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Transformative Technology in the PK-12 Classroom

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Abstract: *Technology integration, particularly its growing popularity in PK-12 classrooms in the United States, is an ongoing issue. Studies have shown that professional development around integrating technology in the classroom can only go so far with increasing teacher workloads. Integrating technological pedagogical content knowledge (TPACK) and substitution augmentation modification redefinition (SAMR) frameworks, known as transformative technology, is an effective way for teachers to integrate technology in a meaningful way. Examples are included for elementary, middle, and high school levels to integrate transformational technology in specific content area tasks. Further research is needed to fully understand effective technology integration in schools, especially in public school systems in the United States.*

Keywords: Technology, Pedagogy, TPACK, SAMR

According to research, teachers and students benefit from quality practice with technology integration (Liu & Li, 2018). One issue that requires clarification is quality technology integration practice in PK-12 educational settings. Technology integration is defined as the use of digital technologies in teaching to support learning (González-Howard et al., 2019). This integration is used in a variety of contexts, districts, grade levels, and classrooms, dependent on factors like budget, program or district goals, and teacher familiarity. The effective integration of technology into teaching is not only related to the sources of technology available to teachers, but also the teachers' perceptions about successfully using the technology in their teaching processes (Pittas & Adeyemi, 2019). Many educators continue to struggle with integrating technology into their classroom routines, procedures, and instruction. These educators apply technology into low-level instruction like demonstrations (e.g., introducing a concept), transfer of information (e.g., provide an example), and simple management tasks (e.g., lesson planning and taking attendance; Ryan & Bagley, 2015).

LITERATURE REVIEW

Society has been heavily influenced by changing information and technology, particularly in the field of education. The federal government invested billions of dollars for technology infrastructure in schools as they aimed to connect 99% of students in school by 2018 (Liu et al., 2017). In the years that followed, this large investment stimulated significant research in relation to the impact of teaching with integrated technology. Similarly, Akcay (2017) found that while preservice teachers could integrate technology, they needed guidance to help them do so effectively. Akcay (2017) concluded that teacher preparatory programs need to address pedagogy and content knowledge when teaching mathematics, as well as explore "the use of technology

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within specific pedagogy (e.g., learner-centered classrooms) and content (e.g., mathematics)" (Akcay, 2017, p. 172).

Current research shows that the relationship between teachers' pedagogical beliefs and technology integration can be described as critical because teachers' beliefs appear to be a major predictor of teachers' uses of technology (Mertala, 2019). For example, if a teacher believes that direct instruction is the most efficient way to teach, they may find the open nature of some technological solutions to be pedagogically unsuitable (Donnelly et al., 2011). The teacher may also be unaware of how technology can enhance student learning; thus, they may be more reluctant to implement these tools in their classroom. In one study, teachers of early childhood and elementary students showed a limited understanding of integrating technology into their current practices in the classroom. Factors like readiness and accessibility were strong indicators of teachers' inability to integrate technological practices (Tandika & Ndijuye, 2019). This understanding could be linked to teachers' limited preparation in terms of pedagogical beliefs and knowledge regarding integrating technology in teaching and learning in early grades. The study also found barriers like limited electrical power and availability of technology resources like computers and televisions for classroom instruction (Tandika & Ndijuye, 2019).

The study concluded that there is a need for collaboration by stakeholders, families, and teachers to invest in ICT at home and school to prepare children for the future, ever-changing world. Skills needed for employability in the U.S. include creativity and innovativeness, which the study concluded would be provided by incorporating technology into classroom instruction (Tandika & Ndijuye, 2019).

Another issue with technology integration in early elementary settings is that many teachers are unaware of how to utilize technology in a transformative way. Transformative technology integration is a shift to "learning with computers" (Eteokleous, 2008, p. 673). In this approach, students use technology to create meaning in constructivist or socioconstructivist ways. The creation of YouTube presentations is one example of this socioconstructivist approach as students use technology to articulate and present their understanding of a topic (Jones, 2017). Teachers of young children lack the basic skills and exhibit higher level of anxiety in learning these skills. Therefore, these teachers need quality support and software in the educational uses of technology (Arikan et al., 2017).

CHALLENGES OF TECHNOLOGY INTEGRATION

There are many reasons why teachers may not use technology, including lack of PD or training, an unwillingness to learn the necessary steps to use the technology, lack of hardware or software (not having proper cords to connect a smartboard or projector), or believing it is an unproductive use of instructional time. Understanding the nature of technology implementation in the classroom also impacts the teacher's concept or perception of technology education. This includes an understanding of the differences between the learning objectives of content and technology education (Rohaan et al., 2010). According to Jones (2017), while the participants had technology experience and knowledge, they were not able to utilize technology in transformative ways. This is an important piece of technology integration because both TPACK and substitution augmentation modification redefinition (SAMR) frameworks for technology integration focus on utilizing technology in transformative ways (Puentedura, 2013).

TPACK comes from work by Mishra and Koehler (2006), which looked at technology integration through one of three lenses: (1) knowledge of technology (TK); (2) knowledge of

pedagogy (PK); and (3) content knowledge (CK). CK is the educator's knowledge of the subject matter to be learned by students. Examples of CK at the early elementary levels include subitizing, number sense, phonics, and letter/sound identification. PK is the educator's knowledge "about the processes and practices or methods of teaching and learning and how it encompasses, among other things, overall educational purposes, values, and aims" (Mishra & Koehler, 2006, p. 1026). In an early elementary setting, this could include teaching tools like utilizing movement, songs, rhymes, tracing letters with multiple writing instruments, dominoes, showing number amounts on cards, and touching and/or counting physical objects. Finally, TK is the knowledge of standard and/or advanced technologies.

TRANSFORMATIVE TECHNOLOGY IN PRACTICE

Upon deeper inspection, the SAMR model's goal is to help educators increase the functionality of their technology integration by moving students from enhanced learning to transformational learning. This model, which does not consider the daily contextual factors faced by teachers, is open to interpretation (Hamilton et al., 2016). For example, two teachers from the same school (who both teach the same grade level) may utilize the SAMR model to incorporate the same technology in their classroom settings. Still, the teachers might reach various levels of the SAMR model due to the context of the teachers having different teaching styles, personalities, and viewpoints in their understanding of the levels in the SAMR model. Kindergarten teachers may be teaching about the letter "A" in the alphabet. Teacher A may find a YouTube video about the letter and words that begin with that letter. Teacher A's method would demonstrate the substitution level, using online resources instead of a physical basal curriculum. Teacher B may let their students use an iPad application to discover words that begin with the letter "A." Teacher B's method would be considered an augmentation. Both teachers are teaching the same concept in different ways and using different levels of SAMR. Furthermore, the students in each of the classrooms are different and bring different contextual factors (Zipke et al., 2019).

An example of transformative technology in a third-grade classroom may be a social studies lesson on map elements and skills. Based on the content, elements, and skills, the teacher uses physical maps to demonstrate map elements. Small groups of students are asked to explore map elements with vocabulary words. Next, using the SAMR model, the teacher utilizes the Internet to show students interactive maps through Google Maps. They discover how to use scale to determine distance and zooming options to determine size. The students can use these tools to interact with landforms, cities, and roads. To transform the learning, as well as make the task more impactful, the teacher may introduce apps like Scribble Maps and Google Tour Builder, in which students can create their own maps or discover places around the world.

RECOMMENDATIONS

Investigating patterns of children's learning needs regarding technology will address the design of future technology applications that are developmentally appropriate and helpful to children's development (Wang et al., 2006). Children's activity use with technology must be explored to determine what programs or applications are considered "exploratory" (learning the given functions) or "innovative" mastering (Bird & Edwards, 2015). Barriers must be evaluated, including Wi-Fi connectivity, consistent Internet access, and classroom computers with up-to-date hardware and software (Jones, 2017). Future work can address needs by studying a more diverse

elementary environment, focusing on marginalized and lower-socioeconomic communities (Chorida et al., 2019). Another suggestion, especially for teacher preparatory programs, is providing research-based practices with positive results in both the U.S. and global educational systems.

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