a school into the online world.

Components of a Digital Infrastructure

A robust digital infrastructure is essential for leveraging technology to achieve teaching and learning goals within a school system, school, and community (Office of Educational Technology [OET], 2019). It consists of several components that support digital learning, including learning devices and high-speed internet access for both students and teachers, digital tools and resources necessary for effective learning experiences, technological and personnel support, organizational policies and planning, and teacher and learner development (OET). Ensuring online safety for students is also a crucial aspect of a robust infrastructure, which involves complying with data privacy and security regulations and teaching digital citizenship (OET). The OET defines "digital citizenship" as "teaching students the skills and mindsets needed to safely, respectfully, and securely operate within digital spaces—which students across the country are now experiencing, regardless of whether they possess the skills to learn in a fully virtual or hybrid environment."

Digital Tools and Resources. Martin and Xie (2022) discuss in detail some of the digital tools and resources used in a digital infrastructure for learning, which are essential for facilitating digital teaching and learning in education settings.

1. Learning Management Systems (LMS): An LMS serves as a centralized platform for housing course materials, modules, and activities (Martin & Xie). Instructors can utilize the LMS to communicate with students, facilitate discussions, create and grade assignments, and maintain an online grade book.

2. Synchronous Technologies: Synchronous technologies enable real-time online meetings and interactions (Martin & Xie). They encompass features such as audio and video capabilities, text/chat functionality, screen sharing, polls, whiteboards, and breakout rooms for small group discussions (Martin & Xie). These technologies facilitate interactivity and engagement within online classrooms.

3. Multimedia Applications: Multimedia applications encompass audio, video, and interactive elements that enhance learner engagement; instructors can employ multimedia software to record microlectures, demonstrations, and orientations (Martin & Xie). Some applications are freely accessible, while others may require purchase. Integration of multimedia applications within the LMS allows for easy access and utilization.

4. Collaborative Applications: Web-based or cloud-based collaborative applications enable students to collaborate with peers and instructors online (Martin & Xie). These applications encompass word processing, presentation, social participation, and whiteboard functionalities, fostering collaborative learning experiences.

5. Cloud-Based Technologies: Cloud-based applications are widely utilized by educational institutions for storage and accessibility purposes. Faculty members often leverage cloud-based applications to store files, granting them the freedom to access resources from any location (Martin & Xie).

6. Emerging Technologies: Emerging technologies, such as Artificial Intelligence (AI), Extended Reality (XR), Augmented Reality (AR), Virtual Reality (VR), and analytics, provide opportunities for innovative and engaging teaching methods and learning experiences (Martin & Xie).

These technologies have the potential to revolutionize the educational landscape, offering novel approaches to instruction.

It is important to note that the above list is not exhaustive, as the landscape of digital teaching and learning is continuously evolving. Institutions should carefully evaluate the outcomes, quality, and costs of each technology before implementing them. Additionally, they must assess and ensure that their technology infrastructure adequately supports digital teaching and learning initiatives (Martin & Xie, 2022).

Common Instructional Modalities. Digital teaching and learning encompass various instructional modalities, providing students with flexible learning options. Martin and Xie (2022) outline common instructional modalities used within a digital infrastructure, which include:

1. On-Campus Technology-Enhanced: In this modality, instruction occurs in person, with technology integrated to enhance teaching and learning.
2. Hybrid/Blended: This modality combines in-person and online instruction, allowing students to benefit from both on-campus and online learning experiences.
3. Asynchronous Online: In this modality, teaching and learning take place entirely online without real-time meetings. Students can access course materials and complete assignments at their own pace.
4. Synchronous Online: Teaching and learning occur in real time in this modality, utilizing online platforms for interactive live sessions.
5. Bichronous Online: Bichronous online learning blends asynchronous and synchronous approaches (Martin & Xie). Students engage in asynchronous classes at their preferred time and participate in synchronous classes in real time.

6. HyFlex: HyFlex offers the greatest flexibility, allowing students to choose their preferred modality for each class session (Martin & Xie). In-person and online students can participate in the same classroom.

While on-campus technology-enhanced courses have minimal technology integration, the other modalities heavily rely on digital teaching and learning approaches. These modalities cater to diverse learner needs and preferences (Martin & Xie, 2022).

Personnel and Support Services

To support the widespread adoption of digital teaching and learning, educational institutions need to invest in:

Personnel and Technological Support. To support the widespread adoption of digital teaching and learning, schools need to invest in additional personnel and technological support services. Martin and Xie (2022) highlight the following personnel and support services essential for successful digital transformation in the teaching and learning space:

1. Instructional Designers: The demand for instructional designers and technology specialists has increased significantly in higher education institutions, but the appeal in K-12 schools might expand as well. These professionals collaborate with instructors to design effective courses for various instructional modalities, ensuring the integration of digital learning principles and technologies (Martin & Xie).

2. Technology Support Specialists: As institutions expand their digital teaching and learning offerings, additional staff are needed to maintain networks and provide technical support (Martin & Xie). The availability of 24/7 technology support for students and instructors has become

essential, encompassing one-on-one assistance and just-in-time support (Martin & Xie).

3. Academic and Student Support Services: Access to academic resources and student support services is crucial for digital teaching and learning. Schools should ensure that students can access library resources, writing centers, and academic advising services (Martin & Xie). Additionally, students with specific needs should have access to support services that can assist them in their digital learning journey (Martin & Xie).

4. Incentives and Recognition: Recognizing and incentivizing staff members who embrace innovative digital teaching methods is important (Martin & Xie). Financial incentives and appropriate release time provide teachers with opportunities and dedicated hours to explore and integrate digital innovations into their courses (Martin & Xie).

These personnel and support services contribute to the effective implementation of digital teaching and learning strategies, promoting quality and accessibility in education (Martin & Xie, 2022).

Organizational Policies and Planning. Effective leadership, policies, and strategic planning are vital for the successful implementation of digital teaching and learning initiatives. Martin and Xie (2022) emphasize the following aspects of organizational policies and planning:

1. Policies and Standards: Schools should establish policies and standards specific to digital teaching and learning; these policies may cover areas such as teaching load, enrollment criteria, and performance evaluation (Martin & Xie). Evaluation instruments should be designed or adapted to assess the effectiveness of digital teaching methods as well (Martin & Xie).

2. Strategic Planning: Strategic planning involves defining a strategy and allocating resources to pursue it in order to achieve institutional goals (Martin & Xie). Administrators must integrate digital teaching and learning into strategic planning processes, ensuring faculty buy-in and support (Martin & Xie).

3. Funding Models: Administrators should examine funding models to accommodate different instructional modalities (Martin & Xie). Necessary equipment for accessibility, for example, must be considered in funding received by the school.

4. Equitable Learning Opportunities: Institutions must address disparities in student access to technology and the digital divide (Martin & Xie). Efforts should be made to provide students with the necessary hardware, software, and internet access. Furthermore, courses should be designed to be accessible to students with cognitive and physical disabilities, reducing barriers to learning (Martin & Xie).

Elements for Sustainability. According to Fox et al. (2021), in addition to the technological components, several important elements were also identified as necessary for the success and sustainability of a digital learning infrastructure. These elements are crucial for achieving equitable student outcomes. Fox summarizes these elements:

Leadership, Budget, and Policy:

1. Clearly communicated goals that are related to achieving equitable student outcomes.

2. Recognition of the significance of digital learning in attaining equity goals.

3. Collaboration between academic and technology leadership.

4. Prioritization of the needs of faculty and students in decision-making processes.
5. Dedicated, sufficient, and sustainable resources in terms of staff and funding.
6. Budgetary structures that encourage collaboration and maintain quality.
7. A focus on continuous improvement.

Course Design and Delivery:

1. Course design that centers around student needs and aims for equitable outcomes.
2. Policies to ensure consistent course quality.
3. Utilization of data to target course redesign efforts.
4. Faculty support for implementing digital pedagogy and tools.
5. Faculty-led activities for course improvement.
6. Integration of adaptive courseware for personalized learning.

Student Success for Digital Learning:

1. Access to devices and internet connectivity.
2. Readiness among students to use digital tools.
3. Availability of accessible technology.
4. Affordability of materials.
5. Provision of academic support.
6. Utilization of data to monitor student progress and promote success.

Evaluation and Analytics:

1. Availability of learning analytics and faculty training on how to effectively use them.
2. Proactive use of data to inform improvements at the course level.
3. Disaggregated data analysis based on student characteristics such as race and income.
4. Mechanisms in place to interpret and take action based on data.

Professional Learning:

1. Targeted and regular professional development focused on digital learning and equity.
2. Policies and practices that support continuous learning for all instructors.
3. Dedicated funding and infrastructure for faculty support and development, including centers for teaching and learning and instructional design.
4. Prioritization of faculty-led professional learning and the establishment of learning communities.

Technology Infrastructure:

1. Inclusion of faculty and student voices in technology selection and procurement processes.
2. Policies that encourage the adoption of tools that are interoperable, accessible, equitable, and of high quality.
3. Support and guidance for technology and tool procurement.

4. Ensuring equitable access to technology for students, faculty, and staff.

These elements provide a comprehensive framework for building an effective digital learning infrastructure that prioritizes equity and student success.

Building a Digital Infrastructure

To build and maintain a digital learning infrastructure, it is beneficial to consider managing the lifecycle of educational technology (EdTech) investments (OET, 2019). This involves assessing the specific needs of the school or school system, procuring and deploying technology, measuring the effectiveness of new EdTech investments, and determining when to renew or replace software licenses (OET). Numerous tools and frameworks are available to assist with lifecycle management, and it is important for each school or school system to explore, evaluate, and utilize the tools and processes that align with their unique learning goals, needs, and requirements (OET). Factors such as student population size, central office structure, school leadership, decision-making responsibilities, and available funding may also influence the selection and implementation of these tools and processes (OET).

Benefits of a Digital Infrastructure

According to Haleem et al. (2022), the globalized nature of education and the COVID-19 pandemic have emphasized the need for digital infrastructure and digital technologies in the education system. Online platforms have played a vital role in conducting classes, sharing resources, and managing academic activities, particularly during the crisis (Haleem et al.). This global situation has highlighted the importance of integrating digital technologies into the education system on an international scale. Additionally, digital technologies assist in developing skills that are crucial for students' professional success, such as problem-solving, critical thinking, and understanding complex processes (Haleem et al.).

Furthermore, digital technologies prepare students for an increasingly unpredictable and technology-driven future, where their acquired abilities and qualities will be essential for their professional growth (Haleem et al., 2022). Educational resources and digital tools not only enhance the classroom environment but also provide educational institutions with greater flexibility and the ability to customize the curriculum based on individual student needs. This customization ensures that all students receive an education that suits their specific requirements.

Moreover, incorporating technology in the classroom can significantly enhance student engagement and interest. With children being accustomed to the use of electronic gadgets, integrating technology into education can captivate their attention and increase their involvement levels (Haleem et al., 2022). By utilizing projectors, computers, and other cutting-edge technological equipment, the learning process can become more fascinating, interactive and entertaining. The use of technology resources, oral presentations, and group participation allows for dynamic and engaging learning experiences, going beyond traditional verbal communication (Haleem et al.).

Digital technologies empower students to play an active role in their learning process, with the instructor serving as a guide and facilitator. Through the abundance of digital resources, students can access and download necessary information, as well as upload their own content (Haleem et al., 2022). Additionally, the use of web 2.0 technologies, such as wikis, podcasts, and blogs, enables learners to generate content, collaborate with peers, assess each other's work, and engage in co-learning (Haleem et al.).

The integration of a digital infrastructure in schools also opens doors for innovative teaching strategies, such as gamification and flipped classrooms. These approaches optimize the learning experience and make instruction more inspiring

and meaningful for students. Technology enables the creation of learning landscapes that incorporate various techniques and offer different learning pathways for all students, catering to their individual needs and preferences.

Section 2 Key Terms

Cloud-Based Technologies - Applications, services, or storage solutions hosted on remote servers and accessed via the internet, allowing for easy data storage, accessibility, and collaboration from any location.

Digital Infrastructure - The tools and technologies that form the foundation of an educational institution's information technology and operations, enabling them to establish their presence in the digital realm and support teaching and learning activities.

Digital Tools - Software applications or online platforms designed to facilitate specific tasks or activities related to teaching, learning, communication, collaboration, and assessment in a digital environment.

High-speed Internet Access - Reliable and fast internet connectivity that allows students and teachers to access online resources, collaborate, and participate in digital learning activities without delays or connectivity issues.

Learning Devices - Physical devices, such as computers, tablets, or smartphones, used by students and teachers to access digital resources and engage in online learning.

Multimedia Applications - Software programs or tools that incorporate various forms of media, such as audio, video, and interactive elements, to enhance learner engagement and facilitate the creation of multimedia content for teaching purposes.

Robust - Strong, resilient, and able to withstand challenges or changes without significant disruptions or failures.

Synchronous Technologies - Digital tools or platforms that enable real-time online meetings, interactions, and collaborations between students and teachers, supporting live discussions, video conferences, and interactive activities.

Section 2 Discussion Questions

1. Reflecting on the evolving landscape of digital teaching and learning and the continuous advancements in educational technology, what steps do you believe your school or school system should take to build and maintain a digital learning infrastructure that aligns with your school's unique learning goals, needs, and requirements?
    a. How can your school effectively manage the lifecycle of educational technology investments, considering factors such as student population size, central office structure, school leadership
2. How would you define a robust digital infrastructure in the context of your own school or educational institution? What can your school do to improve its digital infrastructure? In what areas are you already succeeding?
3. How can digital tools and resources, such as learning management systems and multimedia applications, enhance student engagement and learning outcomes?
    a. What are some essential components of a digital infrastructure that you believe are necessary for effective teaching and learning?

4. In the context of instructional modalities for digital teaching and learning, which modalities resonate most with your teaching philosophy and the needs of your students?

    a. Reflect on the benefits and challenges associated with on-campus technology-enhanced, hybrid/blended, asynchronous online, synchronous online, bichronous online, and HyFlex modalities, and discuss how these modalities can cater to diverse learner needs and preferences.

5. Considering the potential of digital technologies in promoting innovative teaching strategies, such as gamification and flipped classrooms, and creating learning landscapes that cater to individual student needs and preferences, reflect on how these approaches align with your teaching philosophy and the learning outcomes you aim to achieve.

    a. How do you envision integrating technology in your classroom to make instruction more inspiring, meaningful, and tailored to the diverse needs of your students?

Section 2 Activities

1. Analyze Organizational Policies and Planning: Review your school's policies and planning documents related to digital teaching and learning.

    a. Identify any gaps or areas that require revision to better support the integration of technology in instruction.

    b. Consider factors such as policies for evaluating digital teaching methods, strategic planning for technology integration, funding models, and ensuring equitable access.

c. Develop recommendations for policy updates or additions to address these areas and promote effective digital teaching and learning practices.

2. Research and Explore: Conduct research on the digital tools and resources mentioned in the section, such as learning management systems (LMS), synchronous technologies, multimedia applications, collaborative applications, and cloud-based technologies.

    a. Explore their features, benefits, and examples of how they are being used in educational settings.

    b. Create a resource list or a presentation summarizing your findings.

3. Digital Citizenship Education: Dive deeper into the concept of digital citizenship and its importance in the context of digital infrastructures for schools.

    a. Research current guidelines and best practices for teaching digital citizenship skills to students.

    b. Develop a lesson plan or an activity that focuses on promoting responsible and ethical behavior online.

4. Evaluate Infrastructure Readiness: Assess your school's or institution's digital infrastructure readiness.

    a. Consider factors such as internet connectivity, availability of devices, access to digital tools, and support services.

    b. Identify any gaps or areas that need improvement.

    c. Collaborate with colleagues or administrators to develop a plan for addressing these infrastructure needs.

Section 3: Technology Access Gaps & Equity Issues

While technology has the potential to improve people's lives, it can also exacerbate existing inequalities. Those who lack access to information and communication technologies (ICT), lack digital literacy skills, or possess lower levels of cognitive skills may find themselves unable to navigate the digital world, ultimately being left behind (OECD, 2022). Addressing inequities in access to and proficiency in ICT, particularly among socio-economically disadvantaged students, has long been a focus of educational policy (OECD). However, the COVID-19 pandemic has laid bare the magnitude of these challenges and brought them to the forefront of education systems worldwide. With the sudden shift to distance learning and school closures, the inadequacies in access to broadband, computers, and the ability of teachers and students to effectively engage in online learning have been exposed (OECD). Furthermore, marginalized students, who already face limited access to digital learning resources and lack support from their parents, are at a heightened risk of falling behind in digital education (OECD). It is crucial to examine and address these technology gaps and equity issues in order to ensure a fair and inclusive education system in the digital age.

Defining Equitable Access to Technology

Equitable access to technology refers “to all students having access to technology and information regardless of their ethnicity, socioeconomic status, age, physical ability, or any other quality” (GoGuardian Team, 2020). It goes beyond simply providing electronic devices and connectivity to students; it also encompasses ensuring that every student has access to technology and information, as well as the support of teachers who understand how to use technology effectively (GoGuardian Team).

When students lack equitable access to technology, it hampers their learning experiences and can limit their opportunities in the future (GoGuardian Team, 2020). In today's digital age, technology plays a significant role in education and everyday life. Without access to technology and information, students may struggle to acquire the knowledge and skills necessary to become digitally proficient citizens. This can further widen the gap between those who have access and those who do not.

Technology Gap

The impact of inequitable access to technology is particularly pronounced during periods of distance learning, such as the shift in 2020 due to the COVID-19 pandemic. Students who lack the necessary technology and connectivity face significant challenges in accessing online resources, participating in virtual classrooms, and completing assignments (GoGuardian Team, 2020). This exacerbates the existing disparities and further hinders their educational progress. The technology gap in education has created significant inequities for students, with the digital divide becoming increasingly apparent in 2020 (McElroy, 2023).

As schools transitioned to online learning, a considerable number of students faced challenges not only academically but also due to the lack of access to the internet and suitable devices (McElroy, 2023). According to the OET (2022), more than 18 million households in the United States still face challenges in accessing high-speed broadband. Although schools have made efforts to provide devices to students, the ability to connect and participate relies heavily on reliable high-speed internet access at home; without this crucial connectivity, these students are unable to demonstrate the same level of academic achievement as their peers (McElroy). Failing to address the digital divide within education poses a significant risk of leaving an entire segment of America's youth behind, hindering their academic progress.

Inequity Based on Race

Similar to disparities observed in other areas of society, the digital divide in education disproportionately affects students of color, even among student groups attending the same school (McElroy, 2023). An analysis of internet access in 2018 revealed that a higher percentage of students from marginalized groups lacked access to the internet or only had dial-up connections in their homes (McElroy). Among K-12 learners, approximately 40 percent identify as Black, Hispanic, or Native American; however, a disproportionately higher percentage of unconnected learners, around 54 percent, belong to these racial and ethnic groups (OET, 2022). Additionally, Black and Hispanic learners are less likely to have a computer at home compared to their white peers. These percentages do not align proportionately with the overall population of each group. It is evident that marginalized groups bear a disproportionate burden of the digital divide.

Inequity Based on Socioeconomic Status

Socio-economic status is another one of the key factors influencing access to technology. Studies have shown that students from lower-income households are less likely to have access to high-speed internet and electronic devices (GoGuardian Team). For example, a survey by the Pew Research Center found that 35% of households in the United States with school-age children and an annual income of under $30,000 lack high-speed internet, while only 6% of households earning $75,000 or more face the same issue (GoGuardian). This disparity, often referred to as the "homework gap," highlights the unequal opportunities faced by students based on their socio-economic background (GoGuardian).

Moreover, a survey conducted by the National Center for Education Statistics revealed that only 61% of school-aged children in the United States had internet access at home; yet, a majority of students reported needing the internet to complete their assignments (GoGuardian, 2020). This underscores the critical role

that technology plays in modern education and emphasizes the urgency of addressing the digital divide.

Effects of the Technology Gap

The quality and type of home broadband access directly impact students' school participation, performance outcomes, and digital literacy (OET, 2022). Insufficient access to technology also decreases the likelihood of students planning for postsecondary education, which can impact their potential for high earnings in the long term (OET). Among the estimated 15-16 million K-12 learners with insufficient access to broadband or devices for learning at home, approximately 6 million face usage barriers beyond availability and affordability (OET).

Immigrant learners and those from multilingual homes encounter unique challenges in getting connected and engaging with learning once connected, including credit checks, deposits, and digital literacy gaps (OET). Children with disabilities, who often reside in low-income households, face additional technology barriers such as outdated equipment, inaccessible online platforms and course materials, and a lack of in-person support to utilize technology tools for learning (OET). Despite high technology usage in classrooms, there are limited opportunities for educators to receive professional training on effective technology use in instruction, particularly among educators working with low-income and rural students (OET). These barriers collectively contribute to the digital divide and further exacerbate inequities in educational opportunities.

Remedies for the Technology Gap

According to the OET (2022), there are several key steps that leaders can take to ensure technological equity for all learners, families/caregivers, and communities. These steps involve collaboration, community engagement, goal-setting, raising awareness, and providing ongoing support. The OET summarizes the suggested strategies:

1. Develop and earn public trust through partnerships:

    - Establish cross-sector coalitions involving government agencies, schools, edtech companies, ISPs, nonprofits, and community leaders.
    - Collaborate with partners to develop long-term, sustainable solutions while providing immediate interim solutions to address broadband access challenges. (OET)

2. Learn from those impacted by inequitable access and provide opportunities for feedback:

    - Partner with community-based organizations to engage with learners, families/caregivers, and communities most affected by the digital divide.
    - Collect accurate and representative data on the availability, affordability, and adoption of broadband and technology tools for learning.
    - Create safe and confidential spaces for community members to share information and feedback, ensuring accessibility and cultural responsiveness. (OET)

3. Co-develop clear goals and strategies with communities to craft a comprehensive digital equity plan:

    - Include diverse stakeholders from education agencies as well as other relevant sectors like health, housing, and justice.
    - Recognize the unique expertise and experiences of each member and organization involved in the partnership.

- Utilize asset-mapping to identify community strengths and existing programs that can be leveraged and extended. (OET)

4. Raise public awareness and provide ongoing support for low- or no-cost broadband programs:

    - Engage in outreach through various communication channels and formats to share information about available programs.
    - Provide personalized support, such as digital navigators, to assist families/caregivers and learners in learning about and enrolling in low-cost broadband programs. (OET)

5. Provide digital literacy training and professional learning opportunities:

    - Identify and share available resources for digital literacy training, particularly in multiple languages and accessible formats.
    - Collaborate with educational institutions to create professional learning opportunities for educators to enhance their digital instruction practices.
    - Offer multilingual, on-demand technical support to ensure learners and families can maintain their connection to broadband. (OET)

By following these steps, leaders can work toward closing the technology gap and promoting digital equity among learners, families/caregivers, and communities.

Section 3 Key Terms

Digital Divide - The gap between individuals or groups who have access to digital technologies and those who do not. It refers to the disparities in access to technology, internet connectivity, and digital literacy skills.

Digital Divide Remedies - Strategies and actions taken to address and reduce the digital divide, including initiatives to improve access to technology, digital skills training, and community partnerships to ensure equitable opportunities for all.

Digital Equity - The principle of fairness and equal access to digital technologies, information, and opportunities, regardless of socioeconomic status, race, gender, or other factors.

Distance Learning - A mode of education where teaching and learning take place remotely, usually through online platforms and digital resources, enabling students to access educational content and interact with teachers and peers from a different location.

Digital Proficiency - The level of competence and fluency in using digital technologies and tools for communication, collaboration, information processing, and problem-solving.

Equitable Access to Technology - Ensuring that all students have fair and equal opportunities to access and use technology and information, regardless of their background, ethnicity, socioeconomic status, or other characteristics.

Homework Gap - The disparity in access to technology and internet connectivity at home that creates obstacles for students to complete homework assignments and engage in online learning outside of the classroom.

Socioeconomic Status - A person's social and economic position in society, typically determined by factors such as income, education, occupation, and wealth.

Section 3 Discussion Questions

1. In your school or district, what specific data or evidence do you have that indicates inequities in access to technology among students based on factors such as race, socio-economic status, or language background?
    a. How does this data inform your understanding of the problem?
    b. In what ways have you observed technology exacerbating existing inequalities among your students?
    c. How do you address these challenges?
2. When considering the remedies suggested by the OET, how feasible do you find these strategies to be in your specific educational context?
    a. What potential challenges or barriers might you anticipate in implementing these strategies, and how could they be overcome?
3. What specific steps can you take as an individual teacher, as well as collaboratively with your colleagues and school leadership, to ensure that technology access gaps are consistently addressed and progress is made toward achieving digital equity in your educational setting?
4. In your opinion, what types of digital literacy training and professional learning opportunities would be most beneficial for educators to enhance their ability to effectively integrate technology into their instruction?
    a. How can these opportunities be made accessible to all educators, particularly those working in low-income or rural areas?
5. Based on your understanding of the effects of the technology gap, how do you think it impacts students' long-term educational and career

trajectories? What evidence or examples can you provide to support your perspective?

Section 3 Activities

1. Research and Data Analysis: Conduct research on technology access gaps and equity issues in your local community or district.
    - Gather data on factors such as race, socio-economic status, and language background that contribute to the digital divide.
    - Analyze the data to identify patterns and disparities in technology access among different student groups.
    - Reflect on the implications of the data and consider how it aligns with the information provided in the section.
2. Resource Curation: Create a resource guide or toolkit for teachers, students, and families to support equitable access to technology.
    - Include information on low-cost or free broadband programs, digital literacy training resources, and strategies for bridging the technology gap.
    - Develop a list of educational websites, apps, or digital tools that can be accessed offline or with limited internet connectivity to support students who lack consistent internet access.
3. Classroom Observations and Reflections: Observe your classroom or virtual learning environment to identify any disparities in technology access among your students.
    - Reflect on how these disparities impact student engagement, participation, and learning outcomes.

- Brainstorm strategies or modifications to your instructional practices that can help address the technology gap within your classroom.

4. Student Empowerment and Advocacy: Develop a project or initiative that encourages students to advocate for equitable access to technology.
    - Provide opportunities for students to share their experiences, ideas, and concerns related to technology access.
    - Support students in creating digital projects or presentations that raise awareness about the digital divide and its impact on education.

Conclusion

This course aims to provide educators with the necessary tools and insights to navigate the complex landscape of technology in education, and to assist their schools in creating a robust digital infrastructure. By addressing access gaps, equity issues, and the demands of planning and leadership associated with technological upgrades, teachers can provide high-quality, personalized instruction that fosters collaboration, engagement, and creativity. Through the exploration of various topics, including the role of technology, understanding digital infrastructure, and best practices for digital learning, educators work toward gaining the knowledge and skills needed to ensure equitable access to transformative digital learning experiences for all students. By embracing the potential of technology, educators are able to create dynamic and inclusive learning environments that prepare students for success in the digital age.

Case Study

Maple Elementary School is a mid-sized public school located in a suburban community. Recognizing the increasing importance of digital tools and technologies in education, the school administration embarked on a journey to transform its digital infrastructure to better support teaching and learning in the 21st century. However, they are already lagging far behind other schools.

The existing digital infrastructure at Maple Elementary is outdated and unable to meet the evolving needs of students and teachers. Slow internet connectivity, limited access to digital resources, and a lack of integrated systems hampered the school's ability to leverage technology effectively. The administration understands that a robust digital infrastructure is crucial to improve efficiency, foster student engagement, and prepare students for the digital world, but they don't know where to begin. Their first steps include bringing together a committee of teachers and support staff to help with the initiative, and conducting proper research to assist in adequately meeting their digital needs.

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