

ARTIFICIAL INTELLIGENCE, EXTENDED REALITY, and AUTOMATION in SPEECH-LANGUAGE PATHOLOGY

Integrating Technology Into Clinical Practice

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● Foreword

Access an additional interview with Dr. Martin Hall on the PluralPlus companion website.



Today, as in many other professions, speech-language pathology practitioners are inundated with claims for the efficacy of new and emerging digital applications. How should they decide which are appropriate and aligned with their professional requirements and which are not? And how should educators, responsible for teaching the next generation of clinicians, decide what to include in the curriculum and how to align accelerating digitization with appropriate ethical principles?

This collection of expert perspectives surveys the leading edge of digital innovation as it impacts speech-language pathology, always emphasizing the implications and opportunities for clinicians. In turn, this leads to a proposal for an integrated clinical framework that will balance the transformative potential of digital innovation with ethical considerations, social and cultural context, and relevant time-honored interventions.

A defining characteristic of digital innovation that sets it apart from the pace and nature of previous eras is an exponential-like rate of change; “Moore’s Law” (Intel Newsroom, 2023) conceptualized, when the Internet was no more than a theoretical projection, that the processing capacity of an integrated circuit doubles every 2 years or so. Today, this capacity for continual innovation has resulted in an environment of constant professional disruption, a characteristic that uniquely distinguishes this Fourth Industrial Revolution. Speech-language pathologists (SLPs), like their colleagues in all other health care fields and their contemporaries from other professions, have to engage in a cycle of learning, implementation, and relearning, and this book will help meet this need.

The phenomenon of waves of digital innovation follows a distinctive pattern (Gartner, 2022). An initial innovation trigger spurs intense interest and investment, which is followed by criticism, counterarguments, and disillusionment. Following this,

more considered evaluations move steadily toward a plateau of application, a cycle that can play out over 5 or more years and overlaps with successive innovation triggers as the pace of overall change continues to speed up. Across health care, and for the focal points of the contributions that follow in this book, we can imagine the evolving use of artificial intelligence (AI), extended reality, and automation as three successive and overlapping cycles of overhyped promotion followed by increasing acceptance, calibrated by the market value of these transformative innovations.

The most recent innovation trigger for the development was the release of ChatGPT as a commercial application in November 2022. Medicine had already been identified as one of the most promising areas for innovation, and the global market for AI in health care was approximately \$15.1 billion by the end of 2022; this is expected to grow rapidly at 37% per annum and to reach \$188 billion by 2030 (Pandey, 2024b). Here, the distinctive pattern of hyped excitement followed by rejection and criticism has unfolded more rapidly, with an emerging consensus that AI will play a key role in areas such as research and the development of new drugs, accurate diagnosis, and a wide range of routine administrative functions, albeit with significant risks.

The innovation trigger for extended reality (XR) was the commercial availability of head-mounted displays, driven by the demand for 3D games and virtual entertainment, which had reached highly sophisticated levels by 2010. As with automation, the use of XR in health care has now plateaued into widespread applications in different health care fields, with an estimated global market of \$2.85 billion in 2023 that will continue to increase by about 20% each year (Pandey, 2024a).

The innovation trigger for automation in health care was the development of digital databases and the commercialization of the Internet in the 1990s, resulting in the increasing availability of enterprise-level systems in the early 2000s for planning, electronic health records, and patient requirements, while reducing the incidence of misdiagnosis, prescription errors, and data breaches, and lowering costs. By 2022, the global market for health care automation was firmly established and valued at \$35.2 billion (Gokhale, 2024).

For each of these innovation cycles, considerations in moving toward acceptance and adoption are the ethical principles of clinical practice. This is particularly so for AI applications, for which the World Health Organization has set out six priorities that cover well-being, safety, the public interest, accountability, transparency, and inclusiveness (WHO, 2021). For its part, the American Medical Association (AMA) emphasizes the importance of empowering patients to make informed decisions that enhance their care, improving overall health at the population level by eliminating inequities in access to health care, improving the professional efficacy of health care providers, and reducing the cost of provision (AMA, 2024). This concern for ensuring the ethical use of AI in speech-language pathology and automation and XR is evident in the following contributions.

The final section of this book integrates these three innovation cycles, providing the basis for SLPs to adopt and adapt a combination of new and emerging digital technologies in ways that are appropriate for their professional objectives, the context in which they work, and the needs of their patients. As it is always future looking, this integrated framework will align with both professional training and continuous professional development for experienced clinicians.

As ever-accelerating digital innovation continues to surprise, delight, and alarm us, one thing is certain: there will always be a need to learn more.

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● About the Editors



Michelle Boisvert, PhD, CCC-SLP is a doctoral-level clinician providing and supervising high-quality speech and language services on-site and remotely in a public school and private practice setting. Dr. Boisvert received her PhD in Communication Disorders from the University of Massachusetts Amherst in 2012, where she investigated the viability, use, and effectiveness of teleprac-

tice for the online delivery of speech and language services, specifically for individuals with autism spectrum disorders. Her research helped validate this method of service delivery and has informed her clinical and entrepreneurial work post graduation.

Driven by a passion for leveraging technology to ensure access to high-caliber services and to enhance workload efficiency, Dr. Boisvert subsequently cofounded and developed the software easyReportPRO.com, a division of WorldTide, Inc. The customizable easyReportPRO is an innovative online platform designed to streamline report writing for speech-language pathologists (SLPs) using customizable, automated templates. With a focus on continuous improvement and a drive to advance tech-based resources for SLPs and related fields, Dr. Boisvert has always been committed to bridging the gap between clinical work and technology, offering SLPs tangible and practical solutions to reduce manual tasks and improve professional outcomes.

Dr. Boisvert has published several articles in peer-reviewed journals on the topic of telepractice and is the former editor for the *Perspectives on Telepractice* (a journal published by Perspectives of the American Speech-Language-Hearing Association's Special Interest Groups [ASHA's SIG 18]). Dr. Boisvert provides training on the use of telepractice and has spoken at national and international conferences on this topic. She also offers professional training on entrance and exit criteria for speech and language services for students in U.S. public schools, specialist

and teacher collaboration methods, as well as caseload management strategies that incorporate the use of artificial intelligence, extended reality, and automation.



Nerissa Hall, PhD, CCC-SLP is cofounder of Commūnicāre, LLC, and the Speech Language and Literacy Center at Tate Behavioral, Inc. Dr. Hall's love for applied technology started as an undergraduate studying psychology at the University of Massachusetts Amherst where she was encouraged to apply for an internship with the speech-language pathologists working for the Department of Developmental Services (DDS). Her volunteer experience turned into a dual major (psychology and communication disorders) and a speech-language pathology assistant position with DDS, where she assumed responsibility for designing and developing lite-tech augmentative and alternative communication (AAC) systems, as well as programming and implementing high-tech speech-generating devices for adults with complex communication needs.

Dr. Hall went on to get her master's and PhD degrees from the University of Massachusetts Amherst. Her clinical work and experiences, upbringing in Cape Town, South Africa, plus her desire to ensure access to high-quality AAC services irrespective of geographical locale, evolved into her clinical work and research interests focusing on AAC, tele-AAC (AAC service delivery online), and the innovative use and application of current and available technology to support access and enhancement of AAC for people with complex communication needs.

During her doctoral program, Dr. Hall cofounded Commūnicāre, LLC (a private practice focusing on AAC), with her mentor and colleague, Hillary Jellison. Together they developed a specialty practice, pioneering innovative AAC assessment, intervention, and consultation work. They extended their reach by incorporating synchronous (real-time) and asynchronous (overtime) telepractice to diversify their methodology and application of clinical services through collaborative research and service delivery. Since graduating, Dr. Hall has continued to grow her

practice, merging with behavioral health leaders at Tate Behavioral, where clinical practice is merged with rigorous data collection to systematically explore innovative technologies and refine service delivery outcomes for neurodivergent individuals with complex communication needs, benefiting from AAC.

Dr. Hall has presented nationally regarding AAC, tele-AAC, and artificial intelligence (AI). She has served as a LEND Fellow, adjunct faculty at Elms, Cambridge College, and UMass-Amherst. Dr. Hall coedited *Tele-AAC: Augmentative and Alternative Communication Through Telepractice* and *Fundamentals of AAC: A Case-Based Approach to Enhancing Communication*, and is passionate about advancing the field to ensure meaningful outcomes for individuals with complex communication needs, those using AAC, and the teams and communities that support them.

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SECTION I

Fundamentals of Integrating Technology Into Clinical Practice

This text represents the compilation of the voices and expertise of various thought leaders and practitioners who are working closely with innovative technology in the field of speech-language pathology and clinical practice. This book introduces readers to three major types of new technology, summarizing the technical underpinnings and describing some clinical applications of each. However, the goal of this text is to support *the integration of new technologies into clinical practice*, by equipping readers with a balance of foundational and applicable information along with considerations for further development and advancement for the field of speech-language pathology (and comparable fields).

The content of this book is divided into five sections to help organize the delivery of information. Sections 2, 3, and 4 cover artificial intelligence (AI), extended reality (XR), and automation, respectively. Each of these sections starts with a chapter on the foundations of the technology, then presents information about application of the technology within the field, and follows with thoughts about the future of the technology in the context of clinical application. These sections are introduced by a series of chapters covering theoretical considerations (Section 1), and the book concludes with practical information to support readers to incorporate innovative technology into their own practice (Section 5).

This first introductory section of the text helps calibrate the lenses through which readers absorb the content disseminated across the book, creating a shared theoretical understanding for approaching the integration of innovative technology into practice:

- Chapter 1 reminds readers that we have experienced waves of innovation that have disrupted us only momentarily before we have adapted to the change and adjusted our practices and policies accordingly.
- Chapter 2 reviews ethical considerations at the very foundation of clinical practice and addresses ethical concerns inherent to innovation, equipping readers with practical information to guide ethical implementation of new technology.
- Chapter 3 builds on Chapter 2 by encouraging readers to also think about any potential cultural bias in the

development, adoption, and/or implementation of new technologies to ensure cultural relevance and inclusiveness.

- Chapter 4 synthesizes the content shared across the first three chapters by tying the information introduced to the specifics of data security and algorithmic transparency, for example, empowering readers to truly understand the balance between technological innovation and clinician expertise.
- Chapter 5 proposes a framework for clinical implementation of new technologies (iCARE) to support readers by incorporating their professional expertise when utilizing the technologies discussed within this text, as well as future technologies.

While practically oriented, this book supports readers in broadening and refining their clinical perspectives and in fostering a mindset of inquiry necessary for utilizing new technologies in ethically, culturally, and practically informed ways. Some chapters are technical and others conceptual, but the book as a whole offers the same balance of practical and theoretical content inherent in high-quality implementation of innovative technologies in human service fields of practice.

● PluralPlus Online Ancillaries for Section I

Access additional resources for Section I on the PluralPlus companion website. These videos and downloadable materials are designed to extend your learning and help you apply key concepts in clinical settings.



Videos

Section I Overview

Interview on Practical Considerations With Mai Ling Chan

Downloadable Checklists

Chapter 1

Helpful Tips for Integrating Devices and Apps in Therapy

Helpful Tips for Using Digital Material in Therapy

Helpful Tips for Caseload Management Software

Chapter 3

Culturally Responsive Strategies to Technology Adoption

Downloadable Tables

Chapter 4

Methods of Data Security

Chapter 5

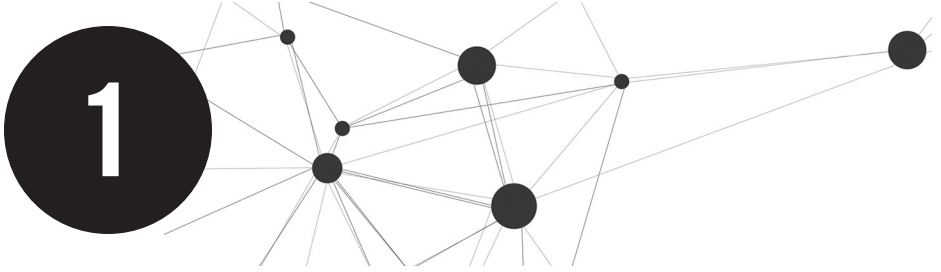
Application of TPACK Framework for AI, XR, and Automation

Application of SAMR Framework for AI, XR, and Automation

iCARE Pillars, Phases, and Descriptions

Downloadable Takeaways

Takeaways from Chapters 1–5



Digital Generations in Speech-Language Pathology

Michelle Boisvert, Nerissa Hall, and Gareth Walkom

● Overview of Digital Generations

Technology gives the quietest student a voice.

—Jerry Blumengarten

Speech-language pathology is transforming, driven by the rise of artificial intelligence, extended reality, and automation. These technologies are no longer on the horizon; they are actively reshaping how care is delivered. This book offers a practical framework for speech-language pathologists to integrate these tools thoughtfully to enhance their clinical expertise. Clinicians will find guidance on integrating therapeutic insight with technological skills, using the right tools for critical tasks, and applying innovative technology to tackle long-standing challenges such as burnout, documentation, and limited access to services for diverse populations. At its core, the message is simple: innovation is inevitable, but meaningful integration requires reflection and revision, evaluation, and critical thinking to focus on what truly benefits clients.

Technology has become integral to speech-language pathology, revolutionizing therapeutic, diagnostic, and collaborative practices. In our field, technology typically refers to the tools and applications used to assess, diagnose, treat, and manage communication and swallowing disorders as well as to support and enhance interprofessional collaboration. The basis for modern technology includes hardware, software, and high-speed Internet. While speech-language pathologists (SLPs) have integrated technology into their practice for decades, new and innovative technologies are again transforming how SLPs deliver services.

The Past: Foundations of Digital Technology in Speech-Language Pathology

The field of speech-language pathology has been shaped by pivotal digital technologies before. In particular, advancements in digital technology in the early to mid-20th century led to significant change. The ability to capture and convey audio signals, like recording voice (Fumo, 2024), electronic speech synthesizing (Lemmetty, 1999), and human-machine interfacing (HMI; Vanderheiden, 2003) led to a drastic increase in the availability of technology for SLPs not only to support the efficiency of their work, such as recording speech samples instead of live transcriptions, but also to best support the individuals with whom they work (as evidenced with the evolution of high-tech augmentative and alternative communication [AAC]). Building on these foundational innovations, the field continued to experience transformative developments in the decades that followed. Early innovations like voice recordings and analog hearing aids in the mid-20th century laid the groundwork for technological advancements. The 1980s saw the introduction of software, such as IBM's Speech Viewer, which provided visual feedback for clients (Wempe & van Nunen, 1991). The transition to digital hearing aids in the 1990s brought advanced sound processing capabilities. In comparison, the emergence of telepractice in the 2000s expanded access to clinical services regardless of geographical location (Boisvert et al., 2010; Mashima & Doarn, 2008). Digitized and synthesized speech led to AAC voice out-

put. These tools, paired with HMI and computer miniaturization, revolutionized the technology available to individuals with complex cognitive, communication, and/or physical needs through improved accessibility and more robust communication options (Alliano et al., 2012). This progression set the standard for a new wave of innovation in the 2010s, further expanding the use of technology used by SLPs.

The 2010s witnessed the explosion of mobile apps for therapy, AAC, and wearable technology, offering hands-free access to powerful digital technology (Wendt, 2023). Around the same time, AI-powered diagnostic tools emerged as part of clinical practice (Alzayer et al., 2014; Topol, 2019). Virtual reality (VR) began to be utilized in therapy in the mid-2010s, providing immersive environments for skill practice (Parsons & Cobb, 2011) and is now under the umbrella of extended reality (XR). Moreover, electronic medical records, automated data collection, and digital analysis have allowed for more precise, data-driven interventions, report documentation, and streamlined workflows.

Throughout the decades, there is a consistent trend that technology has not only supported but also expanded the possibilities within the field of speech-language pathology. These milestones reflect the dynamic interplay between technological advancements and clinical practice within the field. As early uses show, technology enhances and complements intervention, diagnostic, and consultative services; caseload management; and practice organization. The range and systemic use of technology are evident, as more than 80% of clinical sites employ digital technology (OpenClinica, 2023).

Now, SLPs are entering another era of revolutionary technology that will significantly transform the field. New technologies, such as artificial intelligence (AI), extended reality (XR), and automation transform clinician–client interactions in direct and indirect services, interprofessional collaboration, and overall workload management and efficiency. AI and machine learning continue to drive innovations in personalized therapy, and virtual and augmented reality are being integrated into intervention environments. Additionally, intelligent automation streamlines time-consuming workload tasks, enabling clinicians to spend less time doing paperwork and more time focusing on clinical care.