Chapter 10
A Typology for Professional Development

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ABSTRACT

In an attempt to improve the efficiency and effectiveness of the professional development activities offered to help teachers improve their use of technology, the leaders of a rural school district participated in a design process modeled after the Delphi technique. Leaders from the schools summarized past efforts and created plans for future professional learning. Those summaries and plans were critiqued by a panel of experts through multiple iterations. The documents created through that process along with transcripts of the discussions of the panel of experts were analyzed to identify the factors that affected the group's decisions. Three dimensions were identified, and variation in those were used to define three types of professional development activities.

INTRODUCTION

One purpose of school has always been to help students become competent readers, writers, reasoners, and calculators; this means teachers incorporate the dominant information technology tools into their lessons. The details of this teaching and nature of the skills taught depend on the technologies used in the social system for which students are being prepared. For many generations of students in public schools, the tools were those needed to participate in a society dominated by print and the written word. Throughout the 20th century, electronic media emerged and became widely used in popular culture. Despite promising rhetoric from advocates, efforts to use radio, movies, and television in education largely failed (Cuban, 1985) and they disappeared from classrooms or were used for marginal purposes.

The arrival of desktop computers reversed the trend to marginalize electronic technologies and information in classrooms; digital tools and digital media have become important tools for all students, and comprehensive education is understood to provide students experience using these tools. Early in the history of desktop computers in K-12 schools, the Apple Classrooms of Tomorrow (ACOT) project sought to understand the role of computers in education and the factors associated with the effective use

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of technology. One of the findings of that early study focused on the nature of teachers' learning about technology. According to ACOT researchers, it is essential to teach teachers both how to use hardware and software and to support teachers as they create curriculum and instruction that incorporates technology (Sandholtz, Ringstaff, & Dwyer, 1997; Schofield, 1995). Teaching teachers how to operate the computing devices in their school does not mean they will be able to use them effectively for teaching and learning.

Drawing on the observations of ACOT, school and technology leaders have dedicated time and resources to supporting teachers' learning about technology during the years when desktop computers and high-speed Internet connections were installed in schools. This practice has continued as one-to-one computing became common and as schools adopted web-based systems for all aspects of teaching and learning as well as school management. Despite decades of attention to teachers' growth as technology-using professionals; organizing and presenting effective professional development continues to be a problem faced by practitioners, leaders, and scholars. The tenacity of the problem arises from the rapid evolution of technology (de Reuver, Sørensen, & Basole, 2018), the effects of technology on pedagogy (Gordy, Jones, & Bailey, 2018), the lack of a dominant theory of educational technology (Hew, Lan, Tang, Jia, and Lo, 2019) and a variety of teachers' personal skills and beliefs (Joo, Park, & Lim, 2018).

Given these observations, it is reasonable to expect school and technology leaders to sustain efforts to develop teachers' skill using information technology and their abilities to use these tools to teach. Indeed, effective professional development continues be an active area of scholarship (Jin, Li, Meirink, and der Want, & Admiraal, 2019; Merchie, Tyytens, Geert, & Vanderlinde, 2018). The exact nature of the professional development necessary for teachers to understand how to efficiently use computers and to create meaningful activities using it depends on the nature of the students, the initiatives of the school, and the individuals' capacity to develop this knowledge. Meeting these needs can be especially challenging for rural schools that tend to be smaller and have fewer resources to be dedicated to professional technology staff than suburban and urban schools. This chapter describes the efforts of one rural school district to improve this aspect of their professional development program that supports teachers' learning about technology.

PURPOSE

The project described in this chapter was motivated by a group of school leaders who were dissatisfied with the current state of their efforts to provide professional development for their teachers. As the curriculum coordinator who led this team explained,

we offer 'technology workshops' and we get some high-fliers who attend, and others who are just starting out. We need a way to clarify—as leaders—what we want and need, and we need to communicate that to the consultants who help us teach teachers and the teachers who are signing up. We need to give everyone better information so principals and teachers can make better decisions about what to attend so they get what they need, and only what they need. We end up frustrating faculty who make the effort to attend workshops, but they leave feeling it was a waste of their time.

In order to address this situation, the curriculum coordinator initiated a project to design a comprehensive plan for supporting teachers' learning about technology and its role in the classroom. As the work proceeded, several themes focused the work, and eventually these were sufficiently well defined

that they were used to define a typology. While such a definition was not the intent, it was reasoned the typology captures the purpose and strategies of the activities, and its use will facilitate all aspects of supporting teachers to use technology in their classrooms.

THE SETTING

This project involved the leaders of a school district in the northeast USA comprising five small schools enrolling students in grades PK-6 and a single school which enrolls students in grades 7-12. The 7-12 school enrolls about 480 students in a typical year; most of those students attended one of the five elementary schools in the district, but others choose to attend it as they live in towns that do not require students to attend a specific secondary school. The 7-12 school along with the central office are located near the geographic center of the district; the schools that are furthest from the central office are separated from each other by almost 20 miles.

The curriculum coordinator for the school district led a curriculum and instruction team which included the principals from all of the elementary schools and the assistant principal at the 7-12 school. The committee was responsible for all aspects of teachers' professional development and often "used data to make decisions about what to focus on for the upcoming year." All members of that committee indicated an interest in promoting the use of technology in their schools, but all also indicated they felt this was outside of their areas of expertise. One of the principals summarized the position of the group when she stated,

We all know we need to do this well. Technology is in our district and school vision statements and the school board is very supportive, and we try hard, but sometimes we just don't have the experience we need. I mean, my background is literacy, I can plan professional development to help our teachers help struggling readers, but technology is not my field.

Pointing to another principal, she continued, "he can do the same for science, and I trust his judgement, but who here can we trust when we talk about technology?" The school leaders described their existing professional development efforts with the term *ad hoc* to capture the lack of consistency and direction in their efforts to support teachers' learning about technology, but they "needed some good scaffolding, so we can be more systematic and more purposeful than we have been."

It should be noted as well that the district had previously retained a technology coordinator who was responsible for managing the information technology infrastructure, and he was also involved in organizing and presenting professional development in educational technology. The curriculum coordinator described the failed search to fill that position,

We realized [our best candidate] was really good at technology but had no education background. The search committee couldn't decide which direction to go, so we left the position open. Right now, we have technicians in each school who keep stuff up and running, set up email accounts, [and manage the network], but they stay away from teaching issues.

The members of the curriculum and instruction team concurred the infrastructure in their schools was robust and reliable, and they had contracts with vendors to provided sufficient support. "After hiring

consultants to do some technology workshops, we decided—as educators—we needed to take a more active role leading our work with educational technology," explained the curriculum coordinator.

DATA COLLECTION

Because the leaders in the schools sought to answer the question, "What can we do to improve our practice?" the author (who was retained as an external consultant for this project) recommended adapting Delphi research methods (Delbeq, Van De Ven, & Gustafson, 1975) for this project. Typically, Delphi methodology finds a panel of experts discussing a question in multiple sessions until they reach consensus regarding the answer. The methodology has a long tradition of application to planning and administrative problems when new strategies are deemed necessary (Malekpour, de Haan, & Brown, 2016)

The data reported in this chapter were generated as the school leaders described past practices and planned future practices for providing teachers opportunities to learn about all aspects of technology in their classrooms. A panel of experts discussed the documents that were created as these plans emerged. Specifically, data were collected from four sources. First, documents composed by school leaders were collected. Second, transcripts of recordings of the discussions held by school leaders during the work were collected. Third, transcripts of the focus panel interviews at which the panel of experts reviewed the summaries and plans were collected. Fourth, the copies of the notes kept by other school leaders and the participants in the focus group interviews were collected.

Capturing Previous Professional Development

Because there were existing professional development practices, the school leaders began the project by summarizing what they had done in the last year. Those summaries were compiled and edited by the author and the curriculum coordinator who confirmed they accurately reflected the professional development activities of the previous school year. Once the summaries were completed, the principals were asked to compose brief (fewer than 500-word) reflections on the effectiveness of their efforts including, "your perceptions of what was successful, what you heard teachers say about it, and changes practices you noticed after the professional development."

At the end of this step, a 12-page summary of the previous professional development activities that had been undertaken to improve teachers' use of technology had been created. For each of the five schools and the central office there was one page that contained a paragraph summarizing the goals and content of the activities that had been undertaken at the location and a bulleted list of the specific activities that were offered. In addition, there was a one-page reflection on the effectiveness of the activities at each site.

First Focus Group

The author recruited five professionals who work in the field of educational technology to participate in a discussion and critique of the summaries and reflections. Two were technology coordinators who had more than ten years of experience managing information technology networks and supporting educators in K-12 schools. One was a high school science teacher who was recognized as being one of the leading users of technology in the district where he worked; he is also a frequent presenter at regional conferences on the use of technology is science classrooms. One was a technology integration special-

ist who had left her elementary classroom about five years previously to work with other faculty to use technology in their classrooms. The fifth was a former teacher who had recently left the classroom for family reasons, and who was perusing a graduate degree in educational technology to assume a leadership role in technology when she decided to return to work. While it is expected some of the focus group participants may have had professional acquaintances with the school leaders, the two groups were never identified to the other.

The participants agreed to participate in the first of two 30-minute focus group interviews over a software-based video conferencing platform (the group choose to use Zoom). Two days before the meeting, each participant received a digital copy of the summary of past activities. Each was asked to print the document and was encouraged to take any notes they wished before and during the interview. Further, each participant was informed the focus the semi-structured protocol would begin with the prompt "What seemed to focus their decision making?"

The participants agreed to have the focus group interview recorded, and they were aware the audio recordings were to be shared with the school leaders. Also, the participants understood the audio recordings were to be transcribed and coded with excerpts being used to report the work. Further, they scanned their copies of the documents, including the notes they took, and they understood those would be transcribed and coded as well.

Preparing a New Plan

At their next curriculum and instruction team meeting, the leaders watched a video recording of the focus group interview. After watching, they dedicated 30 minutes to brainstorming a new plan for organizing professional development in technology for the following year. At the end of their allotted time, the group was dissatisfied with the current state of the emerging plan. As a result, they decided to continue working on the plan independently until the next meeting where they would spend 30 minutes to prepare a draft of a plan for the professional development for the next school year. Audio recordings of those two meetings were transcribed, and the notes kept by the school leaders during and between the meetings were also collected and transcribed.

Second Focus Group

Once the draft of the new professional development plan was prepared, it was sent to the participants in the original focus group. Two days later, each reconnected to the same video conferencing platform as was used before and each had printed and annotated the new draft. Due to an oversight, the participants did not receive any indication the content of the semi-structured protocol until about 30 minutes prior to the focus group session. That protocol included three questions: "What appears to have been their rationale?" "What can they do to improve the content of these sessions?" and "What can they do to ensure the success of this plan?" An audio recording of the second focus group, along with the participants' notes were transcribed.

Preparing the Final Plan

After listening to the audio recording of the final focus group interview, the curriculum and instruction team composed their final plan for organizing and presenting professional development in the following

year. The plan did not describe the contents of the professional development activities that would be offered. It did define several characters of the sessions that teachers and leaders were expected to include in their planning. The characteristics were captured in a collection of document templates that would be used to plan and announce learning activities for teachers. While this plan was not reviewed by the focus group, each member received a copy and were asked to provide any final reflections; further, the curriculum and instruction team participated in a final discussion that lasted 10 minutes. This discussion was also recorded, transcribed, and collected.

Coding the Data

Two individuals, the author and one of the participants in the focus group interviews who was a graduate student enrolled in a research course, coded the transcripts, documents, and notes that were the data collected during all phases of this project. The first step of coding the data was identifying the words that appeared most frequently in the digital copies of the documents and the transcripts. These words became the major categories used to for the initial coding of the data (Savin-Baker & Major, 2013). The researchers read a sample of the documents using the codes derived from the most frequent words. When negotiating the interpretation of those codes, they determined several could be combined, thus reducing the number of codes. For example, "experts" and "expertise" were easy to combine, and they included "knowledgeable" as that was applied to use to describe the individuals who were demonstrating technology or otherwise coaching teachers as they learned. This process reduced the number of codes to six and the researchers read the data coding for these identified themes, but also identifying additional themes consistent with the constant comparative method (Glaser, 1965).

In discussing their coding of the data, the researchers concurred that three themes "technology," "expertise," and "students" dominated the conversations. Specifically, the researchers concurred that the data recorded the group's increasing focus on those themes. Both researchers had independently decided to use only these three codes and "other" to code the transcript of the meeting at which the second plan was drafted and the focus group discussion of that plan. In the final negotiation of the codes, the researchers concurred that "focus on technology," "source of expertise," and "the role of the students" were the dominant themes.

DIMENSIONS OF TECHNOLOGY PROFESSIONAL DEVELOPMENT

Because the three themes appeared to describe independent (although connected) factors that varied in opposite ways, they were interpreted as dimensions which can be defined along continua. Benchmarks along the continua were defined so that different values of each could be useful in predicting the type of learning experience that was to be planned as well as to explain the nature of the professional development activity to school leaders and other educators.

Focus on Technology

While it may seem obvious that technology is an important factor in planning for professional development in the field, the leaders who participated in this project demonstrated a more sophisticated understanding of technology at the end of this project compared to what they had at the start of the project. These

leaders differentiated "teaching teachers which buttons to push to do what they need" from "learning which features are useful for students" from "understanding why students need to use the features." They further perceived the basic operation of information technology systems to be the foundation for teachers' use of technology. "Some things we need to be sure people we hire have, but for other skills, we need to show them what to do when they first start or when we change our systems," wrote one of the principals when reflecting on the past professional development. Accurately describing what they expected teachers to be able to do when they arrived for professional development activities became a focus of their future professional development plans.

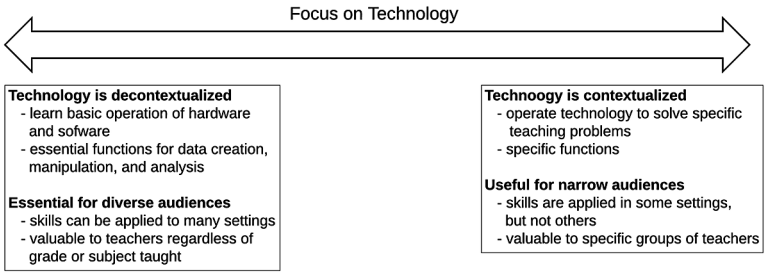
The leaders' emerging understanding of technology was grounded in the context within which the technology was presented. When it was decontextualized, there was no consideration of the setting in which the technology would be used. Decontextualized technology skills were perceived as needed by all teachers regardless of the subject they teach or the age or nature of the students their classrooms. This led to their use of "breadth of application" as a factor in their planning. Professional development in which the skills could be used to create and disseminate information to all students and audiences was differentiated from that technology used to accomplish specific tasks or to create for specific audiences (see Figure 1).

Efforts to use a new student information system (SIS) illustrates the emerging understanding of the need to focus on technology for professional development in this area. Whereas the school leaders perceived "using the new student information system" to sufficiently describe the professional development they had offered previously, the school leaders realized different users expected different types of outcomes from this vague description.

"I kind of assumed knowing how to use [computers] was just part of teachers today," observed one principal and her colleague continued "but, we found out that some young teachers who were savvy still struggled with the basics of [the SIS], just because they were unfamiliar with both [the interface] and the types of reports we were creating." They contrasted the needs of those teachers with those who were familiar with using an online SIS. "My tech-savvy teachers became very frustrated with the new student information system," one principal noted, "we have been doing online grades for years, but they just couldn't figure out how to set the scales, enter grades, then generate reports that were useful to students and parents." The needs of those veteran teachers were understood to be different from the new teachers "who were trying just to get logged on and understand the basics of using the system. Putting them together just won't work."

Referring to the sessions designed to introduce the new SIS, the focus group commented, "If they had their new faculty in one session and covered the basics of how to get on and what they were supposed

Figure 1. Focus on technology dimension



to do and when they were supposed to do it, the time would not have been wasted." In drafting the plan for professional development for the following year, the school leaders included a template for announcing workshops; the template included a section, "If you can do the following, then this workshop is for you:" With that the curriculum coordinator noted, "we want to clearly communicate what [devices] and software we expect you to know before taking this step."

As the school leaders began to look carefully at the technology operations that were the basis for the professional development they planned, they realized the potential audience of the technology was also an important factor in their planning. The assistant principal from the high school explained the difference:

We can send our new teachers to basic SIS training along with teachers from the elementary schools, because it was the same for all. No matter what or who you teach, the demographic pages are the same, attendance is the same, and announcements are the same, so we can get everyone together and show them what buttons to push and give everyone the same handout to use when they forget what to do. When we look at [the bibliography tools] for writing research papers, however, we can focus on just our English teachers and the science and history teachers who assign long papers. Everyone needs to know how to take attendance, but not everyone needs to know how to create sophisticated bibliographies.

The curriculum coordinator noted, "I think we saw [the focus on technology] previously, but we did not make it an important part of what we communicated to faculty." She pointed to sections of the of the templates which were part of the final plan that were labeled, "This workshop is best if you teach [subject] in [grades.]" as evidence they understood the context in which the technology was to be used was an important part of the activity.

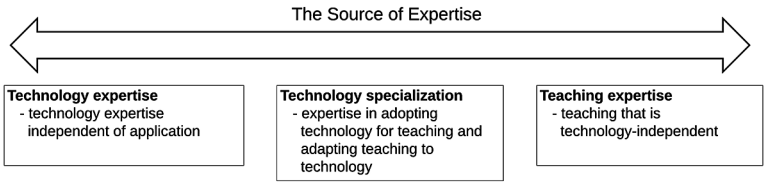
The Source of Expertise

One of the fundamental assumptions of all student-teacher relationships (including those in which teachers become the students) is that teachers have expertise in a particular area, and students work with teachers to gain some of that knowledge. Just as the school leaders who participated in this project realized a more sophisticated understanding of technology; they realized a more sophisticated understanding of the differing sources of expertise and the different types expertise necessary for a comprehensive professional development in technology.

The increasing sophistication of this understanding was grounded in school leaders' realization that knowing how to use technology is not the same as using technology in the classroom. The focus group made the observation when first reviewing the work of the curriculum and instruction team, "they don't seem to appreciate the difference between knowing which buttons to click and why we need to click them." This paralleled their discovery that technology can be differentiated into basic operation and application for a purpose. This also led to the realization that there are different types of expertise needed for different types of professional development. One principal noted, "the people who know what to click to create a graph don't always know what we are trying to communicate, which graphs are appropriate for particular students, or why it is important."

The types of expertise they identified as being important also fell along a continuum (see figure 2). At one extreme was the technology expert who understands how to use the graphic user interface to access, create, analyze or display information. The knowledge of the technology expert can be used by any teachers or staff, and that "knowledge is dispensed with little concern for who is using it or what

Figure 2. Source of expertise dimension



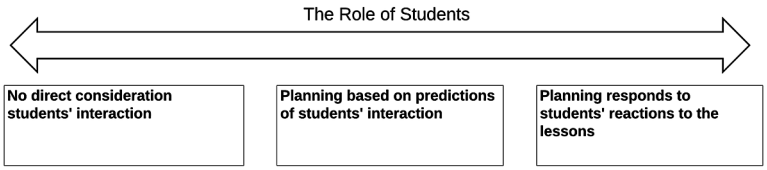
purpose they will apply it." The group also recognized this type of expertise could be developed by anyone regardless of their background and experience. The plans for future professional development included paying paraprofessionals a stipend to participate in additional training from the vendor, so they could become the local experts on operating the SIS.

At the other extreme of the continuum is the teacher who arrives at professional development activities with a strong sense of the purpose of the lessons, the nature of the students, and types of experiences that will be educative for the students. While this expertise may have been influenced by the technologies used previously, "they see teaching expertise as technology-independent as they come to learn how the apply new technologies to their classroom." One of the situations the school leaders were trying to address through this work was the recognition that "a recently-retired teacher had been using software from like 20 years ago. No one knew how it was still running, but we needed to replace obsolete technology, but accomplish the same curriculum goals." Teachers alone, it was reasoned, have the expertise necessary to make those decisions about the appropriateness of the technology tools used in classrooms.

Between these two extremes, there is a group that were identified as "technology specialists." In the data collected for this project, all of the individuals who were referenced in the data who held this expertise were teachers who had developed greater technology expertise than their peers. "Teachers can develop technology expertise by following directions and reading, but technology experts cannot become teaching experts without years of experience in the classroom," noted one of the focus groups participants. Another clarified, "that does not minimize technology expertise, but to use business jargon, teaching is the core competence of schools and that lives in teachers, not technicians." These experts were largely perceived to be gatekeepers; they influenced decisions regarding which technology would be introduced to those with teaching expertise and they served to refine the methods and strategies whereby technology is used to accomplish teachers' goals. In addition, they served as the liaison between those with teaching expertise and those with technology expertise. For example, when teachers identify problems with the SIS and how it was functioning, it is technology specialist who will communicate that to the technicians and who report back to teachers when it is resolved.

In these data, the three type of expertise were recognized as held by different individuals. The technology experts played the role of showing others how to operate the systems, but they were expected to have no expertise in teaching or learning. Some of the individuals who were represented in the data who played this role were employed by vendors of technology and others were technicians or other non-teaching professionals employed by the school. Once their work was accomplished, they played no further role in teachers' professional development.

Figure 3. Role of students dimension



The Role of Students

Students were not present during any of the past professional development activities described by the leaders, and they were not anticipated to be present in any of the planned professional development. Despite their physical absence, students emerged as an important factor in the decision-making and planning of the curriculum and instruction team.

When listening to the recording of the first focus group discussion, the curriculum and instruction team heard one of the participants comment, "they didn't seem to have students in mind when they did much of this." One principal interrupted, asked the recording to be paused, and exclaimed, "that cannot be true." She challenged the group to "go find a place where we can prove them wrong." In the recording of that meeting, there was almost two minutes during which no one spoke, but the sounds of pages turning could be heard. The principal was the first to speak when she said, "um… maybe what they said is true… I don't see much direct reference to students." The group reluctantly agreed with that assessment. From that point on in the discussions, the members of the curriculum and instruction team appeared to be very purposeful in their consideration of students. The principal who had called for the video to stop asked for clarification or redirected the discussions with the phrase "remember students" on several occasions as the project was completed.

As their attention frequently turned to students in the final stages of planning, the members of the curriculum and instruction team appeared to differentiate the types of professional development based on the importance of the students in the teachers' work. "Some professional development," they reasoned, "can occur without knowing anything about students, some we do with students in mind, but maybe the most important is what we do after we know how students reacted to it" (see figure 3). For this group of educators, redesigning in light of students' reactions appeared to be a new approach to professional development. The curriculum coordinator admitted, "Educators talk a lot about using data in our decision-making, but I'm not sure we really know what that means sometimes. What we have created is different. We will be asking and taking students' direct feedback."

Feedback from the focus group was identified as motivating the curriculum and instruction team to include the active feedback of students in professional development plans. They observed, "They really have no idea how the plans they develop are going to work, they really need a way to revise things once they have been tried in classrooms." The team suggested there are two important factors that necessitate this level of participation in some professional development. First, teachers may not be completely aware of the technology skills of students. They may either overestimate or underestimate the capacity of students to operate technology and that may lead to either boring or incomprehensible activities.

Second, teachers may inaccurately predict the effectiveness of the technology lessons. Teachers may find students focus on unimportant aspects of the lesson or they may not learn to the degree they intended; alternatively, the technology may contribute to more efficient or more effective lessons. By

debriefing with students, the team reasoned teachers would gain new insights into their lessons, thus improving their professional development.

This aspect of the work was also formalized the planning documents and templates developed to organize and give structure to future professional development activities. The final plan for structuring and organizing professional development asked those who were seeking to add items to the professional development calendar to "describe existing classroom activities that will be extended or enhanced through this work." And that was followed with the question, "Describe students' reactions to this activity."

TYPOLOGY OF PROFESSIONAL DEVELOPMENT

In the final plan for professional develop for the following year, the curriculum and instruction team decided to plan the activities around three types of work. "We are unsure of exactly what we are going to plan," the curriculum coordinator noted, "but we know the kind of things we will take into account when we structure professional development for our teachers." The three factors were also formalized in the documents the groups included in their final plan. "To be supported by our team, which means we dedicate resources in our individual schools, and that we invite teachers from other schools, we must articulate what we expect in terms of technology skills, expertise, and students," summarized one principal. When a member of the team asked how they should respond if a proposed activity did not appear to fit with these three types, the consensus response was to "ask whoever is proposing it to clarify what they want to do so we can understand it in terms of our three factors."

Training

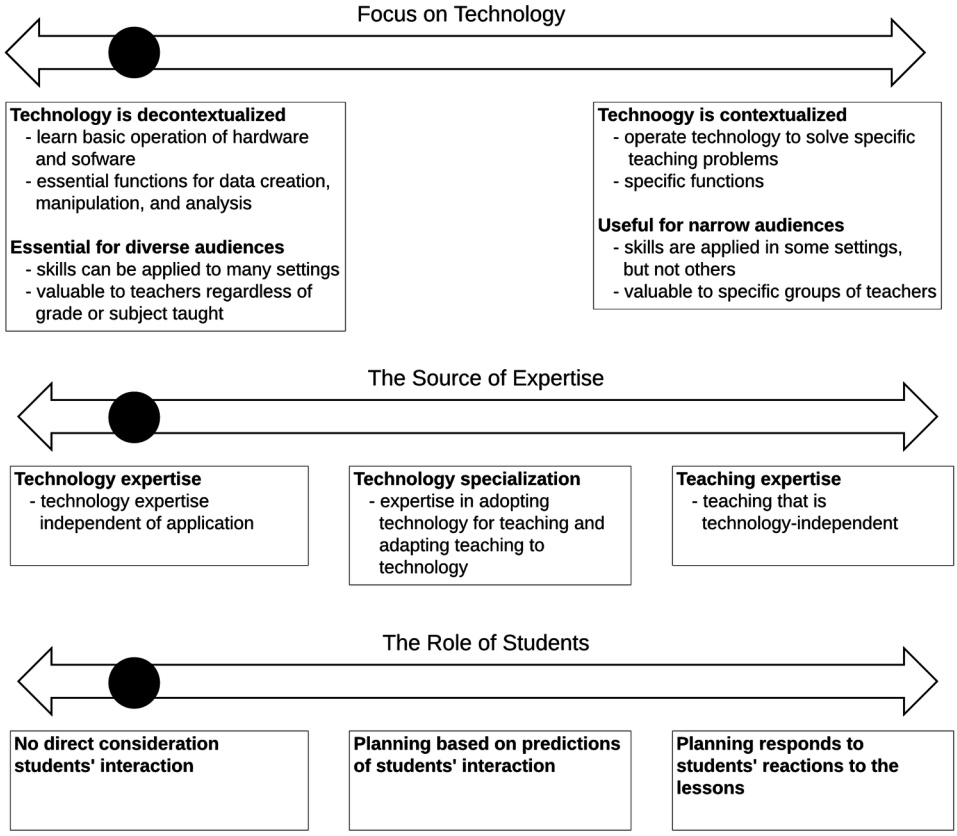
Training is that professional development characterized by an exclusive focus on how to operate hardware and software. The individuals who lead this type of activity have technical expertise, and there is little or no mention of the nature of the students or their interaction with the technology (see figure 4).

When participating in training sessions, teachers are being spoken to and directed what to do to perform specific and clearly defined tasks. Ostensibly, participants in training may appear to be passively listening to directions but training has the potential to be very interactive. Teachers' attention will be focused on screens or devices, and they are likely to be following along with the directions of the technology expert who leads the training. They will interact with others around them, for example if they missed a step, and they ask the presenter for clarification or to repeat steps as they need.

The outcomes of training can be articulated in a set of statements that capture what teachers are expected to be able to do independently when the training is complete. Once a participant has achieved the outcomes that organize a training, they are unlikely to participe in the same training again. Training is also supported by materials that summarize or remind participants of what to do and how to do it. In this way, participants have access to on-going support, although they must use those resources independently or without the intervention of the original technology experts.

Because training focuses on the operation of technology, any data or information that is created can be discarded at the end. Sample class rosters and assignments, for example, may be used to train teachers how to operate the student information system. Because the data is meaningless, training can be provided to large groups of individuals from diverse backgrounds and with diverse roles in the school. Further,

Figure 4. Characteristics of training



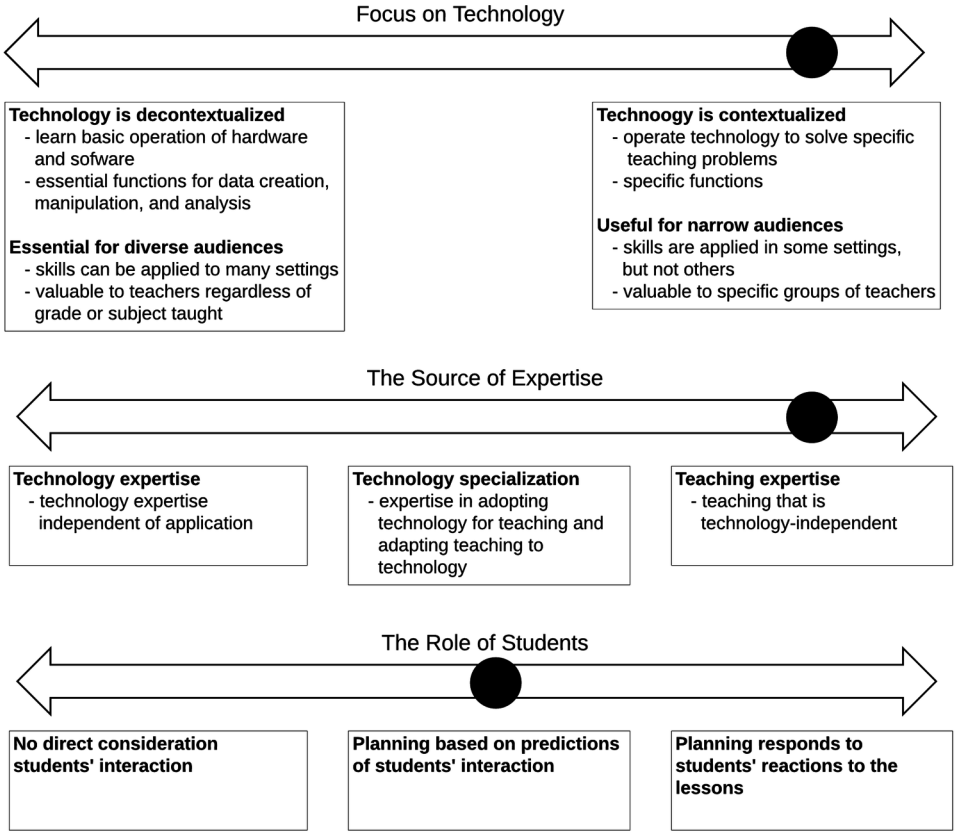
training can be effective in large groups, small groups, one-to-one coaching, and even self-directed through print or video tutorials.

Planning

Planning is that professional development in which teachers, in collaboration with technology specialists, prepare lessons and activities in which technology is used to accomplish specific curriculum goals. This type of professional development is scheduled only after the teachers demonstrate a sufficient level of technical skill with the tools they plan to incorporate into the lesson with a very specific purpose and audience. That purpose and audience define the context in which technology is interpreted during planning. Although sufficiency is a very ill-defined and it depends largely on the judgements of the teachers who are engaged in the planning, it was understood to be a relevant factor in defining professional development. Planning is also dominated by teaching expertise as any decisions made must address the teaching and learning they will undertake. Teachers plan for specific students and curriculum goals, but "they are unsure of exactly how the plans will play out when they actually deliver the lessons," so planning makes assumptions about how the activities will proceed (see figure 5).

During planning, teaching expertise is the most important in defining strategies. This arises from the focus of planning on achieving curriculum and instruction goals. Technical specialists also play a minor

Figure 5. Characteristics of planning



role in recommending adaptations to technology to ensure the technology will be available and operable when the plans are implemented. When questions regarding the specific instantiation of a pieces of technology arise during planning, this individual finds the answer and reports back to the others. It is also anticipated that the technology will be adapted to fit the teaching needs rather than teaching adapting to technology when planning is underway.

When teachers are engaged in planning, the session will be organized as workshop and it is initiated by and led by a teacher. Participants will be observed interacting with each other and creating, assessing, and editing materials for students and for themselves to actually use when the plans are implemented. The outcome of the planning session may be perceived as incomplete at the time, but teachers can expect to be able to polish and use the materials that are generated with their specific students and for a specific purpose. Planning is based on assumptions, however, with the teachers making general predictions about how well the technology will use in their specific locations. As the focus group noted, “as some point, they need to stop planning and try it with students in the classroom with the devices they have to use.”

Design

Design is that professional development in which teachers reconsider the technology-based lessons they planned and revise them after they have been deployed with students. The name design was chosen to

describe this type of professional development as it is iterative and continues with different participants at different times. The intent of design is to improve the lessons for both the individual classrooms in which they are used and to identify generalizations that may improve similar lessons in other classrooms. As envisioned by the curriculum and instruction team, design is an extension of planning and participants are expected to transition from planning into design as they engage in professional development.

Design begins when teachers decide a plan is sufficiently developed that it can be implemented. The outcomes of design are both revised materials for the particular activity and generalizations regarding the technology infrastructure, planning process, and other systems that support technology-based teaching and learning. "If one lesson fails because the technology did not work, we need to know about it and fix it before that same problem affects another lesson," concluded one of the principals, but he also noted, "we need to know if the teaching wasn't sound. What we do to fix technology is different from what we do to fix teaching."

As the transition proceeds from planning to design, there is a shift away from a very contextualized focus on technology as the teachers and technology specialists seek to share what they have learned in the initial implementation that can be used applied to other lessons by the same teacher and in the same space as well as by others undertaking similar lessons in different spaces. The technology specialists also play an increasing role in design compared to planning as they help assesses the technology and improve it for future lessons. Perhaps the most important aspect of design is the input of students who have experienced the lesson as it was planned (or last designed) (see figure 6).

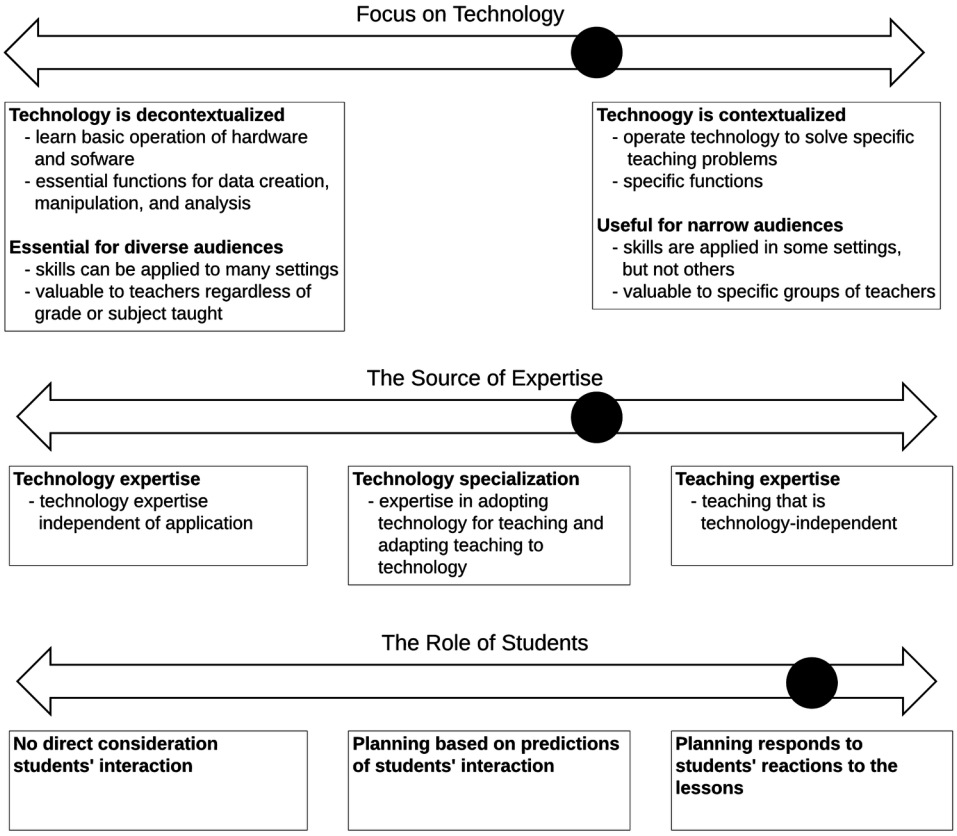
Although the curriculum and instruction team was not explicit in the procedures that would inform design, the planning documents and templates did communicate the expectation that designers take steps to answer the question "How will you understand students' experience with this activity?" Immediately after the lesson is implemented, a highly-contextualized debriefing is undertaken. With students and technology specialists, the teacher seeks to answer questions such as "How did the technology perform in this particular instance?" "How can this plan be improved with these specific students?" Those questions were suggested on the templates in the final plan, but the curriculum and instruction team encouraged teachers to "Use whatever debriefing strategies allow you to capture students' experience or other input that can inform revisions, troubleshooting tips, and other refinements of the plans.

Once planned lessons have been described by students and technology specialists, teachers (along with the technology specialists) are expected to return to the original planning groups to conduct subsequent planning work to both improve this lesson and to refine technology practices and configurations (or even to replace technology that proved deficient with students). As envisioned by this group of school leaders, professional development that follows their design model will "be directed ultimately by teachers in dynamics groups as they have on-going discussions about how to improve what they do with technology."

DISCUSSION

Data collection for this project ended when the plans for professional development for the following year were as complete as was possible within the time allowed by their schedule. While the results of those plans are not known, this project did appear to address the pressing problem that motivated the project in the first place. The school leaders demonstrated deeper and more clear understanding of the factors affecting their decisions about how to support teachers' use of technology. Through this understanding, they appeared to be more confident in providing leadership. One principal observed, "I have something

Figure 6. Characteristics of design



I can use to at least have a conversation with teachers about their needs. Do they need training? Are they ready to prepare activities? Their answers matter and I can see that now." Their increased understanding was demonstrated by the planning documents they intended to use, "We built our own scaffolding," exclaimed the curriculum coordinator, "so now we can communicate to faculty what technology opportunities we are offering, and we will know when to 'get out of the way.'"

This project appears to have to the improved the nature of professional development in the area of educational technology for the teachers served by the members of the curriculum and instruction team. The improvement appears to have been grounded in three factors: a) shared conceptual artifacts, b) an increased roll for the expertise of educators, and c) the design nature of this planning. Further, the typology appears to have applications to the organization of professional development in the field of educational technology.

Conceptual Artifacts

For the school leaders who participated, this project became work that is accurately described as knowledge building. Scardamalia and Bereiter (2003) define knowledge building as "the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of

broader cultural efforts." (p. 1371). Several factors are identified as essential to knowledge building, and many of those focus on the definition of and consistent application of conceptual artifacts, which were documented in this project.

A conceptual artifact is a shared understanding of what is intended when using certain vocabulary; when planners are consistent with conceptual artifacts and avoid applying them too broadly, groups can improve the concept and interventions based on the conceptual artifacts. By avoiding compromise on what is meant by a term, opting instead to introduce more nuanced vocabulary to describe more nuanced practices, leaders can improve their conceptual artifacts. This leads to more efficient and effective communication about what leaders expect and what teachers should do (Ackerman, 2015). The members of the curriculum and instruction team admitted they were poorly prepared to lead professional development activities related to educational technology, and they also described situations in which poor decisions had been made because opportunities were poorly communicated. Similar situations are commonly observed in organizations in which there are weak conceptual artifacts.

According to the reviews of the previous years' technology training, there were multiple situations in which faculty attended professional development activities that were not appropriate for the individuals because the nature of the professional development was not clearly articulated. A member of the focus group noted, "As I read the list of activities, I really had no idea what I would have learned had I attended." One of the principals further observed, "we offer something, and the presenter spends half the time showing people how to get started and others are checking email or just surfing the web because they are waiting for others just to get ready to start." This phenomenon was attributed to a lack of clarity in both describing their need to consultants and the communicating the plan with potential participants.

In reviewing the final plan, the curriculum coordinator observed, "we seem to have agreement about the different kinds of experiences we will offer for our faculty." One of the principals summarized the change in her understanding of technology and the approach to professional development she anticipated using,

I may not feel confident in providing the instruction or support our teachers need, but I now if Mike is doing gradebook training at the high school, I can send my people, but if he is doing web sites for English teachers, I should avoid sending my people. I used to see all technology workshops as the same, but now I discriminate them, and we are all using the same vocabulary and we know what to expect or what are teachers can expect when we send them to professional development that is described when we use the words.

The consistency of the conceptual artifacts that emerged during this project and dominated the work near its end was demonstrated by the manner in which they spoke with each other and what they understood to be the essential parts of their plans. In addition, the strength was illustrated in the templates they developed that would be used to announce future professional development in technology. As the person responsible for approving events that were added to the official district calendar, and also the person who approved the use of certain grant funds to support these opportunities, the curriculum coordinator told the school leaders

Rest assured that if you send me something that is missing the intended audience, who is providing it, what teachers need to bring, what they can expect to get out of it, and the other things we said, I will not approve funding and it will not show up on the calendar and no one else will know about it. We know these are important, so we need to live up to it.

When organizations are planning with the intent of improving practice, they undertake a special type of knowledge building that Bereiter (1994) calls progressive discourse. According to Bereiter, conceptual artifacts are the foundation of "what it means to have progress as a goal" as opposed to "compromise, which presumes [planners] will not alter their beliefs, but that each side will yield just enough to achieve a practice resolution of conflicts" (p. 7). In their emerging plan, these school leaders demonstrated the ability to maintain their conceptual artifacts regarding factors they believed were essential to teachers' professional development related to educational technology.

Expertise of Educators

In the past, leaders in the school district had taken a decidedly passive approach to professional development related to technology. Rather than making decisions about what to do and how to do it based on their own observations and judgements the leaders had "handed off decisions to technicians, vendors, or consultants and they almost always followed the lead of those individuals." While this was implicitly understood by the participants, the feedback from the focus group made it explicit, and the team decided to "find ways to increase the role of teachers and their skill in this work" because, it was reasoned, "we seem to have left education out of some pretty important decisions."

In two of the three types of professional development activities defined by the project, teachers were the leaders, actively deciding what tasks the technology would be used for and how it would be adopted and how it needed to be adapted. In both planning and design, there is an almost nonexistent role for the technology-expert. In those types, technology support and decisions are mediated by the technology specialist who are largely drawn from those with a background in education rather than a background in technology. The technology decisions made by those specialists are also expected to adapt the technology to the teaching as well. In these schools, this represented a new focus of teaching on technology decisions.

The role of the technology specialists whose expertise is central to the implementation of planning and design play the role of technology stewards. According to Wenger, White, and Smith (2009), technology stewards are individuals who are deeply familiar with the critical functions of the organization, and who gain specific expertise in how technology can be used to accomplish those tasks. Technology stewardship is grounded in support of professional learning how to use technology to accomplish the goals of the organization rather than adopting technology for the sake of using technology.

When adopting technologies, leaders and members within organizations find it necessary to negotiate differences in goals, expectations, and identities. Wenger, White, and Smith (2009) found the introduction of technology can result in the practitioners' goals and identities being reduced when leaders adopt tools (often that they do not understand and that are not specialized for their types of organizations) with little consideration for how it affects the rest of the organization. Reducing the role of those with technology expertise alone in the professional development of the teachers in this school district allowed for teachers and technology specialists to find new leadership roles in this field.

This new role for education professionals did represent a change in the practice for the school district. In reviewing the summary of the previous year's professional development work, one on the focus group observed, "it is as if no one teaching there knows how to use technology. Everyone who led sessions was from outside." This observation was confirmed by statements made early in the project by the curriculum coordinator. "Teachers who have been here for a long time tell me that professional development used to be someone coming in and talking at teachers." One of the principals indicated she had begun

talking about this project with her teachers and confirmed "my faculty was pleased to see this team are identified a n expanded role for them as we move forward."

Planning Through Design

For many leaders, planning is a linear process (Ackerman, 2020) and this can belie the true nature of how knowledge is built and how decisions are made. Richey and Klein (2007) suggest design and development research, which seeks to both design improved interventions and to articulate generalizations find six different aspects of organizational learning contributing to final decisions and plans. These aspects include strategies and methods to support how the organization functions; the templates developed during this project are an example of such practical aspects that affect design. In addition, these aspects include the context in which learning occurs and that nature of materials created and used, such as those that will be produced during planning. Further, these aspects include the individuals lead and implement plans as well as those served by the organization. In design, on-going interactions among these contribute to emerging systems and their improvement.

No data were collected to confirm the observations that this project led to improvements, but both the school leaders and the focus group participants commented on the changes they could perceive in plans at the end of the project compared to the beginning of the project. In the second focus group, there appeared to be consensus around the observation "they seem more organized. No not organized… more sophisticated… they see more, and they know how things connect in a way they did not at first." McKenney and Reeves (2014) suggest methods whereby interventions are developed and improved must be iterative and plans much emerge though multiple efforts to understand and construct interventions that reflect theoretical and practical knowledge that exists in the greater community, but also that reflect the realities of the local situations. The similarities between the design process they had undertaken and the design process they proposed for their teachers were noted by these participants. Specifically, one principal noted, "If the design we are having teachers do is anything like what we have done, then we need to start it right away."

Ultimately, both this design project and that embodied in the planning typology are about the participants coming to deeper understanding. For these leaders, it was understanding of how to support teachers. For the teachers, it will be understanding of technology in their classrooms. The curriculum coordinator asked the school leaders a question near the end of the process, and their responses captured the nature of the change. She asked, "Be honest now, how many of you used to see the technology sessions as a chance to stop paying attention, and get caught up on other things?" One of the principals admitted, "If it said 'technology' I just put it in the pile and tried to find one of my tech-savvy teachers to go to it." All confirmed also they believed they had greater capacity to be active in these decisions and they believed the group would be a valuable resource as they implemented their plans.

Applying the Typology

It is reasonable to conclude school and technology leaders will continue to extend and enhance professional development experiences for teachers to become more skilled users of technology for many purposes. The typology developed in this chapter can be used to analyze needs and organize appropriate activities. According to the TPACK Model (Mishra & Kohler, 2009), educators need seven types of knowledge and these are combinations of technological knowledge, pedagogical knowledge, and pedagogical knowledge.

In situations where technology systems are unfamiliar to teachers, training is appropriate. New faculty and staff should have the opportunity to be introduced to new tools through training provided by experts in the technology. Training is also necessary when new systems are installed or upgraded. Education populations tend to use certain aspects of technology systems infrequently; for example, final grades may be submitted only a few times each year. For this reason, good training for teachers includes supports that are available after the training is complete.

The nature of the training sessions (including the goals, structure, and presentation) is determined by people other than the teachers. Further, the expected levels of performance are determined by those others. Because of the central role in defining and determining what happens in training, it is appropriate only for professional development intended to develop technological knowledge.

Whenever professional development is intended to address technical knowledge in combination with pedagogical knowledge (TP knowledge) and with content knowledge (TPC knowledge), it is appropriate to provide professional development that begins as planning and leads to design. Educators are also anticipated to continue to develop understanding of how technology affects their content area (TC knowledge). When teachers are engaged in planning and design, they seek to understand the nature of pedagogy in their classrooms, as well as the nature of how to teach their content (PC knowledge).

In addition to addressing a wide range of types of knowledge needed by teachers, professional development that is aligned with planning and design requires teachers themselves take an active role in defining the nature of the work. Albion and Tondeur (2018) conclude teachers who have an active role in defining the nature of their professional learning have important benefits for the teachers, their students, and the systems in which they work.

CONCLUSION

This chapter describes the work of a group of school leaders to improve the systems through which they supported teachers as technology users. In describing plans that were the focus of criticism and feedback from a panel of experts, the school leaders were able to identify three aspects of professional development activities and varying these provided a framework for defining and communicating different types of learning activities.

It is reasonable to conclude this group made three discoveries during this project. First, there is a difference between training teachers to operate technology and helping them learn to use it well. Second; the focus on technology, the source of expertise, and the role of students are important factors to consider when making professional development decisions. Third, there are different types of professional development activities. It is unreasonable to conclude these are original to this group. The typology described in the chapter is grounded in the findings of Apple Classrooms of Tomorrow and the literature that has grown since.

"Why," we might ask, "would a group of professionals want to engage in such an extended project? Especially when the knowledge already exists, and we can just read the literature." The result of the design process appears to have been a group of individuals who engaged in a meaningful professional learning activity. While the limits of this project suggest it cannot be labeled research, it does appear to have been a valuable design and development project for this group. For this group, the design process itself in which they looked at their ideas and concepts as a group and individually over the course of several months and they accepted the feedback and criticism of experts was valuable. Interestingly, the

outside experts could not be questioned or challenged. This was frustrating for some of the participants as they could not get clarification about the meaning of the focus group; they were forced to identify the ambiguities and then to look at their plans from the perceptive of both interpretations of the ambiguities.

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