

TRANSFORMING DIGITAL LEARNING AND ASSESSMENT

*A Guide to Available and Emerging Practices
and to Building Institutional Consensus*

Edited by Peggy L. Maki and Peter Shea

Foreword by [To Come]



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INTRODUCTION

Peggy L. Maki

Before the unexpected need for colleges and universities to shift suddenly to teach online as a result of the COVID-19 pandemic in 2020, annual trends in online enrollment had continued to increase compared with annual declining postsecondary enrollments for traditional face-to-face delivered courses. Specifically, enrollments for spring 2019, reported by the National Student Clearinghouse Research Center (2019), documented that overall traditional postsecondary enrollments decreased for the eighth consecutive year, down 1.7% from the previous spring. Overall enrollments for fall 2019, dropped 1.3% from the previous year, although, as *The Chronicle of Higher Education* reported, there were institutions in the mix that experienced enrollment growth while others experienced declines greater than the average decline (Conley, 2019; Piper, 2019). Doug Lederman (2018), coeditor of *Inside Higher Ed*, concluded that “without online education, college and university enrollments would be declining even more” (para.1). Julia E. Seaman, director and coauthor of the 2018 Babson Survey Research Group’s report on online enrollment trends, described growth of distance enrollments as “relentless. . . . They have gone up when the economy was expanding, when the economy was shrinking, when overall enrollments were growing, and now when overall enrollments are shrinking” (Radicioni, 2018, para. 3).

Given this trend in online enrollment, more institutions will deem it necessary to establish an online presence or expand their current offerings of online courses, programs, degrees, certificates, or microcredentials to

- stabilize enrollment, given the current decline in traditional-aged student enrollment and, at some institutions, even a decline in students over 25—of which many are electing to work instead of attend college, given the current upswing in job opportunities (Bauer-Wolf, 2019);
- offer less expensive nonresidential programs;

- reach underrepresented populations or geographically bound students such as rural or Native American students by making quality broadband access a national priority in those “education deserts” (Meyers, 2018);
- accommodate working students’ schedules;
- keep pace with employees’ needs to advance themselves in an existing or emerging field—a commitment increasingly assumed by alternative providers as well; or
- in collaboration with other institutions, offer students in a program of study access to a broader range of course options than a home institution can offer, such as the Council of Independent Colleges’ (CIC) Consortium for Online Humanities Instruction (launched in 2014). This collaboration among some of CIC’s member institutions extends students’ upper level humanities course options beyond those offered at their home institution (Griffiths et al., 2015).

Motivated by these or other internal or external catalysts, such as reduction of funding for public institutions, colleges and universities will need to recruit more full- and part-time faculty to transition into the digital environment. The experience of the COVID-19 pandemic that pressed faculty either to offer their face-to face courses remotely or attempt teaching online for the very first time only emphasized the importance of developing a coherent and integrated plan for facilitating learning online and developing a robust infrastructure to support it. In an interview with Doug Lederman (2019), Flower Darby, author of the 2019 book *Small Teaching Online: Everyday Lessons From the Science of Learning*, identified what lies behind faculty reluctance to teach online. Writing from the depth and breadth of her experiences as a senior instructional designer, faculty developer, and online teacher at both a community college and her university, she describes online teaching and learning as “relatively unfamiliar territory” (Lederman, 2019, para. 12) for faculty. Faculty members she supports, “like many others at institutions large and small, feel unprepared to teach online” (Lederman, 2019, para. 11) principally because they do not bring the “depth of experience” (para. 12) that they have built up from their years of teaching in the physical classroom. Just as crucial, many first-time faculty may not know what it is like to be a student in an online class. As a result, their preferred methods of teaching are likely to be influenced by their own experiences as a student in a traditional classroom rather than by research on principles of effective teaching online.

Making matters even more difficult for faculty new to teaching online and professionals on campus who guide and support their transition into the digital environment, such as individuals in educational technology or

instructional design, is the fact that the landscape of learning technologies in the 21st-century is rapidly evolving. There is now a bewildering number of learning technologies to choose from. Older learning technologies are being enhanced while technologies with new capabilities are simultaneously emerging. These emerging learning technologies are designed and built based on: (a) the learning sciences, a multidisciplinary field dedicated to research on teaching and learning and (b) new applications of algorithms in artificial intelligence (AI) or its subfields, such as machine learning. Given new design principles and algorithm-based software, emerging learning technologies represent an evolution in learning technologies that focuses on the processes of teaching and learning made visible through the connective role of technology-enabled real-time assessment data. This focus is raising the bar for developing evidence-based, research-informed teachers and reflective, self-regulated learners. In time, as well, institutions that realize the potential of emerging learning technologies will distinguish themselves in their ability to continuously address the specific learning needs of individual students along their educational pathways.

In his edited book, *Emergence and Innovation in Digital Learning: Foundations and Applications*, Veletsianos (2016) offers the following characteristics of *emerging technologies* and the *emerging practices* that develop as these technologies are adopted into different contexts and for different purposes. Based on his research on usage of these terms, Veletsianos identifies the following four characteristics:

Emerging technologies and *emerging practices*:

- (1) are not defined by newness [they may or may not be new; they can be recent developments in older technologies, for example]
- (2) are evolving organisms that exist in a state of ‘coming into being,’
- (3) are not yet fully understood or researched
- (4) have promising but as yet unfulfilled potential (Veletsianos, 2016)

Veletsianos’s characteristics describe the emerging learning technologies and practices presented in this book, technologies and practices that are coming into being, particularly over the last decade, facilitating, contributing to, or supporting teaching, learning, and assessment of student learning. They may be altogether new based on their purpose and underlying principles of design or may represent older technologies that now offer new capabilities for faculty and students. Indeed, they are not yet fully understood across all of our colleges and universities at this point in time. They do not have a mature higher education research history similar to that of face-to-face educational practices. Although there is a growing body of research on the use

of emerging learning technologies, articles and reports often appear in technology-focused journals that faculty and other educators may not initially access as part of their research. Scholarly publications, such as journals on teaching and learning, often feature research on the integration of emerging learning technologies into courses. Widely read higher education publications such as the *Chronicle of Higher Education*, *Edsurge*, *EducationDive*, *EDUCAUSE Review*, and *Inside Higher Ed* regularly report on developments in emerging learning technologies and ways in which faculty and others across an institution are implementing them and harnessing the affordances these technologies offer. Educause is the central higher education repository of research articles, resources, guidelines, studies of faculty or institutional implementation of specific emerging learning technologies, and the annual *Horizon Report*. That report documents technology usage trends; faculty and institutional needs as colleges integrate emerging learning technologies, such as faculty development; and projects the expected time period when widening use of specific emerging learning technologies is likely to occur.

Although emerging learning technologies have, as Veletsianos (2016) describes “promising and yet unfulfilled potential” (p. 10) because they do not reflect a long history of usage, what distinguishes them from current learning technologies is, perhaps, the most potentially significant innovation in learning technologies: learning analytics (LA). LA software mines student performance data and reports each student’s performance patterns on assigned tasks, providing unique insights valuable to both instructor and student. LA is now built into most learning management systems (LMSs) to report test, quiz, poll, survey, questionnaire, or rubric scoring results in real time, as well as to report patterns of student behavior related to students’ academic work, such as the amount of time a student contributes to an online discussion group. LA is also now increasingly being integrated into etextbook exercises or activities, courseware, other digital options, and even in interactive video presentations, providing continuous evidence of students’ learning as it unfolds within the contexts of teaching and learning. Thus, to best prepare individual faculty and campus teams to transition effectively into the 21st-century digital landscape, this book is anchored in the evolving learning technology landscape that extends from current to emerging learning technologies.

Audience and Purpose of this Book

As many colleges and universities realized in their sudden shift to offer courses online during the coronavirus pandemic, transitioning an institution

and its faculty into the digital teaching and learning environment benefits from the collaborative contributions of multiple campus constituencies. This book, by offering an overview of the rapidly evolving digital learning landscape and introducing readers to current and emerging learning technologies and how they will transform future practice, is intended for the following campus constituencies:

- Campus leaders and administrators who oversee campus teams charged with identifying learning technologies to meet an agreed-on program- or institution-level educational need and who are responsible for developing policies, practices, and the institutional consensus necessary to build a successful and sustainable commitment to digital teaching, learning, and assessment of student learning
- Campus experts who assist faculty and campus teams identify and effectively integrate learning technologies into courses, across programs, or across the institution; namely, instructional designers; individuals in educational, instructional, and information technology; and assessment and professional development directors
- Early-adopter full- and part-time faculty who are faced with designing their first online or hybrid course and may be unfamiliar with the range of major learning technology options that exist within and outside of an LMS

Harnessing the experiences, guidance, and perspectives of experts on the forefront of the 21st-century digital teaching, learning, and assessment environment, this collection aims to prepare two audiences to transition into that environment. One critical audience is campus leaders, administrators, and the range of experts on campus who support individual faculty and campus teams as they identify learning technologies to facilitate, contribute to, or support teaching, learning, and assessment of student learning. These experts, who also may be new to or newly hired into their roles, include individuals in information, educational, and instructional technology; instructional design; assessment; and professional development. The other critical audience is full- and part-time faculty designing their first online or hybrid course or serving on a campus team charged with identifying a learning technology that meets a shared program- or institution-level need or goal.

To assist campus leaders or administrators, specialists in technology, instructional designers, directors of professional development, and assessment professionals who may be new in their campus technology roles this book does the following:

- Widens the canvas of major learning technology options you may suggest that faculty or campus teams consider so that they develop a more comprehensive understanding of the technological capabilities available to them.
- Provides a resource to learn more about educational technologies that foster communication and collaboration, critical thinking, creativity, and lifelong learning by way of an online professional development hybrid MOOC developed through the SUNY system. This MOOC includes a wiki component, a socially curated discovery search engine that identifies a range of digital tools, websites, mobile apps, tutorials, and resources. The search engine continues to expand new categories of technology options and online resources based on participants' contributions.
- Identifies collaborative processes related to engaging and supporting campus teams in identifying, adopting, leveraging the affordances of, and piloting or implementing an agreed-on program- or institution-level learning technology option or options to address a shared educational need.
- Includes case studies illustrating those processes that address the realities of confronting sticky issues along the way.

For individuals who may be seasoned in their leadership or support roles, chapters may contribute new strategies or processes to existing practices or provide new information about emerging technologies.

To assist full- and part-time faculty transition into the digital environment, this book does the following:

- Provides an overview of major current and emerging learning technology types across the evolving digital landscape as a foundation to assist faculty new to teaching online identify technologies with capabilities that effectively facilitate, contribute to, or support teaching, learning, and assessment of student learning. Particular attention is focused on emerging learning technologies that have the potential to transform those processes: (a) LA and adaptive-based learning technologies; (b) developments in immersive environments and 3D technologies that provide enhanced opportunities for students to assume different learner roles, teach themselves, construct meaning, represent their creativity, or demonstrate their learning in safe practice environments that may also build in feedback; and (c) AI-driven tools and virtual assistants that are contributing to or have the potential to contribute to teaching, learning, and assessment of learning.

- Deepens understanding of how representative emerging learning technologies are developed based on research on teaching and learning and new applications of algorithms that are at the core of AI.
- Helps faculty explore an ever-changing digital world by introducing them to a hands-on online professional development opportunity consisting of two components: (a) a hybrid massive open online course (MOOC) that is also an open educational resource (OER), developed through the State University of New York (SUNY) and (b) its affiliated wiki. The hybrid MOOC is designed for faculty, students, and others interested in learning about developments in educational technologies that contribute to collaboration and communication, critical thinking, creativity, and lifelong learning. In addition, through the affiliated socially curated wiki, participants can explore specific technologies, such as digital tools, websites, mobile apps, tutorials, and related resources. This online opportunity represents one of the types of “untethered” professional development alternatives that Pacansky-Brock (2019) proposes should evolve in higher education, stating that “face-to-face events don’t foster digital literacy as effectively as learning in an online environment” (para. 9). Thus, she calls for professional development opportunities that are self-paced, collaborative, and flexible to meet the needs of individuals, particularly part-time faculty who usually cannot attend so-called tethered campus-based professional development times. Online professional learning opportunities also expand the range of colleagues with whom an individual can interact.
- Includes case studies, scenarios, and examples of how faculty are using current and emerging learning technologies.

To address our audiences, we invited a range of experts on the forefront of digital teaching, learning, and assessment to contribute to this book. Why? Altogether these voices from the vanguard offer seasoned perspectives, first-hand experiences, realistic guidance grounded in those experiences, resources, and campus scenarios or case studies that are, in themselves, instructive. Our contributors include the following:

- Campus leaders—deans, directors, and faculty who oversee their institutions’ digital transition
- Technology innovators and designers who apply research ranging from the multidisciplinary field of the learning sciences to computational sciences, specifically AI and its subsets, such as machine learning and natural language processing

- Campus specialists with learning technology expertise in areas such as information technology, educational technology, media, eLearning or distance education, or LMSs and instructional designers who provide professional development and support for faculty as they design online or hybrid courses. Two of our contributors are also doctoral candidates researching new applications of learning technologies.
- Directors of assessment and professional development who have an educational background in or conduct research on learning technologies.

With the experiences of the challenges faced by institutions and faculty as they shifted overnight into remote teaching or teaching online, driven of necessity by the COVID-19 pandemic, fresh in our minds, the contents of this book provide the needed context and perspective to build on or advance institutions' transition into the digital teaching, learning, and assessment environment. At the very least, as Barbara Oakley, professor of engineering at Oakland University and teacher of a popular and free online MOOC course, *Learning How to Learn*, recently stated, online learning “should be part of our educational arsenal” (Young, 2020, para. 24)—a safeguard against future crises.

Organization and Sequence of Chapters

Although some readers may want to read all chapters in this book, in order, we have identified specific readers for whom the content may be most directly relevant. Those readers are identified at the end of each chapter summary that follows

Part One: An Introduction to Current and Emerging 21st-Century Learning Technologies

The first part takes a big-picture approach to the evolving learning technology landscape represented inside and outside an institution's LMS, where first-time faculty will likely design their first course. A chapter on how principles of research on learning and the engine of algorithms work together in the design of emerging learning technologies deepens readers' understanding of how the capabilities of some emerging learning technologies are developed.. An online professional development hybrid MOOC and its associated wiki provide an opportunity for faculty; campus leaders; administrators, instructional designers; and experts in technology, professional development, and assessment to explore and even try out learning technologies, some of which are the focus of several campus scenarios. The final chapter in Part One provides overall guidance for the “messy middle” processes of integrating and

successfully using a learning technology across the institution after one has been selected.

“Chapter 1: The Evolving Landscape of 21st-Century Learning Technologies” provides readers with an overview of the evolving landscape of learning technology options that reside within and outside of an institution’s LMS. In particular, this chapter focuses on capabilities of emerging learning technologies that have the potential to transform the processes of teaching, learning, and assessment of student learning. Evidence-based learning technologies, LA-based and adaptive learning-based platforms, represent a type of emerging learning technologies that continuously generates technology-enabled real-time assessment of student learning, developing (a) faculty potential to become adaptive, evidence-based, and research-informed teachers and (b) student potential to become self-regulated learners. A second type is immersive environments with 3D technology that expand opportunities for students to learn first-hand, construct meaning, create, or practice and demonstrate their ability to integrate knowledge, skills, behaviors and habits of mind in a range of safe environments that ready them to deal with challenges and situations they likely will face after graduation. 3D tools enable students to translate their concepts, ideas, and creativity into dimensional representations. A third type of emerging technology is AI-driven tools and virtual assistants that mimic human capabilities, such as decision-making, that have the potential to contribute to teaching, learning, and assessment of student learning. *Relevant to all readers.*

“Chapter 2: Learning Science and Educational Technology” provides readers a window into the thinking and planning processes of two individuals who design emerging learning technologies based on research on learning. The contributors introduce readers to major principles that anchor the architecture and design of their learning technologies, illustrated in scenarios. Specifically, they identify three concepts from educational research used to develop effective digital learning experiences: principled assessment design, effective feedback, and metacognition leading to self-regulated learning. They then discuss how these concepts, integrated into learning technologies, can improve learner outcomes. This chapter also prompts readers to learn more about the science of learning and software applications that underlie specific learning technologies they may be considering. *Relevant to all readers.*

“Chapter 3: Empowering Faculty to Design Technology-enriched Student Learning: A Constructivist and Connectivist Hybrid MOOC” is the collaborative work of diverse experts knowledgeable about learning technologies. This chapter begins with a rationale for how and why a hybrid MOOC serves as a unique professional development opportunity for faculty who may feel reluctant to integrate learning technologies into online, hybrid, and even face-to-face delivered courses in substantive ways. Contributors

then proceed to describe and illustrate the contents of this online professional development opportunity, also a type of open educational resources (OER), developed through the SUNY system.

The first component, #EmTechMOOC (Exploring Emerging Technologies for Lifelong Learning and Success) serves as a means of learning about, exploring, and experimenting with educational technologies in courses that foster students' communication, collaboration, critical thinking, creativity, and lifelong learning. The second component, #EmTechwiki, is a socially curated technology resource site that helps participants gain more in-depth knowledge about specific types of technologies or online resources based on search engine categories. The site continues to expand based on participants' contributions, such as added tutorials, material about a specific technology, or ratings of a particular product. In some cases individuals can try out a specific technology option before deciding to use it in a course. The chapter ends with several scenarios describing how instructors from a variety of disciplines have used the #EmTechMOOC to identify tools and resources to integrate into their courses. Scenarios include instructors' and students' perceptions of the effectiveness or usefulness of a selected technological option. Additionally, readers will learn that this hybrid MOOC also can assist students with tools, information, and strategies to navigate the digital world. *Relevant to faculty, instructional designers, individuals in educational and instructional technology, and assessment and professional development directors.*

Chapter 4: “A Guide for Successful Integration and Support of Educational Technologies” identifies core guidelines for teams of faculty, administrators, instructional designers, and technology experts to integrate an agreed-on learning technology into a campus culture. It draws on the expertise of the authors who collectively have many years of experience in piloting innovative academic technology adoption. This chapter provides checklists for the members of an educational technology adoption team to help with their project management plan, and it identifies some potential problems and issues that institutions may encounter and suggestions about how to address them. *Relevant to campus leaders and administrators, faculty, experts in instructional design, and experts in educational and information technology.*

Part Two: Some Representative Examples of Course-Based Use of Emerging Learning Technologies

Part Two consists of four chapters that illustrate either the development or integration of course-based emerging learning technologies that facilitate,

contribute to, or support teaching, learning, and assessment of student learning. Two chapters illustrate how data stored in a LMS can be mined to learn about patterns of students' learning behaviors and their performance levels. Two designers of learning technology platforms—one, an automated human-quality feedback platform; the other, a professional immersive environment scenario—illustrate how principles of or research on learning, the importance of real-time feedback, and applications of AI are integrated into the design and capabilities of these platforms.

Chapter 5: “Applying A Learning Analytics Approach to Improve Course Achievement: Using Data Stored in Learning Management Systems” provides an overview and examples of formative, summative, or predictive use of LA based on student data stored in—or that can be stored in—an institution's LMS. This chapter also includes a guide for how to use the LA software bundled into an LMS along the progression of a course. It closes with an engineering case study that identifies, first, how faculty have used predictive LA to identify student risk factors in one component of an engineering course and, second, how they have used formative LA to monitor the short- and long-term severity of those risks if students are unable to address them based on faculty interventions. *Relevant to faculty; administrators; instructional designers; experts in educational technology, instructional design, and instructional technology; and assessment and professional development directors.*

Chapter 6: “Data-Informed Online Discussion Facilitation: Using Data From a Social Network Analysis App to Improve Students' Online Interactions” describes how an in-house developed social networking app applied to data in an LMS visually represents students' levels of engagement and interaction in course discussion forums, leading faculty to develop interventions to improve those levels. With input from her faculty, a learning analytic and learning management system specialist describes how the Social Networking Analysis (SNA) app she developed applies measures of student engagement in course-based discussion forums to student data stored in the college's learning management system. Results of students' levels and patterns of engagement, heretofore invisible to faculty, are represented visually. Based on the visual representation of data, faculty have been able to develop timely interventions aimed at improving students' contributions to collaborative learning and community building, demonstrated in postintervention results. *Relevant to faculty; campus leaders and administrators; experts in instructional technology, instructional design, educational technology, and information technology; and assessment and professional development directors.*

Chapter 7: “Teaching, Technology, and Building Trust: What I've Learned About How Artificial Intelligence Can Improve Student

Writing” is written from the perspective of a designer of a digital platform that provides real-time, human-quality feedback to students as they write their first draft. The author describes the learner-centered motivation behind the design of the platform, the sound pedagogical practices that underlie the design, and the integration of an application from one of the subbranches of AI. The technology is a time-saver for faculty, especially those who teach large courses or say they do not have time to read drafts of student work. It is also a confidence builder for students because it provides a safe digital environment to get critical feedback in a timely manner. Further, as students write more, teachers get accurate baseline data about students’ performance patterns. Armed with these data, faculty can direct time toward addressing students’ individual underperformance patterns before they write their next draft or prepare a final copy of their paper. *Relevant to campus leaders and administrators; faculty; experts in instructional design, instructional technology, and educational technology; and assessment and professional development directors.*

Chapter 8: “How We May Learn: Cybersecurity Awareness Training as a Model for Future Learning Platforms” describes the ways in which learning technology used for cybersecurity awareness can provide a useful template for technology intended for teaching, learning, and assessment in other domains. Frequently, the most sophisticated learning technology available is found in domains where people are trained to deal with significant risks (aviation, medicine, military, cybersecurity). In this chapter, contributors examine a set of cybersecurity awareness training games called *Agent Surefire*. The contributors describe how *Agent Surefire’s* immersive learning environment, capabilities of adaptive learning, and performance data capture are anchored in research on learning and algorithm-based software. They also suggest ways in which cybersecurity awareness training can serve as a model for learning tools that address academic subjects. *Relevant to campus leaders and administrators; faculty; experts in instructional design, instructional technology, and educational technology; and assessment and professional development directors.*

Part Three: Adoption and Use of Learning Technologies Across the Institution: Case Studies

Part Three consists of three chapters that focus on the challenging processes of integrating learning technologies across institutions, thus requiring broad stakeholder buy-in. The first chapter identifies a framework that guides collaborative processes institutions can use to engage campus stakeholders in identifying an agreed-on assessment technology system that reports student

assessment performance levels at the program or institution levels. Two institutional case studies in that chapter illustrate how institutions have used this model to attain agreement about the system they are currently piloting. The second chapter provides a campus leader's firsthand reporting of the processes that led to his campus adopting both ePortfolios and an assessment portal that provides faculty data about students' demonstration of general education outcomes. The third chapter in Part Three illustrates how transitioning from traditional curricula to learning technology-driven curricula has created a continuous and sustainable commitment to assessing medical and dental students' performance. That commitment includes nimble adaptation or refinement of learning technologies and teaching practices based on continuous reporting of students' performance to faculty, students, and even campus decision makers

Chapter 9: “Enabling a Solution for Assessment and Technology” presents an assessment technology adoption framework (ATAF) that identifies major practices to guide campus stakeholders in collaboratively identifying an assessment technology system that facilitates or manages program- and institution-level assessment processes to meet various external and internal audiences' requirements or needs. Based on two institutions that are using the ATAF, contributors discuss how partnership-relationships based on collaboration, trust, and respect for others' expertise in each of the four quadrants of the framework—assessment, academic, educational technology, technology solution—effectively contribute to the process of achieving agreement about adopting a technology. *Relevant to campus leaders and administrators, faculty, experts in information and educational technology, and directors of assessment.*

Chapter 10: “Advancing General Education Assessment Through Faculty and Student Engagement With College-Wide Electronic Portfolios and an Assessment Portfolio” describes the practices and collaborative processes that enabled a community college to promote its student learning outcomes through the adoption of ePortfolios in conjunction with an assessment portal external to its LMS. The chapter contributor, also the leader of this initiative, describes the technological and cultural challenges that emerged in: (a) the stages of identifying, adopting, implementing and sustaining a commitment to an agreed upon assessment portal and in (b) the development of agreed on procedures for students to submit work that demonstrates general education outcomes. Key processes described and illustrated mirror those identified in chapter 4, with particular focus on the importance of: (a) engaging students as well as faculty in piloting a potential technological option to learn about its capabilities as well as the inherent challenges it may present to them and (b) developing rounds of workshops to assist both become comfortable using it. *Relevant to campus leaders and*

administrators, individuals in educational and information technology, faculty, and assessment and professional development directors.

Chapter 11: “Assessment and Technology Use in a Graduate Health University” provides an in-depth look at how faculty across three schools within A.T. Still University have transitioned from traditional curricula to technology-based curricula that generate real-time assessment results about dental and medical students’ progress toward mastering professional competencies and intraprofessional and interpersonal behaviors. In addition to benefiting students along their educational pathway, continuous assessment results benefit (a) faculty who then adapt pedagogies, simulations, and digital scenarios in real time to improve students’ learning along their educational pathway and (b) campus leaders who are focused on designing or redesigning students’ learning environments to improve professional outcomes that prepare their graduates to address 21st-century patient needs. *Relevant to campus leaders and administrators, faculty, experts in instructional design and educational technology, and assessment and professional development directors.*

The Human-Technology Relationship

Arguably, the greatest force in shaping the direction of educational practices over the past 25 years has been technology, specifically technologies related to the internet. The invention of the world wide web in 1989 created a communications platform the likes of which we had never seen before. That, in turn, fueled the creation of an ever increasing number of learning technologies which took advantage of the possibilities for communication and collaboration via the web. Throughout this book, contributors focus on the human-technology relationship, describing the ways learning technologies can support student learning. One overarching theme that emerges from these chapters is how the relationship between educators and students and learning technology has grown more complex than what it was only a few decades before. Of all the challenges, few seem more pressing than the issue of managing the data created when students interact with these technologies.

Both the amount and variety of student data that learning technology can obtain have increased as technology has become more sophisticated. However, as several contributors point out in this book, how individuals or institutions use the data technology generates raises ethical issues. For example, who has access to or owns generated data? How might data be used to form a stereotypical view of certain students and their likelihood of success, rather than used to help individuals realize their potential? Writing about responsible use of learning technologies in higher education, Maren

Deepwell (2019), chief executive of the Association of Learning Technology in the United Kingdom, identified a driving question for our institutions: “How can we empower faculty and students alike in acquiring the data and digital literacy skills required to make informed decisions about using technology intelligently and responsibly and ethically?” (para.13).

Another measure of how complex learning technology has become is the way in which algorithm-based software has come to play a dominant role in the learning technology industry. The design of the algorithms that shapes the technology is crucial. Consequently, when selecting a learning technology, it is important to identify not only the affordances a learning technology offers but also its limitations. For example, what is the relevance of the sampled population used to train a technology’s algorithm in relation to the specific student demographics of a course into which that technology will be deployed? As one of our contributors writes:

There will always be higher order tasks that are part of the learning process that cannot be reduced to an algorithm. Effective technology requires a design that acknowledges the limits of what that technology can do. The tradeoff is that humans should return the favor and acknowledge what technology is capable of doing and embrace that capability as a learning resource” (Heit, p. x).

Whatever problems are posed by this new generation of learning technology, they seem small when compared to the extraordinary opportunities this technology offers in regard to solving challenges that once seemed intractable. The increasing capacity of emerging learning technologies to generate continuous real-time evidence of student learning has the potential to transform teaching and learning into dynamically interrelated activities that keep both faculty and students continuously focused on student learning along the trajectory of a course. Closing traditional time gaps among teaching, learning, and assessment, the continuous process of documenting student learning patterns through LA, in particular, draws immediate attention to the relationship between teaching practices and student learning.

Faculty can learn about the efficacy of their practices from those data, prompting them to adapt their practices or materials to meet the various needs of students. Identifying content and materials that meet individual student needs leads towards the development of evidence-based teaching practices and conversations with individual students that probe the causes of and ways to improve their underperformance patterns. In the words of the late Canadian teacher, Joe Bower, “Assessment is not a spreadsheet; It’s a conversation” (Brown-Martin, 2016).

Students also simultaneously learn about their performance levels from those data. In the company of faculty, students become actively involved in investigating the reasons for—or causes of—their difficulties. In addition, real-time data provide students the opportunity to take responsibility for monitoring their progress toward overcoming their difficulties. Teachers become evidence-based course designers who also develop their teaching practices based on research on learning; students become reflective, self-regulated learners with the guidance of their faculty mentor.

The potential to improve students' learning across our student demographics is now within reach based on the capabilities of LA to continuously generate real-time formative assessment data about each student in a class. The central role that LA will play in the evolution of learning technologies in the coming years should not be underestimated. Effective learning technology has always been intended to support student learning outcomes. Along with the promotion of learning, this new generation of learning technologies will likely be designed to place equal importance on the aggregation and display of complex learning data about students from multiple contexts to support real-time assessment and the adoption of timely instructional interventions to promote greater degrees of student success. Let us suggest a new phrase, teaching and data aggregation (TADA), to denote the defining quality of next-generation learning technology.

The other phenomenon likely to have an enormous effect on the direction of learning technology is AI. The increasing adoption of AI has been a source of anxiety since it is seen by many people as a tool for making human workers obsolete. However, when discussing the future of AI in education, authors Holmes et al. (2019) do not see a future in which it replaces teachers. They do see “a future in which the role of the teacher continues to evolve and is eventually transformed; one where their time is used more effectively and efficiently” (p. 159). For example, AI, rather than replacing human instructors, has the potential to provide faculty members with their own teaching assistant.

The future of technology in education is much like its past. What will matter most is not the tools, but how humans use them. Before we use new tools, it is always best that we think about them carefully and then share our thoughts. This book aspires to contribute to that very important conversation.

Note

1. Throughout this collection, contributors use the terms *learning technologies* and *educational technologies* interchangeably to refer only to those current

and emerging technologies that facilitate, contribute to, or support the processes of teaching, learning, and assessment of student learning or provide new sources of data about teaching and learning that have been heretofore invisible or inaccessible to faculty and even students. Some readers may be more familiar with the term *educational technologies*, instead of *learning technologies*; however, often that term serves as an umbrella for the broader range of technologies institutions use to meet their educational needs. That range is outside the scope of this book. For purposes of clarity, then, we use the two terms interchangeably as stated.

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