Exploring Teachers' Technology Integration Self-Efficacy through the 2017 ISTE Standards

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Abstract

This quantitative study examined self-efficacy as a factor in teachers' technology use and integration efforts in urban K-12 classroom settings of 327 Catholic school teachers in Southern California. This study employed an online survey that utilized the Technology Integration Confidence Scale (TICS) version 3, an instrument developed by the first author which is aligned to the ISTE (2017) Standards for Educators, and found that, on average, participating teachers had a fair level of confidence (i.e., they are fairly but not highly confident) in both using and integrating technology ($M = 3.2$, $SD = .73$). Accordingly, the study established participating teachers' level of confidence in using and applying technology through sustained continuous professional development intervention as a key implication that influenced teachers' self-efficacy in leveraging technology for professional practice.

Keywords ISTE standards for educators · Professional development · Self-efficacy · Technology integration confidence scale · Technology use and integration · Urban K-12 teachers

Introduction

With the advent of the Social Web or “Web 2.0” (O'Reilly, 2005), the traditional approach of unidirectional, teacher-centered instruction has been increasingly abandoned in preference to innovative, reciprocal approaches that utilize interactive (or participatory) digital multimedia and technology integration (Brown, 2012; Clark & Mayer, 2016; Shadiev et al., 2014). Digital technology presents new possibilities for living, as well as learning inside the classroom and remotely (Clark & Mayer, 2016; Kay, 2006; Paus-Hasebrink et al., 2010). New media has had a growing impact on most aspects of human endeavor, including that of education where, over the last decade, the availability of technology has significantly increased in schools at all levels (Howard, 2013; Tamim et al., 2011). However, it must be pointed out that though daily technology usage is widespread, technology integration in

education (during the pre-COVID-19 era) has not kept pace (Capo & Orellana, 2011; Deye, 2015; Fioriello, 2011; Warham et al., 2017).

As the number of schools moving towards or adopting a one-to-one (1:1) teaching environment steadily increases, teachers have greater access to technology; yet, teachers are not capitalizing on this opportunity to optimize and effectively integrate technology into the curriculum (Slutsky, 2016). These teachers in their pre-COVID-19 professional practice routinely use the same tools as the previous generation of teachers (Bauer & Kenton, 2005; Cuban, 2003). Their response to the call for twenty-first-century teachers to pivot their teaching and students' learning toward the inclusion of Web-based technology lagged behind expectations (Capo & Orellana, 2011; Deye, 2015; Fioriello, 2011; Warham et al., 2017). Technology, widely advanced as a tool to facilitate effective teaching and student-centered learning, is often not being used to support the kinds of instruction believed to be most powerful for twenty-first-century learning and STEM-related career fields (Ertmer & Ottenbreit-Leftwich, 2010; LaForce, 2018). The COVID-19 crisis thrusts teachers, whether they were techno-pedagogically prepared or confident or not, into an instructional environment where technology became a necessary medium in the form of remote learning and later in a hybrid of remote and in-person instruction.

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Teachers' limited, or lack of, in-depth pedagogical familiarity with technology integration, virtual experiences and online instruction, in effect, made the abrupt pivot and rapid transition to (emergency) remote modes of teaching and learning an even more arduous task, stressful and incredibly challenging practice for many teachers (Hodges, Moore, Lockee, Trust, & Bond, 2020; Marshall et al., 2020; Tate, 2020).

According to Kent and Giles (2017), a credible indicator, or meaningful predictor, of a teacher's ability and willingness to engage learners through innovative twenty-first-century instruction is self-efficacy of technology integration. There is growing evidence suggesting teachers' own beliefs in their capacity to effectively integrate technology are a significant factor in determining actual technology use and implementation in the classroom (Albion, 1999; Bauer & Kenton, 2005; Ertmer & Ottenbreit-Leftwich, 2010; Holden & Rada, 2011). Research findings showed that technology integration for meaningful classroom use remains among the greatest challenges facing today's teachers (Cennamo et al., 2010; Fioriello, 2011; Slutsky, 2016). Thus, there is a need to investigate the association between teachers' technology self-efficacy (TSE) and their ability to effectively use and integrate technology into their teaching practice.

Research Questions

Teachers' TSE, which concerns the beliefs about their abilities to succeed at a specific task (Bandura, 1997), involves the relevant use and meaningful integration of technological tools to classroom settings. Subsequently, teachers' TSE can increase the effectiveness of the teaching process via technology-supported instruction (Holden & Rada, 2011). The International Society for Technology in Education (ISTE, 2017) has developed new technology use and integration standards for educators to better engage student learning and to support teachers' technological and pedagogical competencies. These standards, which go beyond executing technological skills, specifically challenge teachers with integrating technology across the curriculum. The ISTE Standards are intended to serve as a framework for digital age learning, no matter where teachers are on the journey to effective educational technology integration (ISTE, 2018). Hence, the ISTE (2017) Standards for Educators are proffered as a road map to deepen teachers' practice, promote collaboration with peers, and challenge them to rethink traditional approaches as they prepare students to drive their own learning with the help of technology. Thus, the purpose of this study was to examine self-efficacy as a factor in teachers' technology use and integration efforts in urban K-12 classrooms based on the ISTE (2017) Standards for Educators.

Schools in urban settings in the United States, like those of Southern California, tend to be heavily populated with culturally and racially diverse learners as well as having a heavy

concentration of English language learners, and a large number of poorer students, particularly students of color (Milner, 2006). Furthermore, urban schools tend to have "high attrition of teachers, heavy institutional and systemic barriers, and meager resources" (Milner, 2006, p. 346). As a result, in urban classroom environments like those included in this study, teachers need to possess an eclectic array of skills and practices that are suitable to a diverse group of students (Lingam, 2010). However, due to limited resources in urban schools, professional development (PD) training sessions addressing techno-pedagogical considerations are oftentimes infrequent and inadequate to support student-centered instruction (Cuban et al., 2001; So & Kim, 2009). This type of professional support can have a negative impact upon teachers' perceptions of self-efficacy and, ultimately, adversely affect teachers' technology use and integration (Brinkerhoff, 2006; Kenny et al., 2010).

Within this urban context of schooling, this study investigated how confident participating Southern Californian urban teachers are in using and integrating technology in the K-12 classroom setting. In the process, a survey instrument (TICS version 3) to evaluate the components of teachers' technology integration self-efficacy was pretested and pilot studied. This instrument examines the self-efficacy, confidence, and beliefs of teachers. These constructs, following the self-efficacy framework of Bandura (1997), are used in this study in much the same way as Browne (2011) did in his TICS versions 1 and 2. Thus, the TICS version 3 seeks to measure teachers' confidence to use and integrate technology, which is interpreted as a measure of teachers' self-efficacy and belief in their capacity to leverage technology to perform technological-pedagogical tasks. To accomplish the purpose of the study, the following research questions were investigated:

- What is the participating Southern Californian urban Catholic school teachers' level of confidence in using technology?
- What is the participating Southern Californian urban Catholic school teachers' level of confidence in integrating technology during the teaching process?

Theoretical Framework

Technology Integration Self-Efficacy

Self-efficacy, a key element of Albert Bandura's social cognitive theory (Pajares, 2002; Perkmen & Pamuk, 2011; Van Dinther et al., 2011), is defined as "people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives" (Bandura, 1994, p. 1). It follows that self-efficacy beliefs not

only affect but “determine how people feel, think, motivate themselves and behave” (Bandura, 1994, p. 1). As Hongu et al. (2011) noted, unless people believe that they can produce desired effects by their actions, they have little incentive to enact behavioral changes or continue their behavior changes once their goals have been achieved. In order to succeed and achieve, then, teachers need a strong sense of task-specific self-efficacy, tied together with resilience, to meet the unavoidable obstacles inherent within the framework of instructing using digital platforms and tools (Artino, 2012; Dean, 2020; Koehler & Mishra, 2009).

Self-efficacy as such is a personal belief about one’s own ability to perform a given action or one’s own capability to produce given attainment or mastery (Bandura, 1997; Denzine et al., 2005). However, it must be pointed out that self-efficacy beliefs do not automatically translate into the actual use of technology among teachers, but rather self-efficacy beliefs are “a necessary condition for technology integration” (Wang et al., 2004, p. 242). This is so since, as Artino (2012) commented, high self-efficacy in one area may not necessarily coincide with high self-efficacy in another area given that individuals may believe other factors will keep them from succeeding. Self-efficacy simply indicates how strongly individuals believe they have the skills to do well as it relates to the specific task being attempted (Artino, 2012; Bandura, 1994; Bandura, 1997). Thus, in terms of integrating technology in the classroom, self-efficacy is concerned with a teacher’s perceived ability to incorporate digital tools, such as Web 2.0 technologies, into classroom lessons as well as facilitate meaningful instruction using applicable digital tools (Ertmer, 2005; Holden & Rada, 2011; Spencer, 2016).

Technology integration self-efficacy is a predictor of actual technology integration (Anderson et al., 2011; Anderson & Maninger, 2007). Successful integration of technology in the K-12 classroom is influenced by teachers’ ability in making technological and pedagogical decisions of how, why, and when to employ technological tools to enhance teaching and student learning (Brown, 2016; Mishra & Koehler, 2006; Pierson, 2001; Straub, 2009). Teachers’ self-efficacy, like self-efficacy beliefs in general, is about how confident they are in their current recognition or realization that they can do a specific task (Bandura, 1994; Bandura, 1997, 2006). Technology self-efficacy is concerned with a teacher’s perceived ability to incorporate digital tools, such as Web 2.0 technologies and software applications, into classroom lessons and across the curriculum. As such, technology self-efficacy is preoccupied with the confidence level of an individual when using technology given that it is both task-specific and task-dependent (Albion, 1999; Artino, 2012; Bandura, 1997; Holden & Rada, 2011). Self-efficacy, therefore, plays a critical role in a teacher’s level of confidence to integrate technology (Beard, 2016). As Bandura (1997) suggested, a strong sense of self-efficacy is necessary to access

skills and knowledge while at the same time remaining focused on the task, for example, integrating technology, in a complex environment such as today’s urban K-12 classroom setting.

Methodology

Survey Instrument Development

A survey instrument, predicated on Browne’s (2011) TICS version 2, was developed. In 2006 and 2007, Browne (2011) created TICS versions 1 and 2 in alignment with the first iteration of ISTE’s (2000) National Educational Technology Standards for Teachers (NETS-T). Construction of the TICS version 3 survey instrument commenced by generating items grounded in alignment with the newest ISTE (2017) Standards for Educators. These statements described specific tasks of technology integration such as teachers’ self-efficacy or confidence level in using technology in the classroom. The items were then examined for ambiguity, wording, and content overlap. To ensure content validity, the items were subjected to the scrutiny and evaluation of an educational technology professor, a director of technology, a coordinator of technology, a lecturer of education, and a statistician.

As a result of this initial work with the instrument, a 34-item survey that corresponded to the seven subscales of the ISTE (2017) Standards for Educators emerged for further evaluation and modification. To gather more systematic data on the instrument, the 34-item version of the TICS version 3 was then administered as a pretest through an online survey to 118 urban K-12 teachers in multiple Southern California Catholic school settings. There was a total of 97 usable completed surveys ($n = 97$) whose data were utilized for the initial analysis. As a result of this initial field test of the instrument, nine statements were omitted due to reliability and validity concerns based on the psychometrics and experts’ feedback, leaving 25 items to be included in the final pretested form of the five-component instrument (see Appendix A Table 1 for an overview of TICS v.3).

A pilot study was carried out to statistically confirm the 25-item TICS version 3 survey instrument. One hundred and eleven teachers responded, of which 43 had missing/incomplete data thereby resulting in 68 respondents who completed the survey ($n = 68$). These participants were teachers employed in Southern California, who had access to utilize and integrate technology in the classroom environment as an instructional and/or learning tool. Based on the 68 responses, the overall Cronbach’s Alpha reliability coefficient for the TICS version 3 is .977. An exploratory factor analysis (EFA) was also performed to investigate the factor structure underlying responses to the 25-item TICS version 3. The EFA

confirmed that 65.35% of respondents' total variance toward the target construct is explained by the instrument. This result is considered adequate, as ideally at least 50% of the variance should be explained (Hatcher, 2013; Lomax & Hahs-Vaughn, 2012).

Participants

The target population for this study consisted of approximately 2,500 teachers in a large, diverse Southern California Catholic school district with 215 elementary schools and 40 high schools. Participants in this study were urban K-12 teachers in multiple Catholic school settings from Southern California, who had access to utilize and integrate technology in the classroom environment as an instructional and/or learning tool. Accordingly, these teachers were employed in schools with computer access, and over time most received some form of continuous PD training sessions on technology integration. The complete survey was answered by 327 teachers ($n = 327$), resulting in a 5.05% margin of error with a 95% confidence level (Raosoft, 2004), which is an acceptable response rate.

Data Collection and Analysis

Approval for the study was obtained by the first author through the Institutional Review Board at a northwestern university. To collect the requisite data for the study, an online survey was administered to a random sample of teachers in Fall 2019. Catholic elementary and high school principals in Southern California were contacted to explain the scope and purpose of the study. The principals, in turn, emailed teachers an invitation to participate in the study. A letter of invitation and participant consent along with the link to the online survey were shared with those indicating a willingness to participate. Teacher-participants had the option, before commencing the survey, to proceed with completing or declining the invitation to participate and terminate the survey. To answer the research questions, descriptive statistics, such as mean, median, standard deviation, and variance, were computed.

Results

Demographics

Teachers who participated in the study were females (77.1%) and males (22.3%). Of the eight categories of race/ethnicity on the online survey, the largest group of teachers self-identified as Hispanic/Latino (40.4%) followed by White (38.5%). Also, some teachers self-identified as Asian (7.0%) and mixed race (6.1%). Only 7.9% of the teachers self-identified as one of the remaining four categories of race (Black/African American,

Other, American Indian/Alaska Native, and Hawaiian/Other Pacific Islander). The majority of teachers in the sample were between the age of 26 to 45 years old (57.2%). Further, 37.6% of the teachers were older than 45 years and only 5.2% of the teachers were younger than 26 years.

The largest groups of teachers who participated in the current study were elementary (46.2%) and middle school teachers (36.7%). Additionally, a majority of the participants reported that their highest educational attainment was a master's degree (59%). This was followed by 34.9% reporting that they had earned a bachelor's degree as their highest educational attainment. A few of the teachers' highest educational attainment was a doctorate degree (4%). Instructional experience of teachers in the sample ranged from 1 to 42 years. The mean, median, and mode years of teaching experience was 13.4 years ($SD = 9.5$), 12 years, and 3 years, respectively.

One of the demographic items on the online survey asked teachers to indicate how frequently they participated in technology-oriented PD training sessions. The largest group of teachers (25.1%) reported that they participated in one technology-oriented PD training session per year. Further, 18.3% and 16.8% of the teachers indicated that they participated in technology-oriented PD training sessions twice and four times per year, respectively. Also, 14.7% of the teachers reported that they participated in technology-oriented PD training sessions monthly. Furthermore, 14.4% of the teachers reported that they did not participate in any technology-oriented PD training session in the last year.

Urban Teachers' Level of Confidence in Using Technology

To answer the first research question, the means and standard deviations of the indexed scores for the subscales Technology Usage (C1), Technology-infused Learning (C3), and the overall Technology Usage (C1 and C3) were computed. The results indicate that, on average, participating teachers' level of confidence in using technology was 3.2 ($SD = .78$) for Technology Usage, 3.2 ($SD = .78$) for Technology-infused Learning, and 3.2 ($SD = .73$) for overall Technology Usage on a scale from 0 to 5, where 0 means not confident at all and 5 means completely confident. These mean scores between 3 and 4 out of a possible score of 5 for using technology by teachers indicate fair levels of confidence in using technology.

Urban Teachers' Level of Confidence in Integrating Technology

To answer the second research question, the means and standard deviations of the indexed scores for the subscales Technology Application (C2), Technology Literacy and

Digital Citizenship (C4), Technology-supported Assessment (C5) and the overall Technology Application (C2, C4, and C5) were computed. The results indicated that, on average, participating Southern Californian urban K-12 teachers' level of confidence to integrate technology in the teaching process using the ISTE (2017) Standards for Educators was 3.0 ($SD = .89$) for Technology Application, 3.5 ($SD = .68$) for Technology Literacy and Digital Citizenship, 3.1 ($SD = .88$) for Technology-supported Assessment, and 3.2 ($SD = .73$) for overall Technology Application on a scale from 0 to 5, where 0 means not confident at all and 5 means completely confident. These mean scores between 3 and 4 out of a possible score of 5 for integrating technology by teachers indicate fair levels of confidence in integrating technology during the teaching process.

Discussion

Digital technology use in the pre-COVID-19 classroom gained steady and greater importance concordantly with increases in computer access and technology training (Houghton Mifflin Harcourt, 2018; Kay, 2006). The COVID-19 pandemic brought the need for adequate technology training to the fore and magnified this reality as schools transitioned into the technology-supported post-COVID-19 classroom. However, it must be noted that a teacher's high computer self-efficacy level, often exhibited through their technology usage know-how, does not guarantee that she or he will be able to thoughtfully and effectively integrate technology in the classroom environment (Kilic, 2015; Paus-Hasebrink et al., 2010). For example, though male instructors generally report having more competence and comfort with using technology (Peluchette & Rust, 2005; Young, 2000), female teachers are more likely to utilize and integrate technology in their instructional practice (Yang & Spears, 2017). This gender difference in using technology in teaching has consequences for students, especially in urban schools where representation matters given the under-representation of women and minorities in technological fields (Tettegah & Mayo, 2005). As Ertmer et al. (2012) observed, teachers' attitudes and beliefs of other teachers concerning technological capabilities were perceived to be among the most impactful factors on students' uses of technology. This suggests that technology usage is not a neutral concept but one impacted by global and regional contexts (Tettegah & Mayo, 2005). As such, acquisition of better technology integration practices through risk-taking or exposure from others serving as social models raises perceived self-efficacy—for both the teacher and students.

Research studies (like Peluchette & Rust, 2005; Yang & Spears, 2017; Young, 2000) showing male teachers possessing better technology usage know-how but having integration level disproportionate to that of female instructors

serves to illustrate there are two connected but distinct skills involved with technology-enhanced teaching in classroom settings. These are (1) how to use technology and (2) how to integrate technology (Paus-Hasebrink et al., 2010; Sadaf et al., 2012, 2016; So & Kim, 2009). The latter, which presupposes the former, is impacted by factors such as fear and anxiety associated with computer usage (Kilic, 2015), belief about technology integration (Ertmer et al., 2012), and preference to use technology in the classroom (Peluchette & Rust, 2005). As such, the benefits gained from emerging technologies and promising new media will depend, to a large degree, on the extent they can be leveraged for effective teaching (Clark & Mayer, 2016). Instructing with technology allows teachers to use advances in technology to increase teaching effectiveness as well as explore more meaningful curricular pathways (Rebora, 2017). In fact, innovation in educational technology may even hold the twin promise of addressing social problems and closing the achievement gaps in educational communities and among urban students (Tettegah & Mayo, 2005).

New technologies continue to create opportunities, though not without challenges, when it comes to designing and delivering content for instructional and learning purposes. Teachers need to know how to set the stage to help students, whether for in-person, online, or remote teaching. This quantitative study examined self-efficacy as a factor of teachers' technology use and integration efforts utilizing Web 2.0 technologies as pedagogical tools in the urban K-12 classroom setting. Accordingly, this study evaluated the components of teachers' technology integration self-efficacy by examining results from the researcher-validated TICS version 3 survey instrument, that is aligned to the seven benchmarks of the current ISTE (2017) Standards for Educators. Specifically, the study measured the self-efficacy of teachers to perform tasks of effective technology use and integration. The findings from this study, predicated upon the teachers' technology integration self-efficacy and competency, highlight the need for sustainable techno-pedagogical preparation and serve to inform technology integration efforts in different settings.

Teachers reported having a fair level of confidence in performing tasks in the areas of Technology Usage and Technology-infused Learning. Coupled with a growing need for teachers to use and infuse technology into the classroom (Deye, 2015; HMH, 2018; Kay, 2006), there is a corresponding need for professional and teacher-led intervention measures to increase teachers' self-efficacy in Technology Usage. As Bandura (1997) explained, an effective strategy to improve, or develop, a strong sense of self-efficacy is through mastery experiences from performing tasks successfully. As implied, competence (i.e., expertise) is predicated upon confidence (i.e., self-efficacy) as expertise eventually occurs from gradual improvements and successful repetition via the 'confidence/competence loop' (Eikenberry, 2012). Moreover, research shows that experiential knowledge of

pedagogical decision-making for the use of technology from actual in-class practice increases teachers' self-efficacy in their ability to use technology effectively (Power, 2018). Therefore, effective teaching with technology requires multiple opportunities for practice as well as reflections on the deep structure of teaching after enactive contextual experiences (Bandura, 1997; Mishra, 2018; Willingham, 2002). Additionally, the COVID-19 crisis provided an abundance of the former in the form of remote teaching while disrupting the usual mechanisms for reflection (Dean, 2020). Yet, individual teachers and faculties should not overlook reflective practice during times of disruption and in challenging circumstances since it builds resilience which helps teachers to better digitize their instruction (Dean, 2020).

As the results further pointed out, more than 50% of the surveyed teachers reported a level of confidence for integrating technology that was fair for the subscales of Technology Literacy and Digital Citizenship as well as the overall Technology Application. Accordingly, as Ifenthaler and Schweinbenz (2013) suggested, a majority of teachers are open to incorporating digital technology into daily lessons and feel they would enhance their instructional practice, but others are not self-efficacious about integrating digital devices in their everyday instruction. This finding is also reflectively in alignment with the current study's analysis that, on average, teachers have a fair level of confidence to integrate technology in the teaching process using the ISTE (2017) Standards for Educators. Therefore, the number of teachers who integrate technology beyond resources for instructional support remains below desired levels (Kidd, 2013). Yet, as Smith and Dobson (2011) stated, digital technology as a tool is quite powerful when it is deployed strategically to enhance collaboration, encourage creative discovery, or reinforce foundational knowledge.

Digital technology, as Prensky (2009) suggested, not only has the power to make us smarter but, more importantly, wiser. This is especially so if the technology is leveraged to enhance our capabilities. This is even more true for teachers if they are to effectively use and seamlessly integrate technology into their teaching practice. On average, to reiterate the current study's findings, teachers have a fair level of confidence in both using and integrating technology. These findings are similar to those from Houghton Mifflin Harcourt national surveys for 2016, 2017, and 2018, which confirmed that only 58% of teachers reported being extremely or very confident in their ability to use educational technology in instructionally effective ways. According to those national surveys, on average, 36% of the teachers over the three-year period reported that they are somewhat confident while 6% declared that they are not very confident in their ability to use educational technology in instructionally effective ways (HMH, , 2018). These results, aligned with prior research on teacher self-efficacy scores and technology use in classrooms (DeSantis, 2013;

Ertmer & Ottenbreit-Leftwich, 2010; Evers et al., 2002; Liu et al., 2017; Tweed, 2013), further reveal there is room for meaningful improvement of integrating technology as part of teachers' classroom practice.

Accordingly, elevating teachers' technology self-efficacy and preparing them to effectively integrate technology into their classrooms via multiple-track sustained PD programs to facilitate meaningful professional learning is vitally important in today's urban classroom and the world of educational practice (Beard, 2016). The absence or underdevelopment of which, as the COVID-19 crisis made clear given the need for remote teaching, has made the transition to digitize teachers' instruction an even greater challenge and a more arduous task (Dean, 2020; Marshall et al., 2020; Tate, 2020). A teacher's technology integration competency, within the scope of instructional proficiency whether for in-person, online, or remote teaching, is a work in progress. As Milner (2010) pointed out, to successfully teach students in diverse, urban schools, teachers need to give persistent attention to professional learning and development, as well as avoid complacency. Therefore, an emphasis on teachers' technology efficacy should be a key focus on teaching as a purposeful means to promote the success of all students. In fact, given that teacher efficacy is essential to the integration of technology (Franklin, 2007; Moore-Hayes, 2011), teachers' technology integration self-efficacy and competency should remain among the top priorities in education and, through PD programs, it needs to be continuously addressed.

Implications for Practice

The findings from this study lend themselves to a few key implications, listed summarily below, for school- and teacher-level educational practices.

1. Teachers need to continue honing their technological skills through ongoing professional development opportunities.

Prior to the COVID-19 pandemic, many teachers were in need of technology skill development (Power, 2018; Slutsky, 2016). The COVID-19 pandemic brought this to the fore and magnified this reality. Teachers with their various levels of technological skills were thrust into the COVID-19 pandemic to adopt and utilize technology to facilitate emergency remote learning at first and later hybrid learning models. As Powell (2021) puts it, teachers had to redesign entire lessons, units, and courses on the fly while learning new technology such as Zoom, Google Meet, Seesaw, and Microsoft Teams. Remote learning required teachers to quickly utilize and integrate many educational apps, resource websites and digital communication platforms to facilitate both asynchronous and synchronous

lessons and meet students' learning needs. Thus, as teachers and students return to classrooms for in-person teaching and learning, teachers find themselves in a position whereby they have to learn and adopt new platforms and approaches to incorporate a suitable student response tool or backchannel replacement into lessons. The latter, for example, enables teachers to continue providing students a layer of safety in sharing ideas, especially to communicate concerns discreetly, in face-to-face classroom settings. Teachers need to recognize what has worked for them in remote learning and continue to leverage those tools and resources for student learning in the in-person classroom (Schwartz, 2021). In-person learning can better students' academic chances of success if offered with adequate teacher techno-pedagogical support that allows for lessons to be engaging and challenging as well as for learning to be scaffolded, personalized, gamified, and adaptable (Stevenson, 2021; Weiss, 2019). Teachers, in a post-pandemic world, will continue to be in need of honing their technological know-how and techno-pedagogical skills, including those that sharpen a teacher's skill set for future emergency remote teaching (Hodges et al., 2020), through professional learning and continuous professional development opportunities.

2. Professional development training sessions need to address current techno-pedagogical challenges in a distributed manner as recommended by research.

It is a given that professional development opportunities have and will continue to be offered to teachers. However, for these PD opportunities to be effective and worth the financial investment associated with their offerings, they need to be frequent or continuous and follow the research-suggested timeframe of more than 14 hours and as much as 49 hours distributed over time with sufficient practice (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009; Desimone, 2009; Guskey & Yoon, 2009; Yoon et al., 2007). Random, haphazardly scheduled, single-shot, one-day workshops and webinars rather than sustainable, adequate, distributed PD training will continue to be inept in meeting teachers' ongoing and growing technological skill development needs. PD programs or training sessions need to be strategic, needs-based, application-oriented, and distributed over time.

A meta-analysis by Yoon et al. (2007) suggested that PD training is most effective when it is completed over multiple sessions for at least the minimum number of hours recommended to optimize teachers' techno-pedagogical efficacy and be intense enough to elicit change at both the teacher- and student-level. Supporting teachers as they shift their pedagogical practices to leverage technology tools is not a one-stop experience providing them with a single-shot, one-day workshop or webinar on a specific technology concern or pedagogical problem.

Teachers need ongoing distributed PD training sessions to provide de facto coaching and reinforcement of confidence to help them develop their technology integration competency and pedagogical content expertise (Bandura, 1997; Koehler & Mishra, 2009; Mishra & Koehler, 2006; Sadaf et al., 2016).

3. Teachers with a willing disposition when learning to use and integrate technology is a plus for techno-pedagogical change.

Schools can, will, and must continue to offer quality, relevant, and sustainable professional development training sessions seriated with the required research-based caveats suggested. Yet, for these PD training sessions to be beneficial to student learning and enhance instructional practices, teachers need to have a genuine desire to learn, implement, and apply the technological resource and skill development offered. At the individual level, teachers' willingness to learn to use and integrate technology in their instruction is key for successful integration and thus a concerning consequence. Many teachers resist change or otherwise ignore the information about adoption or innovation shared at PD training sessions (Bohn, 2014; Koksall, 2013). This is in part because some teachers and academics do not want to change their instructional practices and are tired of hearing about innovation including that of digital innovative solutions and technology integration (Conole, 2021a). Some teachers' enthusiasm for new ideas are undermined by the many swings from one instructional approach to another (Knight, 2009). Others struggle with moving from intellectual understanding of the theory and research facilitated at PD sessions to enactment in practice (Darling-Hammond & Snyder, 2000). Teachers who expand their repertoire are those with a strong sense of task-specific self-efficacy in tandem with resilience to willingly overcome the unforeseen and often unavoidable challenges associated with instructing using digital platforms and tools (Artino, 2012; Dean, 2020; Koehler & Mishra, 2009). Thus, successful PD training necessitates teachers' buy-in and commitment coupled with schools requiring their use as needed and providing strategic and targeted support to help teachers achieve meaningful integration goals (Ertmer et al., 2012). In the COVID-19 post-pandemic educational landscape, teachers will need to willingly capitalize on PD training opportunities to optimize and effectively integrate technology into lessons and across the curriculum (Slutsky, 2016).

4. TICS v.3 is a reliable instrument to measure teacher's techno-pedagogical competence.

Increasing use of technology in the pre-COVID-19 classroom changed the process of learning and teacher's roles. The COVID-19 pandemic has further accelerated this reality via remote and hybrid learning. Students and teachers can choose

from an ever-expanding list of technologies to communicate and locate resources as well as create, share, use and develop information (Conole, 2021b). Teachers need to know how to use and integrate a wide range of technologies into lessons to support learning and teaching (Ertmer & Ottenbreit-Leftwich, 2010; ISTE, 2018; Mishra & Koehler, 2006; Rebora, 2017). Additionally, school leaders would benefit from a measure to determine and reliably indicate if teachers are capable of enacting technology integration. Hence, there is a corresponding need to measure teacher's techno-pedagogical competence to perform tasks of effective technology use and integration in various classroom settings.

The TICS version 3, which is aligned to the ISTE (2017) Standards for Educators and is predicated upon technology integration self-efficacy, is one such reliable and valid instrument designed to measure teachers' techno-pedagogical competence. The latter is important as strategic, effective, and meaningful use and integration of technology not only engages students but also builds personal connections with them and promotes feelings of inclusion and belonging (Lynch, 2018; Schwartz, 2021). Both of these are central to social and emotional learning as well as a positive classroom climate (Schwartz, 2021), which in turn has a positive impact on student learning. Technology has steadily become an integral part of learning and teaching (Conole, 2021b), and this study adds to the literature in a meaningful way by introducing an update to a useful instrument (TICS v.3) for measuring teachers' technology self-efficacy.

Limitations

While the study offered many promising results, it was not without limitations. Since principals served as secondary gatekeepers, the study was limited to teachers who received their approval to participate in the study. Thirdly, the study was restricted to the geographic location of Southern California and was opened only to urban K-12 teachers in Catholic schools. This may serve to limit the generalizability of the current study. Similarly, while diversity of experiences, environments, backgrounds, and grades taught by teachers were represented, the fact that the survey was administered electronically may have limited the sample pool to those who were most comfortable and/or savvy with technology, which could have potentially skewed the results toward technology usage and integration in schools. Subsequently, the researchers recognized as a limitation that other variables may have impacted teachers' technology usage and integration efforts for instructional purposes. Lastly, a key limitation to the study was the disparity of the Southern California public, charter, and private school organizational structures, that may inadvertently limit the generalizability of the findings as it relates to how confident teachers are in using and integrating technology in the classroom.

Conclusions

In the twenty-first-century, teachers are asked to innovate and take a risk to possess an adaptable mindset and be growth-oriented in their practice (Heggart, 2015). In a word, they are asked to be flexible in their teaching to meet the changing needs of students and the times. Given that Southern Californian urban K-12 teachers in a parochial setting have, on average, a fair level of confidence in using and integrating technology, teachers may need to develop flexible knowledge-bases to truly achieve teaching expertise. Teaching with technology starts at the skill-level first by addressing task-specific problems and then through contextual application and enactive practice, which imbue confidence and advance self-efficacy, evolves into flexible knowledge as expertise is developed (Bandura, 1997; Mishra, 2018; Willingham, 2002). Supporting teachers as they shift their pedagogical practices to leverage technology tools is not a one-stop experience providing them with a single-shot, one-day workshop on a specific technology concern or pedagogical problem. Teachers need ongoing distributed PD training sessions to provide de facto coaching and reinforcement of confidence to help them develop their technology integration competency and pedagogical content expertise (Bandura, 1997; Koehler & Mishra, 2009; Mishra & Koehler, 2006; Sadaf et al., 2016).

Techno-pedagogical skills are developed as teachers' contextual experience increases (Mishra, 2018), and their self-efficacy improves accordingly (Bandura, 1997). Like that of Ertmer et al. (2012), the findings of this study showed that teachers need further support and opportunities to develop higher levels of techno-pedagogical self-efficacy and expertise as part of their teaching repertoire. As teachers work with the experiential knowledge they possess from actual enactive contextual experiences of teaching or inflexible knowledge obtaining from ongoing PD training sessions, their repertoire of techno-pedagogical knowledge and skills will become larger and increasingly more flexible (Bandura, 1997; Mishra, 2018; Willingham, 2002). Flexible knowledge gives rise to higher self-efficacy, allowing teachers to integrate technology into their classrooms (Ertmer & Ottenbreit-Leftwich, 2010; Gilakjani, 2013; Mishra & Koehler, 2006; Tweed, 2013).

Though a useful tool, professional development should not be taken as schools' de facto catch-all solution to address teacher-learning deficits or proffer as quick fixes in teaching practice. PD intervention is only effective when it is well-designed and intense enough to elicit change at both the teacher- and student-level. In today's classroom, twenty-first-century learning requires sophisticated forms of teaching to develop student knowledge and skills such as critical thinking, problem-solving, communication, collaboration, positive creativity, and self-direction (LPI, 2019; Sternberg & Karami, 2021). Effective PD training sessions are those that empower

teachers to meaningfully support learning and transform schools into spaces where teachers are driving improvement through their own learning, initiative, and leadership with the goal of raising student achievement (LPI, 2019). This call for PD intervention, though not novel given its many inclusions in the extant literature over the past three decades, is reiterated here as its adequacy to elevate teachers' technology self-efficacy and prepare them to effectively integrate technology into their classrooms still holds true. However, PD programs work best when they are guided by recommended research-based caveats. In short, through PD intervention, flexible knowledge acquisition, and a willingness to take instructional risks with technology integration, teachers will be better positioned and able to raise their levels of technology integration self-efficacy to facilitate twenty-first-century teaching, whether in-person or remotely.

Appendix 1

Table 1 TICS v.3 Components, Definitions, # of Items, & Sample Questions

The Technology Integration Confidence Scale (Version 3)			
Component	Definition	# of Items	Sample Question
Technology Usage (C1)	Teachers' confidence to use and model technological devices and digital tools to support student learning.	7	How confident are you in using technology to stay current with research to support student learning outcomes?
Technology Application (C2)	Teachers' confidence to integrate technological devices into lessons and provide application opportunities of digital tools for students' use and benefit as part of instructional practice.	5	How confident are you in exploring and applying instructional design principles to create innovative digital learning environments that engage and support learning?
Technology-infused Learning (C3)	Teachers' confidence to embrace student-centered learning through effective use of technology in	5	How confident are you in using technology to support student needs through increased personalization

Table 1 (continued)

The Technology Integration Confidence Scale (Version 3)

Component	Definition	# of Items	Sample Question
Technology Literacy & Digital Citizenship (C4)	the classroom as part of their instructional practice. Teachers' confidence to effectively use technology to communicate information to enhance the learning process and to recognize the skills and concepts students should know to use technology appropriately.	4	How confident are you in teaching students to think critically, be safe, and responsible in the digital world?
Technology-supported Assessment (C5)	Teachers' confidence to create an environment in which appropriate technology is integrated to provide meaningful assessment and feedback.	4	How confident are you in using digital tools to provide immediate feedback to students?

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Declarations

Informed Consent Participation in the study by teachers was entirely voluntary and did not entail any foreseeable risks. Consent for the study was obtained through a letter addressed to teacher participants. Teachers who participated in this study via an online survey gave their informed consent before commencing the survey. They had the option to proceed with completing or declining the invitation to participate and thereby terminate the survey as well as the choice to end the process at any point in completing the survey. Participants were reminded that choosing not to participate, complete, or submit the online survey would not adversely affect their relationship with anyone associated with this study including the primary investigator, the school district, place of employment, and the university approving this study.

Conflict of Interest There is no potential conflict of interest to be declared by the authors. No funding was received by any of the authors to support this research project or in the execution of this research study. Also, there was no compensation given for participating in this study.

Research Involving Human Participants and/or Animals This research study involved human participants. The study, which was opened only to K-12 teachers in Catholic schools in Southern California, commenced after procuring approval from the Institutional Review Board (IRB) at Boise State University and the approval of the assistant superintendent for Catholic elementary and high schools for the Archdiocese of Los Angeles. A letter of invitation and participant consent was sent via email to teachers along with the link to the online survey. Teacher-participants had the option, before commencing the survey, to proceed with completing or declining the invitation to participate and terminate the survey. Participants who consented but did not complete the entire online survey were not included in the sample size for this study. A total of 327 teachers who consented and completed the survey was utilized for this study. The data collected from the online survey was analyzed in a non-identifiable way assuring that the responses remained confidential.

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