Commentary: A Response to an Interview With Joseph South by the Teacher Education and Technology and Media Divisions of the Council for Exceptional Children

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Thriving in the digital age workplace requires, in part, professionals who think differently about how they prepare the next generation workforce. Teachers and teacher educators are no exception. When reflecting on how today's teacher educators prepare teacher candidates for the multitude of roles and responsibilities they will shoulder, including being wise consumers of technology, Joseph South pointed out (Bull, Spector, Persichitte, & Meier, 2017) that many faculty members in schools and colleges of education fall short. Based on professional knowledge and practical experience, we agree more work needs to be done to improve faculty readiness and prepare all teacher candidates adequately for the 21st-century workforce.

The Real: Challenges of Current Approaches

As is the case with general education teacher education, the contemporary landscape in digital age special education teacher preparation is best described as highly variable. By that, we mean some programs are characterized by minimal technology use and integration, while other programs are distinguished by infusion of innovative, high tech practices throughout. Most, however, wind up somewhere in between.

Joseph South proffered that faculty members in colleges and schools of education begin by embracing a common goal, which is to develop teachers who are savvy consumers of technology. Regardless of whether teacher educators prepare general, special, or dually licensed teachers, they also need to produce teacher leaders who empower all students to consume, produce, use, and embrace digital age technologies in school, work, and life.

Achieving the expanded goal – savvy consumer plus technology-enabled learning leader – requires, in part, that faculty in colleges and schools of education take stock of current approaches, chart a course for the future, and bridge the gap between the two – all with a sense of urgency not accomplished through traditional academic silos. No doubt, all teacher educators must work together in equipping special education teacher candidates with the knowledge, skills, and dispositions needed to lead the charge in preparing individuals with disabilities, one of society's most underemployed and unemployed populations, to be college and career ready in the 21st century and beyond. That said, important distinctions and unique considerations warrant explanation in the case of special education teacher educators.

One consideration stems from the United States laws and policies that influence what it means for special education teacher candidates to become savvy consumers of technology and technology-enabled learning leaders. For instance, federal mandates such as the *Individuals with Disabilities Education Act* of 2004 and its predecessors, which protect public schooling for students with exceptionalities, not only influence the birth to age 21 (B-21) services students with exceptionalities and their families receive, but also impact the higher education curriculum through which special education teacher candidates are prepared (Smith & Kennedy, 2014). Thus, the federal role in preparing the special education teacher and leader workforce differs from the processes and procedures that govern general education teacher preparation.

Consider, for instance, that special education teacher preparation faculty are required by law to prepare teacher candidates not only to provide individualized instruction but also to select and evaluate technology for pedagogical uses. This means, in part, that special education teacher educators must teach special education teacher candidates how to select, implement, monitor, and evaluate assistive technology (AT), instructional technology (IT), and accessible educational materials (AEM)[a] with many, varied purposes in mind – chief

among them removing cognitive, sensory, physical, or communication barriers, meeting each student's unique educational needs, and leveling the playing field for students with exceptionalities. Special education teacher educators must also teach special education teacher candidates how to use technology to monitor the progress made by B-12 students with exceptionalities, thereby maximizing the educational benefit they receive.

The Ideal: What's The Vision?

Special education teacher educators need to foster teacher candidates' learning in ways that can adapt to the ever-changing technology environment. The approach requires integrating into teacher preparation curricula the very technology innovations that are altering instructional practices and experiences in the classroom. By walking the talk, teacher development professionals can and should embed technology-rich experiences that foster knowledge and practice with rich, just-in-time feedback and inquiry-centered clinical experiences that foster application and generalization, particularly in the use of AT, IT, and AEM (National Research Council, 2000).

A vision, then, for the future of special and general teacher preparation programs is to meaningfully embrace and infuse innovative, evidence-based, and high tech practices in every aspect of teacher preparation (see Rock et al., 2016). In many ways, using technology-enabled knowledge, practice, and inquiry-based approaches with feedback would redirect the status quo of current teacher preparation programs, supporting efforts reflective of the ongoing demands of living and working in the digital age (Ertmer & Ottenbreit-Leftwich, 2012; Jonassen & Carr, 2000) and of prevailing professional standards, such as those put forth by the Council for the Accreditation of Educator Preparation.

Guiding Principles

A sound 21st-century vision of preparing special education teacher candidates who are tech-savvy consumers plus technology-enabled learning leaders requires a set of guiding principles. We, the authors, proffer four: embedded innovations, applied technologies, sustained applications, and theoretical foundations.

Embedded Innovations. To this end, teacher educators, special education teacher candidates and B-12 students with and without exceptionalities would benefit from ensuring wider spread adoption and application of current technology-based approaches to special education teacher education practice. *Personalized learning* is one example of an instructional practice altering B-21 student learning that should be embedded into special education teacher preparation. Central to the personalized learning experience are embedded learning pathways, where individuals are supported to work at their own pace and through personal learning plans (Martindale & Dowdy, 2010). Performance-based assessments direct candidates' experiences and a focus of anywhere, anytime learning permeates across the essential elements (Dabbagh & Kitsantis, 2012).

Applying this approach to special education teacher candidates' experiences, similar to current B-21 student initiatives, would require faculty members to adopt a dynamic instructional platform embedded within blended, virtual, or fully online learning environments (e.g., learning management systems, Massive Open Online Courses [MOOCs], or content management systems) and compatible with formal and informal learning environments. Through this immersive experience, special and general education teacher candidates would then be better prepared to carry out personalized approaches when using digital learning systems to facilitate learning and behavior for B-12 students with and without exceptionalities.

Applied Technologies*.* In the ideal preparation program, special education teacher candidates would have authentic opportunities to practice high leverage practices (HLPs; McLeskey et al., 2017) via technology-enabled (Jonassen & Carr, 2000), clinically rich, inquiry-based practice (American Association of Colleges for Teacher Education, 2017). Technologies such as video modeling, game-based learning, virtual, augmented, and mixed realities (such as Mursion, TeachLIVE, and simSchool) and the growing list of context-rich simulations allow teacher candidates to develop essential skills in a realistic environment. These virtual experiences provide safe and supportive environments, allowing candidates to develop perspective and proficiency with B-21 students with exceptionalities before, and while working in, real world classrooms –thereby minimizing the potential for adverse effects on real students, and maximizing the potential for positive impact. Also, when integrated throughout a teacher preparation program, these technology-enabled opportunities scaffold teacher candidates' content and pedagogical learning in developmentally appropriate ways.

Sustained Applications*.* The future requires special education teacher preparation experiences that extend beyond technology exposure and practice. Incorporating the technology as a function of the instruction in teacher preparation facilitates teacher candidates' development again, in part, through scaffolding their technology experiences. For example, consider the growth in digital solutions that foster real-time connections, virtual instruction, coaching, collaboration, and customized feedback. Consider the current bug-in-ear or e-coaching experience that allows a supervisory expert or coach to provide immediate, discrete, and unobtrusive feedback to teacher candidates. Extend this practice to the growing array of wearable technologies and apply it to a coaching model that could model practices, support real-time application, and continue to offer explicit feedback to an individual with a disability within an educational or community setting.

Although the technology has not yet enjoyed widespread application, e-coaching researchers have found that application to pre- and in-service special and general education teachers and their B-12 students with and without exceptionalities has merit. For instance, e-coaching can be used effectively to improve teachers' instruction (Coogle, Rahn, & Ottley, 2015; Ploessl & Rock, 2014; Rock et al., 2009, 2012, 2014; Scheeler, McKinnon, & Stout, 2012) and B-12 students' engagement (Rock et al., 2009; 2014). Also, e-coaching benefits for teacher candidates have included improvements in confidence, ownership of learning, resilience, efficacy, and a growth-oriented mindset (Stahl, Sharplin, & Kehrwald, 2016). In addition, Ottley, Coogle, and Rahn (2015) showed evidence that e-coaching is a socially valid practice.

Through a reconceptualization of teacher preparation and the integration of technology supports, the teacher development pipeline can be redesigned. Just-in-time learning experiences, such as e-coaching, that are aligned with a teacher candidate's specific needs and provided in a manner that offers the appropriate support and experience to ensure initial competency can be placed in their instructional environment and can continue fostering job embedded professional growth thereafter.

Theoretical Frameworks*.* Just as technology expands human cognition, theory extends human thinking and provides a rationale and framework for inquiry-based preparation (i.e., developing and testing hypotheses about learning technologies in teacher education and special education). When exploring technology-enabled teaching and learning, special education teacher education faculty members must consider current technology-specific theories that are actively employed, including Technological, Pedagogical, and Content Knowledge (Koehler & Mishra, 2005), Substitution, Augmentation, Modification, Redefinition (Puentedura, 2006), and Multimedia Learning Theory (Mayer, 2005). Seminal (e.g., behaviorism, constructivism) and digital age learning

theories (e.g., connectivism) apply, too, and are useful frameworks for designing and delivering technology-enabled teaching and learning in teacher preparation (e.g., video-modeling, student response systems, and case-based instruction).

Another important and recent aspect of technology-oriented learning theory special education teacher educators must consider is the interface between cognitive science, demonstrable learning, and theory (e.g., Glaser, 2000; Mayer, 2005). Other enduring theories that continue to guide researchers and to make contributions to technology in teacher education and special education include but are not limited to positivist research approaches (Klingner et al., 2016), the How People Learn framework (Fishman & Dede, 2016), and the concept of affordances (Gibson, 1977).

Finally, the advance of Universal Design for Learning (UDL; Rose & Strangman, 2007), a guiding framework that borrowed constructs from architectural accessibility, which is grounded in cognitive science, has quickly moved into policy (Hehir, 2009) and practice (UDL-IRN, 2011). Although no single theory can encompass all possibilities for exploring complex technological learning environments and learning diversity, special education teacher educators and researchers generate and frame important problems about the potential and actualities of learning technologies through theory. To be effective in solving the complex learning and behavioral challenges often exhibited by students with exceptionalities, a theoretical lens is often useful for special education teacher candidates too.

Overhauling the Real and Achieving the Ideal

The next generation of special education teacher preparation should integrate across technology platforms and tools seamlessly, be designed with a mobile-first mindset, and be guided by Universal Design and UDL principles to ensure accessibility by all stakeholders (U.S. Department of Education, 2017). Special education teacher candidates also need to be able to use B-21 student analytics in a manner leading to effective instructional practice to establish a means to develop, implement, and assess technology-enhanced instruction for traditionally marginalized populations using guidelines established by Reis (2011).

Translating that vision into reality in special education teacher education requires a blueprint – one that administrators and faculty members can consider as a guide when redesigning, refreshing, or upgrading their programs to achieve the goal of preparing special education teacher candidates who are tech-savvy consumers and technology-enabled learning leaders. Such a blueprint includes pioneering research, inter- and cross-disciplinary collaboration, leadership and influence, and partnership-based, network improvement communities.

Pioneering Research. Achieving upgrades and redesign requires not only the adoption of new practices, but also the production of new knowledge. In response, faculty in special and general teacher preparation programs should focus on undertaking research and development that improves pre- and in-service teachers' ability to use personalized learning. They would, thereby, enhance educational outcomes for all learners, including those with exceptionalities, in part, by seeking to understand how systems (e.g., users, tools, data, analysis, and visualization), interfaces (e.g., natural language, speech, vision, agents, and robotics), and cognition (e.g., memory, emotion, curiosity, pattern-recognition, problem solving, and decision making), interact in ways that improve B-21 students' academic, behavioral, and social outcomes through personalized learning (e.g., recommendation systems, self- and guided reflection, growth curves, learning pathways, reinforcement, and remediation).

Inter- and Cross-Disciplinary Collaboration. All teacher candidates should be ready to match technology innovations to B-21 student needs and provide critical analysis of innovations to industry leaders, parents, and other educators for meaningful use. As such, another critical component in the redesign blueprint is an expanded notion of collaboration. Special and general education teacher education faculty members also need to enhance their knowledge and skillsets by working closely with people and professionals from outside our discipline. Although special education professionals have always valued collaboration, more collaboration amongst teacher educators is not the answer. We must broaden and deepen our collaborative partnerships in innovative ways *and* immerse teacher candidates in those partnerships.

Leadership and Influence. Achieving redesign, requires higher education leaders and teacher education faculty members to join in leveraging six sources of influence – personal motivation, personal ability, social motivation, social ability, structural motivation, and structural ability (see Grenny, Patterson, Maxfield, McMillan, & Switzler, 2013). Doing so requires a shared approach to leadership, which is often fraught with complexities that result in premature abandonment and failure. Thwarting resistance and achieving success through shared leadership requires mutual trust, clear communication, a shared commitment, and ongoing monitoring and evaluation.

Partnership Based, Networked Improvement Communities. Much like the existence of disability communities, communities of innovative technological practices are needed to envision and stimulate change in general and special education teacher preparation and to monitor the effects of redesigns and upgrades over time (Bryk, Gomez, & Grunow, 2010; Zorfass & Rivero, 2005).

This blueprint to create a 3.0 upgrade in special education teacher preparation is by no means exhaustive. Clearly, faculty members need the platforms, supports, incentives, and infrastructure, at programmatic and state licensure levels, to follow this blueprint. Still, the need for change is urgent and perhaps best encapsulated in this statement by Robinson (2015): "Technology convergence occurs where scientific disciplines or key enabling technologies combine with other disciplines or enabling technology to promise new or added value beyond synergism" (p. 16). A new synergism is essential to produce a special education teacher preparation model 3.0, not only for the future of the field, but also most importantly for the special and general education teachers and the students with exceptionalities whom they serve, the latter of which total over 6 million in the U.S. alone.

Note

[a] The term AT is defined as "any item, piece of equipment or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with exceptionalities. The term does not include a medical device that is surgically implanted, or the replacement of such device" (http://www.gpat.org/georgia-project-for-assistive-technology/pages/assistive-technology-definition.aspx). IT is defined as "a systematic way of designing, carrying out, and evaluating the total process of learning and teaching in terms of specific objectives, based on research in human learning and communication, and employing a combination of human and nonhuman resources to bring about more effective instruction" (Commission on Instructional Technology, 1970, p. 199). And, AEM is defined as "print- and technology-based educational materials, including printed and electronic textbooks and related core materials that are designed or converted in a way that makes them usable across the widest range of individual variability regardless of format (print, digital, graphic, audio, video)" (http://aem.cast.org/aem-center/glossary.html#.WMnaGxIrKfU).

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