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TPACK Leadership Diagnostic Tool: Adoption and Implementation by Teacher Education Leaders

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Abstract

This case study describes how leaders from three teacher education institutions utilized a technological, pedagogical, and content knowledge (TPACK) leadership diagnostic tool in the design, development, and implementation of technology rich initiatives. Participants were interviewed to find out how the diagnostic tool guided their decision making. Content analysis and a priori coding were used to analyze transcripts along with constant comparative methods to explore elements within the diagnostic tool and identify additional codes. Results indicate that education leaders utilized the TPACK leadership diagnostic tool in different ways to guide the design, development, and implementation of their technology initiatives. Participants also provided recommendations for how the diagnostic tool and its use might be enhanced in order to support change. (Keywords: teacher education leadership, technology implementation and adoption, Technological Pedagogical Content Knowledge (TPACK))

Teacher education leadership helps establish the physical and instructional context for teacher education faculty and teacher candidates to learn about technology integration. To prepare teacher candidates to integrate technology efficiently into their future classrooms, faculty should incorporate technological, pedagogical, and content knowledge (TPACK) throughout their teacher education curriculum (Tondeur, Roblin, van Braak, Fisser, & Voogt, 2013; Voogt, Fisser, Pareja Roblin, Tondeur, & van Braak, 2013). TPACK is a framework for teacher knowledge for technology integration built upon Shulman's (1986) construct of pedagogical content knowledge (PCK) to include technology knowledge (Koehler & Mishra, 2008). The integration of TPACK throughout a teacher education program often requires an ongoing change process in which education leaders must have a direct role.

There have been numerous calls for greater technology use and adoption in the preparation of teachers. The American Association of Colleges for Teacher Education (AACTE)

and the Partnership for 21st Century Skills (AACTE & Partnership for 21st Century Learning, 2010) released the *21st Century Knowledge and Skills in Educator Preparation* white paper that called for the development of “a shared vision for 21st century knowledge and skills in educator preparation” and “meaningful dialogue among higher education leaders ... about implementing [that] vision in educator preparation” (p. 3). Additionally, the U.S. Department of Education and Office of Educational Technology (2016) put forth its *Advancing Educational Technology in Teacher Preparation: Policy Brief*, and offered four principles for technology use in teacher preparation programs:

- Focus on the active use of technology to enable learning and teaching.
- Build sustainable, program-wide systems of professional learning for higher education instructors.
- Ensure preservice teachers’ experiences with educational technology are program-deep and program-wide.
- Align efforts with research-based standards, frameworks, and credentials.

Around the same time as the publication of the U.S. Department of Education principles, the International Society for Technology in Education (ISTE) released the Educational Technology Standards for Educators (ISTE, 2017a) and worked with the Council for the Accreditation of Educator Preparation (CAEP) to establish technology integration as a cross-cutting theme throughout the CAEP standards for teacher education programs accreditation (CAEP, 2016). Since then, others have developed teacher educator technology competencies (Foulger, Graziano, Schmidt-Crawford, & Slykhuis, 2017; Foulger, Graziano, Slykhuis, Schmidt-Crawford, & Trust, 2016). These various calls for action address the reality that teacher education programs across the country can find it difficult to support learning opportunities for faculty and teacher education candidates that challenge existing conceptions about technology use.

In 2012 AACTE tasked its Innovation and Technology (I&T) Committee to develop materials that supported education leaders in the effective implementation of technology, content, and pedagogy into their teacher education programs. This request ultimately resulted in the development of the TPACK leadership diagnostic tool (Graziano, Herring, Carpenter, Smaldino, & Finsness, 2017) (see [appendix](#)). The tool was developed as a resource for education leaders to assess existing supports for technology adoption and integration within teacher education programs. It is intended to serve as a device to engage leaders in a change process that will ensure all teacher candidates graduate TPACK ready. Examination of how teacher education programs, and the leadership within them, support institutionalization of TPACK-based initiatives is a vital component in helping to develop the next generation of TPACK-ready educators.

Graziano et al. (2017) have suggested that further research and application of the diagnostic tool was needed. Therefore, current and former members of the AACTE I&T Committee conducted two rounds of interviews with three teacher education institutions that utilized the TPACK leadership diagnostic tool. The purpose of this study was to explore how representative the TPACK leadership diagnostic tool was of education leaders’ concerns and processes when seeking to create and sustain an environment that supports TPACK-based initiatives. The research questions that guided this study were:

1. How was the TPACK leadership diagnostic tool used by education leaders during the implementation of TPACK-based initiatives?
2. In what ways did the TPACK leadership diagnostic tool serve as an opportunity to examine current practices and set realistic goals?
3. What are education leaders’ recommendations for the TPACK leadership diagnostic tool?

Literature review

Prior to discussing the theoretical frameworks that support the TPACK leadership diagnostic tool, we provide an overview of the TPACK framework. The TPACK framework (Mishra & Koehler, 2006) depicts the types of knowledge that inform effective teaching with technology. Unlike prior conceptions of these knowledge domains, the TPACK framework defines content knowledge (CK), pedagogical knowledge (PK), or technological knowledge (TK) knowledge as interrelated. The framework posits that CK, PK, and TK overlap, creating four knowledge domains: technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK), technological content knowledge (TCK), and, at the framework's center, technological, pedagogical, and content knowledge (TPACK).

The TPACK framework recognizes that various contextual factors affect teaching and learning. For example, Porras-Hernandez and Salinas-Amescua (2013) posited that contextual factors that impact TPACK can occur at micro (i.e., classroom), meso (i.e., school/institution), and macro (i.e., society) levels, and can relate to the teacher and/or the students. Knowledge of contexts is therefore understood to be essential to effective technology integration, although this element has received relatively less attention in the existing TPACK framework research (Rosenberg & Koehler, 2015; Swallow & Olofson, 2017). In relation to the purpose of this study, the meso-level context of institutional leadership can affect how preservice and in-service educators develop, practice, and use TPACK.

The TPACK framework has been utilized, studied, and/or critiqued by many researchers (e.g., Archambault & Barnett, 2010; Brantley-Dias & Ertmer, 2013; Graziano et al., 2017; Harris, 2016; Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009; Voogt et al., 2013; Wetzel & Marshall, 2011). Despite the number of TPACK-related journal articles that have been published, the topic of leadership to support TPACK framework integration in teacher education has received scant attention (Graziano et al., 2017). The results of prior research have implications for how faculty can advance teachers' TPACK development in coursework (Mouza, Karchmer-Klein, Nandakumar, Ozden, & Hu, 2014), but it is less clear how deans, department chairs, and other administrators can lead, support, and contribute to larger TPACK initiatives. This article addresses this gap in the literature by describing how teacher education leaders used a TPACK leadership diagnostic tool in their development and support of TPACK framework-related initiatives.

Theory of action

Argyris and Schon's (1974) concept of a theory of action guided the creation of the TPACK leadership diagnostic tool. No organization should move forward without a theory of action that maps out the components of a change process (Argyris & Schon, 1974; Hill & Celio, 1998). The theory of action that undergirds the diagnostic tool explains the cause-effect relationships among inputs, activities, and intended outcomes (Bennett, 2010), and supports an individual's needs to become competent in taking action and simultaneously reflecting on that action to learn from it (Salaway, 1987). This theory of action (see Figure 1) identifies critical areas that teacher education leaders should consider as they plan for effective TPACK integration into their teacher preparation programs. It also helps leaders identify how change is expected to happen, what leaders are able to control, and what is not under the leader's control but needs to occur if the hoped-for change is to occur (Thomas, Herring, Redmond, & Smaldino, 2013; Herring, Thomas, & Redmond, 2014).

Transformational leadership framework

The TPACK leadership diagnostic tool is also grounded in the transformational leadership framework (Day, Sammons, Hopkins, Leithwood, & Kington, 2008; Leithwood, Harris, &

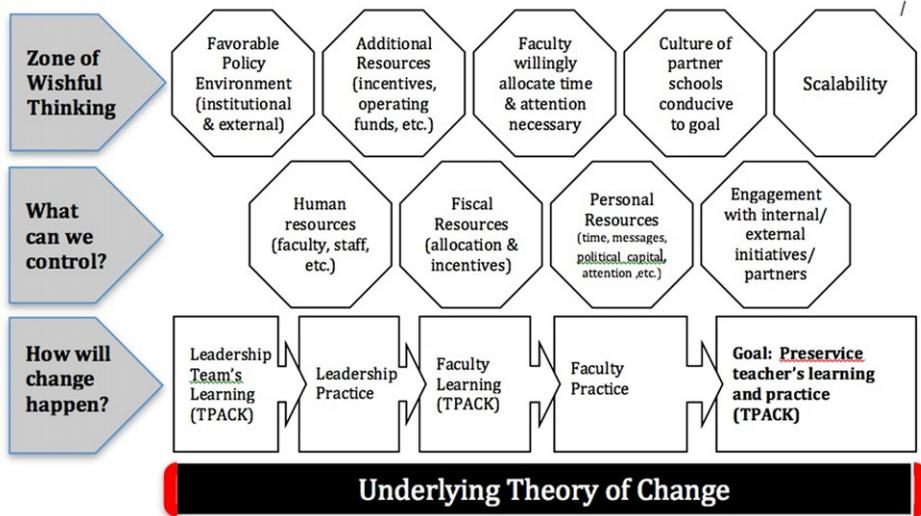


Figure 1. TPACK leadership theory of action. Adapted from Thomas, Herring, Redmond, and Smaldino (2013, p. 57).

Hopkins, 2008; Leithwood & Jantzi, 2008). Transformational leadership seeks to change the status quo, involves leaders motivating followers to improve present attitudes and assumptions, and is concerned with notions of purpose and vision (Hine, 2014). Meeting the demand to be transformative allows for inclusive and extensive participation in the quest for social change across the school and community. The transformational leadership framework involves three key components: (a) establish a vision to set direction, (b) develop faculty members to accomplish vision, and (c) redesign the organization to support member's work toward the vision. Each component is briefly described in the following paragraphs.

To guide systemic changes, teacher education leaders must define a clear vision for how their preparation programs will develop TPACK competent candidates, who can become agents of change in their schools. Teacher education leaders should also develop their faculty's capacity to move towards the defined vision through modeling and providing individualized support and opportunities to learn (Thomas et al., 2013). The direct experiences faculty and staff have with those in leadership roles, as well as the organizational context within which people work, influence work-related practices (Leithwood & Jantzi, 2008).

Appropriate conditions and support from teacher education leaders can facilitate faculty members' movement towards a desired vision (Thomas et al., 2013). To support both the students' and faculty members' work to achieve their vision, leaders may need to redesign their organizations to remove barriers to progress. Restructuring the unit as a learning organization and establishing professional learning communities could be means for developing the shared knowledge, skills, values, and norms needed for full TPACK integration into preparation programs (Dexter, Herring, & Thomas, 2012).

In the end, those who participate in the collective action that transforms leadership become empowered by the process. Transformative leadership facilitates the redirection of one's mission and vision, a renewal of one's commitment, and the restructuring of one's systems for goal accomplishment (Roberts, 1985). For a greater discussion on the theory of action and transformational leadership framework that led to the development of the diagnostic tool, view Graziano et al. (2017). The methods used in this study are highlighted next, followed by the results and a discussion of the results.

Table 1. Overview of Institutions Participating in Both Year 1 and Year 2 of the Study

	Midwest #1	Midwest #2	Eastern
University population	19,000	10,000	16,000
Number of campuses	1	5	1
College of Education: undergraduate enrollment	1,200	750	600
College of Education: graduate enrollment	2,750	450	350
Number of licensure programs	31	36	36
Annual number of teacher preparation “completers”	350	260	360
Full-time College of Education faculty	125	86	100

Methods

Participants

Education leaders from teacher education programs were recruited to participate in the study via an international call distributed through relevant listservs, a post on AACTE’s EdPrep Matters blog, and via the researchers’ professional networks. The call targeted leaders such as deans and department chairs with an ongoing or planned TPACK-based initiative. Interested participants ($N=10$) submitted a basic description of the TPACK-based initiative at their institution. Participants were provided a copy of the TPACK leadership tool, but were not required to have previously used it, or to make use in a particular way during the study. The researchers received applications from international institutions ($n=2$) and institutions in the United States ($n=8$). Eight respondents described relevant TPACK-based initiatives within teacher education programs and were included in the initial round of interview data collection. Of these eight respondents, three respondents discussed initiatives already underway, while the other five respondents were still in the planning stage of their initiatives. Approximately 1 year later, education leaders from the three institutions with existing initiatives agreed to continue in the study and participated in follow-up interviews. Table 1 provides an overview of these three institutions, including size, enrollments, and number of licensure programs as found on each institution’s website.

Data collection

Two rounds of semistructured interviews, approximately 1 year apart, were conducted. The first round of interviews took place in late 2015 and early 2016. During round 1, eight teacher education program leaders described their existing or planned TPACK-based initiative and provided information on key personnel involved. Participants were also asked to describe their use of the TPACK leadership diagnostic tool, perceptions of the diagnostic tool’s use, and future plans for the tool at their institution. During round 2, three leaders who had begun their initiatives took part in a follow-up interview to discuss the progress of their TPACK-based initiative. Interviews included questions and prompts about the TPACK leadership diagnostic tool and how it was used. Interviews for both round 1 and round 2 were digitally recorded and transcribed. This article focuses on the second round of interviews because the participants discussed progress on their TPACK-based initiatives through the lens of the diagnostic tool.

Data analysis

Content analysis using a priori codes was selected as the method of analysis for determining how participating institutions were using the TPACK leadership diagnostic tool to guide leadership decisions in TPACK initiatives. Content analysis can be a useful technique for allowing researchers to discover and describe the perspectives of individuals, groups, or institutions (Weber, 1990). A priori content analysis uses predetermined coding units to

evaluate responses (Adams & Lawrence, 2015; Weber, 1990). The TPACK leadership diagnostic tool (Graziano et al., 2017) itself served as the basis for codes used to analyze the second round of interviews ($N=3$). Constant comparative methods (Glaser & Strauss, 1967) were used to triangulate interview data with additional information from each institution and their TPACK initiatives.

As described earlier, categories within the diagnostic tool are based on the theory of action (Argyris & Schon, 1974) that guided its development (Graziano et al., 2017). Codes and code descriptions were based on the “leading” column of the diagnostic tool and then compiled into a code book. The researchers were also open to the emergence of new codes during analysis. Three researchers participated in the coding process, reviewing case transcripts in at least three rounds of coding: individual coding followed by two rounds of group coding and discussion. Two additional codes, demographics and discussion of the tool, were used to capture data on specific demographic information and the ways in which the participants discussed their use of the diagnostic tool in decision making.

Once individual coding was completed, the researchers used HyperRESEARCH qualitative analysis software to examine the frequency of codes across cases, and to run a report that grouped text from each case with corresponding codes. The researchers then met to discuss code frequencies and emergent cross-case themes from the text. Weber (1990) notes, “Reliability problems usually grow out of the ambiguity of word meanings, category definitions, or other coding rules” (p. 15). Accordingly, after the initial round of individual coding, researchers met to discuss how particular codes were used and why additional codes were generated. Researchers made revisions and tightened up categories and definitions to eventually come to consensus on the meaning of the text segments and how they should be coded during the two successive rounds of collaborative coding.

Study context

A summary of the initiatives for each institution and how the TPACK leadership diagnostic tool was used to direct each institution’s TPACK initiative is included in [Table 2](#).

Results

This section reports how education leaders utilized the TPACK leadership diagnostic tool in the development and implementation of their TPACK-based initiatives, examined current practices and set goals, and offered recommendations for future use of the diagnostic tool.

TPACK leadership diagnostic tool use by education leaders

The first research question, “How was the TPACK leadership diagnostic tool used by education leaders during the implementation of TPACK-based initiatives?,” is discussed in what follows. Participants reflected on who at their institution used the diagnostic tool and the relevance of it for decision making and gauging progress. The grant director at Eastern mentioned that she was the only one who used the tool at her institution. The dean at Midwest #1 introduced the tool to two other individuals leading their technology initiative. The dean explained, “I think it’s helped in some of our decision making or at least planting the seeds of what we’d like to see happen. That’s been helpful in the process of thinking from this ideal and making it happen.” As an example of how the tool could be useful, the faculty member leading integration at Midwest #1 referred to the university’s earlier purchase of “clickers” and one instructor’s perception that clicker use was required. The faculty member stated:

Table 2. Summary of TPACK Initiatives by Institution

Eastern

A Teacher Quality Grant recipient, Eastern was partnering with several school districts to develop a model for integrating technology in preservice teacher curricula and clinical experiences. Teacher preparation programs in the college encompassed more than 20 licensure areas. The director of the grant provided leadership, soliciting faculty participation and organizing professional development for both faculty and school-based participants where coaches were provided. The director was the single user of the diagnostic tool, reviewing progress and next steps in consideration of elements listed on the tool. Overall, Eastern could be described as being at the developing or acceptable levels for many elements on the diagnostic tool. Because fiscal resources were readily available through the grant, the bigger challenge was identified as obtaining faculty time and attention. Distribution of a request for proposals (RFP) for faculty-initiated subprojects was one method used to increase faculty engagement.

Midwest #1

Midwest #1 was in the beginning and/or developing levels of each element and subsection within the diagnostic tool.

Leadership at this institution had identified a team of individuals to initiate the change process, but decisions had not been made to put all plans into action. There was also indication that the leadership structure would be changing (e.g., dean going back to faculty). The institution was responding to a variety of factors (e.g., accreditation, feedback from employers, general need to improve educator preparation) as the rationale for change. Physical spaces within the college could be repurposed for the initiative; however, lingering challenges about funding resources, competing priorities on institutional leadership, and politics within the institution were cited as challenges for implementing the TPACK initiative. Midwest #1 did not have external funding in support of their initiative and instead sought to restructure existing personnel, physical spaces, and the means of bringing faculty from across colleges together toward the goals of their initiative. This institution was using the diagnostic tool to aid in the decision-making process and to assess how existing resources might be best utilized in efforts to move the college forward in preparing faculty and candidates to use technology for learning and teaching.

Midwest #2

The original goal as listed in Midwest #2's application for this study was to integrate instructional technology across the academic curriculum in a three-phase model focused on user skill development, instructional tools development, and use with students in clinical experiences through a one-to-one technology initiative utilizing iPads for students from their freshman through senior year. The project evolved and expanded to include an entire classroom equipped with makerspace materials, Lego robotics, coding, and 3D (three-dimensional) printers. When discussing use of the diagnostic tool to support the initiative, Midwest #2 appeared to be in the developing stage in most areas. It was the most advanced in terms of scalability. The dean, who was responsible for leadership of the initiative, stated that the TPACK framework and the diagnostic tool helped her to "clearly communicate to both internal and external audiences, how when technology is used effectively [with pedagogy and content] ... [the approach] can improve the learning for everybody." At the point of the second interview, Midwest #2 stated that they had a "pretty cool" faculty- and student-shared professional development model and that enrollment in the College of Education had doubled, describing the technology changes as contributing to this increase.

The message was [the instructor] had to use it even though he didn't find an instructional rationale for it. What I think the [diagnostic] tool provides [is] like a pause button for administrators before they spend thousands of dollars on this shiny object. Why don't they think how and why that [the technology] would be useful as part of the larger program?

Likewise, the grant director at Eastern used the tool "as a check" and "reflection tool" for herself, "to think about where we are and how we need to move through this." She shared:

I was stuck. I wasn't getting where I wanted to go, so to look back and see what are these other factors that I have control over that I might be able to address or another pathway that I might move this forward.

Participants commented on the value of the diagnostic tool, including the 12 elements and the statements within each cell; as the leader from Eastern expressed:

[The statements within each cell] help[ed] you to look as you [are] defining, refining, developing programs or initiatives ... You can't attend to everything. I feel the same way about this rubric ... I can't attend to everything at every moment, but it helps me to think about where is the appropriate pressure point right this minute.

The categories of the TPACK leadership diagnostic tool (the zone of wishful thinking, what can be controlled, and key leadership functions) were addressed by all the teacher

Table 3. Frequency of Year 2 Interview Codes

Category	Code	Frequency	Range	
			Minimum references by a single participant	Maximum references by a single participant
Zone of wishful thinking		36		
	Additional resources	4	0	4
	Culture of partner schools conducive to goal	5	1	2
	Faculty members willingly allocate time and attention	10	1	5
	Favorable policy environment	10	2	5
	Scalability	7	1	4
What can be controlled		21		
	Engagement with internal/external partners	3	1	1
	Fiscal resources	7	1	4
	Human resources	4	0	4
	Personal resources	7	1	4
Key leadership functions		39		
	Develop faculty capacity	18	2	8
	Organizational redesign	13	2	7
	Vision statement	8	1	5

education leaders during their interviews. Each element within these categories provided insights and raised additional questions into how leadership could move ahead with supporting TPACK-based initiatives. While the tool appeared to be useful for spurring reflection, it was not apparent that it was used as an essential reference during the implementation of participants' respective initiatives.

Current practices and setting goals

Findings from the second research question, "In what ways did the TPACK leadership diagnostic tool serve as an opportunity to examine current practices and set realistic goals?," are discussed next. Results of this section are structured upon the diagnostic tool's three sections: (a) zone of wishful thinking, (b) what can be controlled, and (c) key leadership functions.

During the interviews, participants referred to all elements of the diagnostic tool, with most participants mentioning each element at least one time (Table 3). Across the three categories of the tool, "key leadership functions" were most often referenced ($n = 39$), with items in the "zone of wishful thinking" second ($n = 36$). Items within "what can be controlled" were identified less frequently ($n = 21$). Added together, "developing faculty capacity" and "faculty willingly allocate time and attention" were mentioned 28 times.

Zone of wishful thinking, Favorable policy environment. All three participants referenced favorable policy environment in terms of accreditation policies (e.g., CAEP), initiatives from the U.S. Department of Education Office of Educational Technology and several professional associations (e.g., ISTE), and/or a collaborative project undertaken by representatives from several professional associations. Participants also mentioned the relevance of the policy environment (e.g. internal politics, competing demands for finances, and competing priorities) at the college, university, and state levels.

Additional resources. Only Midwest #1 mentioned this element of the diagnostic tool, referring to the "price tag" and "trying to find money" for selected projects in support of TPACK integration and "talking to the provost and outside resources to make that

happen.” The other two institutions had already obtained additional resources: One had a major grant and the other had raised funds via a capital campaign.

Faculty time and attention. Participants expressed concern about obtaining faculty time and commitment and motivating faculty. The grant director from Eastern saw faculty time as “a critical resource ... What has been a bigger barrier is time and folks are being asked to do more and more with less and less time.” Although a leader in the technology initiative, she was not in a position with direct influence on faculty commitment. The participant from Midwest #1 referred to the need to persuade faculty from different programs across the university to integrate TPACK into their programs. Faculty “buy-in” was also mentioned by the participant from Midwest #2.

School partners. All three participants mentioned university outreach to area schools. Eastern’s grant included funding for coaches to work with P12 faculty; pairing professional development with curriculum reform went “hand-in-hand.” Midwest #2, in a rural location, provided area school personnel with an opportunity to view the college’s 21st-century technology facilities for teaching and learning. Midwest #1 established a mentoring project, pairing undergraduate education technology students with teachers at a local high school to implement a new learning management system.

Scalability. The TPACK leadership diagnostic tool defines scalability in terms of curricular changes involving the adoption and implementation of the TPACK framework. The dean at Midwest #2 confirmed that its initial launch of a large-scale technology initiative focused on integration of technology in the curriculum. Participants from other institutions also referred to specific TPACK elements such as technology (e.g., planning for a digital playground—Midwest #1) and pedagogy (e.g., using a design studio as a place to “create projects for their students’ learning”—Eastern), in addition to programs that might be “bolstered” by a TPACK initiative, such as curricular changes in process to include TPACK elements within programs” (Midwest #1). Thinking about scaling up, one participant reflected on the adoption process itself, noting “that change takes time and things don’t necessarily move as quickly as I’d like.”

What can be controlled. Human resources. Human resources within the diagnostic tool refers to faculty, staff, and so on who have agreed to participate, and/or are supported in integrating TPACK curricular areas. For example, Midwest #1 identified themselves as being in the developing phase of the diagnostic tool’s human resources elements and identified five individuals most directly involved in their initiative. While the dean was the division head, the associate dean oversaw educator preparation and was tasked with making decisions about how spaces within the college were to be utilized. A technology director managed requests for technology purchases and equipment troubleshooting and repair, a support employee was tasked with working on the student information system TK20 and portfolio support, and a tenured associate professor coordinated technology integration and adoption efforts for faculty and students. There were also existing personnel such as graduate student assistants that could be used to help with the initiative.

Fiscal resources. All three institutions commented on how fiscal resources made an impact on the initiatives. Midwest #2 indicated they had completed a capital campaign that was used to purchase almost all of the equipment in their initiative. Eastern had received a grant that provided resources to faculty and to support development of a makerspace within their design studio. Despite these resources, the Eastern participant indicated uncertainty about the continuation of funding: “We are in year 3 out of 5, subject to annual appropriations. At this point we are not sure, but we are proceeding as if there is going to be a year 4 and 5.” Midwest #1 indicated that they were just beginning to make decisions about budgeting and that there were competing priorities for limited fiscal resources.

Personal resources. This section of the diagnostic tool defined personal resources as how “time, attention, messages, political capital, etc. ... are being used to support of the TPACK

initiative.” The participant at Eastern indicated that she was the project director for the grant, but not actually program faculty. Instead, her role was to support faculty members and their research by providing resources through the grant that allowed faculty members to use technologies within the teacher education program. Midwest #1 defined each team member’s role within the initiative. The dean indicated that he planned to return to a faculty position at his institution, but was currently still the unit head to support faculty and make sure that resources were available. The dean identified the associate dean as the key person who would lead the vision into action. The associate dean indicated that he would serve as a facilitator, connecting resources and individuals together in alignment with CAEP accreditation and looking at the technology theme throughout. The faculty member identified his role as helping to facilitate the adoption and integration process throughout the college.

Engagement with internal/external partners. This section of the TPACK leadership diagnostic tool indicates how teacher education programs are engaging with internal/external partners about the TPACK initiative. The tool specifically indicates that internal and/or external partners (e.g., grant funding agencies, other TPACK initiatives) should have an understanding of their responsibilities and incentives to support the TPACK initiative. Results related to this section of the tool were limited. Midwest #1 indicated that they were in the developing stage. Midwest #2 reported that the initiative had helped the college communicate to both internal and external audiences how pedagogically sound practices improve learning for everyone. Eastern stated that the spaces provided through grant funding (e.g., makerspace) created avenues for outreach with partners and opportunities for future grant proposals.

Key leadership functions. Vision statement. Although all three participants described their projects in terms of potential results, none shared that a vision statement was guiding their plan of action. Midwest #2 commented that their project was a good investment because it would result in better teachers and it led to increased enrollment. Eastern stated that their project was building a better understanding of technology among their faculty. Only Midwest #1, when asked about a vision statement, commented that such a statement was “developing.” These key leaders noted that they were thinking and planning how to effectively utilize space and align their project with the domains of knowledge within the TPACK framework.

Develop faculty capacity. All three participants admitted that faculty development was a challenging area. Midwest #1 had a dedicated faculty leader to specifically work with faculty to develop their capacity. One activity was a professional development workshop for content area faculty that included augmented reality elements demonstrating instructional activities using a variety of technologies. The program director from Eastern stated, “I am not program faculty so it’s much more a support role. I provide resources through the grant that allow faculty to research, to learn about and to employ these technologies in their teacher education program.”

Organization redesign. The diagnostic tool defines organization redesign as “Leaders have used resources aligned to vision and program change goals and incorporated externally related requirements to redesign curricula and support for TPACK implementation.” The participants varied in their interpretation of “organizational redesign.” Resources were interpreted as physical, monetary, and human resources. Midwest #1 focused on the fact that they were preparing for a CAEP accreditation review. This was an important factor in examining the entire spectrum of technology use throughout the educator preparation program, including space, professional development, and curriculum with a TPACK focus. Eastern and Midwest #2 participants’ responses focused on the physical redesign of space.

Participant recommendations

Participants recommended additions to the tool that might address the TPACK elements more specifically. These recommendations address the third research question, “What are

education leaders' recommendations for the TPACK leadership diagnostic tool?" Both the director at Eastern and the dean at Midwest #2 suggested the possibility of additional specificity in relation to addressing TPACK within the diagnostic tool—perhaps as “guiding questions” in terms of curriculum development (Midwest #2). The grant director at Eastern offered questions including: “What is the technology applicable within the content discipline as well as what does the discipline not know about how to use the technology yet?” The grant director at Eastern also reflected that the diagnostic tool could apply broadly to pretty much any initiative in the education field:

I think it is generic. Substitute in another initiative and I think it would be useful to help people think about—what are these things you need to address as you're moving a change initiative forward, and [the tool] has that applicability, other than TPACK.

Additional recommendations for utilization of the tool included opportunities for leaders to:

- Examine where a college is in terms of policy environment, resources, vision, and partnership, with a view of the “ideal.”
- Assess and make plans about how to move forward with TPACK at the program and faculty levels.
- Reflect on appropriate pressure points to leverage progress or to hit the pause button before moving forward.
- Communicate with upper level administration, to assure them of a framework for planning, implementing, and evaluating the initiative.
- Introduce key players to the initiative with a starting point for self-evaluation and planning, and what might be seen as a set of “essential conditions” for success.

When asked about their initial suggestions for improving the utility of the diagnostic tool, participants proposed possible additions to the content or structure of the tool. These suggestions included providing examples of the elements in the tool, illustrating what levels of implementation might look like, adding expectations for TPACK-specific curriculum development, and tracking how the technology has changed instruction.

The categories of the TPACK leadership diagnostic tool provided education leaders with opportunities to reflect on the variety of decisions that needed to be made in order to successfully implement a new initiative. On the other hand, the diagnostic tool in its current form was recognized as something that could be used more generically by leaders as they took on any new initiative, not just those dealing with technology adoption and integration.

Discussion

The TPACK leadership diagnostic tool “was developed as a self-assessment tool to serve the individual institution in its decision-making process” (Graziano et al., 2017, p. 378). This study investigated how education leaders utilized the diagnostic tool during the implementation of TPACK-based initiatives at three teacher education institutions. Results indicated that all components in the diagnostic tool were relevant for education leaders as they planned for and implemented their initiatives. Education leaders used the diagnostic tool to engage with others about their initiatives, to consider how physical spaces and personnel could be repurposed in support of their initiatives, and to think critically about prioritizing competing political, financial, and contextual demands. Results illustrate that leadership decisions were instrumental in the planning and implementation of TPACK initiatives. Five important areas for decision making are discussed in what follows.

Vision for change. Participants each described a rationale for redesigning their educator preparation programs to embed technology. However, while they had specific reasons for pursuing their TPACK initiatives, they did not clearly articulate overall visions of how their preparation programs would develop TPACK competent candidates or how their initiatives were aligned to the vision of their respective universities.

Creating opportunities for faculty. Education leaders have an important role to play in addressing the competing demands on faculty time and attention. How leaders advocate for, recognize, and incentivize faculty members to participate in initiatives are key factors to help faculty members prioritize these demands (Hall & Hord, 2015; Hord, 2017; Kolb, Kashef, Roberts, & Borthwick, 2018). Leaders in this study developed, or planned for, opportunities for faculty to engage with each other and school partners around technology adoption, integration, and modeling of TPACK, but they also recognized that scaling up these initiatives would take time (Hall & Hord, 2015).

Engagement with internal/external partners. Participants indicated that TPACK initiatives, including new educational spaces, created opportunities for outreach to external partners such as a technology mentoring program and professional development for area teachers. Questions remain, however, about how the diagnostic tool was used to improve the internal/external partners' understanding of their responsibilities and incentives to support the initiative.

Funding. Two of the three institutions funded their TPACK initiatives through external funding sources (Eastern: grant, Midwest #2: capital campaign). While external funding is often used as a catalyst for initial change, technology initiatives require dedicated budget allocations to sustain progress (ISTE 2017b; U.S. Department of Education & Office of Educational Technology, 2017). Only Midwest #1 depended on existing personnel, budgets, and resources to enact their TPACK initiative. A personnel change impacting one institution was that the dean would be retiring. Without a continuing higher level decision maker in place to spearhead the change process and carry on support for the initiative, it was unclear how funding might fare in the future (Hall & Hord, 2015).

Restructure of physical spaces. Each institution mentioned the restructuring of physical spaces as part of their initiatives. The interrelationship between restructuring of physical space, faculty development for transformational instructional practices with technology, and improved teacher education candidates appears to be fertile ground for further research.

Results revealed that having a designated leader to manage participants' TPACK initiatives was a key factor for success (Kolb et al., 2018). However, utilization of the diagnostic tool for its intended purpose varied. For example, at Midwest #2, the dean was the lead for the project. Although it appeared that the dean began with the desire to utilize the diagnostic tool at the beginning of her initiative, the tool did not appear to be employed as a "checkpoint" as the initiative progressed. Leadership for TPACK initiatives at the meso level of the institutional context (Porrás-Hernández & Salinas-Amesúa, 2013) is crucial when juggling competing institutional and financial priorities. Without leadership to prioritize goals and support personnel, the ability to empower faculty and transform organizations may linger adrift (Argyris & Schon, 1974; Hill & Celio, 1998). Most importantly, the TPACK leadership theory of action identifies that leadership learning and practice precede faculty learning (Thomas et al., 2013).

Conclusion

Based on this case study, participants did not continuously refer to the tool as a "road map" throughout the implementation of their initiatives. Results indicate that effective use of the tool requires support, scaffolding, or even training. Possible steps to ensure effective use of the tool include:

- Encouraging leaders to complete the Measures/Artifacts Used column within the diagnostic tool to define for their context how they will evaluate the development and outcomes of TPACK initiatives. For example, prompt education leaders to check their institution's vision statements to ensure that their TPACK initiatives are aligned with their institution's vision or define what may be for them, a favorable policy environment. The decision to include the column Measures/Artifacts Used provides a means for those involved in the process to keep a record of the change process and program development (Graziano et al., 2017). This can provide an opportunity for self-review and/or evaluation of each item in the diagnostic tool.
- Developing a process for use of the diagnostic tool to assist leaders throughout the implementation of their TPACK initiative. This process may include networking with other professionals as exemplified in the Future Ready Schools initiative (Alliance for Excellent Education, 2018) or recommended "check-in" points for an institution's leaders to collaboratively determine best use of the tool, to measure progress, and to consider areas of concern, as well as next steps. For example, at what stage does a leader focus on elements in the zone of wishful thinking, or does the leader revisit the zone at multiple times in the process?
- Providing education leaders with TPACK resources to help them convey the necessity of and opportunities for change. This study confirmed the essential nature of faculty participation in TPACK-based initiatives. Education leaders with knowledge of TPACK within instructional practice can use their knowledge to convey a vision for technology use, develop faculty capacity (Foulger, Buss, Wetzel, & Lindsey, 2015), and enhance buy-in for the initiative. Leaders' knowledge of TPACK within context can also help to create time and space for faculty development, and opportunities for faculty members, and their teacher education students, to model and practice technology-infused instruction.

Without guidance for leaders to understand and participate in the change process, leaders may be left chasing grant funding for technology or undertaking a vision based on the determination of a single individual. Neither is optimal if the goal is transformational and sustainable change for effective technology use by teacher education faculty and candidates to enhance P12 learning. Leaders need to thoughtfully reflect on how competing priorities and resources, faculty time and attention, involvement of school partners, and the ever-critical policy environment can impact the development and implementation of their TPACK-based initiatives. Making time to consult elements, such as those outlined in the TPACK leadership diagnostic tool, while leading the change process of TPACK-focused initiatives can help ensure that the initiatives are successful.

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Appendix: TPACK Leadership Diagnostic Tool

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Leaders need to consider a number of issues when determining how to design and implement teacher preparation programs that will prepare Technological Pedagogical Content Knowledge (TPACK) ready teacher candidates (Thomas et al.,2013). Among these considerations is developing a process to prepare teacher education faculty in their understanding of the interplay of TPACK elements. This TPACK leadership diagnostic tool is designed for self-reflection and guidance for teacher education leaders and leadership teams as they develop vision and plans for developing a technology rich model for teacher candidates to become 21st century educators. The diagnostic tool serves as an opportunity to examine current practices and to help develop realistic goals for program development.

Theory of Action

How do policies in your University/College/School support your teacher candidates to acquire Technological Pedagogical Content Knowledge (TPACK)? What elements within your University/College/School can impact change initiatives related to TPACK integration into programs?

Zone of wishful thinking	Beginning	Developing	Acceptable	Leading	Measures/ artifacts used
Favorable Policy Environment	The aspects of the environment (internal and external) have started to articulate policies to guide the change process.	The aspects of the environment (internal and external) have drafted articulated policies to guide the change process.	Most aspects of the environment (internal and external) have clearly articulated policies to guide the change process.	All aspects of the environment (internal and external) have clearly articulated policies to guide the change process.	
Additional Resources	Information on additional resources (incentives, operating funds, etc.) is being collected and budget issues are being identified.	Additional resources (incentives, operating funds, etc.) have been identified and a draft budget has been developed to support action.	Additional resources (incentives, operating funds, etc.) have been identified and budgeted for some support of action.	Additional resources (incentives, operating funds, etc.) have been identified and budgeted for long-term support of action.	
Faculty Time and Attention	Information on faculty time and attention for steps to change is being collected.	Faculty time and attention for steps to change have been identified.	Faculty time and attention for steps to change have been included in the process.	Faculty time and attention for steps to change have been an integral part of the process.	
School Partners	Partnerships are being identified for TPACK initiatives for teacher candidates.	Partnerships are being developed to include TPACK initiatives for teacher candidates.	Partnership relationships are being extended to include TPACK initiatives for teacher education.	Partnership relationships are established with long-term mutual benefits, including TPACK initiatives, for teacher education.	
Scalability	TPACK elements and curricular areas are being identified.	Curricular changes are being processed to include TPACK elements within programs.	TPACK is included in the majority of the teacher education curriculum.	Entire teacher education programs embrace TPACK as part of the curriculum.	

What can be controlled?	Beginning	Developing	Acceptable	Leading	Measures/artifacts used
Human Resources	Information is gathered about interest by faculty and staff involvement with TPACK initiatives.	Faculty and staff are identified regarding levels of interest in participation in TPACK initiatives.	Faculty, staff, etc. have agreed to participate in TPACK integration initiatives.	Faculty, staff, etc. are supported in integrating TPACK into curricular areas.	
Fiscal Resources	Allocation of budget issues for TPACK initiatives are being identified.	Budget allocations for TPACK initiatives are being considered.	Some budget allocations include resources for integration of TPACK initiatives.	Fiscal resources have been budgeted for long-term integration of TPACK initiatives.	
Personal Resources	Information is gathered about time, attention, messages, political capital, etc. to support TPACK initiatives.	Time, attention, messages, political capital, etc. are being developed to support TPACK initiatives.	Some time, attention, messages, political capital, etc. are being used in support of TPACK initiatives.	Time, attention, messages, political capital, etc. are all being used in support of TPACK initiatives.	
Engagement with Internal/ External Partners	Information is gathered about responsibilities and incentives for internal and external partners for TPACK initiatives in teacher education.	Responsibilities and incentives are identified for both internal and external partner responsibilities for TPACK initiatives in teacher education.	Internal and external partners have understanding of some responsibilities and incentives for TPACK initiatives in teacher education.	Internal and external partners have clear understanding of responsibilities and incentives for TPACK initiatives in teacher education.	

Key Leadership Functions

How do policies in your University/College/School support your teacher candidates to acquire Technological Pedagogical Content Knowledge (TPACK)? What resources do you have available in your University/College/School to generate and support initiatives to integrate TPACK into your programs?

	Beginning	Developing	Acceptable	Leading	Measures/artifacts used
Vision Statement	The vision statement is being drafted with consideration of a rationale and goal statements that will guide ideas for teacher candidate TPACK development.	The vision statement is undergoing revisions to include a rationale and goal statements that will guide ideas for teacher candidate TPACK development.	The vision statement includes a rationale and includes goal statements that provide ideas for teacher candidate TPACK development.	The vision statement shares a rationale and supports goal development for teacher candidates' TPACK development.	
Develop Faculty Capacity	Leaders are aware of the need for procedures to address a TPACK-based professional development process and the need for data to be used for improvement and incentives.	Leaders are developing procedures to address a TPACK-based professional development process that will include data to suggest means for improvement and ideas for incentives.	Leaders have identified a TPACK-based professional development process that includes data to support improvement and faculty participation incentives.	Leaders have developed and implemented a TPACK-based professional development process to support TPACK that is data based for continuous improvement and includes faculty participation incentives.	

(Continued)

(Continued).

	Beginning	Developing	Acceptable	Leading	Measures/ artifacts used
Organization Redesign	Leaders are preparing a plan that includes identification of goals, the resources to meet them, and any external requirements for TPACK implementation.	Leaders have prepared a plan that includes using resources aligned with the vision and goals and includes identification of external requirements for TPACK implementation.	Leaders have implemented a plan to use resources aligned to vision and goals and have identified external requirements to redesign curricula for TPACK implementation.	Leaders have used resources aligned to vision and goals and incorporated externally related requirements to redesign curricula and support for TPACK implementation.	