

Overcoming Second-Order Barriers to Technology Integration in K–5 Schools

Lisa Durff

Grand Canyon University

Maryfriend Carter

Walden University

The use of technology engages students and increases academic achievement, as Tamin, Bernard, Brookhovski, Abrami, and Schmid (2011) found in a study summarizing 40 years of research on this topic. Educators face attitudinal, sociocultural, and pedagogical barriers to technology integration in spite of its positive impact on academic achievement. In this qualitative multicase study, three groups of educators were interviewed to determine how some teachers successfully overcame barriers to technology integration. Each case contained two or three teachers, one administrator, and one technology support person in each of three schools in a rural northeastern school district. The findings showed that a team approach among administrators, technology support personnel, and teachers resulted in the strongest technology integration. Successful strategies included providing appropriate professional development, building collegial support and sharing among teachers, training teachers to locate relevant technological resources, and establishing value and support for the use of technology for learning.

Keywords: *teacher beliefs, teacher change, technology integration, pedagogical barriers, social and cultural barriers, attitudinal barriers*

Introduction

Although research (e.g., Elliot & Mikulas, 2012; Tamin, Bernard, Borokhovski, Abrami, & Schmid, 2011; Zielezinski & Darling-Hammond, 2016) has demonstrated that student achievement improves with the use of technology, certain barriers impede teachers from integrating digital technology into their classrooms. Ertmer (1999) identified two types of barriers: first-order or external barriers and second-order or internal barriers. First-order barriers include things extrinsic to the educator, such as Internet access, sufficient bandwidth, and access to technology hardware. Second-order barriers are those attitudes, beliefs, and practices that are intrinsic to the educator. These are influenced not only by personal attitudes, but also by social contexts, cultural landscapes, and learned pedagogical practices (Ertmer, 1999; Saxena, 2017).

First-order barriers to technology integration have been lowered in the United States, but second-order barriers persist (Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). While access to technological tools increased, 40% of U.S. educators in K–12 schools failed to integrate technology tools into their classroom teaching (Pittman & Gaines, 2015). Second-order barriers continued to be obstacles to technology integration in classrooms across the United States. The literature revealed that teachers have difficulty overcoming second-order barriers to technology integration (Celik & Yesilyurt, 2013; Chaloo, Green, & Maxwell, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Frick, 2012; Kim, Kim, Lee, Spector, & DeMeester, 2013; Zehra & Bilwani, 2016). By identifying how the teachers in the study overcame second-order barriers, administrators in

similar schools can be better equipped to encourage and assist teachers in overcoming barriers to integration.

Literature Review

Many classrooms now contain computers. The National Center for Education Statistics reported that 97% of rural public K–12 teachers had at least one computer in their classrooms (Ertmer et al., 2012; National Education Association & American Federation of Teachers, 2008). Mosley (2013) found that although technology has the potential to positively impact K–12 education, it is currently underused in schools. Ping Lim, Yong, Tondeur, Ching Sing, and Chin-Chung (2013) indicated it was difficult to prove that the use of technology improves student achievement. They felt that student achievement is influenced by many factors all at the same time, including environmental factors, peers, and users, making it impossible to identify a causal relationship.

Consequently, many educators prefer to stay with traditional methods they know will raise student achievement rather than using technology with their students in learning experiences. Perry (2018) noted that educators integrate technology for student learning if they see that student achievement will be positively impacted.

Several recent studies found that sociocultural surroundings, attitudes, and pedagogical considerations worked together to influence how teachers integrated technology (Grosser, 2017; Heath, 2017; Magana, 2016). Research into how well preservice teachers were prepared to enter classrooms and use technology with their learners, showed that educators need to be better equipped with ways to overcome barriers to successful technology integration in their classrooms (Batane & Ngwako, 2017; Instefjord & Munthe, 2017; Mulder, 2017).

Research showed technology integration is influenced by attitudes, social contexts, and the surrounding cultural environment, as well as pedagogical styles. A positive connection between technology integration and increased student achievement has been shown (D'Aprile, 2017; Eyyam & Yaratan, 2014; Montgomery, 2017). As noted by Eyyam and Yaratan (2014), the use of digital technology during instruction had a positive impact on student achievement and student engagement in their study of seventh-grade math students. Higgins, Juscroft-D'Amgelo, and Crawford (2019) examined 24 studies and found a significant positive influence on student achievement when technology was integrated. However, many teachers continue not to integrate technology even though first-order barriers have been lowered (Hao & Lee, 2015; Tondeur, van Braak, et al., 2017; Parker, Bonney, Schamberg, Stylinski, & McAuliffe, 2013). By identifying and comprehending how teachers successfully overcame second-order barriers, administrators could be equipped better to provide support enabling their teachers to overcome second-order barriers as well as complying with Title I Elementary and Secondary Education Act guidelines for receiving federal funds in their schools.

Second-order barriers are often more difficult to influence as they include teachers' attitudes about technology, beliefs about computers, and willingness to change (Teo, Huang, & Hoi, 2017). Social contexts including surrounding teachers and the school culture, cultural views about education, and beliefs about pedagogy intertwined to influence the integration of technology. Specifically, this study looked at second-order barriers impeding technology integration in a rural northeastern school district, and how a group of teachers successfully overcame these barriers to use technology with their students to enhance student learning. This study did not focus on the integration of a specific technology but explored the attitudes and behaviors of teachers whose students used technology to demonstrate learning.

Barriers to Technology Integration

Second-order barriers can impede the integration of technology into many primary school classrooms (Ertmer, 2015). The barriers identified by Ertmer included teacher attitudes or how teachers felt about using technology for education, how comfortable teachers were with using technology, and how useful teachers perceived technology to be for learning. Three influences of technology integration were identified that determined whether teachers integrated technology or not: attitudes, social connections/cultural landscapes, and pedagogical methods.

Attitudinal Barriers

Researchers indicated that attitudes affect technology integration (Baş, Kubiato, & Sünbül, 2016; Cooper-Gaiter, 2016; Kilinc et al., 2016; Zehra & Bilwani, 2016). How teachers felt about technology positively or negatively influenced their use of technology with learners (Burden & Hopkins, 2016; Sahin, Top, & Delen, 2016; Tondeur, Siddiq, Scherer, & Baran, 2017). Van Der Ross and Tsibolane (2017) found in-service teacher attitudes affected technology integration in their study of 64 high school teachers in South Africa. Even when participants thought technology integration was useful, their attitudes acted as a barrier to integration. Sadaf, Newby, and Ertmer (2016) found in their mixed-methods study of 245 preservice teachers that usefulness, self-efficacy, and supportive mentor teachers were strong predictors of digital tool use. Teo and Zhou (2016) studied 592 teachers in Southeast Asia and discovered that attitudes are not influenced by gender, age, or experience using computers and did not sway teachers' intentions to use technology in teaching. In another study, Teo et al., (2017) found that English teachers' intentions to use technology in Chinese universities was influenced by the perceived usefulness of the technology and the how easy it was to use.

Sociocultural Barriers

The school culture, the administration's leadership, the teacher's content area, and the teacher's sense of self-efficacy influenced whether the technology was integrated into student learning (Al-Mashaqbeh, 2012; Augspurger, 2014; Ertmer & Ottenbreit-Leftwich, 2010; Li & Ni, 2010). Social connections and cultural landscapes surrounding educators affected when and how teachers implemented technology into their classrooms. Three things particularly influenced teachers to overcome barriers: whether specific hardware or software was required by administrators, the status quo or "how we have always done it," and whether the use of technology was valued for educational purposes (Durff, 2017).

Social connections and cultural landscapes influence technology integration in classrooms. The school culture includes the students, teachers, staff, administrators, and the schoolboard. Ertmer and Ottenbreit-Leftwich (2010) noted school culture influenced classroom use of technology for student learning. Ottenbreit-Leftwich, Liao, Sadik, and Ertmer (2018) confirmed that the school environment influenced whether teachers integrated technology into their classrooms, echoing Ertmer et al.'s (2012) findings that attitudes of surrounding teachers were the most influential barrier or enabler of whether a teacher integrated technology for student learning into their own classroom.

Administrators are in a position to positively influence whether teachers in their buildings integrate technology or not. Studies have found administrative support was important in whether teachers were able to integrate technology into instruction (Al-Mashaqbeh, 2012; Ertmer et al., 2012; Iscioglu, 2011; Weng & Tang, 2014). Administrators can propel their teachers over these types of second-order barriers by providing professional development in schools and by enabling teachers to attend conferences and take online courses. Administrators can encourage collegial sharing, mentor relationships, and provide technical support to teachers without requiring specific software or

hardware use. Finally, administrators can allow time for teachers' technology skills to develop, show they value the use of technology for educational use, and encourage their teachers to move beyond the status quo of traditional, lecture-based instruction.

Pedagogical Barriers

Pedagogical barriers are often formed in undergraduate teacher education programs and by experiences in K-20 classrooms as students (Agyei & Voogt, 2016; Coats, 2018; Ottenbreit-Leftwich, et al., 2018). When teachers were engaged in preservice college classes where they used technology to demonstrate learning, they were more likely to use technology with their students when they became teachers (Taylor, 2017). Pedagogical barriers are interrelated to personal attitudes, the surrounding society including the school culture, and the cultural landscape. Tondeur, van Braak, et al. (2017) observed that technology integration depended on teachers' pedagogical beliefs, or whether a teacher subscribes to a teacher-centric or a student-centric classroom (Tondeur, Siddiq, et al., 2017). Deng, Chai, Chin-Chung, and Min-Hsien (2014) defined teacher-centric classrooms as identifying with the traditional behaviorist learning theories such as lectures, discipline, and teachers as experts who fill up the students with knowledge. They consider student-centric classrooms as those arising from constructivist learning theories where students build their own knowledge, engage in group work, and self-directed learning.

Markauskaite and Goodyear (2014) agreed that pedagogical barriers were tied to folk beliefs about teaching. For example, folk beliefs about teaching and learning are formed through experiences as students, siblings, and parents involved with primary, secondary, and college classrooms. These core beliefs shape how teachers teach and represent what educators have come to know about teaching and learning from a young age. An example might be the folk belief that popular texts should not be taught in English literature courses and only those books from the literary canon should be used (Peacock et al., 2018). Liu (2011) contended even teachers who have student-centered classrooms used teacher-centered activities like lectures when integrating technology, rather than engaging their students with the use of technology. As Bruner (1996) noted, these core beliefs are formed early through one's experiences with learning and schooling. Such core values can be difficult to change (Bruner, 1996; Skott, 2015).

Methodology

This was a qualitative, multicase study designed to discover how educators successfully overcame barriers to technology integration in their classrooms. Teachers were nominated by their principals. Principals were asked to nominate teachers who, in their opinion, successfully integrated technology. Interviews were conducted with two or three teachers, an administrator, and a technology support personnel in each of three schools. Two administrators were male; one was female. Two technology support personnel were male; one was female. The eight teachers were female. The research questions asked educators about the various barriers they had overcome to integrate technology into their classrooms.

Central Research Question: How do K–5 teachers overcome barriers to technology integration in a rural Northeastern district?

Subquestion 1: How do K–5 teachers overcome attitudinal barriers to technology integration in one rural Northeastern district?

Subquestion 2: How do K–5 teachers overcome sociocultural barriers to technology integration in one rural Northeastern district?

Subquestion 3: How do K–5 teachers overcome pedagogical barriers to technology integration in one rural Northeastern district?

Fourteen participants provided in-depth insights and reflections into these research questions and were divided into three cases including four to five people in each of three schools. Principals at each school were asked to nominate teachers who they thought were successfully integrating technology into their classrooms. Teachers were to be using technology themselves, and also their students were to be using technology to demonstrate learning. Teachers were invited to participate in the study to talk about using technology with their students for learning activities. Participants were interviewed for 1 hr via Skype. Data were collected during the spring of 2016, and each interview was recorded using Callnote software. The audio recordings were transcribed by Automatic Sync Technologies, a professional transcription service.

The participants discussed ways they overcame their attitudes, social expectations, cultural norms, and pedagogical preferences, as well as any other issues important to them. Themes that emerged during coding were categorized by the type of barrier: attitudinal, sociocultural, or pedagogical. While the purpose of the study was to discover how educators overcame second-order barriers, the reemergence of a first-order barrier in one school presented an obstacle at the beginning of data collection. In this school, the server was shared with the administration building, and during the work/school day, the server became overloaded. Fewer teachers could access the Internet during this time and many rewrote lessons and shared the use of classroom sets of Apple iPads due to this challenge. This barrier was overcome by the end of the data collection by the school district installing an additional server exclusively for that school.

The trustworthiness of the results included the use of “thick, deep, and rich” descriptions (Patton, 2002, p. 331), creating an audit trail, triangulation, prolonged engagement, and peer debriefing (Lincoln & Guba, 1985). The credibility of the data was established by triangulation of data where each case included three data points to enhance triangulation, namely, interviews with teachers, administrators, and technology personnel in each of three schools. The conclusions of this study were based on an in-depth analysis of the interview data, so others might determine if these findings are transferable to other contexts.

Results

The findings revealed that teachers overcame barriers to technology integration in three areas. Namely, they overcame attitudinal barriers, sociocultural barriers, and pedagogical barriers. During the interviews, the following themes emerged: adaptability, evolution of technology skills, peer support, and professional training (Research Subquestion 1); required software, status quo, and unvalued (Research Subquestion 2); and continual change, appropriate resources, and preparing students (Research Subquestion 3).

The results of this study may be useful to administrators looking for ways to have teachers in their schools overcome barriers to technology integration as well as to educators seeking to overcome barriers on their own.

Research Subquestion 1: Attitudinal Barriers

Attitudes affect the integration of technology (Zehra & Bilwani, 2016). Botha, Herselman, Rametse, and Maremi (2017) described these barriers as ingrained in a teacher’s beliefs about teaching and learning. Educators need support to feel more comfortable with technology to realize they will not break it. Because there is a connection between technology integration and increased student achievement (Eyyam & Yaratan, 2014; Glassett & Schrum, 2009; Styron & Styron, 2011), overcoming attitudinal barriers becomes more urgent.

By recognizing the value of integrating technology, educators were propelled to find ways to overcome any barriers that dissuaded them from using technology with their learners. Being willing

to use technology themselves was easier than turning the technology over to their students to demonstrate learning. Participants talked about how technology skills for themselves and their students evolved over time. The importance of being adaptable in lesson design was critical to handling those days when technology worked well and when it did not. They stressed the importance of effective professional development and peer support to help move beyond the fear of using technology.

Peer support emerged as a frequent theme. One teacher spoke of the negative impact the lack of support had when she did not have support for using technology during student teaching, which is required in the United States to obtain a teaching license. Most study participants talked about sharing with peers and the positive impact that the support of one's peers offered. At one school, teachers formed a group for sharing, which they referred to as a professional learning community. This group shared both during and outside of planned faculty meetings. The support of one's peers boosted morale and confidence in using technology.

Educators overcame attitudinal barriers to technology integration through training, talking with peers, and brainstorming with peers. Teachers who shared technology use, tips, and demonstrations felt empowered to overcome this barrier and integrate technology into their classrooms. Because many factors work together to influence behavior, both internal and external factors must be considered. As Ertmer (1999) clarified, first-order barriers include things extrinsic to the educator, like Internet access, sufficient bandwidth, and access to technology hardware. Second-order barriers include attitudes, beliefs, and practices that are intrinsic to the educator. Because these barriers work together to influence behavior, the support of peers impacts educators and helps them overcome attitudinal behaviors.

While peer support enabled teachers to overcome attitudinal barriers obstructing them from integrating technology into their classrooms, professional training was another way in which teachers overcame attitudinal barriers to technology integration discussed in the Research Subquestion 2 results. Teachers preferred and particularly benefited from professional training in their own classrooms, where they could use the technology they daily used with students, a finding echoed in the 2017 National Education Technology Plan Report (U.S. Department of Education, 2017). This enabled them to transfer their learning into relevant lessons with available technology. They also learned from attending conferences and training sessions outside of their school because they were exposed to ideas they had not thought of and to software that was new to them. The combination of professional training within their school and at conferences increased the confidence level to try new strategies with their learners.

Research Subquestion 2: Sociocultural Barriers

The school culture, the administration's leadership, and the teachers' sense of self-efficacy influenced whether the technology was integrated into student learning (Al-Mashaqbeh, 2012; Augspurger, 2014; Ertmer & Ottenbreit-Leftwich, 2010; Li & Ni, 2010). Social connections and cultural landscapes surrounding educators affected when and how they implemented technology into their classrooms. Teachers were able to successfully overcome barriers to technology integration when administrators did not require specific hardware or software, by valuing the use of technology for teaching and learning, and by stretching beyond the status quo of school culture (Durff, 2017).

Educators in the study expressed that technology skills were age related. One administrator said teachers felt "that they're too old to do it; they're not smart enough to do it." However, that administrator felt teachers valued the integration of technology into teaching, so he provided professional development opportunities for teachers on how technology worked. In addition, he provided time for educators to voice their concerns and opinions about integrating technology into

the curriculum, creating a culture of openness regarding technology integration. While participants talked about negative attitudes toward technology use among older educators, many suggested this barrier would dissolve as older educators retired and left the profession. Participants suggested using technology as an option for school group projects, using technology to communicate with parents, and supporting peers in overcoming the status quo barrier.

The surrounding social context and the culture of the school can impede technology use in the classroom for student learning (Ertmer & Ottenbreit-Leftwich, 2010). Interviewees shared that requiring specific software or hardware without supporting teachers in other ways raised barriers to technology integration. Change can be unsettling, and educators' beliefs about how education ought to be done can be difficult to change. Interviewees mentioned older teachers were supportive of maintaining the status quo in education. Lastly, the use of technology is often more valued for entertainment or for communication with parents than it is for the education of students.

The teachers identified several ways they wanted their administrators to support them that could change the culture of the school more positively and increase support for technology integration. They believed their administrators could positively influence the integration of technology by supporting teachers to overcome sociocultural barriers to technology integration. Administrators could support teachers by scheduling technological training in the school building, as well as enabling teachers to attend conferences outside of the school building. They believed that having training where they used the technology would be more beneficial than just seeing technology demonstrated. Administrators were also able to influence overcomers by encouraging collegial sharing during the school day. This would require providing time for sharing during teacher planning times. Offering technology support to teachers without the stigma of requiring software or hardware use would make it feel "safer" and allow for teacher buy-in. Teachers felt attitudes were more negative when technology was mandated regardless of its value to their curriculum.

Teachers overcame the sociocultural influences that stood as barricades to technology integration when they were supported by their peers, their administrators, and the parents of their students in successfully overcoming these barriers. Administrators who supported these teachers scheduled training in school and outside of school, promoted and provided time for collegial sharing, while offering support to teachers but not requiring compliance. Teachers set up both formal and informal peer mentoring to assist each other in overcoming the barriers that stood in their way. By encouraging each other, participating in professional development opportunities, and scheduling planning periods to investigate technology use for lessons, teachers were able to overcome this barrier.

Research Subquestion 3: Pedagogical Barriers

Pedagogical barriers are interrelated with personal attitudes, the surrounding society including the school culture, and the cultural landscape. Tondeur, van Braak, et al. (2017) observed that technology integration depended on teachers' pedagogical beliefs. Markauskaite and Goodyear (2014) agreed that pedagogical barriers were tied to folk beliefs about teaching. These folk beliefs are formed through experiences as students, siblings, and parents involved with primary, secondary, and college classrooms. Liu (2011) contended that even teachers who have student-centered classrooms used teacher-centered activities like lectures when integrating technology.

Pedagogy is the method and practice of teaching. In looking at this theme, how educators were taught to teach and the method they used for teaching were focal points. In examining in what way pedagogical barriers were overcome, three themes emerged: continual change, appropriate resources, and preparing students.

Pedagogical barriers included beliefs about teacher-centered or student-centered learning, teaching, and teaching methods that impeded the use of technology in the classroom for student learning (Liu, 2011). Pedagogy is concerned with how to teach learners and part of an educator's undergraduate experience; many methods courses teach traditional, teacher-centered pedagogical styles. Researchers suggested that pedagogical barriers impede technology integration into classrooms for student learning (Ertmer, 2005; Ertmer et al., 2012; Prestridge, 2012; Tondeur et al. 2017; Tsai & Chai, 2012). Without training on how to integrate technology, a pedagogical barrier is set up for new teachers entering the field. Those educators in the field may also experience this obstacle to technology (Yan, Xiao, & Wang, 2012; Teo & Zhou, 2016).

Pedagogical beliefs are often formed in undergraduate teacher education programs, with experiences in K–20 classrooms as students, and are interrelated to personal attitudes, the surrounding society including the school culture and the cultural landscape. Just as Bandura's (1989) social cognitive theory contained three interconnecting factors that work together to influence behavior, attitudes, sociocultural influences, and pedagogical beliefs all work together to guide teachers' behavior. Three influences of pedagogical barriers were identified: continual change, appropriate resources, and preparing students. The interviews revealed three themes in the data for how study participants overcame pedagogical barriers to technology integration.

Change is unsettling and study participants noted that technology, both hardware and software, is continually changing. Two administrators felt that change brings improvement in hardware and software but that the constant change raises barriers for some educators. Educators in this study agreed that although the continual changes in technology could be annoying, the path to successfully overcoming this barrier started with realizing how technology use benefits students. To successfully overcome this pedagogical barrier to technology integration, educators needed to see how using technology improves efficiency in differentiating instruction, communicating with parents, and group work. Teachers who successfully overcame these pedagogical barriers were able to adapt to changes in hardware and software.

Educators overcame the pedagogical barrier of locating appropriate resources by integrating technology into the practice section of lessons where apps existed for artifact creation at multiple grade and age levels, sharing with colleagues, and attending professional development sessions. One administrator mentioned that he provided professional development training that included age- and grade-appropriate resources while one technology coach's school sent her to a state technology conference to improve her insights into technology integration. While both administrators talked about formal ways to locate appropriate resources, many educators reported that casual conversations with colleagues were influential. Educators were spurred to overcome this pedagogical barrier by their goal of preparing students for their futures.

One principal summed up this sentiment succinctly when he said, "we are doing a disservice if we are not preparing them for the future, and the future is technology." Study participants spoke about their focus on preparing students for their future lives beyond primary and secondary school. Three administrators talked about preparing students to work with technology in the workforce or in higher education. The educators felt teachers overcame this barrier by letting go of the past and looking to the future.

Discussion

The conceptual framework that informed this study included the social cognitive theory of Bandura and the groundwork laid by Ertmer on barriers to technology integration, especially her work that defined first- and second-order barriers to technology integration. The research questions for the study asked how teachers overcame attitudinal barriers, sociocultural barriers, and pedagogical

barriers to integrating technology into their classrooms for student learning. The findings revealed that teachers overcame these barriers with help and encouragement from their peers, the community, and their administrators.

Ertmer and Ottenbreit-Leftwich (2010) are among researchers who have claimed that professional development is the key to getting teachers to integrate technology. This study found that administrators influenced teachers to integrate technology by not only scheduling professional development focused on the use of technology in-house but by also enabling teachers to attend conferences outside of the school building and by providing asynchronous online training. However, additional support was needed from administrators for teachers to overcome barriers to technological integration. Administrators influenced overcomers by encouraging collegial sharing and offering technology support to teachers without the stigma of requiring software or hardware use. Administrators who placed value in technology for education, who conveyed their understanding that technology skills evolve over time, and who encouraged teachers to prepare instruction that did not perpetuate the status quo of traditional, lecture-based lessons were able to propel their teachers over barriers to successful integration of technology.

Technology integration specialists indicated that talking with teachers privately, pairing teachers with fellow teachers who successfully integrated technology, and visiting teachers in their classrooms were strategies that best-helped teachers to overcome barriers to technology integration. Two participants shared that teachers were often hesitant to ask questions about technology use because they “feel like they’re asking a stupid question. And since they’re a competent professional, they don’t want to appear stupid.” Both technology integration specialists visited teachers in their classrooms after the school day to build rapport with teachers and provide a private space in which teachers could ask questions. One tech specialist shared during his interview that it was helpful to pair new teachers with teachers who have successfully integrated technology. Integration specialists helped teachers overcome barriers to technology integration by providing privacy, pairing teachers with technology using teachers, and visiting teachers in their classrooms where they integrated technology during lessons.

Teachers found there were ways they could overcome barriers to technology integration whether they had the support of administrators or technology integration specialists. By focusing on the benefits to their students, teachers were propelled to put aside the annoyances of changing hardware and software and the difficulties in locating appropriate resources. To successfully overcome barriers to technology integration, educators focused on how the use of technology improved their efficiency in differentiating instruction, communicating with parents, and group work. Teachers who talked with peers shared ideas and supported each other could overcome barriers to technology integration on their own. Integrating technology mattered because one of the benefits of technology integration was an increase in student learning.

Conclusion and Implications

This study advanced the profession by increasing the knowledge about how end-users overcame barriers to technology integration. To lower those barriers for all teachers, educational technologists need to know how teachers who have overcome those barriers have done so. Ottenbreit-Leftwich et al. (2018) repeated that barriers impede teachers from integrating technology into classrooms. Aldunate and Nussbaum (2013) claimed that teachers do not integrate technology into teaching or use technology for student learning. By focusing on the perceptions of rural K–5 classroom teachers, the study uncovered how educators overcame attitudinal, sociocultural, and pedagogical barriers that prevented many teachers from integrating technology into their classrooms in rural northeastern United States.

A positive connection between the integration of technology by teachers and student achievement has been identified (D'Aprile, 2017; Eyyam & Yaratan, 2014; Montgomery, 2017). Whether or not a teacher integrated technology into his or her own teaching was influenced by attitudes, social contexts, cultures, and pedagogical styles. Administrators are in an excellent position to encourage their teachers to integrate technology and positively influence student achievement in their schools. They can propel their teachers over barriers to successful integration of technology by providing professional development with in-school workshops, conference attendance, and online courses; encouraging collegial sharing and mentor relationships; offering technical support to teachers without requiring the use of specific software or hardware; and allowing time for teachers' technology skills to evolve, valuing the use of technology for educational purposes, and encouraging teachers to break out of the status quo of traditional, lecture-based lessons.

References

- Agyei, D. D., & Voogt, J. M. (2016). Pre-service mathematics teachers' learning and teaching of activity-based lessons supported with spreadsheets. *Technology, Pedagogy and Education, 25*, 39–59.
- Aldunate, R., & Nussbaum, M. (2013). Teacher adoption of technology. *Computers in Human Behavior, 29*, 519–524.
- Al-Mashaqbeh, I. F. (2012). The use of computer skills in teaching and administration support. *Damascus University Journal, 28*, 31–50.
- Augspurger, B. A. (2014). *Teacher perceptions of effective school leadership using twenty-first century skills and knowledge* (Doctoral dissertation). Lindenwood University, Saint Charles, Missouri .
- Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development: Vol. 6. Six theories of child development* (pp. 1–60). Greenwich, CT: JAI Press.
- Baş, G., Kubiato, M., & Sünbül, A. M. (2016). Teachers' perceptions towards ICTs in teaching-learning process: Scale validity and reliability study. *Computers in Human Behavior, 61*, 176–185. doi:10.1016/j.chb.2016.03.022
- Batane, T., & Ngwako, A. (2017). Technology use by pre-service teachers during teaching practice: Are new teachers embracing technology right away in their first teaching experience? *Australasian Journal of Educational Technology, 33*, 48–62.
- Botha, A., Herselman, M., Rametse, S., & Maremi, K. (2017, May). *Barriers in rural technology integration: A case study from the trenches*. Paper presented at the 2017 IST-Africa Week conference, Windhoek, Namibia.
- Bruner, J. S. (1996). *The culture of education*. Cambridge, MA: Harvard University Press.
- Burden, K., & Hopkins, P. (2016). Barriers and challenges facing pre-service teachers use of mobile technologies for teaching and learning. *International Journal of Mobile and Blended Learning, 8*, 1–20. doi:10.4018/IJMBL.2016040101
- Celik, V., & Yesilyurt, E. (2013). Attitudes to technology, perceived computer self-efficacy and computer anxiety as predictors of computer supported education. *Computers & Education, 60*, 148–158. doi:10.1016/j.compedu.2012.06.008
- Chaloo, L., Green, M., & Maxwell, G. (2010). Attitudinal factors contributing to teacher stage of adoption of technology in rural south Texas: A path analysis. *Journal of Technology Integration in the Classroom, 3*, 33–45.

- Coats, R. B. (2018). *Teacher candidate psychological insight and capacity for change: Developing a professional identity* (Doctoral dissertation). Department of Curriculum, Instruction, and Foundational Studies, Boise State University, Boise, Idaho. doi:10.18122/td/1370/boisestate
- Cooper-Gaiter, E. D. (2016). *Computer anxiety and computer self-efficacy of older adults* (Doctoral dissertation). Walden University, Minneapolis, Minnesota.
- D'Aprile, V. (2017). *Let's get digital: Teachers' perspectives and practices of effective technology integration* (Master's thesis). Department of Curriculum, Teaching, and Learning, Ontario Institute for Studies in Education University of Toronto, Toronto, Canada. Retrieved from https://tspace.library.utoronto.ca/bitstream/1807/76978/1/DAprile_Veronica_201706_MT_MT_RP.pdf
- Deng, F., Chai, C. S., Chin-Chung, T., & Min-Hsien, L. (2014). The relationships among Chinese practicing teachers' epistemic beliefs, pedagogical beliefs and their beliefs about the use of ICT. *Journal of Educational Technology and Society*, 17, 245.
- Durff, L. (2017). *Overcoming pedagogical, social/cultural, and attitudinal barriers to technology integration in K-5 schools* (Doctoral dissertation). Walden University, Minneapolis, Minnesota. Retrieved from <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=4705&context=dissertations>
- Elliot, S., & Mikulas, C. (2012). Improving student learning through teacher technology training: A study of the effectiveness of technology integration training on student achievement. In P. Resta (Ed.), *Proceedings of the 2012 Society for Information Technology and Teacher Education International Conference* (pp. 1759–1766). Chesapeake, VA: Association for the Advancement of Computing in Education. Retrieved from <http://www.editlib.org/p/39842>
- Ertmer, P. A. (1999). Addressing first-and second-order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, 47, 47–61. doi:10.1007/BF02299597
- Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research and Development*, 53, 25–39. doi:10.1007/BF02504683
- Ertmer, P. A. (2015). Technology integration. In J. M. Spector (Ed.), *The Sage encyclopedia of educational technology* (p. 307). Thousand Oaks, CA: Sage. doi:10.4135/9781483346397.n307
- Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research and Technology in Education*, 42, 255–284.
- Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, 59, 423–435. doi:10.1016/j.compedu.2012.02.001
- Eyyam, R., & Yaratan, H. S. (2014). Impact of use of technology in mathematics lessons on student achievement and attitudes. *Social Behavior and Personality*, 42, 31S–42S.
- Frick, J. (2012). *The relationship between faculty and administrator attitudes toward Internet-based technologies and virtual networking and the development and support of social capital in six selected rural secondary schools in Pennsylvania* (Doctoral dissertation). Drexel University, Philadelphia, Pennsylvania. Retrieved from http://idea.library.drexel.edu/bitstream/1860/3781/1/Frick_John.pdf
- Glassett, K., & Schrum, L. (2009). Teacher beliefs and student achievement in technology-rich classroom environments. *International Journal of Technology in Teaching Learning*, 5, 138–153.

- Grosser, D. A. (2017). *A multiple case study of co-teachers' technology integration knowledge: How it is held, built, and shared* (Doctoral dissertation). The College of William and Mary, Williamsburg, Virginia. doi:10.21220/W4KM2K
- Hao, Y., & Lee, K. S. (2015). Teachers' concern about integrating Web 2.0 technologies and its relationship with teacher characteristics. *Computers in Human Behavior, 48*, 1–8. doi:10.1016/j.chb.2015.01.028
- Heath, M. K. (2017). Teacher-initiated one-to-one technology initiatives: How teacher self-efficacy and beliefs help overcome barrier thresholds to implementation. *Computers in the Schools, 34*, 88–106. doi:10.1080/07380569.2017.1305879
- Higgins, K., Huscroft-D'Angelo, J., & Crawford, L. (2019). Effects of technology in mathematics on achievement, motivation, and attitude: A meta-analysis. *Journal of Educational Computing Research, 57*, 283–319. doi:10.1177/0735633117748416
- Insteffjord, E. J., & Munthe, E. (2017). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. *Teaching and Teacher Education, 67*, 37–45. doi:10.1016/j.tate.2017.05.016
- Iscioglu, E. (2011). Perceived computer self-efficacy of secondary education teachers. *New Educational Review, 23*, 189–198.
- Kilinc, A., Ertmer, P.A., Bahcivan, E., Demirbag, M., Sonmez, A. & Ozel, R. (2016). Factors influencing Turkish preservice teachers' intentions to use educational technologies and the mediating role of risk perceptions. *Journal of Technology and Teacher Education, 24*, 37–62.
- Kim, C., Kim, M. K., Lee, C., Spector, J. M., & DeMeester, K. (2013). Teacher beliefs and technology integration. *Teaching and Teacher Education, 29*, 76–85. doi:10.1016/j.tate.2012.08.005
- Li, G., & Ni, X. (2010). Elementary in-service teachers' beliefs and uses of technology in China. *International Journal of Technology in Teaching and Learning, 6*, 116–132.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Liu, S. H. (2011). Factors related to pedagogical beliefs of teachers and technology integration. *Computers and Education, 56*, 1012–1022. doi:10.1016/j.compedu.2010.12.001
- Magana, A. J. (2016). *A model for improving instructional quality for all students* (Doctoral dissertation). Seattle University, Seattle, Washington. Available from ProQuest Dissertations & Theses Global. (1826873966)
- Markauskaite, L., & Goodyear, P. (2014). Tapping into the mental resources of teachers' working knowledge: Insights into the generative power of intuitive pedagogy. *Learning, Culture and Social Interaction, 3*, 237–251. doi:10.1016/j.lcsi.2014.01.001
- Montgomery, M. C. (2017). *Factors that influence technology integration in the classroom* (Doctoral dissertation). Department of Education, University of Maryland, College Park, College Park, Maryland. Retrieved from https://drum.lib.umd.edu/bitstream/handle/1903/19411/Montgomery_umd_0117E_17917.pdf?sequence=1&isAllowed=y
- Mosley, V. (2013). Qualitative study: Why technology is underutilized in K–12 education. In R. McBride & M. Searson (Eds.), *Proceedings of the 2013 Society for Information Technology and Teacher Education International Conference* (pp. 2307–2314). Chesapeake, VA: Association for the Advancement of Computing in Education. Retrieved from <http://www.editlib.org/p/48449>

- Mulder, D. J. (2017). *Pre-service teachers' perceptions of their abilities for technology integration: A mixed methods case study* (Doctoral dissertation). Boise State University, Boise, Idaho. doi:10.18122/B26417
- National Education Association & American Federation of Teachers. (2008). *Access, adequacy and equity in education technology: Results of a survey of America's teachers and support professionals on technology in public schools and classrooms*. Washington, DC: National Education Association,
- Ottenbreit-Leftwich, A., Liao, J. Y.-C., Sadik, O., & Ertmer, P. (2018). Evolution of teachers' technology integration knowledge, beliefs, and practices: How can we support beginning teachers use of technology? *Journal of Research on Technology in Education, 50*, 282–304. doi:10.1080/15391523.2018.1487350
- Parker, C. E., Bonney, C., Schamberg, M., Stylinski, C., & McAuliffe, C. (2013). *Exploring the elements of a classroom technology applications implementation framework*. Paper presented at the American Educational Research Association, San Francisco, California.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage Publications.
- Peacock, J., Covino, R., Auchter, J., Boyd, J., Klug, H., Laing, C., & Irvin, L. (2018). University faculty perceptions and utilization of popular culture in the classroom. *Studies in Higher Education, 43*, 601–613.
- Perry, N. D. (2018). *Teacher attitudes and beliefs about successfully integrating technology in their classroom during a 1:1 technology initiative and the factors that lead to adaptations in their instructional practice and possible influence on standardized test achievement* (Doctoral dissertation). Youngstown State University, Youngstown, Ohio.
- Ping Lim, C., Yong, Z., Tondeur, J., Ching Sing, C., & Chin-Chung, T. (2013). Bridging the gap: Technology trends and use of technology in schools. *Journal of Educational Technology & Society, 16*, 59–68
- Pittman, T., & Gaines, T. (2015). Technology integration in third, fourth and fifth grade classrooms in a Florida school district. *Educational Technology Research and Development, 63*, 539–554. doi:10.1007/s11423-015-9391-8
- Prestridge, S. (2012). The beliefs behind the teacher that influences their ICT practices. *Computers & Education, 58*, 449–458. doi:10.1016/j.compedu.2011.08.028
- Sadaf, A., Newby, T. J., & Ertmer, P. A. (2016). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K–12 classroom. *Computers & Education, 59*, 937–945. doi:10.1016/j.compedu.2012.04.001
- Sahin, A., Top, N., & Delen, E. (2016). Teachers' first-year experience with Chromebook laptops and their attitudes towards technology integration. *Technology, Knowledge and Learning, 21*, 361–378. doi:10.1007/s10758-016-9277-9
- Saxena, A. (2017). Issues and impediments faced by canadian teachers while integrating ICT in pedagogical practice. *The Turkish Online Journal of Educational Technology, 16*, 58–70.
- Skott, J. (2015). The promises, problems, and prospects of research on teachers' beliefs. In H. Fives & M. Gregoire Gill (Eds.), *International handbook of research on teachers' beliefs* (pp. 37–54). London, United Kingdom: Routledge.
- Styron, R. A., & Styron, J. (2011). Connecting technology with student achievement: The use of technology by blue ribbon school principals. *Journal of Systemics, Cybernetics & Informatics, 9*, 7–12.

- Tamin, R., Bernard, R., Borokhovski, E., Abrami, P., & Schmid, R. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research, 81*, 4–28.
- Taylor, R. L. (2017). *Preparing teachers to embrace educational technology* (Doctoral dissertation). Alliant International University, San Diego, California.
- Teo, T., Huang, F., & Hoi, C. K. W. (2017). Explicating the influences that explain intention to use technology among English teachers in China. *Interactive Learning Environments, 4820*, 1–16. doi:10.1080/10494820.2017.1341940
- Teo, T., & Zhou, M. (2016). The influence of teachers' conceptions of teaching and learning on their technology acceptance. *Interactive Learning Environments, 4820*, 1–15. doi:10.1080/10494820.2016.1143844
- Tondeur, J., Siddiq, F., Scherer, R., & Baran, E. (2017). *Exploring the link between pre-service teachers' ICT-related profiles and their TPACK*. Paper presented at the Society for Information Technology and Teacher Education International Conference, Austin, Texas.
- Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development, 65*, 555–575.
- Tsai, C., & Chai, C. (2012). The “third”-order barrier for technology-integration instruction: Implications for teacher education. *Australasian Journal of Educational Technology, 28*, 1057–1060.
- U.S. Department of Education. (2017). *Reimagining the role of technology in education: 2017 national education technology plan update*. Retrieved from <https://tech.ed.gov/files/2017/01/NETP17.pdf>
- Van Der Ross, D., & Tsibolane, P. (2017). *The influence of teacher attitudes and beliefs on information and communications technology integration behavior in South African high schools*. Paper presented at the 2017 International Conference on Information Resources Management. Retrieved from <http://aisel.aisnet.org/confirm2017/32>
- Weng, C.-H., & Tang, Y. (2014). The relationship between technology leadership strategies and effectiveness of school administration: An empirical study. *Computers & Education, 76*, 91–107. doi:10.1016/j.compedu.2014.03.010
- Yan, H., Xiao, Y., & Wang, Q. (2012). Innovation in the educational technology course for pre-service student teachers in East China Normal University. *Australasian Journal of Educational Technology, 28*, 1074–1081. doi:10.14742/ajet.813
- Zehra, R., & Bilwani, A. (2016). Perceptions of teachers regarding technology integration in classrooms: A comparative analysis of elite and mediocre schools. *Journal of Education and Educational Development, 3*, 1–29.
- Zielezinski, M. B., & Darling-Hammond, L. (2016). *Promising practices: A literature review of technology use by underserved students*. Stanford, Ca: Stanford Center for Opportunity in Education. Retrieved from <https://edpolicy.stanford.edu/sites/default/files/publications/scope-report-promising-practices-v1.pdf>

The *Journal of Educational Research and Practice* provides a forum for studies and dialogue that allows readers to better develop social change in the field of education and learning. Journal content may focus on educational issues of all ages and in all settings. It also presents peer-reviewed commentaries, book reviews, interviews of prominent individuals, and additional content. The objectives: We publish research and related content that examines current relevant educational issues and processes aimed at presenting readers with knowledge and showing how that knowledge can be used to impact social change in educational or learning environments. Additional content provides an opportunity for scholarly and professional dialogue regarding that content's usefulness in expanding the body of scholarly knowledge and increasing readers' effectiveness as educators. The journal also focuses on facilitating the activities of both researcher-practitioners and practitioner-researchers, providing optimal opportunities for interdisciplinary and collaborative thought through blogging and other communications. **Walden University Publishing:**
<http://www.publishing.waldenu.edu>
