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The Ever-Changing and Evolving Role of K-12 Technology Coaches and Specialists: A Systematic Literature Review

Jason Harron
Kennesaw State University

Katheryn Shannon
Southeastern Oklahoma State University

This article shares a systematic literature review of journal articles between 2010 and 2024 that focus on the leadership role of K-12 technology coaches and specialists. Using the PRISMA methodology, 38 articles were initially identified, with 18 articles meeting the eligibility criteria. Using qualitative research methods, the researchers found that the job titles of technology coaches and specialists varied based on their institutional roles. Primary responsibilities included planning and coordinating, leading professional development, mentorship and coaching, curriculum integration, collaborating with coaches/teachers, leading reflective practice, providing technology and logistical support, and policy development and advocacy. Effective technology coaches were experienced former teachers who possessed technical knowledge and were flexible/responsive to the needs of teachers. Effective coaches had leadership and administrative support, actively engaged in collaboration and partnerships, and knew how to navigate the strategic management of resources. Barriers to effective coaching included the ambiguous definition of the role, ineffective professional development implementation, limited resources, organizational alignment, and challenges when navigating teachers' existing attitudes and beliefs. Additionally, unique barriers included assistive technologies, the digital divide, and technological determinism. The discussion includes recommendations for best practices to better support technology coaches and specialists, as well as suggestions for future research directions.

Over the last 15 years, technology integration in K-12 education has become ubiquitous with the shift toward the daily use of learning management systems, one-to-one devices, and increased delivery of online learning. Due to these changes, demand has increased for specialized personnel who have the knowledge and skill to leverage technology as part of the teaching, learning, and assessment process (Ottenbreit-Leftwich et al., 2020). This growing need has led to the emergence and growth of the K-12 technology coach and specialist (TC&S) role.

Unlike more established educational roles, such as classroom teachers, librarians/media specialists, and administrators, the roles and responsibilities of the TC&S have emerged across a variety of contexts and settings, resulting in a position that is ever-changing with job titles that remain in flux (Caneva et al., 2023; Johnston, 2015). As a result, the TC&S role is unique and continues to adapt and change to respond to the ways technology shapes teaching and learning.

The pervasive use of technology has increased in K-12 schools since the early 2000s, when the purchase of technology (i.e., computers) was criticized as "oversold and underused" (Cuban, 2001). The growth and reliance on technology have led schools and districts to seek personnel who can provide ongoing technical and training support to ensure teachers can work proficiently and productively with these tools (Susin et al., 2023).

Instructional technology in the classroom is not a new phenomenon, with a history dating back to after World War II with instructional media (i.e., films, radio, and television) and the advent of the microcomputer in the late 1970s (Reiser, 2001a, b). Historically, technology support fell into the domain of the librarian (Wine, 2016), who was responsible for maintaining access to physical audiovideo materials and technologies such as mobile television sets, film projectors, and overhead transparencies.

In the late 1990s, libraries started to become media centers that provided students and teachers with computer-supported access to digital books, interactive software, and the ability to search for information on the internet (Erikson & Markuson, 2007). Since the early 2000s, one-to-one classroom access to computers and the internet has become more common (Penuel, 2006; Zheng et al., 2016). Additionally, classroom presentation technologies, such as projectors (Lacina, 2009), interactive whiteboards (Türel & Johnson, 2012), document cameras, and other tools, have become essential for the delivery of instructional content. The increase in the number of devices and digital tools being used in any given classroom has escalated the need not only for technical support but also for individuals who have a deeper knowledge about how to most effectively leverage technology to deliver pedagogically appropriate instruction (Grierson et al., 2024).

The International Society for Technology in Education (ISTE) formally recognized the role of technology coaches and specialists in 2011 with the introduction of the *ISTE Standards for Coaches*. These standards established six main competencies that defined the responsibilities of TC&S in K-12 education, emphasizing how coaches should model and facilitate technology integration while supporting both teachers and administrators. The TC&S role was also included in the *Essential Conditions for Effective Tech Use in Schools* (ISTE, 2018), where "edtech

coaches" were placed at the center of preparing teachers to use technology effectively.

The ISTE coaching standards were revised in 2019 to reflect an expanded vision of the TC&S role, highlighting seven key dimensions: (a) change agent, (b) connected learner, (c) collaborator, (d) learning designer, (e) professional learning facilitator, (f) data-driven decision maker, and (g) digital citizen advocate (ISTE, 2024a). The expanded scope of these seven dimensions reflects an important shift in the ways schools and districts conceptualize technology support. The emphasis on dimensions such as change agent, collaborator, and professional learning facilitator underscores how the TC&S role extends beyond traditional technical models to addressing both the human and pedagogical aspects of change.

In practice, this reconceptualized role emerges as holistic support that addresses not only the technical challenges, but also the human and pedagogical barriers to technology integration. TC&S assist teachers in overcoming their fear of technology, while helping them become comfortable with digital tools and devices that can effectively advance teaching and learning through practices such as collaboration, modeling, and reflection (Caneva et al., 2023). Technology coaches have a unique role in K-12 schools since they work to help build the capacity of the organization while also serving as implementation experts (ISTE, 2024b). Ultimately, the targeted support that TC&S provide to address specific integrations within content yields one of the greatest impacts on teacher adoption of technology (Sugar, 2005).

This represents a significant evolution from earlier conceptions of the role. Tasks 20 years ago centered primarily on troubleshooting, acquiring resources, supporting software use, and identifying appropriate media for teacher use (Johnston, 2015; Sugar, 2005; Wine, 2016). Today, technology coaches manage a multitude of responsibilities related to teacher and student use of devices and digital tools (Bennett & Bromen, 2019; Ottenbreit-Leftwich et al., 2020), with their partnerships extending to direct student engagement as learners create their own digital products to demonstrate knowledge and skills (Anthony, 2012; Grierson et al., 2024). Thus, contemporary TC&S integrate technical expertise with skills in designing and delivering relevant, engaging, technology-mediated instruction that supports positive learning outcomes for both teachers and students.

Given the evolution in the scope and complexity of the TC&S role, it is necessary to take a systematic look at the current state of research to better understand how to support these roles effectively, offer suggestions for best practices, and identify possible avenues for future research. Thus, in this systematic literature review, we look back at the peer-reviewed research from the past 15 years to identify the roles, responsibilities, and conditions that support or constrain the work of TC&S.

Research Questions

To shed light on the complicated role of the TC&S, this systematic literature review summarized findings from peer-reviewed journal articles published between January 2010 and July 2024 that focused on the

leadership role of K-12 TC&S. This systematic literature review addressed the following three research questions:

> **RQ1:** What institutional job titles are used to describe the roles of the K-12 TC&S?
>
> **RQ2:** What are the technology leadership responsibilities carried out by K-12 TC&S?
>
> **RQ3**: What are the (a) enablers and (b) constraints that influence the effectiveness of K-12 TC&S?

Methods

Data Collection

The literature review was performed under the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) framework for reporting systematic reviews (Moher et al., 2009). PRISMA includes a 27-item checklist and a flow diagram that takes place in four phases of (a) identification, (b) screening, (c) eligibility, and (d) inclusion.

In total, 579 records were identified from 2010 to 2024 across the Web of Science (n = 95), Education Resources Information Center (ERIC; n = 33), PsycINFO (n = 7), Scopus (n = 44), and Google Scholar (n = 400). Both Web of Science and Google Scholar were searched with two sets of search terms (see Table 1) to ensure the sample included all relevant papers. We, the researchers, agreed to limit Google Scholar searches to the first 20 pages of results (i.e., the first 200 results for each search query), since the database initially returned over 3,000 results. The records were screened to ensure they were relevant and from a peer-reviewed journal (n = 38). Based on eligibility, a total of 20 studies were excluded based on the criteria of duplicate articles (n = 9), publication type (n = 6), incorrect focus (n = 2), participants (n = 2), and time span (n = 1). Ultimately, 18 studies were included for review (see Figure 1 and the appendix).

Data Analysis

We created a Google Sheets shareable document and evenly divided the papers (i.e., nine each) to code for purpose, methodology, participants, data sources, job titles, TC&S responsibilities, and barriers/supports. Taking a pragmatic open-thematic coding approach (Miles et al., 2015), we used draw.io (2024) to group together primary and secondary themes along with associated quotes. This draw.io mind map and data from the Google Sheet were utilized to manually identify 10 job titles for RQ1 and eight primary themes for RQ2 that we mutually agreed upon.

For RQ3, which focused on enablers and constraints, we once again evenly divided and read the papers (i.e., nine each) prior to creating a list of emerging themes. Applying the same open-thematic coding techniques used on RQ1 and RQ2, we collaborated on creating an initial list of primary and secondary themes. After conventional thematic coding was complete, we uploaded all 18 PDF documents to Google NotebookLM, an artificial intelligence powered research and note-taking tool, and had it generate a

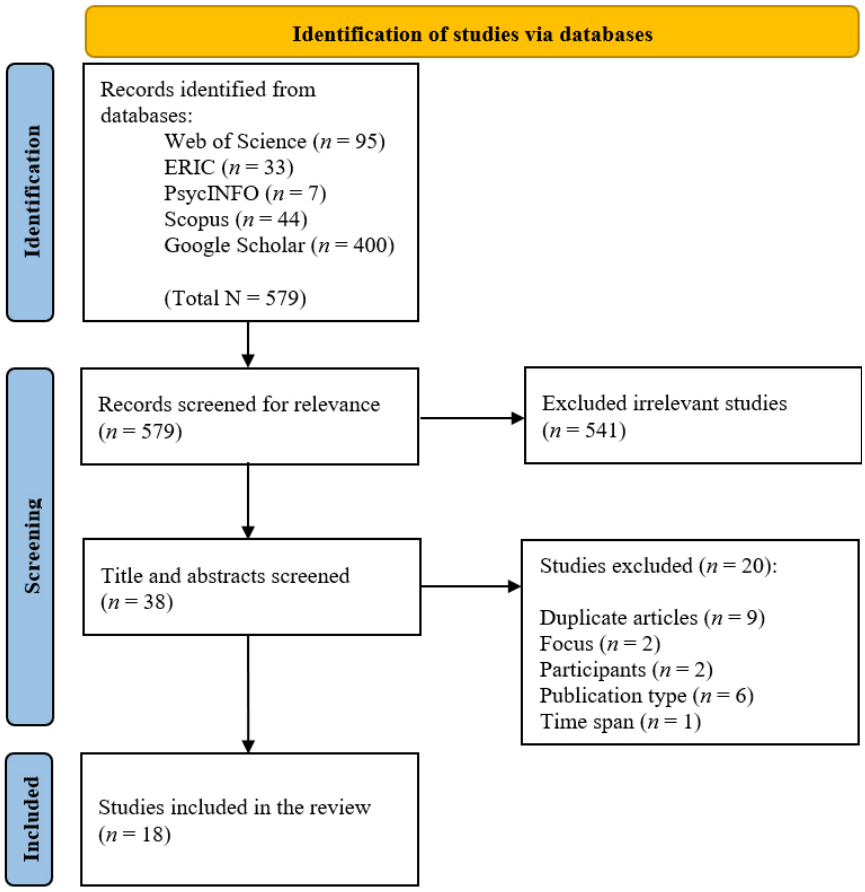
detailed mind map that we used to manually compare and collapse potential themes (as recommended in Fabiano et al., 2024; Shor et al., 2025). Based on this approach, we collapsed the barrier of "time constraints" (i.e., insufficient time for PD, lack the time to meet and plan, and inadequate time for practice) into the "resources" primary theme.

Table 1
Search Terms Used in the Five Databases

Databases	Search Terms	*n*
Web of Science	(((TI=(technology coach* OR technology specialist)) AND ALL=(K-12 school OR school district))) (((TI=(technology leadership)) AND ALL=(administrators OR Principals OR Superintendents)) AND ALL=(K-12 school OR school district))	8 89
ERIC	(technology coach* or technology specialist*) AND (K-12 school OR school district)	33
PsycINFO	((technology coach* or technology specialist*) AND (K-12 school OR school district)	7
Scopus	TITLE-ABS-KEY (technology AND coach* OR specialist AND k-12 AND schools OR district) AND PUBYEAR > 2010 AND PUBYEAR < 2025	44
Google Scholar	technology AND coach* OR specialist AND "k-12" "technology coach*" OR "technology specialist*" AND k-12	200 200

One drawback to this approach was that NotebookLM included all content, including the literature review of the papers, which resulted in suggested themes not being isolated from the findings. Ultimately, we reached a consensus on seven enabler and seven barrier themes. As a final step, queries in NotebookLM were used to verify the accuracy of specific citations and quotes.

Figure 1
PRIMA Framework for Systematic Literature Review of K-12 Technology Coaches and Specialists



Findings

RQ1: Institutional Job Titles

Across the literature, 10 unique job titles were used to describe the role of TC&S. The wide variety of institutional job titles reflects that these roles are diverse and ever changing to meet the contextual needs of the position (Caneva et al., 2023; Johnston, 2015). TC&S job titles typically highlight aspects of their institutional role, often placing emphasis on the title of "coach." Assistive technology coach was the only job title found to specifically focus on accessibility (Ocasio-Stoutenburg et al., 2024). The digital aspect of the TC&S role was emphasized in job titles such as digital learning coaches (Gallagher et al., 2023) and digital technology coaches (Gallagher et al., 2024; Grierson et al., 2024). Similarly, the technology and pedagogy roles were highlighted by job titles that included instructional coaches (Bennett & Bromen, 2019; Caneva et al., 2023; Huang, 2023), instructional technology coaches (Cowart & Jin, 2024), and

technology coaches (Liao et al., 2021; Ottenbreit-Leftwich et al., 2020; Susin et al., 2023).

The label "specialist" was also commonly found in job titles, such as instructional technology specialists (Johnston, 2015; Webster, 2017; Wine, 2016) and technology integration specialists (Anthony, 2012; Hatten & McDonald, 2016). The title technology leaders was used more generically to include "technology coaches, technology coordinators, and eLearning specialists" (Karlin et al., 2018, p. 728). Additionally, educational technologists (Mayes et al., 2015) was the broadest term, which encompassed anybody involved in the "design, development, implementation and evaluation" (p. 222) of technology in a K-12 educational system.

RQ2: Technology Leadership Responsibilities

The technology leadership responsibilities of K-12 TC&S cover a wide spectrum of tasks and duties focused on integrating technology into teaching and learning environments. Based on the review of the literature, we identified eight primary categories including (a) planning and coordinating, (b) professional development and training, (c) mentorship and coaching, (d) curriculum integration, (e) collaboration, communication, and relationship building, (f) technology and logistical support, (g) reflective practice, and (h) policy development and advocacy.

Planning and Coordinating

Planning and coordinating frequently begins with a needs assessment process, which generates data used to inform technology-integration planning (Grierson et al., 2024; Karlin et al., 2018; Mayes et al., 2015; Ocasio-Stoutenburg et al., 2024). This planning often involves teachers to effectively and responsively address their needs (Hatten & McDonald, 2016; Huang, 2023; Karlin et al., 2018; Ottenbreit-Leftwich et al., 2020; Wine, 2016) and should happen before technology acquisition (Susin et al., 2023). Resource management is another domain of the TC&S responsibilities(Anthony, 2012; Bennett & Bromen, 2019; Karlin et al., 2018; Ocasio-Stoutenburg et al., 2024; Wine, 2016).Hatten and McDonald (2016) asserted that coaches support implementation by provisioning adequate technology and working to reduce "glitches" (p. 642) or hindrances that impact student and teacher engagement with technology resources.

Structures for ongoing assessment of the implementation (e.g., surveys) have been used to collect feedback from teachers to "modify policies, improve technology reliability, and change the professional development model" (Anthony, 2012, p. 349). Ongoing assessment allows TC&S to engage in self-reflection, which informs changes when addressing the effectiveness of their coaching/PD sessions, and supports continuous improvement in their work with teachers to achieve their technology integration goals (Anthony, 2012; Hatten & McDonald, 2016). Bennett and Bromen (2019) described technology integration planning as a holistic and intentional process, where personal and institutional goals are met through developing a culture of shared experiences.

Professional Development and Training

Coordinating professional development (PD) and training is one of the primary responsibilities of the TC&S. Across the literature, the importance of collaborative PD was emphasized to support teachers and coaches in both their professional learning and technology integration efforts. Examples of collaborative PD included coaches coplanning with teachers (Caneva et al., 2023; Grierson et al., 2024; Gallagher et al., 2024), teachers coplanning with peers (Anthony, 2012; Huang, 2023), and coaches collaborating among themselves (Cowart & Jin, 2024; Gallagher et al., 2023).

A data-driven approach to PD planning allows TC&S to move beyond self-report teacher data by including classroom observation and student feedback when developing future PD sessions (Karlin et al., 2018). Differentiation and personalization are also essential elements of effective PD and training, with research suggesting that PD models are more effective when situated within a context-specific training to accommodate the unique needs of teachers (Karlin et al., 2018; Liao et al., 2021) while also ensuring content is developmentally appropriate for students (Gallagher et al., 2024).

The development of sustainable professional development (PD) requires a great deal of planning, which includes securing external funding (Anthony, 2012; Huang, 2023), piloting programs (see also Caneva et al., 2023), and addressing administrative directives (see also Karlin et al., 2018; Susin et al., 2023). Sustainable PD includes follow-up sessions where technology coaches and teachers work together to address and revise their long-term goals (Anthony, 2012; Bennett & Bromen, 2019; Gallagher et al., 2024; Grierson et al., 2024; Hatten & McDonald, 2016; Ottenbreit-Leftwich et al., 2020). These follow-up sessions allow coaches and teachers to collaboratively monitor progress and communicate ongoing needs (Gallagher et al., 2024; Hatten & McDonald, 2016; Karlin et al., 2018; Ottenbreit-Leftwich et al., 2020). PD can also be made more sustainable by switching to an internal system instead of solely relying on external presenters (Bennett & Bromen, 2019).

Furthermore, modeling and hands-on practice as part of PD and coteaching provide teachers and other technology coaches with opportunities to explore and work with available technologies (Gallagher et al., 2023; Huang, 2023; Karlin et al., 2018; Ottenbreit-Leftwich et al., 2020). Effective modeling is best done in an authentic classroom environment, with the TC&S codeveloping goals with teachers and providing follow-up support (see also Hatten & McDonald, 2016; Liao et al., 2021).

Mentorship and Coaching

Mentorship and coaching strategies are most effective when feedback is adaptable to meet the technology integration needs of teachers (Ottenbreit-Leftwich et al., 2020). TC&S who clearly define their coaching relationships and expectations are better positioned to support teacher technology growth (Caneva et al., 2023). Ongoing feedback ensures TC&S can tailor their support to address the needs of teachers (Anthony, 2012;

Susin et al., 2023). Coaching can also foster teachers' confidence and positive beliefs about technology use (Huang, 2023).

Teachers benefit when the coaching relationship is professional, builds trust, and provides classroom-specific guidance based on observation of teaching practice (Karlin et al., 2018). Additionally, exposure to coaching can support teachers' comfort in the use and implementation of assistive technologies (Ocasio-Stoutenburg et al., 2024). Further, teachers who transition into a TC&S role report that their own professional learning is supported through their new role as a technology coach (Cowart & Jin, 2024).

TC&S can provide flexible support by giving teachers voice and choice in how they adapt lesson plans to address the needs of individual classrooms (Gallagher et al., 2024). Technology coaches provided critical support when schools were forced to close and transition to online learning during the COVID-19 pandemic. Furthermore, coaches can also provide flexible synchronous coaching options, which were found to support teachers and other stakeholders in the adoption of assistive technologies (Ocasio-Stoutenburg et al., 2024).

Curriculum Integration

One of the primary responsibilities of TC&S is helping teachers integrate both technology and curriculum into their lesson planning and teaching. As discussed in the Professional Development and Training section, effective modeling is a key responsibility of technology coaches, as they leverage authentic teachable moments, provide clear instructions, and guide teachers in their reflective practice (Gallagher et al., 2024).

Technology integration into PD and lesson planning is most effect when it is relevant to the teaching and learning context (i.e., grade-level and discipline; Anthony, 2012; Gallagher et al., 2024). Technology coaches who work collaboratively to develop lesson plans with teachers are able to embed scaffolding and provide just-in-time support, which positively affects teacher technological and pedagogical strategies in the classroom (Huang, 2023; Karlin et al., 2018; Liao et al., 2021).

TC&S must also have technology expertise to successfully lead technology integration efforts in the classroom. Competent technology integration involves a combination of instructional best practices, technical knowledge and skills, ongoing professional growth, and awareness of current research (Gallagher et al., 2024). TC&S who have a well-developed understanding of technology, pedagogy, and contact knowledge (TPACK) are better equipped to enhance others' ability to apply the framework in their own practice (Cowart & Jin, 2024). Technology coaches should also be versed in assistive technology and be able to provide practical and contextually effective recommendations for classroom use (Ocasio-Stoutenburg et al., 2024).

Collaboration, Communication, and Relationship Building

TC&S work across schools and districts tobuild collegial connectionsthat support ongoing technology integration (Gallagher et al., 2024; Hatten &

McDonald, 2016; Liao et al., 2021; Susin et al., 2023). These collegial connections are strengthened when teachers and coaches meet on an ongoing basis to share resources, practices, and experiences (Gallagher et al., 2024; Susin et al., 2023). Coaches need to foster relationships with teachers (Ottenbreit-Leftwich et al., 2020) and work toward developing "a sense of shared responsibility for learning" (Bennett & Bromen, 2019, p. 57).

Technology coaches engage in relationship building with teachers to provide an effective and supportive learning environment. As TC&S develop a deeper understanding of a teacher's needs, they are better able to offer targeted, scaffolded, and personalized support that is aligned with teachers' goals and needs (Caneva et al., 2023; Ottenbreit-Leftwich et al., 2020).

Building effective coaching relationships requires clear and positive communication, with Gallagher et al. (2024) indicating that effective coaches are active listeners who use "clear, positive, [and] intentional language" (p. 161). Additionally, technology coaches can better maintain their relationship with teachers by asking them relevant questions (Grierson et al., 2024; Ottenbreit-Leftwich et al., 2020), communicating with teachers via their preferred modality (Karlin et al., 2018), and making observation notes that support teacher-mentee growth (Hatten & McDonald, 2016; Liao et al., 2021). Furthermore, bilingual TC&S can help build trust and relationships by facilitating bilingual communication between caregivers and school personnel (Ocasio-Stoutenburg et al., 2024).

The formation of communities of practice, such as professional learning communities, can connect teachers and TC&S through the exploration of shared tools while also addressing common discipline-specific technology integration needs (Anthony, 2012; Huang, 2023). Additionally, technology coaches must engage with leadership to ensure there is the necessary administrative support needed for successful technology integration (Huang, 2023; Susin et al., 2023). If TC&S fail to work jointly with site/district leaders, initiatives and their implementation may be plagued with confusion and fail to meet expectations (Caneva et al., 2023). TC&S may be tasked with building technology-industry partnerships by working with external stakeholders to address warranties, troubleshoot and identify technical issues, and repair damaged equipment (Anthony, 2012).

Technology and Logistical Support

As the primary onsite contact, TC&S must be prepared to address technical and maintenance issues, install software, and understand technology policies and processes (Anthony, 2012; Johnston, 2015; Mayes et al., 2015). Troubleshooting takes place across multiple contexts, which include PD sessions, in-class coaching, and ongoing daily support (Bennett & Bromen, 2019; Gallagher et al., 2024; Grierson et al., 2024; Karlin et al., 2018; Liao et al., 2021; Ottenbreit-Leftwich et al., 2020; Susin et al., 2023).

TC&S also works to advance teacher autonomy by sharing their troubleshooting strategies and technological knowledge as part of PD

sessions (Karlin et al., 2018). Technology coaches may also work to curate online resources to support teachers (Ottenbreit-Leftwich et al., 2020). TC&S are often the main point of contact for technology planning and decision making when distributing technology resources to teachers and students (Anthony, 2012; Bennett & Bromen, 2019; Susin et al., 2023).

Reflective Practice

Reflective practice is essential for effective coaching and professional growth. Bennett and Bromen (2019) recommend that coaches who lead reflection with teachers should serve as a facilitator to help build relationships and develop self-assessment skills. Reflection is essential for technology coaches to identify growth areas and to optimize their role in teacher learning (Hatten & McDonald, 2016). Self-study is another reflective strategy that technology coaches can use to improve their technology integration practices (Gallagher et al., 2024). Additionally, reflective practice can also serve as an opportunity for coaches to help mentees unpack their teaching philosophy (Hatten & McDonald, 2016).

Policy Development and Advocacy

Technology coaches play a pivotal role in technology policy change and development efforts. Huang (2023) found that coaches were instrumental in the development of a technology-integration plan, along with guiding implementation. In contrast, Karlin et al. (2018) reported that top-down directives can interfere with the alignment between PD and teachers' actual needs. To overcome this issue, Karlin et al. and Wine (2016) advocated for the use of research-practitioner collaborations and applying the ISTE (2024) coaching standards to inform practice.

Strategic decision making, such as systematic phased rollouts of one-to-one devices, supports scalable and sustainable technology integration (Bennett & Bromen, 2019). Additionally, Wine (2016) said that instructional technology specialists should play an active role in technology procurement and distribution decisions. Furthermore, Webster (2017) noted that "technological optimism" (p. 27) tends to be the prevailing philosophy among technology directors and specialists when making strategic choices about technology integration.

RQ3A: Enablers of Effective K-12 Technology Coaching

Seven themes were identified as effective enablers in K-12 technology coaching. These themes included (a) characteristics of effective technology coaches, (b) collaborative communities of practice, (c) leadership and administrative support, (d) research-practice and external partnerships, (e) resources, (f) specialized support for assistive technologies, and (g) systemic alignment and improvement.

Characteristics of Effective Technology Coaches

Effective technology coaches are typically experienced former teachers, which influences their interactions with teachers, staff, and students (Gallagher et al., 2024). As former teachers, coaches possess content and

contextual knowledge, which may include an awareness of current research (see also Karlin et al., 2018). To be successful in their role, effective coaches must build strong relationshipsand exhibit a demeanor that is encouraging and helpful as they guide teachers toward developing an optimistic view about technology integration (Caneva et al., 2023; Gallagher et al., 2023, 2024; Ottenbreit-Leftwich et al., 2020; Susin et al., 2023; Webster, 2017).

Due to the dynamic nature of K-12 environments, effective coaches must be flexible and responsive, demonstrating humility, patience, and respect when working with teachers (Gallagher et al., 2024; Grierson et al., 2024; Karlin et al., 2018). Effective TC&S demonstrate technical knowledge and resourcefulness, which helps them assist teachers with overcoming technical issues while navigating resource constraints (Grierson et al., 2024; Susin et al., 2023). Additionally, these individuals should possess a growth mindset (Gallagher et al., 2024; Grierson et al., 2024) and serve as an exemplary model for lifelong learning (Gallagher et al., 2023).

Collaborative Communities of Practice

Technology coaches help tofoster collaborative communities of practiceby encouraging teachers to participate in professional learning communities (Ottenbreit-Leftwich et al., 2020) and professional learning networks (Karlin et al., 2018) and by developing a culture of learning through shared experiences (Bennett & Bromen, 2019). These coordinated coaching efforts can help teachers find peer-to-peer support through communities of practice (Karlin et al., 2018; Susin et al., 2023), while also providing a forum for teachers to discuss technology integration ideas with content and grade-level colleagues (Anthony, 2012; Gallagher et al., 2024).

Within schools, a collaborative TC&S-librarian relationship was found to enable technology integration (Johnston, 2015; Wine, 2016). This type of partnership combines the technological knowledge of the technology coach with the librarian/media specialist's knowledge of information literacy, which ultimately benefits both students and staff (Wine, 2016).

Collaboration among TC&S was a strong support, with Gallagher et al. (2023) finding that technology coaches who collaborated across districts learned to appreciate each other while planning for potential barriers and collectively problem solving. Intentional collaboration time, along with established norms for interaction among technology coaches, was also a design element that benefited learning (Cowart & Jin, 2024). Furthermore, coaches acknowledged that participating in regular reflection meetings with their peers led to adjustments in their own practice (Ottenbreit-Leftwich et al., 2020).

Leadership and Administrative Support

School administrators who engage in transformative leadership can provide sustainable support for the implementation of technology integration (Huang, 2023). Administrators have the ability to encourage teachers to use technology, provide PD opportunities, and articulate a clear vision to help motivate teachers (Huang, 2023; Karlin et al., 2018). Leaders at the school and district levels can empower technology coaches

by taking an egalitarian approach to leadership by actively involving coaches in the development of educational training plans (Huang, 2023). Additionally, teachers are more likely to integrate technology when they have school district buy-in (Susin et al., 2023), specifically when administration provides a long-term endorsement that includes technology integration in the strategic plan (see also Mayes et al.).

Distributed leadership is essential to supporting the technology coaches' efforts to facilitate technology adoption among teachers while also supporting systemic school change (Caneva et al., 2023). Effective technology leadership is distributed across "principals, technology coaches, and teachers" (Anthony, 2012, p. 337), allowing each part of the system to supplement each other in terms of technological knowledge, program goals, and instructional decisions. Additionally, TC&S can help to identify teachers who demonstrate strong technical skills to be recruited as Technology Ambassadors (Bennett & Bromen, 2019). This form of distributed leadership reduces the burden on the technology coach while also broadening their role and increasing building-level support.

Research-Practice and External Partnerships

Research-practice partnerships (RPPs) across schools and universities served as a solution to support sustainable coaching while fostering long-term relationships that could address local problems (Ottenbreit-Leftwich et al., 2020). RPPs were seen as mutually beneficial, since they provided teachers with access to knowledgeable coaches and provided researchers with access to study the coaching implementation model. Additionally, external partnerships, including tech-industry and school district consultants, were seen as a resource that was useful for initial and ongoing technology and troubleshooting support (Gallagher et al., 2023; Susin et al., 2023). These partnerships allowed for "knowledge brokering" with the tech-industry partners translating their technical knowledge into "educator-friendly" language to better support coaches and classroom teachers (Susin et al., 2023, p. 6). Furthermore, tech-industry partners helped coaches secure more resources to meet the needs of students and teachers (Gallagher et al., 2023).

Resources

Despite resources frequently being cited as a constraint, strategic resource management was viewed as an enabler for coaching success. Examples of resource management include budgeting teacher release time (Gallagher et al., 2023), requiring PD attendance to gain access to new tools (Anthony, 2012), and providing technology coaches with additional coaching hours (Caneva et al., 2023). Additionally, dedicated funding enabled ongoing support during the phased rollout of devices (Bennett & Bromen, 2019). In at least one case, a technology coach compiled lists for suggested technology purchases (Grierson et al., 2024). Technology coaches are key players in ensuring technology equity across schools and classrooms, despite some schools lacking sufficient resources (Mayes et al., 2015; Susin et al., 2023). Providing equitable PD is also addressed by holding PD sessions at a central location (Bennett & Bromen, 2019) or online (Caneva et al., 2023; Cowart & Jin, 2024).

Specialized Support for Assistive Technologies

Specialized areas, such as assistive technologies (AT), have their own unique set of enablers. Technology coaches who specialize in AT serve as a broker/liaison in terms of building rapport and providing technical assistance (Ocasio-Stoutenburg et al., 2024). Coaches with bilingual and bicultural fluency were better able to provide cultural and linguistic responsiveness to the needs of families and foster a connection within the community. TC&S were able to promote family engagementthrough workshops and two-way communications to track AT goals and progress. Additionally, many of the caregivers were able to replicate strategies learned from the coaches and transfer the AT support to their homes during the COVID-19 pandemic.

Systemic Alignment and Improvement

Drawing on Activity Theory (Engeström, 2000), Anthony (2012) identified that technology integration requires continuous systemic alignment between a school district's technology planning and the teachers' technology integration systems. Technology planning systems should be revised on an annual basis, with the goal of working toward continuous improvement in terms of the quality and frequency of classroom technology integration. These efforts should work toward improving technology reliability through a division of labor across the technology support staff and updated hardware purchases. While external partnerships provide valuable technical support and expertise (see Research-Practice and External Partnerships section), continuous improvement is more sustainable when the PD delivery system is staffed internally rather than relying on external consultants (Bennett & Bromen, 2019; Huang, 2023).

RQ3B: Constraints of Effective K-12 Technology Coaching

Seven themes were identified as constraints that served as barriers to achieving effective K-12 technology coaching. These themes included (a) challenges with technology coaching role and capacity, (b) ineffective professional development design and implementation, (c) organizational and administrative misalignment, (d) resource constraints, (e) teachers' attitudes, beliefs, and perceived needs, (f) tension between technology coaches and media specialists, and (g) barriers that were unique to assistive technologies, rural/remote education, and technological determinism.

Challenges With the Technology Coaching Role and Capacity

The ever-changing and evolving role of the technology coach introduces some specialized challenges in terms of defining their role and identity in the K-12 landscape. As seen in the numerous job titles in RQ1, technology coaches/specialists are a poorly defined role, leaving some administrators unsure about how to most effectively utilize their coaches (Caneva et al., 2023). Furthermore, technology coaches are expected to serve "any device, anytime, anywhere, any task" (Mayes et al., 2015, p. 229), with their role

expanding to include new challenges such as cyberbullying, cyberstalking, and cybersecurity.

Additionally, even though coaches are typically former classroom teachers, they may lack contextual knowledge since their expertise may not translate to all grade levels and content areas (Caneva et al., 2023; Gallagher et al., 2023; Huang, 2023; Ottenbreit-Leftwich et al., 2020). This lack of contextual knowledge impacts their ability to perform as a coach, leading to challenges when preparing for modeling and demonstrations.

Coaches and teachers have different ideas about how to best integrate technology, which can lead to misalignment in terms of how technology enhances the curriculum (Ottenbreit-Leftwich et al., 2020). Due to the lack of standardization in the job role and responsibilities,coaches' backgrounds may serve as a barrier, depending on their coaching context. Technology coaches are viewed as an "eclectic group" who typically first served as a K-12 teacher and may lack prior adult education and coaching experience (Caneva et al., 2023, p. 209).

Ineffective Professional Development Design and Implementation

Technology PD is ineffective when conducted as a single, one-time, "one-size-fits-all workshop"(Karlin et al., 2018, p. 724). This lack of personalization fails to consider the teachers' specific TPACK skills and abilities (Cowart & Jin, 2024). Additionally, PD that lacks personalization is perceived as ineffective by the teacher participants, with research indicating that 40% of TC&S based their PD sessions on administrator, school, or district guidance, rather than focusing on the needs of the teachers (Karlin et al., 2018).

Appropriate skills level needs to be taken into account when planning for PD sessions, with teachers reporting that they felt frustrated or discouraged when struggling with technology that was too advanced for their existing skills (Bennett & Bromen, 2019; Caneva et al., 2023; Cowart & Jin, 2024; Huang, 2023; Karlin et al., 2018; Liao et al., 2021), or when the PD was taught at a rushed pace. PD was also seen as less effective when technical jargon was overused (Huang, 2023).

Furthermore, PD efforts may stall if the technology coach promotes "a culture of replication rather than creation" (Bennett & Bromen, 2019, p. 59). Despite PD being available across many modalities, workshops that lack transformative PD may not inspire teachers to move beyond the conventional lecture-based, test-oriented modes (Huang, 2023) and toward technology-supported constructivist practices (Anthony, 2012). Additionally, coaches who exhibit an overreliance on self-reported data may replicate bias and prevent leaders from accurately identifying how to improve PD to fit teachers' actual integration needs (Karlin et al., 2018).

Organizational and Administrative Misalignments

While distributed leadership was seen as an enabler, the lack of administrators' technical knowledge remains a barrier. School leaders, such as principals, often lack the technical knowledge and skills needed when making informed decisions about equipment, infrastructure, and technology PD (Anthony, 2012; Caneva et al., 2023). Caneva et al. found that administrators may select teachers for the role of technology coach based on traits that serve them as a teacher, which may not be optimal in the role of TC&S. Although technology coaches often possess technological knowledge, they may lack authority to require teachers to implement specific technologies in their classrooms due to administrative control.

School districts often have simultaneous and competing initiatives that can leave teachers and technology coaches feeling overwhelmed (Ottenbreit-Leftwich et al., 2020), especially when implementing both new hardware and software applications (Anthony, 2012). Decision-making about which initiatives to pursue is typically done by administration; however, technology coaches can work within the organizational culture to influence technology-related decisions.

District policy and procurement barriers also serve as constraints to technology integration (Anthony, 2012; Ottenbreit-Leftwich et al., 2020). This may include issues such as requiring a time-intensive multistep process for teachers to receive approval to install new applications. The purchase of software or subscriptions may also fail to meet the needs of the teachers if they are left out of the procurement process (Anthony, 2012). Additionally, those charged with procurement are faced with an overwhelming number of product choices and must account for system requirements, existing infrastructure, and ongoing teacher support needs (Mayes et al., 2015; Susin et al., 2023).

Resource Constraints

The literature also highlighted a lack of resources for coaches. TC&S were often stretched thin and expressed challenges in acquiring "the necessary financial, human, technology, and time-related resources for effective coaching" (Gallagher et al., 2023, p. 222). Common barriers included limited access to technology and devices (Bennett & Bromen, 2019; Grierson et al., 2024) and a lack of funding (Huang, 2023; Susin et al., 2023). Even when technology coaches were flexible and resourceful, access to technology resources was still a significant constraint (Grierson et al., 2024).

Infrastructure issues stemming from the reliability of technology are also a critical barrier (Anthony, 2012; Mayes et al., 2015). This includes accessibility to the server and reliable wireless internet access (Grierson et al., 2024; Susin et al., 2023). In one case, it took more than 4 months to resolve the server and internet issues as part of a laptop rollout program (Anthony, 2012).

Another challenge was resource management/maintenance, in terms of ensuring technology was available, reliable, and usable. While TC&S promote the effective integration of technology, they must also manage the

availability of devices, perform maintenance, and provide training and support (Anthony, 2012; Mayes et al., 2015). The acquisition of technology devices is not enough, since the devices will go unused and become neglected without proper resource management (Mayes et al., 2015). Additionally, technology planners need to consider whether the devices purchased (e.g., student laptops) can withstand the wear and tear of daily classroom use (Anthony, 2012).

Insufficient time for PD is one of the most common barriers preventing the effective implementation of technology (Caneva et al., 2023; Karlin et al., 2018). Technology coaches often lack the time to meet and planone-on-one with teachers, as teachers prioritize standardized test preparation over learning and integrating new technology (Liao et al., 2021; Ottenbreit-Leftwich et al., 2020). Additionally, teachers have inadequate time for practice and would like more hands-on time to explore and become comfortable with new tools prior to implementation in the classroom (Ottenbreit-Leftwich et al., 2020). Time was also cited as a constraint in online PD programs, with participants indicating they wanted more time to collaborate, discuss, and complete breakout room activities (Cowart & Jin, 2024).

Teachers' Attitudes, Beliefs, and Perceived Needs

Teacher attitudes and beliefs are central factors influencing whether teachers integrate technology into their classroom practices. Even when funding and equipment are available, the educational system exhibits a resistance to change, where teachers, staff, and students who are less comfortable with technology use can hold back integration (Huang, 2023; Webster, 2017). TC&S must work with teachers who display a fear of technology failure, since technology failures (e.g., an app crashing) can sometimes trigger aggression directed at the coach (Caneva et al., 2023). Other technical issues, such as malfunctions and firmware updates, can further erode teachers' trust in technology (Ottenbreit-Leftwich et al., 2020). Additionally, teachers' existing beliefs and apprehension about technology can make the technology coaches' job challenging, requiring ongoing relationship building, authentic experiences, and humility from the coach to help teachers overcome this barrier (Grierson et al., 2024).

Another barrier is a lack of perceived need for technology integration (Huang, 2023), especially among experienced teachers who already have hands-on lesson plans (Anthony, 2012). Teachers who did not feel the technology improved instruction were hesitant to adopt it for substantial and regular use. Coaches and teachers might have different ideas about how to integrate technologies, with teachers feeling comfortable with the current integrations and resisting new tools offered by TC&S (Liao et al., 2021; Ottenbreit-Leftwich et al., 2020).

Tension Between Technology Coaches and Media Specialists

An emerging barrier identified in the literature is the tension between TC&S and media specialists. School librarians/media specialists, who historically have taken on a technology leadership role, may feel demoted and squeezed out by the emerging role of the technology coach (Johnston, 2015; Wine, 2016). This overlap may lead to tension and conflict when

there is a lack of collegiality between the media specialist and technology coach.

Unique Barriers

Assistive Technology. While the majority of the literature focuses on general classroom technology integration, there are specific barriers that are unique to assistive technology (AT). Even when available, there is an underuse of AT due to fewer PD opportunities that focus specifically on the tools and their integration (Ocasio-Stoutenburg et al., 2024). Additionally, underuse of AT is reported when the resources fail to meet the diverse support needs of participants. This can include training where AT use is decontextualized, PD that is not culturally responsive and relevant, and programs that fail to account for the needs of the students, teachers, teaching assistants, and family members. Additionally, COVID-19 caused a pandemic magnification, which revealed unforeseen remote learning challenges when providing access to AT tools for students and their families (Ocasio-Stoutenburg et al., 2024).

Rural and Remote Education. One of the greatest barriers to technology integration is the digital divide that exists within rural and remote education. Widespread acceptance of technology is difficult to achieve in educational environments where people lack access to devices, infrastructure, and technology literacy (Huang, 2023; Mayes et al., 2015). This digital divide is amplified when a single technology specialist is charged with supporting numerous schools (Bennett & Bromen, 2019; Grierson et al., 2024; Mayes et al., 2015). As a result, coaches, students, and teachers in remote and rural areas are often at a technological disadvantage when compared with their urban counterparts (Huang, 2023).

Technological Determinism. Webster (2017) took a philosophical approach to examining how technology leaders orient themselves as generally optimistic about the benefits of technology. The term *technological determinism* is used to describe technology leaders who work under the assumption that "technological change is inevitable" (p. 27), with decision makers emphasizing that they need to "keep up with technology (or be left behind)" (p. 29) despite limited fiscal resources. This leads to a technology-driven curriculum, where technology is adopted for its own sake, rather than being selected based on curricular needs. Webster's findings indicate this approach can foster resistance from teachers and lead to failed technology adoption.

Discussion

The role of TC&S is quickly becoming a mainstay in K-12 education, with their roles and responsibilities expanding as schools continue to rely on technology for the delivery of instruction (Susin et al., 2023). Unlike well-established positions that have systematic standards and competencies (e.g., Algebra I and English language arts teachers), TC&S are expected to wear many hats within their schools and districts (Grierson et al., 2024). ISTE has provided guidance through the *ISTE Standards: For Coaches* (ISTE, 2024a) and the *Essential Conditions for Effective Tech Use in Schools* (ISTE, 2018) to support successful technology integration. While

the work of TC&S may align with the proficiencies provided for coaches, there remains considerable ambiguity regarding the leadership role expected and executed by a TC&S (Woo, 2023).

ISTE Standards and the TC&S Leadership Role

Alignment Between Coach and Leadership Standards

ISTE Standards: For Coaches (ISTE, 2024a) explicitly positioned coaches as collaborative partners with educational leaders, emphasizing their role in creating equitable access to high-quality learning (4.1), deepening expertise while serving as models for educators and leaders (4.2a), and planning, providing, and evaluating professional learning (4.5). However, the *ISTE Standards: For Education Leaders* (ISTE, 2024b) lacked specific references to working with coaches to realize successful technology integration. While collaboration with coaches may be inferred by the inclusion of "others" in standards addressing visionary planning (3.2.b) and empowering leadership (3.3.c), this connection remains implicit rather than explicit.

Several leadership standards appear to position administrators as independent actors rather than collaborative partners with TC&S. The Empowering Leader standard (3.3) describes creating an empowering culture by building teacher leadership skills (3.3a), developing educator confidence and competency (3.3.b), integrating technologies to meet diverse students' needs (3.3.d), and developing personalized assessments (3.3.e). Similarly, the System Designer standard (3.4) places the educational leader as the primary overseer of technology policy development (3.4.a), resource management (3.4.b), privacy and security protection (3.4.c), and strategic partnerships (3.4.d). Even the Connected Learner (3.5) standard fails to include the TC&S or establish expectations for collaboration with the educators within their own building as part of the technology learning activities of the leader.

Gaps in the Essential Conditions

The *Essential Conditions for Effective Tech Use in Schools* (ISTE, 2018) also lacks explicit recognition of TC&S as key stakeholders. While the document suggests that leaders create a shared vision for technology use from a variety of stakeholders, TC&S are not specifically mentioned in this list. Regarding implementation planning, leaders are charged with developing a "comprehensive plan," presumably through team collaboration. The conditions for equitable access, high quality learning, and ongoing evaluation fall short of mentioning collaboration with TC&S to achieve these goals.

However, two conditions do acknowledge the role of technology coaches. The Prepared Educators condition addresses the utilization of "edtech coaches," which aligns well with the coaches standards. Similarly, the Skilled and Sufficient Technical Support condition acknowledges the need for "tech leaders to engage collaboratively with tech providers," but does not clarify how TC&S may be incorporated into this process (ISTE, 2018).

Recommendations on Standards Alignment

Given these gaps, we recommend that the *ISTE Standards: For Coaches* (ISTE, 2024a) and *For Educational Leaders* (ISTE, 2024b) be revised to more closely align the leadership activities that fall under the same learning context. This alignment may provide additional opportunities for TC&S to be meaningfully engaged in leadership activities directly aligned with their roles and responsibilities. This approach is underpinned by the concept of a distributed model of leadership, which has been found to be a supportive approach when working toward innovation and successful technology integration (Phillips et al., 2023).

Best Practices to Support TC&S' Technology Leadership

When selecting TC&S from the cohort of teachers in a school or district, leaders should spend time developing a shared vision for this technology leadership position with relevant stakeholders and clearly articulate their expectations (Caneva et al., 2023; Huang, 2023; Mayes et al., 2015). If care is not taken to follow these steps, coaches will likely struggle to navigate a variety of responsibilities, some of which may not be possible, without clear support from site and district leadership (Caneva et al., 2023).

Similarly, districts/sites must plan for the TC&S role by identifying appropriate candidates based upon their technological, pedagogical, and content knowledge and contextualized site needs (Bennett & Bromen, 2019; Caneva et al., 2023; Cowart & Jin, 2024; Huang, 2023; Mayes et al., 2015). Once TC&S are in place, initial and ongoing PD should be provided and aligned with the expectations of the position to empower coaches to successfully serve teachers and students (Ottenbreit-Leftwich et al., 2020). PD should support coaches to deepen their TPACK expertise (Huang, 2023) and build trusting relationships with teachers (Hatten & McDonald, 2016; Ottenbreit-Leftwich et al., 2020). Coaches may need ongoing learning to provide teachers with scaffolded support to address an area of need that the teacher identifies (Huang, 2023; Karlin et al., 2018; Ottenbreit-Leftwich et al., 2020), as well as how to identify and offer opportunities for teacher choice.

Districts/sites should encourage coaches to be flexible in their work with teachers (Gallagher et al., 2024; Grierson et al., 2024) and to support the development of collegial teacher-teacher, coach-teacher, and coach-coach relationships (see also Ottenbreit-Leftwich et al., 2020). Additionally, district/site leadership should promote positive working relationships between TC&S and media specialists to nurture optimal support for teachers' technology use to address the instructional needs of students (Johnston, 2015; Wine, 2016).

When making decisions that impact technology use in the classroom, district/site leadership should engage TC&S and the teachers they serve in decision making regarding the procurement of digital tools (Susin et al., 2023), implementation strategies adopted (Anthony, 2012; Huang, 2023; Karlin et al., 2018), and policies regarding technology use (Anthony, 2012). Additionally, sufficient time must be allocated for coach and teacher learning to support the effective integration of technologies (See also Caneva et al., 2023; Cowart & Jin, 2024).

Future Research

There are several directions that researchers should consider when conducting future research on K-12 TC&S. Multiple studies in this review had small sample sizes, ranging from one to three technology coaches (Bennett & Bromen, 2019; Grierson et al., 2024; Huang, 2023; Ocasio-Stoutenburg et al., 2024). While these detailed qualitative studies did longitudinally illuminate the day-to-day practices of their participants, it would also be helpful to see more studies that capture a broader sample that includes surveys and interviews (see Cowart & Jin, 2024; Karlin et al., 2018).

There is room in the literature to take a closer look at how the role of TC&S has shifted since the end of the COVID-19 pandemic. Several of the studies in the literature were conducted during the pandemic (Caneva et al., 2023; Gallagher et al., 2024; Ocasio-Stoutenburg et al., 2024; Susin et al., 2023), and one study (Cowart & Jin, 2024) mentioned the increased demand for online PD since the pandemic. Examining the shift in PD to online and hybrid models could shed light on how TC&S are better supporting teachers through remote, hybrid, and synchronous or asynchronous learning models.

This systematic literature review identified two articles (Johnston, 2015; Wine, 2016) that examined the tension that exists between TC&S and librarians/media specialists. Researchers may consider interviewing multiple groups of librarians and technology coaches who work in the same school to help researchers and administrators better understand how to support both of these roles moving forward.

The digital divide was only briefly touched upon in the literature (Huang, 2023; Mayes et al., 2015). Further work needs to be done to explore the unique challenges that TC&S face when working in districts that have less access to technology and infrastructure. These issues become even more crucial with technological determinism in education and may continue to lead to the expansion of the Matthew Effect (i.e., the rich get richer, and the poor get poorer; Rigney, 2010), leading to further inequities between the haves and have-nots in a technology-driven society.

Additionally, researchers may consider diving deeper into how TC&S support assistive technology integration into the classroom. This is a crucial topic since technology coaches will likely need to help K-12 teachers meet the upcoming changes with the *Americans with Disabilities Act* Title II Web Content Accessibility Guidelines (WCAG) 2.2 AA compliance requirements, which take effect in April 2026 (Bolton, 2025).

Last, none of the literature reviewed included any mention of artificial intelligence and how generative artificial intelligence technologies are impacting the role and responsibilities of TC&S. This is a crucial area that needs further examination.

Limitations

Limitations of this systematic literature review include that articles were limited to English-language journals and published between January 2010

and July 2024. The study was limited to peer-reviewed journal articles, so information about TC&S that is published in conference papers, book chapters, dissertations, and other non-peer-reviewed sources was excluded. Additionally, not all topics in the review were evenly distributed across the literature, with only two articles about TC&S/media specialists and one article about assistive technologies that were included in the review.

Conclusion

This systematic literature review on the leadership role of K-12 technology coaches and specialists found 10 unique job titles. The wide variety of job titles reflects that these positions are multifaceted and change to meet contextual needs. Primary responsibilities of the TC&S included planning and coordinating, facilitating professional development and training, providing mentorship and coaching, fostering collaboration and building relationships, offering technology and logistical support, leading reflective practice, and engaging in policy development and advocacy. Effective technology coaches were flexible and responsive to the needs of teachers, demonstrated technical knowledge and resourcefulness, possessed a growth mindset, and modelled lifelong learning. Additionally, coaching practice was enabled through fostering collaborative communities of practice, securing leadership and administrative support, actively engaging in collaboration and partnerships, navigating resource management, providing specialized support (e.g., assistive technologies), and working toward systemic alignment and improvement.

Barriers to effective coaching included role ambiguity, ineffective professional development implementation, organizational and administrative misalignment, resource constraints, and teachers' existing attitudes, beliefs, and perceived needs. Furthermore, unique barriers included the underuse of assistive technologies, the digital divide in rural and remote educational contexts, and technological determinism leading to the adoption of technology for its own sake, rather than being selected based on curricular needs.

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Appendix
Articles Included in Systematic Literature Review

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