Technology in Schools

It's Not Like this in Business

Version 1.0

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Introduction

Schools have always been information-rich places. There is a curriculum to be taught that comprises ideas, concepts, information, and skills. Learning the curriculum requires information-rich interaction between teachers and students and among students. Humans have invented technologies to facilitate interaction and information exchange for centuries, and these technologies have been incorporated into teachers' instructional methods. As a result, students graduate from school both knowing the curriculum and knowing how to use the information technology tools they will encounter in the real world. At least that is the intent.

Paper was the dominant information technology for many generations of students and teachers. Printed textbooks, encyclopedias, and other books, along with magazines, posters and maps (some held in hands and some hanging on walls), and other printed materials contained the curriculum. For these generations, written tests, worksheets, research paper, drawings and paintings, and other paper-based assignments were the basis of demonstrating their learning to teachers. Of course, some electronic media were also used for teaching, and generations of students were happy to see the movie projectors, film strip projectors, and televisions with video cassette players on the carts being wheeled into the classrooms. This reflected the greater society in which much of one's economic activity (for example preparing income tax returns) was done on paper while electronic media were encountered in the popular culture. For the last several decades, the information technology used in schools has been changing as print is being replaced by digital electronic devices and information.

Today, when one talks about the information technology (IT) in schools, they almost always refer to computers and other digital electronic devices that are used to access and create information. The information is almost always digital and electronic and stored on "the cloud" (the vernacular term for platforms like *Google Workspaces* in which data and productivity tools are housed on web servers and accessed via web browsers). Most trace the origins of computers in schools from the arrival of desktop models in the late 1970's and early 1980's, but teletypes and even some mainframe computers were found in schools before then.

It did take several decades for computers and electronic data to replace print as the dominant medium for instruction, records, and school operation, but in the third decade of the 21st century, computer technologies are used for all aspects of schooling. It should be noted that radio, television, and movies were promoted as tools that were predicted to replace teachers and reform schooling, but they remained marginal tools. Computers have been integrated into teaching and learning to a much greater degree than the earlier electronic media. Regardless of the age of the students the school enrolls, the number of students, or the nature of the curriculum, all schools rely on information technology systems for:

- **Teaching—**Educators create study guides, worksheets, and other files for students; they curate web sites to support their teaching, create slide shows to present materials to students, manage virtual classrooms, give feedback on work, and otherwise instruct students with computing devices.

- **Learning—**Students gain access to digital information resources including those analogous to paper media, animations, video, library databases, and other sources of information through computing devices. They also participate in discussions, write

papers, prepare presentations, program spreadsheets, graph functions, create art, and otherwise demonstrate their new abilities with digital information technologies.

- **Managing data—**Almost all teachers report attendance and grades using a web-based student information system (SIS), parents can (usually) access the records of their children on the same SIS. Behavior, health, and other records are also secured on those systems and the data saved on them are used for both internal decision-making and the data are reported to external agencies such as regulatory agencies.

- **Facilitating business operations—**Schools are organizations with accounting, human resources, operations, and facilities management needs like those of all businesses and organizations of similar size. Many of the digital tools used for those functions in other organizations are used for the same tasks in schools.

The technology systems installed in schools support all these functions and others. These are seriously complex systems. In the vocabulary of IT professionals, they are enterprise systems (or perhaps business systems in small schools) and managing them requires specialized expertise, so schools employ a variety of professionals to manage the networks, keep end-user devices functioning, and keep data systems secure.

Usually, IT professionals arrive in schools with little knowledge of education beyond their experiences as students. Programs that train IT professionals (trade schools, professional organizations, community colleges, and universities) focus on the technology and how it supports general business and management operations; educational uses of computers or the nature of students and teachers as IT users are rarely the focus of lessons preparing information technology professionals. As a result, many who are hired as IT professionals in schools have deep knowledge of IT and strategies for keeping business users productive and content, but they find those strategies are not as effective in schools. No IT professional wants users of their systems to be unproductive and discontent.

My Rationale

My purpose in writing this book is to give readers a view into the work of managing information technology in schools. IT professionals will notice differences (some nuanced and some significant) between the needs and expectations of IT users in business and IT in school. With the more complete and more accurate concept the nature of the computing environment necessary for successful schooling, which I intend to provide through this book, IT professionals will be better prepared to meet those needs. Educators will also benefit from this book by clarifying the nature of their IT needs and how these may be different from those that are familiar to IT professionals who are hired to work in your school.

The preceding paragraph portends a common situation in schools: The IT professionals lack the expertise to makes decisions about what is an appropriate configuration of IT to meet teaching and learning goals, but their decisions can limit what can be done by teachers and students. Educators lack the skill and expertise to properly configure the IT upon which they rely to do their jobs effectively and efficiently. IT in school is further complicated by the fact that schools are under resourced, and they are obligated to comply with laws and regulations, so some actions educators and IT professional want to undertake are found unreasonable.

Appropriate design, proper configuration, and reasonable implementation are concepts developed in later chapters to illustrate the very different types of expertise necessary to create and maintain IT systems in schools. For now, it is enough to recognize that expertise with IT and expertise with education are necessary to keep educational technology functioning the way educators and their students need, and it is rare to find a single individual who all of the necessary expertise.

> "I know educators, and you don't want them running your network. I know IT folks too, and you don't want them running your schools."

When framing a problem, we define what we believe its cause to be along with the conditions that will indicate the problem has been solved. When attempting to solve problems, we take actions to reduce its effects and to prevent it from returning. When working with IT in schools, it becomes obvious there are differences between how IT professionals and educators define and attempt to solve problems. These differences must be bridged if IT systems are to be appropriately designed, properly configured, and reasonably supported in schools. Notice my careful language. Many problems are not really solved for all stakeholders and in many cases one solution creates new problems.

In the domain of information technology, all problems are solvable. We all know what IT systems are supposed to do, and we get frustrated when they do not. IT professionals know the function of each component; they adopt systematic troubleshooting steps, and most problems can be isolated and resolved in minutes or a few hours. (Yes, I have problems that extended much longer—all IT professionals have—but those tend to be rare.) IT professionals have knowledge of the systems and components they manage, and they have resources (from online communities, colleagues, vendors, and even user manuals) to help them resolve unfamiliar problems. IT problems rarely resolved without something happening; it is often a distant and unknown system being restarted, but some human or other computer must intervene. When IT problems are solved, all users can recognize the green lights that signal functioning connections, operational computers, and—in schools—smiling teachers.

In the domain education, problems are not so easy to identify and resolve. Students and teachers are vastly more complicated than IT and their lives are affected by far more variables than even the most sophisticated IT systems. When looking carefully at problems in education, we discover they cannot be clearly stated, and the causes cannot be isolated. After considerable effort and expense to implement solutions, the original problem may remain, it may have been shifted to another part of the system, or the solution may have caused new and unanticipated problems. Some problems that affect educators and students also resolve spontaneously on occasion. Further, there may be disagreement that the problem even existed or that it has been solved.

Because they solve different types of problems, IT professionals and educators rely on much different types of knowledge, skills, and habits to their work. They must have differences, otherwise, they would not be able to solve the problems they face every day. My purpose in writing this book is to help bridge the gap. My goal is to explain to IT professionals what they can expect when they arrive to work in a school. Those folks are going to make strange requests of you. (This sentence applies equally to IT and to educators—the other group makes little sense sometimes.) My purpose is to help you understand them and for you all to make better decisions because you share understanding of teaching and learning and technology.

I once served on a committee hiring a professional who was primarily going to serve as network administrator. We were in the second interview, so there were fewer questions and more discussions, and the applicant asked, "What can you tell me about the environment?" The superintendent (who admitted little knowledge of technology) began describing efforts they had made to improve the working climate in the schools. The candidate looked puzzled as he listened for several minutes. When she paused to take a breath, I interrupted, "I think he was asking about the network environment?" He said, "yes, I'm glad to have heard that, but I was asking about the servers and stuff." Sometimes IT professionals and educators are not even speaking the same language even when they use the same word.

By writing this book, I seek to help readers bridge the gaps in language, problem-solving, and even agreement between IT professionals and educators. If IT professionals understand a little about how schools operate, the IT needs of students and teachers, and the how the demands put on infrastructure are different from when they have experienced in other situations; they will be better prepared to meet those needs. If school leaders understand those same needs, they will be better prepared to interpret what they need and provide better leadership to the IT professionals they depend on to meet the mission of their schools.

The Perspective I Bring to This Book

When I was a young adult, just entering my undergraduate studies, I had little interest in computers. There were a small number or computers in my high school when I graduated in 1983, but I avoided them. When I was a freshman in college, many of my dormmates spent time in the college's computer rooms, but I avoided them.

When I was finally assigned to use them to analyze some data that my lab mates and I collected in biology class, I realized computers were useful for something that I valued. I bought one (an Apple IIc) and started using it for my schoolwork. I also enrolled in the optional "Computers in the Classroom" course offered by the education department for those studying to be teachers (it was so long ago that the course was an elective for education majors). By the time I started my first teaching job in 1988, the school was replacing their first fleet of computers with the second, so I claimed a few of the old models for my classroom (which I never got working as I wanted).

My math and science students were found using computers as often as I could make reasonable plans, and—over the next few years—I became a teacher-leader in the emerging field of educational technology. At two different schools, I led the first technology planning committees, wrote technology plans, started developing workshops for teachers to help them create technology-based lessons. After 10 years as a science and math teacher with emerging technology expertise, I become a computer teacher. My duties expanded as each new wave of technology arrived. I have been responsible for fleets of computers, local area networks, training, budgeting, planning, and otherwise managing IT in schools.

I have written the grants to buy the devices, recycled them at their end of life and managed everything in between. Users of my systems have included kindergarten students through high school students and adults in community colleges. I have also taught all those populations how to use computers and I have taught other subjects using technology. I have

taught teachers how to use computers, and how to teach with computers. I have also taught those who manage IT in schools.

Along the way, I have studied both the theory of how technology affects institutions and users (especially schools) and how technology systems are deployed and technology plans are implemented in schools. In addition, I have written about technology in teaching, and I have written about managing educational technology. Despite all that I have learned and done, I find interesting new situations, questions, and problems (as well as some very familiar ones) every day.

I am still active in information technology in education; my full-time work finds me working with technology in classrooms and supporting online learning in a community college. I was hired into my current role "to bridge the gap" between faculty and information technology. That is a role I have played many times before. It is a role that many school leaders tell me they need.

My Assumptions About Readers

This book has been written to help those who want to ensure information technology is an effective tool for teachers and students to accomplish their goals and to ensure it supports the efficient operations of schools. Some readers, I expect, will have significant experience with IT and may find my find my treatment of it will be too generalized and it will raise more questions than it answers. Other readers, I expect, will have some specific interests in and experience in education and may find my claims about schooling will raise more questions than they answer. (This is a common situation when working in school IT, planning meetings often raise more questions than they answer.) While this is not a comprehensive list, some readers I have in mind are:

- **IT professionals with experience in other fields who seek to work in schools**. There are many reasons why one might want to transition from business or industry into education. Many are motivated by the desire to support the work of educating; others are motivated by the different working conditions. (School tends to be lower stress and more predictable work environments than many non-school environments.) In schools, some folks make the switch and find out they are not cut out for it. I hope to help you understand what you are getting yourself into if you are considering switching industries.

- **Those who seek their first position as an IT professional** perhaps after having completed an associate or bachelor degree or a certificate. Schools often hire individuals who have little experience into entry-level jobs. This provides an excellent situation for both worker and school. I hope to help these job seekers understand the nature of the work as well.

- **Individuals who seek to reenter the workforce.** Just as schools hire those with little experience, they also hire those who have been out of the workforce.

- **Someone working in a school currently, but who seeks to change their role.** Some jobs in schools can be very stressful and individuals may like working in schools, but

they want to fill a different role. I hope to help these individuals see their work environments from a different perspective.

- **Someone working as a school IT professional who wants to improve their performance.** If you find yourself working in school, but find there seems to be difficult situations arising, you hear complaints about how your department runs or what it accomplishes, I will help you see your systems from a different perspective. I know it is difficult to hear such "complaints" directed towards you and your work. In almost every case, such complaints arise out of misunderstandings of what needs to be accomplished. I also encourage these readers to introduce this book to the administrators in your schools. They need to be aware of what you do as well as much as you need to understand their work.

- **A school leader who seeks to better understand the nature of school IT.** Many school leaders avoid making technology decisions. That may be best as we really don't want them configuring networks or servers, but school leaders do have a role in making decisions about what should be done. This book should help these readers understand the nature of IT and schools and the rationale behind some IT decisions that you find troubling. This book should help you identify your role in school IT decisions.

A Brief History of Computers in Schools

In the United States, desktop computers arrived in classrooms beginning in the late 1970's and early 1980's, which is when they arrived on the consumer market as well. If you walked into a classroom where there were those first desktop computers were installed, you probably would have seen one or two computers on the margins of the classroom; nearby, there would have been a box of disks with applications and data were stored on them. To start a word processing program, for example, one would insert the disk with the application, then boot the computer. Another disk was inserted to load a document. To use another application, the user powered the computer down, then inserted different disks and rebooted the computer.

Before desktop computers arrived in schools, some public schools connected to mainframe computers located at colleges and universities. Students, teachers, and other users entered data on teletype terminals in schools to write programs. Commands entered in the teletypes were sent over plain old telephone system connections to the mainframes where they were executed, and the results sent back to be displayed on the terminal. One of the largest expensed associated with these efforts was the cost of long-distance telephones charges. These localized efforts were centered near colleges in New Hampshire (where BASIC was developed), Minnesota (which contributed the *Oregon Trail* to generations of students), and Illinois (where PLATO included many tools that were later central to the Internet). The institutions hosting those systems were recognized as early leaders in computer science research and education. While there is a rich narrative that the technology gurus in Silicon Valley were the innovators who built the computer revolution, historian Joy Lisi Rankin claimed the teletypes users in schools were as important in laying the foundations of our current computing landscape in the 2018 book *The People's History of Computing in the United States*.

First-hand account: I graduated from high school in 1983. My New England school had a book storage room that had been converted into a "computer lab" where there were six desktop computers. Two were standalone computers with programs loaded from 5 ¼ inch floppy disks. The others were connected to Dartmouth College's shared time computer for high schools. I used the standalone machines a few times, and watched others scroll through screens filled with green text to accomplish something, but I am not sure what, on those connected to the college.

Eventually, the teletype systems were abandoned, and one-computer classrooms were abandoned as well. As demand for computer courses increase, larger numbers of desktop computers were installed. Rather than placing them in individual classrooms, technology leaders installed them in "computer labs" which was the dominant model of computer-based education until the early 2000's. In elementary schools, classroom teachers took all their students there at once for special instruction at regularly scheduled times, and in high schools, students enrolled in computer literacy or programming courses as electives, or teachers took students there for special lessons or projects. The computer lab model of technology-based teaching generally found all students doing the same type of work during their time in the space.

Late in the 1990's, two programs supported by the federal government increased the computing infrastructure in schools in the United States. *Technology Literacy Challenge* (TLC) grants provided funds to purchase computers and support professional development for teachers. The *Schools and Libraries Program of the Universal Service Fund* (eRate) provided financial support for local area network (LAN) infrastructure and to defray to costs of Internet access. Schools have largely assumed responsibility for purchasing devices and teaching teachers, while eRate funds continue to support internet access in schools. IT professionals are usually assigned the task of preparing and submitting the schools' eRate application. Another effort, led by local activists, called NetDays found volunteers installing the cabling necessary to connect the new computers purchased with TLC funds to Internet connections supported by eRate. This was necessary because the schools were built before computer networks were necessary, and few budgets allowed for the considerable capital expenses of installing cat-5 cables throughout buildings. Such amateur endeavors are no longer common in public schools, but the fact they were once common is an interesting reality of the history of computers in school.

At about the same time, the findings from Apple's Classrooms of Tomorrow project were influencing many educational technology initiatives. One of the important observations was that access to computers was not sufficient for teachers to create effective lessons. They needed help understanding how to use computers in their teaching as well as training in how to operate them. This explains, in part, the inclusion of support for professional development in the projects that were awarded TLC funds. Even today, IT professionals are involved with training teachers and others to use IT systems and in some cases teach with the systems that they manage.

As computers arrived in schools that had high speed Internet access in each instructional space, and as teachers began to gain experience teaching with them, there was increasing interest in moving computers back into classrooms. It was reasoned that teaching with computers required they be in classroom so they would be available when students were engaged with all classroom activities and materials. More frequent access to computers in classrooms allows for easier technology integration, which is a popular model of organizing technology-rich teaching (see page x).

Since about 2010, one-to-one computing and cloud-based computing has come to dominate school computing. In many schools, students carry Chromebooks with them, and sometimes they take them home. (While the market share of educational computing devices is difficult to ascertain, estimates are that Chromebooks represent over 60% of the devices purchased for school users.) Some schools do continue to maintain computer rooms for special functions, and computers with full operating systems for administrative staff, but in many schools, Chromebooks are the only devices maintained by IT professionals, which can be a less than optimal situation for many educators. *Google Workspaces* provide most students with productivity applications, and student information systems (including grade books), library card catalogs, and learning management systems are web-based, so students access them from home and school. Because those systems are based in the cloud, robust, reliable, and secure networks are essential to school functions.

While the move to cloud-based computing has many benefits for students, teachers, and IT professionals, it has introduced inequity into education. The "digital divide" has been used to describe the inequitable access to digital learning for generations. Originally, it was used to describe the fact that marginalized populations attended schools with fewer computing devices. It has also been used to describe inequitable access to high-quality instruction with digital tools. As cloud-computing became ubiquitous it described inequitable access to network connections to use those resources away from the school. The problem was particularly acute during the remote teaching necessitated by the pandemic in 2020.

> In March 2020, I was discussing the inability of families to access high-speed Internet in the town with a superintendent of schools. We agreed that "Internet access in the town isn't really our problem, but it is our problem."

Layers of Educational Technology

When looking at information technology in schools, we can break it into five levels (see table 1). As one proceeds from "IT Systems" to "Students and Teachers Using IT for Teaching Tasks," each level introduces more uncertainty into to the design process as each introduces more variables which are outside the control of designers and that are unknowable to the designers.

IT professionals are generally comfortable with layers one, two, and three. "IT Systems" through "Users Complete Tasks with IT" are amenable to planning. Organizational leaders can clearly identify the tasks they need to complete, they can identify and train the users, and the system requirements can be clearly defined. These can be used to define goals, and strategies for achieving them can be implemented, and the degree to which they are accomplished can be measured objectively. When the task becomes teaching and it is done with students and teachers, there are uncomfortable levels of uncertainty for many IT professionals.

Table 1. Levels of IT in Schools

Level	Controllability	Uncertainty
5) Students and teachers using IT for teaching tasks	Low	High
4) IT systems for teaching tasks		
3) Users perform tasks with IT		

2) IT system for a task		
1) IT systems	High	Low

IT Systems

Information technology systems are foundation of the work that is the focus of this book. The end user devices; the Ethernet cables or access points to which they connect; the routers and switches that send packets to and from network nodes; the servers that assign network addresses; and the gateways, firewalls, and other devices that control access to the Internet can be considered in isolation from the purpose to which they are applied.

When networks are planned and installed, the system requirements are clearly defined, and skilled network architects can design and install them to meet the requirements. The task of creating these systems does require very skilled technicians and engineers, but it is an engineering process. Known procedures and used to configure the devices and engineers can test its operation before it is deployed. We can tell our IT systems are functioning by pinging devices (that really is the name of the task of sending signals around networks to confirm networks connectivity).

IT Systems for a Task

In the real world, no IT systems are designed without a task in mind. Those tasks inform the systems requirements that architects must meet. In some business situations, the tasks are very specific, and the system is designed for that task alone. The computing capacity built into the internet of things is an example of very specific tasks; your internet-connected video doorbell serves its function, but it is not useful for analyzing your household budget.

The IT systems created in schools tend to be general purpose computing devices. Rather than being designed for a single purpose, the computers and devices are used for many purposes, some of which are known prior to the system requirements being defined, but some are unknown. In some cases, the decisions made when planning and deploying the systems limit what can be done later. In organizations in which future tasks are not known, it is uncertain if the current system requirements will meet the future requirements, so architects commonly add as much extra capacity that the budget will allow when planning new systems or upgrades. Minimizing the need to build and maintain unused capacity is one of the reasons schools (and other organizations) are adopting cloud-based infrastructure.

Rather than passing random data to confirm connectivity and capacity, designing IT for tasks requires IT professionals support software, error correction, and other protocols to produce meaningful, accurate, and secure data. These additional requirements specify the operations and functions that affect the selection and configuration of the IT systems.

Users Perform Tasks with IT Systems

Technology systems are designed for unknown users, and the assumptions designers make about users can have important implications for how effective it is. Todd Rose begins his 2015 book *The End of Average* with the story of fighter pilots in the 1940's who were unable to control their planes because the cockpits were designed for the "average" body. Once cockpits were designed to adjust to the actual bodies of pilots, they found pilots more able to control them, and fewer planes crashed, and fewer pilots died.

While the consequences of designing IT systems in businesses and schools are not as dangerous as the inability of a pilot to fly their plane, the principle is the same. Once users begin

interacting with IT systems, additional variables are introduced based on users' capacity and preferences, and those variables cannot be controlled by the designers. When there is a disparity between users' capacity and preferences, but the system has passed the IT professional's tests can lead to the user being blamed for the poor functioning. In many cases, this blame is misplaced as deeper situational awareness leads architects to design better functioning systems.

IT Used for Teaching Tasks

The tasks that teachers accomplish using IT systems can be differentiated into two categories. First, are the highly predictable tasks that resemble those performed by business users. IT professionals can plan and test for functionality. These tasks include many of the data management tasks such as recording attendance and grades for which teachers are responsible. It also includes those instructional tools in which the goals and the practices are like workforce training. Designing systems to meet these needs are familiar to many IT professionals as the needs like the those in many other organizations.

Second, there are the teaching tasks that are associated with what are commonly called authentic learning environments. These can be unpredictable as they are driven by students' interests and rely on diverse source of information, and the products of students' learning emerge as the projects progress. When teaching with these methods, teachers question their practices, explore new options, and experiment with new tools and technologies. These individuals will seek to use the IT systems for purposes never conceived when the system requirements were first defined. Obviously, this introduces even more variables and greater uncertainty into the design and configuration of IT systems.

Students and Teachers Using IT for Teaching and Learning

One of the most distressing realizations one makes when they become a teacher is that the best plans one makes for the classroom are just guesses. While teachers apply their knowledge of the curriculum and their familiarity with the students or with similar students when planning, each classroom is different and a lesson that one group finds engaging and meaningful is dull and boring to another. Students with their varying skills, different motivations and perspectives, and clever insights (none of which can be known when planning) can lead teachers to revise their thinking and update their lessons and what they do with IT.

So they can respond in a timely manner to the necessary revisors they identify, teachers often ask for permission to change systems. IT professionals know that is not a good idea; at least it is not a good idea if you want secure, reliable, and robust systems. This is the situation that can cause conflict schools between educators and IT professionals and resolving that conflict requires seeing the problem form the other perspective.

Organization of the Book

The book contains eight chapters. In the first two chapters, I preview what it is like working in schools. In Chapter 1: What Exactly is School? I focus on the differences between what many adults believe about school and what school is actually like. In Chapter2: Working in Schools, I focus on the day-to-day realities of working in schools, including the various IT roles that must be filled in school today.

Chapters 3 through 6 approximately follow the levels of IT in schools I have presented. Chapter 3: Infrastructure in Schools reviews the hardware one typically encounters in school as well as the data systems one commonly encounters and Chapter 4: Supporting Infrastructure in

Schools revies some familiar strategies and approaches to IT management with a specific focus on school environments. Chapter 5: IT Users in Schools presents the unique characteristics of students and teachers and their IT needs that result from those characteristics. The role of technology in the classroom is the focus of Chapter 6: Technology in Teaching,

The different types of expertise necessary to make sound decisions related to IT in school is the focus of Chapter 7: IT Decision-Making in Schools. The book ends with a brief chapter that focuses on job search and application advice.

1: What Exactly is School?

Schools are both familiar places and unfamiliar places. While most readers will have some experience in schools, their familiarity is likely to be grounded in the experience of students and parents whose experience in school is highly mediated. This chapter explores schools as work environments.

There are many types of institutions that are labeled "school." In this book, I am generally writing about the public institutions that enroll students in kindergarten through grade 12 in the United States. Students typically enroll in these schools after they have turned five years old and graduate just after they have turned 18 (some individuals with special needs are entitled to services in public schools until they are 21). Much in this book will be relevant for those who work in private or charter schools or any other variations on schools for children and adolescents. Further, much that is written here applies to post-secondary schools including trade schools, community colleges, and other higher education institutions. Workforce training is a much different type of education, and it is very valuable, but much different from what I have in mind for readers of this book.

The primary difference between public schools and other types of schools is the diversity of the student body. Other schools select their students (or the students self-select) and in many cases serve a specific program to a specific audience. Public schools are prepared to enroll all students in the service area (except for those students with very specific and intensive special needs) and provide a comprehensive curriculum intended to prepare students for a wide range of educational or vocational opportunities once they graduate. The diverse nature of students and the broad nature of the curriculum is part of what make schools unusual places to work for IT professionals.

I expect every reader has experience with school and has a strong concept of school. Much that one "knows" about school, however, is a misconception. In this chapter, I describe some of the lesser-known characteristics of schools as workplaces and I describe some of the day-to-day realities of working in schools. In addition, I describe some of the issues that are specific to educational populations or that have specific implications for IT professionals working in school.

Your Experience Wasn't Everyone's

If you are reading this book, I assume you were a student in elementary, middle, and secondary schools, and perhaps even have some college or trade school education along with workforce training. If you are like most people, you have distinct memories of each phase of your education, and it is likely you were somewhat successful in school, otherwise you would be unlikely to be considering or working in a school. I also assume some readers of this book have experience as a parent of children who were in school or have other knowledge of the experience of school for students.

When humans have important experiences, such as we have in school (either as a youngster or a parent), those will bias our beliefs about the experience for others. We assume everyone's experience in school was like ours. (It was not—even for classmates.) We assume

that everyone should learn what we learned and how we learned it. (This may be true, but it may not be true.) As a result, many adults pursue work in schools with the intent of replicating the structures and instruction they experienced, but that may not be what all students need.

The composition of the leaders who set school agendas, policies, and procedures is an interesting aspect of these public institutions. In general, we recognize two groups of people who participate in schooling as adults. There are those who liked school or were successful in school; individuals in this group tend to advocate schools that reflect their experience. There are those who did not like or succeed in school; these individuals tend to advocate different organizations and different types of teaching than they experienced. In many cases, those who were not successful also advocate for students and form strong relationships with them. While this is an oversimplification of the nature of these groups and the composition of educators, it is noteworthy that both groups include individuals who value school enough that they want to work there and support today's students. The perceptions, experiences, and biases of individuals who never return to school in any capacity are silent in the design of schools.

For school IT professionals, many of the requests they hear seem foreign as they contradict much that they "know" about teaching and learning and schooling. We will also see those requests many contradict what they believe about IT configurations as well.

> I was not a strong math student; my lowest grades were always earned in math class. I attributed this to the "D" I earned in math when I was in 4th grade and the message it sent to me. Despite this, I became a math teacher. My students (and their parents) frequently said I was among the best math teachers they ever had. I attribute this (and the frequent conflicts between me and other math teachers) to the fact that I had first-hand knowledge of the negative effects of traditional approach to math teaching. I challenged what they do because it had failed me as a math student. My students liked my approach; other math teachers did not. Such conflicts are surprisingly common in schools.

One of the most important things to remember as you consider a position working in a school is that your education deserves no special consideration. While IT professionals may not exert direct control over teaching and school management decisions, the priorities they set and the devices and configurations they deploy do exert influence on what happens in classrooms and how it happens. When they work in schools, IT professionals are often asked to build systems that does not make sense to them as it is contrary to their expectations. As will be detailed in later chapters, educators are the stakeholder who should make decisions about the technology they need and what they must do. It is the IT professional's role to ensure whatever technology educators need functions as expected. In general, IT professionals should avoid telling teachers what technology they should install or how to best use it in their classrooms.

One of the most puzzling aspects of teaching for many adults to accept is that teaching is a much more interactive and dynamic activity than many experienced (or remember) or that they see in the popular culture. When one thinks of a classroom, they picture a teacher standing in front of the seated (in rows) students and telling them what they need to know. This Standard Model of Education (Ackerman, 2017) assumes that we know exactly what teachers should teach, how they should teach it, and how to measure it. For IT professionals, this is a familiar and comfortable classroom for which to design technology: give the teacher a computer and projector with web access and a presentation application and let them teach.

Many educators are coming to realize (largely because they are listening to the cognitive and learning scientists who are discovering how human brains really work) that "telling and testing is not teaching," so they need much different arrangements and technology capacities in classrooms than they need is they follow the Standard Model of Education.

> While preparing an early draft of this book, I observed a conversation between IT professionals and a science educator. The educator had grant funds to purchase "computer pods" for their classroom. Each pod would comprise a computer connected to a 40" display mounted on the wall as well as a hub into which students could connect their own devices. Using this arrangement, groups of five students could look at the same display coming from any of their devices connected to the hub. This arrangement affords several options for group work and collaboration.
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> During the meeting at which purchase decisions and installation plans were to be made, the IT professionals were not supportive of the plan. The reasoned, "students can just turn their laptops, or they can connect them to the projectors used for lectures." The IT professionals were going to be responsible for installing the TV and hub but the additional demands on their time were to be minimal. In rejecting the teachers' request they both adversely affected the teaching environment, and they alienated the teacher.

In addition to the changing nature of teaching in schools compared to what previous generations experienced, there are many more factors that affect schools that are commonly recognized. Most of these factors are not new, but their effects on school are often hidden from students and parents, so IT professionals who arrive to work in schools may be surprised by their effects.

Schools Are Multidimensional

It may seem unnecessary to state it, but schools are places where children are present. Lots of children. Children who reflect the social, racial, ethnic, and other characteristics of the local population. They are everywhere and they affect every decision that is made. Ostensibly, decisions are made to support student learning, but the reality of that goal is questionable. Consider, for example, there is ample evidence that high school-aged people benefit, and learning improves, if the school days starts in the late morning, but few schools have adjusted their schedules to align with this finding. Consider, as well, the debates regarding the purpose of school during the COVID pandemic; one very important function of school is providing reliable childcare for large parts of the population. While this cannot be minimized, it seems contrary to the goals of teaching the academic curriculum which is typically ascribed to schools. One of the reasons the decisions made in school may be contrary to "what is good for students" is they are multidimensional; schools fulfill several purposes and different stakeholders exert influence on decisions.

Schools are political organizations. They are funded by taxes levied by state and local governments in the United States, and citizens serve on school boards that govern local schools. Because the officials who fund and govern schools are elected, their selection is a political process. This opens the process of school governance to partisan politics, and participants in such decision-making are not bound to evidence and reason in the same manner as scientists and scholars; so, any decision can be justified.

While drafting this book, the school board I the city in which I live voted to replace the school mascot which was interpreted by many as racist. The composition of the school board changed, and the new board reversed that decision. In the next elections, three of the four open seats were won by individuals who did not support the reversal. It seems reasonable to conclude this issue has been distracting the board from the work of supporting local students and teachers.

Schools are also regulated organizations. Governmental agencies, which take their directions largely from legislation, define the policies local school boards are expected to adopt, and they provide guidance on the contents of those policies. They also approve the qualifications necessary to be a licensed teacher or administrator and approve teacher education programs offered by college and universities. In the United States, the federal government did not exert much influence on education until the Department of Education was founded in October 1979, and since then it has sought to influence decisions and priorities through grants and other programs, but most school regulations and decisions are made by state and local governmental agencies.

Schools are also hierarchical and authoritative organizations. Teachers have some authority over students, and administrators have authority over students and teachers. This authority is not absolute, of course, but it does influence decisions that are made and actions that are taken. The hierarchical authority in school is grounded in age (teachers are adults and the students are children), but also from the position one holds (administrators have more responsibility than teachers) as well as expertise (teachers are experts compared to students, and ostensibly administrators have greater expertise than teachers). As a result, even in classrooms in which the students are adults, there exists a hierarchical and authoritative relationship between students and teachers.

Further, schools are organizations that rely on diverse expertise, and this is especially true in relation to information technology. Early in the history of desktop computing in schools when classroom computing comprised small numbers of computers that were not connected to networks, it was common to find tech-savvy teachers who supported and managed the devices that were in their classrooms. Few educators have the training and experience necessary to configure and manage the enterprise and business class IT systems we find in schools today. In most jurisdictions, the executive leaders who are responsible for all school operations, including the IT, are licensed educators who began their careers as teachers, but who may not have been in the classroom for years when technology was primitive compared to that installed today. As a result, many initiatives are proposed, and even undertaken, without complete consideration of the technology implications. The opposite is true as well; IT professionals often undertake technology initiatives without complete consideration of the educational implications.

Because schools are multidimensional, and many stakeholders influence the decisions that are made, no person who works in school have exclusive authority to make decisions about their work. In this, school employees and leaders are like other regulated and board-governed organizations. In many other types of organizations, many the authority in which decisions and judgements are grounded in the financial success of the organization. In schools, this measure of success is absent. Various factors emerging from the political, regulatory, and authoritative natures of schooling contribute to the decisions made and actions taken (even if they seem unreasonable to those responsible for implementing them). Students are often unaware of these

competing influences on the schools they attend. This makes schools as workplaces for adults very different from learning places for students, and some adults find they cannot work in schools.

> When I was an undergraduate student, the university had recently begun a project which found students in education programs spending time in schools early in their studies. Faculty realized a small fraction of their students discovered during their student-teaching, just before they graduated, that they did not like working in schools as adults. Even those students who had spent several years studying to be teachers had no idea what the work environment would be like.

Special Considerations for IT

Earlier in this chapter, I made the rather obvious observation that schools are filled with children. Because so many of the IT users in schools are children, which is a population deserving of special protections, several wide-ranging national laws in the United States provide guidance and direction for school and technology leaders when they design policy and procedure, and there are also other important considerations that provide indirect guidance for school and technology leaders. Anyone who seeks to work as an IT professional in schools must be aware not only of the requirements of these laws but also the rationale behind them.

FERPA

Most IT professionals are familiar with the need to keep data secure. In some industries this is necessary for regulatory purposes; and, in all industries, it is necessary to protect proprietary information and to protect clients' information. In schools, the importance of privacy takes on special importance because of the age of the individuals about whom the information is kept and the nature of the information that is kept. The *Family Educational Rights and Privacy Act* (FERPA) is law in the United States which is intended to safeguard sensitive information about children in schools. FERPA details who is allowed access to information kept by the school and the conditions under which the information can be stored. The law does specify the rights of students, and their parents if they are under 18 years of age, as well as the steps school officials are expected to take to protect information. Those whose privacy or rights have been violated can file a complaint with the US Department of Education and legal action is possible.

To ensure they comply with FERPA requirements, most schools require all employees (including IT professionals) attend training at which local expectations are described. They also protect the school by having employee acknowledge they received the policy training.

While schools may interpret FERPA differently, there seems to be agreement (at least in the dozens of FERPA training I have attended) that FERPA protects a wide range of information, including that which school employees learn accidently. For example, a school employee who sees a friend in the store and says, "I saw Johnny get in a fight at school today and he was suspended," has violated FERPA. They identified a student and shared information about their behavior and the consequences of it, and the recipient of the information was not entitled to it, nor were the many other people who may have overheard the story.

IT professionals have an unusual level of access to classrooms and data. When an IT professional is in a classroom and sitting at a computer, they are "a fly on the wall." Teachers and students largely proceed as if there is no one else there. They gain an unfiltered view of classroom actions and interactions, and some of what they observe must be protected according

to FERPA. IR professionals also have access to data systems containing protected data. While the student information system should have protections to prevent a technician from accessing grades, a teacher may ask for help resolving a technology issue when they are logged in to student information system and working the gradebook.

What one observes in data systems, classrooms, and schools must be kept confidential; the teacher who shows their gradebook to an IT technician while getting help has violated FERPA. The IT technician who does not share that information with anyone or who does not treat the student differently has not violated FERPA. They have minimized the damage done by the original violation and they have not violated FERPA themselves which both protects the privacy of the students and minimized the liability due to the original violation. The one exception, of course, is if there are situations that are unsafe or potentially troubling. IT professionals have the same responsibility as anyone, especially adults, to prevent and report those situations.

> Now that projectors are found in almost all classroom and those tend to be connected to the single device assigned to the teacher, it is not uncommon for the teacher's gradebook to be displayed accidently when the projector is turned on when the gradebook is open. While most teachers are aware of the potential and will close their gradebooks, those steps may be forgotten. Many technicians have a question they will ask before turning on any projector and they try to make it a joke.
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> One of my former colleagues would always ask "what is going to be on the screen when I turn this on? I'm not going to give away the winning lottery numbers, am I?" when the lottery joke got tiresome, he would say "I'd hate to show everyone your secret cookie recipe." This habit both prevented him being the cause of sensitive data being exposed and it served as a reminder that everyone should be aware of this potential situation.

COPPA

The *Children's Online Privacy Protection Act* (COPPA) has been law in the United States since 1998. The intent of the law is to protect the privacy and the personal information of children; thus, it requires the publishers of web sites that collect user information to have parental consent for those under 13 years of age. This is the law that has motivated social media companies to restrict children from accessing their platforms. Of course, it is very difficult to enforce age restrictions, but the terms of service and privacy statements of companies that maintain web platforms, especially those that facilitate interaction among users, do reflect the requirements of the law.

Because of COPPA, most schools, especially those enrolling students younger than 13, have procedures for identifying the online platforms that can be used by teachers. A teacher may find that are not allowed to have students logging on to and using and interesting new tool until the terms of service have been reviewed and school leaders conclude it is reasonable to allow access and the publishers of the site align with local policy and procedure.

CIPA

In 2000, the United States federal government passed the *Children's Internet Protection Act* (CIPA) which is intended to protect children from indecent information on the Internet, it is

also intended to prevent personal information about students to be available online. Specifically, CIPA requires schools that receive e-rate funds to install and maintain filters to restrict access to inappropriate content, and it requires steps be taken to protect youngsters when using email, chat, and similar tools. CIPA does allow the filter to be disabled when only adults are using the network, but that is rarely done as children are hardly ever absent from school when adults are there.

School IT professionals can be expected to participate in the planning undertaken to ensure the school complies with CIPA. They will review policy and procedures to ensure Internet filters are configured and operational, email and chat is available only to those users for whom it is permitted under local policy, to manage firewalls, and to otherwise protect children who are using the school's IT systems. The planning takes on special importance when systems are being updated or older devices being replaced. In addition, IT professionals are expected to monitor systems installed to comply with CIPA are functioning, and to define steps to take if they fail.

Advertisement-Driven Sites

Another overlooked aspect of IT use in schools is students' exposure to advertisements. Many sources of online information used in schools, including mainstream media and journalism sites, the sites of professional organizations and edited periodicals, and especially social media sites (like YouTube) are funded by advertisements. When students access these sites, they are also exposed to the advertisements.

Some educators, students, parents, and others object to this exposure for several reasons. First, this can be perceived to be the commercialization of students. Students are required to attend school, and they have little choice over the lessons and materials they use. By directing them to information sources that are advertisement-rich, teachers may be exploiting students. Second, some of the products may be unsuitable for children, especially in school. Even if the products are not unsuitable, they may lead to distractions or they may contribute to inappropriate situations.

IT professionals may be asked to minimize students' access to advertisements when at school, this may include installing and configuring software or web browser extensions that block advertisements. In addition, IT professionals may be asked to support faculty as they embed media in virtual classrooms or otherwise minimize expose to advertisements.

Other Privacy and Security

Regardless of the nature of the organization in which they work, all IT professionals are very familiar with the importance of network and data security; this is a lesson taught in preparation programs and all organizations implement data security practices. IT professionals working in schools should also promote data security, but they must be sure their actions align with the decision-making hierarchies in schools and accepted policy and procedure.

Schools are places where IT professionals and others are very likely to find passwords on sticky notes attached to computers (while this is becoming less common, it is still more common than it should be). In some schools where I have worked, technicians and other IT professionals were encouraged to remove those sticky notes, but that was done only with the knowledge and support of the school administrators. Another common practice is for teachers to keep list of their students' usernames and passwords. Ostensibly, this is done to reduce troubleshooting when

passwords are forgotten, but there are other strategies whereby passwords can be recoverable without the potential of them being discovered and used for nefarious purposes.

The teachers in Springfield Middle School insisted their students provide the teachers with their passwords for the school network. One teacher kept the list taped to the inside of the door of the cabinet next to her desk. One afternoon, students noticed the teacher had left the door open and passwords were in plain sight. They memorized some of them and logged on to others' account. An IT technician noticed students behaving suspiciously near a computer and noted it.

A little investigating found those students had logged on as another and sent some emails. It did not take much detective work to trace the origins of the email to the school's IP address, and the student whose account had been used was on a trip with a sports team. The IT technician reported the suspicious activity of the students who were questioned and admitted they had sent the messages.

The question is the degree to which the teacher was responsible for keeping the passwords. It can be argued the students were old enough to remember their own passwords, so there was no reason for the teacher to have them. If the teacher did have a reason to keep them (which seems dubious) then it can be argued, they were negligent in not keeping them more secure.

2: Working in Schools

The nature of schools and the role of IT in their operations contribute to different workplaces for IT professionals compared to business and industry. While many of the roles of IT professionals are similar, the exact nature of the work they do reflects the realities of teaching and learning.

In the previous chapter, I described schools in very general terms, and I made the point that schools are much different workplaces for adults than they are learning spaces for students. As a result, some individuals who arrive to work in school find they are much different places than they expect. In this chapter, I continue to describe schools as workplaces, but I focus on the more specific aspects of schools as workplaces for information technology professionals, including the working conditions in schools and the IT roles that must be fulfilled in schools. This chapter comes with the warning that schools are very localized organizations, so the claims I make may differ depending on the local laws, regulations, and regional norms and expectations. The size of the school can also exert strong influences on the details of working there. Still, there are some aspects of working in schools worthy of readers' attention.

Working Conditions

One of the biggest differences between working in schools and working in business and industry is the lack of a clear and unambiguous measure of success; in the vernacular, we can say, "schools lack a clear bottom line." In education, they attempt to use test scores as a bottom line comparable to financial measures in business, but many educators find those to be a weak proxy for learning.

While the weak bottom line does change the nature of IT configurations in schools, it does not change the expectations of functional IT. While access to functioning IT is necessary for school operations, most teachers can continue to educate children (for the short term) without IT. When schools experience power outages so IT is not available, classes may be able to continue with different (but still valuable lessons). The same is true of IT outages. While no school IT professional wants their systems to be unavailable, and they respond with a sense of urgency to outages, the urgency is different compared to that when a business' bottom line is directly and adversely affected by IT outages. This and other factors make schools workplaces where IT professionals experience less job-related stress when they work in school compared to when they work in business and industries.

Pay and Benefits

The pay for IT professionals tends to be less in schools than it is in other organizations; just as it is for most other professions with similar educational requirements. Because schools are public organizations, they often have requirements to provide health care and other benefits that private organizations may not be compelled to provide. In the past, the benefits provided to school employees were considered among the best in many communities. In recent decades, many factors have resulted in fewer benefits being provided to school employees (which is aligned with the changes in all industries).

Any observations of pay and benefits for employees in schools or any other organization in the years after the COVID-19 pandemic are going to be very uncertain. There has been significant turnover of school employees (just as with all organizations) and there are sure to be changes in the pay and benefits as schools adapt to new financial realities and as they seek to fill open positions.

Unions

In some regions of the United States, schools tend to be highly unionized organizations. Many factors affect whether an IT position in a school is included in master contract agreement. In schools where employees work under a master contract, it is the position that is included under the contract, not the person who holds it. Whether one joins the union is a personal decision, but employees in a position covered by a master contract are expected to comply with those conditions regardless of their union status.

Master contract agreements are established between the governing bodies that employ the workers and the associations of employees; school administrators are generally not involved in negotiating contracts, but they do follow the conditions specified in them when managing the school. Union contracts are generally perceived to provide benefits for both workers and management (in schools, management includes the school administrators who are implementing the policy and procedures mandated by school boards and other regulatory agencies). Pay and benefits are typically defined in a master contract, which means individuals cannot negotiate the salary or wage for a position included in a master contract, but the management cannot decide to withhold health insurance for the individual hired into a unionized position. Working conditions, including supervision and evaluation requirements, are also specified in master contracts. Perhaps the greatest benefit of master contracts for both the organization and the workers is the predictability that is afforded to both.

When individuals find the terms of master contracts are not being followed, they are entitled to file a grievance in which the situation is examined, and disputes are resolved. Such actions can be taken to prevent the management from violating the agreed upon conditions, and they can be taken to prevent individuals from violating the terms of the contract. For example, individuals holding unionized positions cannot voluntarily work for less pay. This protects the other members of the organizations from being coerced into taking pay cuts as well.

In schools that are unionized, it is also common to find multiple unions which are also called local associations. The teacher association will comprise the professionals who hold teaching licenses and who work in positions that require them. Teacher assistants, administrative assistants, custodian staff, IT staff, and others may belong do a different association and their work in covered by a master contract different from the contract covering teachers.

> A principal in a school where I was employed once decided to deny a contract to one of the teachers in the building. Despite having good evaluations throughout her career at the school, the principal claimed his decision was based on poor performance, but he violated several articles in the master contract. For example, the principal had not notified the teacher her performance was not acceptable, he had not defined a performance improvement plan, nor had he met the deadline for notifying teachers who were not be rehired due to performance reasons. All the steps that principal failed to follow were things he was obligated to do under the master contract, so she kept her job.

Initiatives and Change

The title of this section contains significant irony. While school leaders often tout the changes they are making in the teaching and school operation, schools are generally recognized as being very conservative organizations, especially compared to businesses. Regardless of the degree to which "change initiatives" produce different policies or procedures, those who work in schools, including IT professionals, will be expected to participate in various initiatives designed to improve school performance whether they concur with the intention of the change or not.

The irony in the title of this section also arises from the reality that many schools participate in the change efforts described in this section only superficially. Committees may form and make recommendations, but nothing is implemented. Outside consultants may be hired (at very exorbitant fees) to make presentations and lead workshops, but nothing is implemented. While some of these initiatives may not seem directly related to the work of IT professionals, they are likely to be expected to participate in a manner deemed appropriate by school leaders.

Curriculum Changes

Educators are constantly reviewing what they teach. Many regulatory agencies require curriculum documents to be updated and professional organizations update curriculum recommendations, so educational leaders are responsible for ensuring local curriculum documents and instructional practices align with emerging expectations. Although IT professionals will not make recommendations about what should be taught, they will be asked to participate in curriculum redesign initiatives to ensure the existing IT meets any system requirements for technology tools necessary to implement curriculum changes, to plan for necessary updates, to support digital document management, and to otherwise facilitate and support curriculum planning.

DEI Initiatives

Attending school is recognized in the United States as a fundamental right. The government is compelled to provide a free and appropriate education for each person. For generations, of course, the degree to which we have achieved this goal has been debated, legislated, and adjudicated. At least within educational communities and among scholars of school history, it is generally accepted that there are organizational structures and practices that pose barriers to education for some populations. Some of which have histories long enough to be labeled "traditions," and many of these organizations and structure remain even after policy and procedure has ostensibly adopted to prevent them. In recent years, many communities have undertaken diversity, equity, and inclusion (DEI) in schools to address the remaining barriers and prevent new one from being imposed.

While such initiatives are typically considered together, diversity, equity, and inclusion are different aspects the community and effective leaders seek to improve all three. Diversity refers to the composition of the members of the community. When more racial, ethnic, gender, disability, and other identities, and those of various socioeconomic populations are reflected in the community, the more diverse it is. When those with all identities are given the same opportunities to participate in all activities (as students or employees), then the school can be said to be equitable. When the ideas, opinions, and desires of more individuals (representing the diversity of the entire population), then the school can be called inclusive.

One of the difficulties in sustaining engagement in this area is the fact that different people have different perspectives and different experiences which affect their beliefs and opinions

about what is appropriate actions for school leaders to take under DEI initiatives. While some individuals suggest DEI efforts are continuing exclusionary practices, but now just directing them towards the majority populations, those views misrepresent the purpose and outcomes of DEI initiatives. As public institutions, schools have an obligation to remove barriers to participations for all, even if that means those who have been privileged in the past have less privilege after the barriers are removed.

> The goal of DEI initiatives is to ensure no individuals face barriers to full participation in the school. Those who disagree with this goal are ill-suited to work in schools.

Trauma Informed Practices

Another population that school leaders have recognized need particular attention in schools are those who have experienced trauma either inside or outside of school. While the effects of specific very traumatic events have been well-known for some time, post-traumatic stress disorder being an extreme example, psychologists and clinicians have discovered long-term exposure to stressful environments can also be harmful to brains and their ability to learn.

While moderate levels of temporary stress are normal and benefit brains and bodies, long-term and persistent stress even if it does not reach the level of trauma can affect developing brains. Compared to those who have not experienced trauma, students who have are likely to have decreased capacity to attend to lessons, decreased ability to make sense of situations, and less control over their emotional responses to difficult situations. While IT professionals are unlikely to have direct responsibility for planning for implementing strategies for educating trauma-affected brains, they will be working with those who do have direct responsibility, and IT professionals have the same obligations as all school employees to foster a culture and environment where all students can learn.

In addition to their indirect roles supporting trauma-informed practices, IT professionals may participate in remediating difficult situations in which trauma contributed the events. For example, IT professionals may be involved when students misuse IT devices or use them for inappropriate purposes. Trauma-informed practices in school are designed to foster positive relationships and inclusion. The default approach for remediating difficult situations with IT in schools has been to exclude users. This is an increasingly untenable approach as trauma is affecting larger parts of the student population and as IT is increasingly essential for teaching.

The COVID pandemic has affected all aspects of society, and school-aged children and their families have been particularly affected. While it is unclear the exact nature of the stress caused by the pandemic, we can predict that individuals and populations within school communities will have experienced trauma resulting from the pandemic that some individuals and groups will have been more affected than others. This is an emerging area of school life, so school leaders will be responding as the effects become clearer.

IT Roles in Schools

Because the devices that provide local area network and internet access in schools are the same as those installed in other businesses and industry, many of the IT roles filled in schools are similar to those in other organizations. Because the devices are the same, IT professionals perform may similar role as well. There are, however, several types of IT work in schools that are not found in other organizations. Schools are also known to be organizations with under-staffed IT departments. As a result, it is not uncommon for individuals to play multiple roles and

it is also not uncommon for individuals to expand and enhance their technology skills working in schools and to gain experience in new roles. This is one reason school may be excellent places to start an IT career.

One of the realities of working in schools as an IT professional is that other stakeholders often do not differentiate technology roles. IT professionals recognize this is not unique to schools. When someone from "IT" appears, they will be asked to troubleshoot or resolve problems they were not expecting and that they are not prepared to resolve. IT professionals find it necessary to tactfully explain that they have higher priorities at the moment or that they do not have the skill or the authority to solve their problems. Further, IT professionals sometimes find it necessary to explain why some problems have not been resolved.

The IT departments in school comprise a wide range of professionals who are managed by the chief information officer. Each IT professional applied specific expertise fulfil specific roles for specific audiences (see table 1). Schools are organizations in which the titles applied to IT positions are very inconsistent. In some schools a "technology coordinator" may serve as the chief information office (as I define it below); while in a nearby school, a technology coordinator may serve as a technician. For this reason, clean and accurate job descriptions are necessary to ensure qualified applicants apply and are hired.

Table 2. IT Roles in Schools

System	IT role	Function filled	Primary audience
Entire IT system	Chief information officers	Advocate and manage	All stakeholders
Teaching	Technology integration specialist	Design and support	Teachers and student
Educational data	Data specialists	Generate reports for	School leader and regulatory agencies
End user systems	Technicians	Repair	Students, teachers, leaders, staff
Network	System administrators	Configure and manage	Local area network and internet connections
Web presence	Web master	Publish and post	External audiences

Chief Information Officer

It is only recently that educational organizations have adopted the practice of using "c-level" titles for those in management positions. The superintendent of schools is typically recognized as the chief executive officer (CEO); that individual manages and leads a team of senior leaders, such as the chief financial officer (CFO) who is responsible for the business

functions of schools, the chief academic officer (CAO) who is responsible for all aspects of teaching and learning within school, and the chief operations officers (COO) who is responsible for facilities management and similar functions, and the chief information officer (CIO) who is responsible all aspects of the information technology systems within the school. These and others comprise the senior school leadership team, and these individuals typically work in the central office and are responsible for multiple schools in a school district.

Of course, no c-level executive managers work and lead in isolation, so—at the highest level—decisions are made to satisfy the needs and limitations of the entire organization. The c-level manager is responsible to both advocate for the needs with their area of leadership, then to implement decisions within that area. The role of the CIO in schools is to advise the other top-level leaders on the nature of the existing technology, the steps necessary to maintain it, and the potential changes that will improve it. Of the many responsibilities assigned to the CIO, perhaps none is more important that those involved with installing and upgrading information networks and securing them because of the nature of the data stored on them. The CIO also advocates for financial and human resources to maintain those networks and supervises the professionals hired to manage the network and all other devices.

For much of the history of computers in schools, a single individual was allowed to decide what technology to buy and how to install it. The rationale behind this practice was that those individuals held quite specialized expertise, so educators and leaders were willing to defer to those with greater expertise. In many cases, that method of decision-making led to technology that was ineffective and even led to conflict as technology decisions were made for technology reasons with little regard for the effects on teaching and learning. As CIO's have been integrated into technology decision-making in schools, there has been a shift towards making technology decisions for teaching and learning reasons, but that is not yet systemic.

The individual who serves as they CIO in a school is likely to have qualifications similar to the others on the senior leadership team. These individuals are likely to have advanced degrees and years of experience managing technology; as the team of IT professionals becomes more diverse, this individual provides directions and leadership more than they spend time configuring devices or troubleshooting problems. When necessary, however, this individual will be found assisting in whatever IT emergencies arise. Ideally, the CIO will have experience working in schools as well, but many hiring committees opt for individuals with technology experience over school experience.

> A colleague whose experience was as a teacher attended the first planning meeting of the search committee for a new CIO. Afterwards, he observed, "I thought we wanted someone with strong technology chops, but we have experts in that on the team. We want a good manager." I agreed and told him they were not going to get it at the advertised salary.

Technicians

Technicians are the individuals who have one of the most important roles in school IT system operations; these individuals are the face of the IT department to most members of the school. A technician is likely to spend their day troubleshooting and repairing end user devices including desktop computers, laptops, Chromebooks, printers, and other peripherals. Because these professionals spend their time interacting with teachers and students, it is essential they

have excellent customer service skills and are comfortable interacting with teachers when they are in stressful situations (due to malfunctioning computers) and with frustrated students.

On those staffs with multiple technicians, the group can be very interdependent; they collaborate on solving problems and they share what they have learned about the systems and the users of systems. By documenting the repairs that they make (ideally in a ticketing system), technicians contribute to the emerging knowledge of the IT system and help identify those devices that need to be replaced. As professionals who understand IT and who observe users interacting with it the most, technicians are also the first to identify potential problems that are emerging and unmet needs that the CIO and other professionals must plan to address.

Technicians may be hired with a wide range of qualifications. One can develop the expertise they need to be a successful technician in many places other than traditional higher education. Many school IT technicians are hired and begin work as they are completing their education or they complete formal education or earn industry credentials while working.

The CIO plays an active role in ensuring the technicians who are working in the school receives the professional courtesies and the on-going support they deserve. Good CIO's support technicians as they develop their knowledge of technology, and they serve as mentors and models as technicians develop customer service skills and professional dispositions.

Technology Integration Specialists

For decades, school leaders have recognized the need to provide IT training for teachers and to help them learn how to teach with IT. The professionals responsible for organizing and presenting in-service professional development for educators have used a variety of models for delivering learning experiences for teachers to learn how to use technology. In recent decades, technology integration specialists have emerged as a specialty within the teacher populations, and one of their most important roles is to model and co-teach technology-based lessons in classrooms with students and teachers present. This represents an important change in how teachers learn to teach with technology, and these individuals fill an increasingly important role on school IT teams.

> In 2017, a librarian and I were cleaning out a cabinet and found an old CD containing "Oregon Trail." Even though the disk indicated it was for Windows 98 and the copyright was 1998, we tried installing it on a computer with Windows 7 installed and were surprised it worked. A middle school teacher heard our excitement and took the disk to use in his classes. "My students are so going to write journals of their trips, just like I did!" he explained.

Traditionally, teachers' professional development in technology-rich teaching resembled all school-based teaching as it occurred outside of the "real world." Students are separated from the situations in which they will communicate, create, and collaborate to learn how to do so; teachers were removed from classrooms with real students and real curriculum to be trained in how to use computers and how to learn how to teach with them. While the technology and the curriculum were the same during professional development and teaching, the dynamics of students who are engaged and learning is missing from those types of professional development experiences.

In idealized circumstances, technology integration specialists spend most of their time supporting colleagues as they become competent, confident, and independent users of and

teachers with technology. Three common obstacles do interfere with the work. First, especially in smaller schools, a technology integration specialist may have to fill this role on a part-time basis and have other teaching responsibilities. This can introduce scheduling conflicts that can limit opportunities to work with some other teachers. Second, the personal characteristics of some teachers may lead him or her to become dependent on the support of the technology integration specialists, so they will not use technology if the technology integration specialist is not available. Third, because technology integration specialists are among the most visible technology professionals in the school, they are often the first contact for initial troubleshooting help. While this often leads to quick repairs and can lead to opportunities for both students and teachers to receive lessons in troubleshooting, this work does direct technology integration specialists away from their primary responsibility of mentoring teachers.

A final mentoring role for technology integration specialists is to support IT professionals as they develop experience creating systems to meet the unfamiliar needs of educational populations. They advocate for teachers' and students' needs when IT professionals are designing and configuring IT systems, and they interpret educational users' experiences, so the IT professionals understand unmet needs and systems that are perceived to be too difficult to use or ineffective.

Technology integration specialists are almost always licensed teachers who began their careers as classroom teachers, but who pursued additional training and education, to add this certification to their portfolios. Just like all licensed educators, their individuals must maintain their licenses, and most could return to the classroom if needed. Because they are educators, they pose difficulties when it comes to supervision and evaluation. While they are often viewed as part of the IT staff, and they work closely with those professionals, it is inappropriate for a CIO who is not a licensed educator to supervise and evaluate licensed educators.

Data Specialists

Schools store vast amounts of data in sophisticated databases. The expertise necessary to prepare and run queries of the database so that questions regarding correlations and performance can be answered requires much expertise. Often this work includes creating scripts that produce tabular and graphic reports that are used to support decisions made by school administrators and teachers. In addition, regulatory agencies have increased the data reporting requirements for school in many jurisdictions that have accompanied calls for accountability associated with laws enacted since the beginning of the 21st century. As a result, schools have begun hiring data specialists as the amount of data and the sophistication of the databases has increased. The need for this specialist arises from both the skills necessary to manage the demographic, health, behavioral, academic, and other information that is housed in sophisticated databases and the increasing demand for data-driven practices.

These professionals represent one the first ventures into the field of educational data analytics by schools. In this field, educators seek to apply the methods of data science to predict student needs and performances. It should be noted that advocates for data analytics argue these methods hold much promise for improving education, but those claims have not been documented and observed by scholars in the field. Regardless of the degree to which the data are affecting teaching decisions and long-term and desirable learning outcomes, schools are expected to gather and use data so the need for data specialists is expected to increase.

System Administrators

Once computer networks are installed and configured (usually in consultation with external engineers and technicians), system administrators employed by the school ensure the networks remain operational and functional. These professionals listen for network problems by both attending to reports of malfunctions from users and by monitoring system logs, and they both resolve problems that are identified, and they take steps to ensure the continued health of the local area network.

Among the specific responsibilities of system administrators is ensuring users and devices can access network resources, configuring software to backup files and checking those files are being created as expected, upgrading the operating system and driver software on the servers, and otherwise maintaining network hardware and software. As cloud-based systems have become more common, one of their most important roles in user management which often includes ensuring single sign-on systems are connected and functioning. They also play an important role in planning for and deploying software and hardware upgrades, and this individual pays particular attention to potential conflicts that may be introduce when networks are changed. In general, if changes are made to a device that contains or manages local area network traffic, it is the system administrator who performs the task. This individual will also work closely with technicians to ensure that use devices are properly configured to access the LAN and Internet.

Most system administrators have completed an undergraduate degree in information systems, and they are also likely to hold credentials awarded by IT vendors and professional organizations. In many cases these credentials require effort and understanding that is comparable to graduate certificates and graduate degrees in their field.

Web Masters

Almost every school maintains a web presence. These serve as important venue for sharing information with a wide range of internal and external audiences. Those who are responsible for managing school web sites know the most important information that can be posted in the cafeteria lunch menu. Most school web sites provide information and announcements about curriculum, staffing, athletic and extracurricular events (including practices and rehearsals and meetings), governance, and other school activities.

Whereas teachers often maintained classroom web pages in previous decades, those have largely been replaced with *Google Classrooms* (or a full learning management system) or a page integrated into the student information system. These are spaces where students find resources and assignments, parents and students can see grade reports, and all can access the classroom news and announcements posted by the teacher. Once these spaces are configured, school IT professionals, including the web master will not usually post information on classroom spaces.

Many schools are integrating other platforms into their web presence as well. Often interscholastic athletic leagues will ask (quite insistently) that all members use the preferred platform to set schedules. These schedules can be embedded in the web pages of member schools, and it can facilitate reporting of standings, scheduling of officials, and otherwise managing the participation of school team in the competitions. As only one or two individuals in the school need access to post to these sites, they usually handle that without intervention from IT professionals. Once the web master has included the embed code for the schedule in the school web site, changes made by the athletic director automatically appear on the school web site.

One of the more challenging aspects of managing a school web presence is handling images of students. This is especially true on social media. Once images are posted to the web or to social media, the person who posted it loses all control of it. Some maintain that once consent has been secured from parents, then school employees can post images for any purpose. While this may be legally defensible, it can be argued that children cannot give consent and they are the individuals who may be most at risk because of information or images shared on the Internet, so all adults should be very cautious when posting images.

In November 2021, I posted a tweet in which I maintained it is inappropriate for teachers to post images of students on Twitter. It motivated more the 70 replies, some agreeing, and others challenging my position. A few days later, I reflected on my post and the replies. Visit the blog post (which contains the original tweet):

https://hackscience.education/2021/11/12/thoughts-on-a-tweet/

3: Infrastructure in Schools

For IT professionals, much of the IT infrastructure they encounter is schools is familiar. They find laptop and desktop computers being used as well as large numbers of Chromebook. These devices connect to wireless networks that are used to connect to web-based data systems that are used for all aspects of teaching and learning and school operations.

When working in schools, IT professionals encounter many unfamiliar needs and face unfamiliar requests and situations. The computers and other devices they manage for users, the networks that oversee, and the data bases they manage—on the other hand—are likely to be familiar. The computers, operating systems, network devices found in school are the same as the ones installed in the offices, warehouses, and factories of other organizations. System administrators use the same consoles, interfaces, and tools to configure them as IT professional in all organizations. In this chapter, I describe the computing devices commonly found in schools, the nature of the networks, and the commonly used data systems.

One word of caution. Just as schools are localized workplaces, schools tend to be very localized technology environments. Budgetary limits, the expertise of local personnel, and the overall leadership structure of schools influence the infrastructure found in schools. Readers who are familiar with the technology in local schools will find differences between what I describe here and what is installed locally. Further, those with experience as IT professionals may find my descriptions to be too broad. Remember, my goal is to help those who care about school IT will not be surprised at what they find, and to help school leaders to understand the technology in their schools.

Early in the history of computers in schools, they typically purchased and supported only one operating system. Schools were "Apple" schools or "IBM" schools; later they were Macintosh or Windows schools. Ostensibly, decisions were made for financial reasons (PC's were generally assumed to be less expensive than Macintoshes) or for educational reasons ("PC's are what students will use in the reals world" or "Macintoshes are easier to use"). The reality is that many schools adopted the platform preferred by the first IT professionals hired by the school.

> A colleague worked in a school system where the first computers were Apples, then Macintoshes. A tech-savvy teacher (who moonlighted as a computer salesman in a business selling Apple products) installed and managed the computers and servers. He became disgruntled and refused to turn over the administrator passwords for the devices he had installed. The school hired its first CIO and that individual was directed to never purchase Macintosh computers. That was decades ago, but the school district still does not allow the purchase of Macintosh computers.

User Devices

Since the first desktop computers arrived in schools decades ago, several generations of computers have been installed, and they reflect the changes we have seen in consumer computers. It is probably more accurate to use the term devices to describe the hardware

available to users as many things the students and teachers use to interact with information and other users are very dissimilar from the desktop computers that were first installed in schools. The original desktop computers were box-like. Output was displayed on cathode ray tube (CRT) monitors (usually in one color—often green or orange), keyboards were connected via cables, and even applications and data was stored on disks keep in boxes.

Near the end of the first decade of the 21st century, netbooks became popular in schools. Those mobile computers with screens and keyboards smaller than standard laptops and with limited memory and processing capacity compared to standard laptops with a full operating installed. Compared to standard laptops, netbooks were inexpensive, so they were the device of choice for many early adopters of one-to-one initiatives.

iPads and other have not become widely used in schools. There are several reasons for this, but traditional instructional uses (such as typing on full sized keyboards) and the difficulties of managing the devices that are intended for single users for use by multiple users were among the most cited reasons these devices never caught on in education. If there is anyone who uses and iPad or tablet in education, it is likely to be a school administrator. The extreme mobility of the devices makes them appealing to principals and other school leaders. In addition, many special education teachers find the tactile nature of iPads and tablets to be a useful feature for some of their students.

Chromebooks—notebook computers that are used to connect to the Internet and all functionality from user authentication to productivity and other applications provided by web-based applications—are very popular in schools. It is difficult to know exactly what devices compromise the fleet of devices in schools, but the popularity of Chromebooks can be traced to the much lower price compared to computers with full operating systems. The price value of Chromebooks is extended by the fact that software licensing is much lower compared to applications for full operating systems. In addition, they are much easier to manage than other devices. These advantages do come at the cost of computing capacity, however. The popularity of Chromebooks has important implications for network design and management as well. Robust and reliable wireless networks are essential in schools where user devices are mobile and full productivity requires a connection to the internet.

One-to-One Computers

In the United States, the Maine Learning Technology Initiative (MLTI) is recognized as the first large-scale effort to provide school-owned computers to students. In 2002, middle school students in the New England state were provided Macintosh laptops. Since then, one-to-one initiatives have been widely adopted. In some schools, students are allowed to take their devices home, while in others, the device stays at school and is used only during the school day or in afterschool activities. Whether the devices leave campus or not, one-to-one computers are laptop or notebook models.

Obviously, the devices for one-to-one initiates represent a very significant technology expense in schools (although enterprise networks can challenge for the most expensive component of the IT system). In addition to the expense of obtaining the devices and licensing software, the number of devices necessary represent the largest support need in the school. For these reasons, it is not uncommon to find Chromebooks are provided under the one-to-one initiative, and devices with full operating systems are available in much smaller numbers in shared spaces. This affords teachers and students access to plentiful devices for those tasks in

which low-computing capacity is sufficient, but high-capacity devices are available for tasks that demand it.

Desktop and Laptop Computers

While Chromebooks are common especially in one-to-one situations, there are both educational tasks that necessitate students and teachers have access to computers with full operating systems and the applications that can be installed on them. There are also many users in school business offices whose work or preferences require computers with full operating systems.

The computing devices provided to students need not be an either-or decision. Students who are writing the school newspaper, for example, may compose stories and edit drafts on their Chromebooks, but when it comes to layout the newspaper for printing, they may use computers with desktop publishing software installed. This example illustrates the common situation in which information can be created on almost any devices, but create a final product requires capacity that is only available on an application that necessitates a full operating system.

In addition to the desktop computer found in computer rooms, desktop computers with full operating systems are found on the desks of many school employees who serve business or administrative functions. Even if those users can perform most of their job functions by accessing cloud-based systems, thus they could be done on a Chromebook, those users may perceive computers with full operating systems to be necessary. This preference can be explained by the ease of use, effectiveness, social influences, and habits which are factors affecting technology acceptance (see page x).

Special Use Computers and Devices

In addition to the fleets of computers maintained for populations such as students and teachers, schools are places where special purpose computers and peripherals are found. In makerspaces, science laboratories, studios, workshops, and other special teaching spaces, there are computing devices necessary for specialized educational activities. Examples include:

- **Arduinos—**These microcontroller boards are inexpensive and use open-source software, so they are used in makerspaces and similar spaces in which students design and program digital devices.
- **Robots—**There are several organizations that sponsor robotics competitions for students, and these are also popular devices in makerspaces and in science technology engineering and mathematics (STEM) classrooms. IT professionals encounter a wide range of robots in schools as well. Elementary students may use toy-like robots while students in technical schools may use programmed logic control (PLC) devices for mechatronics applications in manufacturing classrooms.
- **Printers—**Much of the printing that happens in schools is high-volume and low-quality. Today, most print jobs in schools are directed to network-connected photocopiers that also serve as scanners. Many schools also provide limited access to color printers for specific purposes. Teachers may find it necessary to print some instructional materials in color, and digital arts classrooms may have printers specialized for printing photographs installed.
- **3-D printers—**Students in makerspaces and STEM classrooms are also likely to be gaining experience with additive manufacturing.

- **Science apparatus—**Teachers in science laboratories have adopted many digital data collection tools in recent decades. Interfacing devices allow various probes to be connected to software so that (for example) temperature can be collected and graphed in real time. In addition, familiar devices from the analog laboratory, such as microscopes, are now digital. Combined with a high-resolution display, these microscopes afford more specific instruction by teachers than traditional microscopes and students can capture images to use for more accurate analysis compared to the traditional methods.
- **Assistive technologies—**In order to access their education, some students need very specific hardware or software. Decisions about what assistive technologies are necessary are made on a case-by-case basis and a team of IT professionals, outside consultants, and special educators collaborate to identify, select, and deploy the necessary assistive technologies. In most cases, assistive technologies are for the exclusive use of individual students. They both need the device all of the time and it is unlikely to be needed by others.

Few schools provide desktop printers as the marginal cost is much higher for these devices than for network-connected copiers. Recognizing the fact that special education teachers and school nurses manage very sensitive data, many school IT professionals will support printers or multi-function printers for those users in their offices and classrooms.

The faculty and staff who work in the areas where special use devices are used often have accounts that allow them to manage the devices they use. For example, librarians may be able to configure and manage the hand-held scanners they use to manage circulation, science teachers will be able to manage the laboratory interfacing peripherals they use, and art teachers may be able to manage the color printers in their spaces. This allows those users to restore service more quickly than if a technician is assigned to the repair, and it minimizes the demands for IT professionals to manage single devices.

Interactive Whiteboards

Another common piece of hardware one encounters in schools is interactive whiteboards. When these whiteboards are connected to computers, they function as an input device. Teachers and students can control the computer to which it is connected by tapping the board, and they can draw on images, markup text documents or slide shows, or write or draw in other applications by interacting with the whiteboard.

Among both teachers and IT professionals, interactive whiteboards have both strong advocates and detractors. For IT professionals, the devices are notoriously difficult to troubleshoot and repair and they are unreliable compared to most other technology devices. A colleague summarizes his perceptions of interactive whiteboards with his oft-repeated statement, “if any device is going to fail, it is one of those.” They also tend to have few user-serviceable parts, so repairs often necessitate ordering replacement parts. These devices are also very expensive compared to other computing infrastructure, so they tend to stay in service for a long time, in many cases whiteboards are used past the “end of life” date of the manufacturer, so catastrophic failures are not uncommon, and they can represent an unplanned significant IT expense and a disruption if the teacher actually uses the interactive elements of the board.

Many educators object to interactive whiteboards because they are placed in the front of classrooms and displace regular whiteboards. If the interactive whiteboard isn't perceived to be an improvement compared to a regular whiteboard, then it is less likely to be used and will be perceived as a barrier to effective teaching. Others find interactive whiteboards to encourage teachers to lecture at a time when the learning sciences are finding other instructional methods are more effective than lecture.

> Story from the real world: Ms. Smith is a special education teacher in an elementary school. Her classroom was one of the last in the district to not have an interactive whiteboard installed. Several years earlier, the school had defined the goal of installing them in every classroom. Ms. Smith did not want the board. She had been taking some courses in which iPads were used in special education classrooms and she wanted to organize her classroom in the same way. She worked with the technology integration specialist to develop a proposal for obtaining the iPads and apps she needed and presented it to the principal and technology coordinator for the school. They rejected the proposal as and stated, "we are committed to the goal of SmartBoards in every classroom."

BYOD Devices

To minimize the expense of one-to-one initiatives, some schools opt for bring your own device (BYOD) initiatives. This finds schools encouraging students to bring devices they own to school, connecting them to an SSID, and using them for their schoolwork. This can pose several difficulties for IT professionals, security being the most important. Others raise concern about equity as individuals may not be able to afford their own devices or may find it necessary to use devices that have less capacity than others.

Even in schools that do not have BYOD initiatives as an alternative to one-to-one initiatives, the fact that students and teachers often bring their own devices to school can be a challenge for school IT professionals. If they are connected to the local cellular network, there is generally little reason to connect these to the school network, but guest SSID's may be provided to allow some connection to the internet through the school's gateway.

School IT professionals will not support devices they do not own, but in many cases, they will recommend strategies for incorporating media on students' and teachers' devices into school projects. For example, school IT professionals may recommend installing *Google Workspace* apps on personal devices so that users can upload images or documents to their school accounts.

> Story from the real world: Kara was using one of the Macintosh computers in the multimedia studio during study hall. It was connected to the library and the technology integration specialist was preparing for a video editing lesson. Kara went into the history on her web browser and found pornographic web sites listed. She reported it to the technology integration specialist who confirmed the internet filter was still functioning, then he looked at Kara's computer and found that the technicians who had installed the computers had not disables the wireless network interface card (NIC) on the computers. To bypass the filter, someone had connected the Macintosh to a wireless hot spot on their phone. In this case, devices not owned by the school posed a potential

threat to the school as the students may have exposed the school computer to malware along with the pornographic images.

Many educators are concerned about students accessing their own devices while in school as they can interfere with learning. It has become clear that human brains are unable to multitask, so attending to incoming messages on their own devices may distract students from lessons. In addition, because the devices bypass the filters maintained to comply with the *Children's Internet Protection Act*, students may be accessing and sharing all types of unsavory information.

Networks

Because *Google Workspaces* and cloud-based data systems are used for all aspects of teaching and learning as well as school operations; secure, robust, and reliable network infrastructure is vital to schools. For many decisions about what to install and how to configure it, school IT professionals must engage educators and other stakeholders (this is considered in detail in Chapter 7: IT Decision-Making in Schools), but the proper configuration of networks must be entirely left to IT professionals.

Essential to the operation of networks is a system for managing networks addresses and routing of packets to the correct node. Managing pools of Internet protocols addresses that are reserved for devices such as access points, printers, and other network devices, as well as identifying the device that will function as the dynamic host configuration protocol server that assigns IP addresses to end user devices that can operate efficiently regardless of its IP address.

System administrators also configure Internet filters, firewalls, and malware protection to protect the school network and secure the data stored on the school's systems. Unified threat management is the term applied to the hardware and software systems marketed to those responsible for enterprise IT systems to provide all varieties of network protection. Recall that schools have responsibilities to protect data under FERPA and CIPA which may be unfamiliar to IT professionals familiar with securing data and protecting networks for other organizations.

Network administrators in schools manage user accounts in the same way they are managed for other organizations. The organizational units (OU) managed by for school users are dynamic in a manner the OU's for other business and industry are not. In addition to adding or deleting users as they join or separate from the school, just like in other organizations, school IT professionals must move large groups of students into new OU's at the end of school years. Some of the biggest changes in the permissions in OU's occur when students transition from one type of school to another (for example from middle school into high school).

Because so many of the one-to-one devices deployed in schools are mobile, the enterprise wireless networks in schools require managed access points which are typically configured to provide multiple service set identifiers (SSID's). In schools, it is not unusual for there to be highly controlled SSID's to which school-owned devices are connected. There may be different SSID's for student devices, another for teacher devices, and a third for those used by administrators. Parameters can be set to restrict types of network traffic allowed on the various SSID's. For example, chat may be allowed on the SSID's used by teachers and administrators but disallowed on those used by students.

One of the challenges for school and technology leaders is addressing the number of devices owned by faculty, staff, and students that are brought into schools. While it is reasonable to have a "no personal devices on the network" rules (and many schools opt for that rule), other

schools recognize these devices can extend and enhance the capacity of existing IT resources, so they will allow personal devices, but limit the demands theses place of the school's network resources.

In those schools where personal devices are allowed on the network, the IT professionals will typically create an SSID that is open to public users, and that provides a pathway to the Internet, but to no other local area network resources. Further the bandwidth available to devices connected to that SSID is limited so that its users do not adversely impact connectivity for school-owned devices.

Data Systems

One of the most significant changes faced by information technology professionals in schools (and other organizations) has been the adoption of cloud-based data and productivity systems. Whereas previous generations of IT professionals configured servers that were physically located on campus to provide necessary services (for example file storage and print management) and they installed applications on hard drives of individual computers, current generations often configure virtual servers and manage user accounts on cloud-based systems.

Schools make significant use of software as a service (SaaS) tools for productivity tools, educational purposes, and business services. *Google Workspaces* is the dominant example, but tools such as the student information system and the library catalog are also provided as SaaS.. The common descriptor for this type of system in "cloud-based" as users connect to a virtual space on the Internet, but the specific location is uncertain. There other instances in which schools will contract with vendors such as *Amazon Web Services* (AWS) provide highly configurable systems that can be used to replicate many of the same functions that used to be configured on physical servers; these are commonly called platforms as a service (PaaS), and they can also accurately be labeled "cloud-based" as the virtual location is clear, but the physical location is not. The benefits of both SaaS and PaaS service systems are:

- **Security—**Cloud providers employ legions of security professionals to protect their data centers. While most SaaS platforms configure their systems in a manner that minimizes the potential for insecure configurations, PaaS services ensure security of the data centers, but the subscriber is responsible for the security of the software and programs they install.

- **Scalability—**System administrators can log on to their administrative dashboard of their cloud-based platform and request additional capacity which is usually available in minutes. That additional capacity does increase the fees, of course.

- **Redundancy—**The data and systems stored on cloud-based systems can be easily duplicated. Depending on the exact configuration, systems can be copied with a few mouse clicks; this allows both duplicate services and automated backups. As a result, essential systems can be restored immediately if service is interrupted.

- **Minimize capital expenses—**Data centers are very expensive to build, maintain, and secure. The expense can be larger than anticipated because it is always necessary to build extra capacity into the system, plus it is necessary to provide air conditioning and other supports to ensure the servers operate as expected. When using cloud-based

systems, IT professionals can "spin up" servers without the need to purchase, configure, and protect hardware.

While SaaS and PaaS systems remove hardware from school data centers, the system administrators employed by schools do continue to manage users and applications. Among the most important responsibilities is user management—typically the users are grouped into organizational units which has been the standard practice for generations of system administrators—and the schools want to ensure only their current students, faculty, and staff can access the systems. They also identify which tools and features are available to the different organizational units.

Cloud-based systems are all built on very sophisticated databases. School IT professionals are often involved with managing the interoperability of different systems. For example, they may manage a learning management system that is connected to the student information system so that grades reported in the LMS are automatically sent to the SIS. This does require the involvement of programmers from the vendors, but once the connections are established, local system administrators manage them.

From the user's perspective, using a cloud-based system is not unlike using files and applications installed on the local hard drive or the local area network, except for the fact that cloud-based computing starts with the web browser. When using them, all users:

- **Connect to the internet—**Cloud -based systems are available on every device that is connected to the Internet.

- **Point their web browser to the URL of the platform—**Most schools provide a portal or web page where students, faculty, staff, and others can find links to the SaaS and PaaS platforms. This facilitates users finding the exact links they need as the network locations of the cloud systems can vary depending on how the school's web domain is configured and how the vendor permits naming. One of the potential challenges for user of the cloud is that different web browsers (*Google Chrome, Firefox, Microsoft Edge, Safari*, among others) handle the code used to create the cloud-based systems differently. This means systems may function differently on different web browsers, and it may even fail on some browsers. Some features may not be available to those who connect using a mobile device (the operating systems and web browsers on smartphones and tablets lack all the capacity of those on full operating system devices), but vendors do provide apps that provide the full functions.

- **Log on—**Access to cloud systems requires one to have an account on the platform. System administrators have options for managing users, including creating users one at a time or uploading spreadsheet files with user accounts define (which is not recommended for many reasons) or connecting existing user accounts across platforms. Because *Google Workspaces* is so widely used, many system administrators will create "customer keys" and "shared secrets" (that is actually what they are called) so that student, faculty, and staff can use their *Google Workspaces* credentials to log on to other platforms.

Access the tools and data they have been given permission to use—Once users are authenticated, they see the data they have permission to see and can access the tools they have permission to use.

> When I was responsible for managing the virtual classrooms system at a community college, we paid Blackboard to host our installation on the learning management. When our users were "on Blackboard," they were connecting to Blackboard's servers on data centers several hundred smiles away from campus. Whenever the region where our primary data center had severe weather predicted, I received an email from Blackboard. In the email, the company reminded us that our system was replicated on two other data centers, each on a different continent. If the primary data center failed because it lost power, then our users would be pointed to one of the other copies of our courses and data.

Another option for accessing application and data that is available, although it is less widely used in K-12 schools than it is in higher education, is a virtual desktop. This finds a user pointing their web browser to the tool (usually on a portal available only to authenticated users) that launches a virtual computer that has a full operating system and applications available, and the use interacts with it just as they do a "real" computer with the operating system and applications.

Google Workspaces

Since it was introduced in 2005, then made available to schools at no cost a few years later, "*Google Docs*" has changed the educational technology landscape. Since then, the platform has undergone nearly continuous upgrading and updating, and renaming. In 2022, it is called *Google Workspaces* and the basic level of service which includes productivity tools, file storage, email and calendaring, and other tools continues to be provided to educational institutions at no cost.

The basic service can be supplemented with a paid version of *Google Workspaces*. The capacity of the applications can also be enhanced and extended by add-ons, some of which are free (or available as freemium) others of which require a subscription. It is the responsibility of school IT professionals to manage the tools that are available, the add-ons, and the tools used to integrate *Google Workspace* files into the other systems provided by the school.

Many educators have their own accounts on the consumer version of *Google Workspaces,* so they are experienced with its features and functions. The features and operations of the consumer and education versions of the platform are similar, the advertisements and data tracking that are unavoidable to consumers are disabled for school users. The familiarity of *Google Workspaces* independently of the school system can introduce some difficulties that must be negotiated. The complaint, "but I can do this on my personal account" is commonly heard by those who manage the school's *Google Workspace* must address.

Almost every IT professional hired into a position in a school will be expected to have some level of expertise using *Google Workspaces* to create and manage information. They are also expected to have some level of expertise managing users and organizational units and configuring services on *Google Workspaces*.

In a 2021 article, Kruta, Smits, and Willhelm conducted a technoethical audit of *Google Workspaces for Education*. The scholars introduced the article by observing, "there is scant criticism of Google in educational technology literature, and they have faced little scrutiny in schools where Chromebooks, browsers, apps, search engines and more are used by students. Just as with users outside schools, we are concerned with what Google is taking from students (e.g., personal data), how it is targeting them (e.g., advertising, product familiarity), and where it is directing them (e.g., search and recommendation algorithms)" (p. 421). They then sought to answer questions about the ethics of its design and use, the unintended consequences of its use, and the limitations educators accept when it is used. While the authors do not suggest educators take a stand for or against the use of *Google Workspaces*, they do conclude, "Schools should not be places where educational technology titans exploit students, test new products, or reimagine education through their own techno-corporate ideals of personalization, efficiency, and profits" (p. 428).

Krutka, D. G., Smits, R. M., & Willhelm, T. A. (2021). Don't Be Evil: Should We Use Google in Schools? *TechTrends, 65*(4), 421–431. https://doi.org/10.1007/s11528-021-00599-4

Student Information Systems

Schools are organizations that require information to be kept about students; this data supports both internal operations as well as reporting to external entities which has gained importance in the decades since *No Child Left Behind* was adopted. The student information system is the term applied to the databases that are designed to collect, store, and report information associated with students' school experience.

The SIS is a large database that contains multiple tables related to students' attendance, courses enrollments, academic performance, health, discipline, and other records. Many SIS will also contain tables and tools to facilitate scheduling. Because many SIS are available on the cloud, parents and others can access the SIS. I many ways, the SIS is the most essential IT system maintained by the school IT professionals.

In addition to ensuring robust, reliable, and secure networks so that users can have uninterrupted access to the SIS, IT professionals play several roles specific to the SIS. They ensure user accounts are accurate; in most cases, this includes ensuring a single sign on tool is configured and secured. They work with registrars and others to ensure data are accurately entered when students are registered and that data are sent to other schools when students leave. They also write scripts and set other controls to ensure data are available and analyzed in a manner needed by regulators and by internal audiences.

There are a number of vendors that provide students information systems for schools. The SIS that has been selected and deployed depends on many factors, and it is not unusual to find SIS that have been used for many years in schools. IT professionals are likely to be asked about their experience supporting the one that is in use. Some schools have replaced traditional grades with "standards-based report cards" which has necessitated modification of the SIS.

Learning Management Systems

Virtual classrooms took on particular importance to teachers and students with the quick pivot to remote teaching necessitated by the COVID pandemic. Even before that, however, virtual classrooms were being managed by school IT professionals and teachers were using them to extend their classrooms and enhance information sharing and interaction. Like other cloud-based infrastructure in schools, the learning management system (LMS) managed by school IT professionals are usually provided by a vendor as a service.

Learning management systems are used to recreate many classroom functions commonly found in face-to-face classrooms. Access to the classroom is restricted to those who are enrolled as teachers or students (or other roles) and different users have permissions appropriate for their role. For example, students can upload assignments or take tests, but cannot see others' submissions or test attempts. While the exact features depend in the LMS that is used and how it is installed and configured (including what optional features are enabled), every LMS provides features to allow:

- **Sharing information—**When using an LMS teachers never have to worry about students saying "I lost the paper," as they can log on to the LMS and get a new copy. In addition to word processing documents, multimedia presentations, audio, video, and portable document format (PDF) files, teacher can create pages with links, embedded media, and other items. The what-you-see-is-what-you-get (WYSIYG) hypertext markup language (html) editor available in LMS's include equation and chemistry editors and other tools that allow teachers to create sophisticated pages, including embedded media and cloud-based files.

- **Interact—**Discussion boards, wiki, blogs, chat, and other tools for online interaction are available on LMS's as well. These are used to replicate the information sharing and knowledge building that happens in face-to-face classrooms, although the asynchronous nature of some of these tools does change the dynamics of the interaction for student and teachers.

- **Administer tests—**One of the most useful tools in any LMS is the ability to create test that can include many different types of questions. For many teachers, the most useful are those that can be graded by the LMS (assuming, of course that the correct answers are accurately identified). Setting up online tests can be a very labor-intensive endeavor, as there can be significant individual data elements that must be input, but once the test is created, it can be shared, edited, remixed, and reused.

- **Collect assignments—**Digital drop boxes are also one of the most useful tools in an LMS. Using this tool, instructors define an assignment and create a digital drop box in which students can upload a file that contains their submission. The problem of lost assignments or students arguing, "I handed it in, you lost it," are avoided by using and LMS to collect all assignments.

- **Record grades—**The gradebook in every LMS can record and display items from tests and assignments with grades associated (and grades can be automatically recorded for those items). Teachers can also add columns to the gradebook to record

items that are done offline. Teachers can further organize the gradebook by assigning grade items to categories, setting weights to categories, adding calculated columns, and setting display conditions for items. Gradebooks are notoriously complicated, in many cases because the language used to describe the configuration is unfamiliar to teachers.

Google Classroom is the LMS associated with *Google Workplaces*. Because of the dominance of Google and the fact it is integrated into the productivity suite used by the teachers and students, many adopt it. Some teachers who have experience with a full learning management system either as a student or as a teacher find *Google Classrooms* to be too limited to accomplish much they want to do.

There are multiple full-feature LMS's available, both as open-source packages and as proprietary packages. Full learning management systems include platforms such as *Moodle*, *Blackboard*, *Canvas, Desire 2 Learn*, among many others. The selection of the LMS is made based on several considerations. While Moodle is often chosen because it is available for free, the cost of installing it on a server (either one in the school or a virtual server on the cloud) can introduce unanticipated costs. Other considerations include familiarity which can increase the perceived ease of use for both teachers and LMS administrators. Perhaps the most important consideration is the degree to which the IT professionals, including the technology integration specialists and other instructional leaders are prepared to provide support, training, and design guidance.

4: Supporting School IT Infrastructure

IT professionals working in schools can use many of the same tools and strategies to keep IT in good repairs as they use on other businesses and organizations. Clear communication is particularly important for those supporting IT in schools, as devices tend to be used by more users and for many purposes in schools than they are in other businesses and organizations. Good customer service is as important for school IT professionals as it is for all IT professionals.

The role of IT professionals in schools is to keep the infrastructure operational for students and teachers and other users. This may seem a silly statement as that is their role in all organizations. The same factors that make schools unfamiliar places for many IT professionals who are designing and managing technology systems also make them unfamiliar places for providing IT support.

One of the most important differences between supporting school IT and supporting IT in business or industry is the relatively low impact of malfunctioning IT in schools. While IT is essential to teaching and schooling, and no IT professional wants their systems to be "down," the circumstances of schools are different then in business. Many valuable teaching lessons can occur for short time without IT, and the extreme impact of financial loss that is common during business outages is absent in schools. The low impact nature notwithstanding, IT support is an important aspect of IT professionals' work in schools.

School users are notorious for waiting until the last minute to get the help they need. If, for example, a teacher calls and asks for assistance getting a *YouTube* video to play through their classroom projector, you can assume there is a classroom full of students awaiting the video. Triaging such situations can be difficult as the teacher may be very anxious, and no IT professional wants to seem unresponsive.

School users are also notorious for being on either extreme of the need for support. On one hand there are the students and teachers who believe they can resolve many problems and they are willing to try to fix problems. While these users can often resolve many problems by themselves, they can also attempt to resolve issues they should not, and they often find workarounds that decrease their efficiency. On the other hand, there are the users who will not attempt any troubleshooting and will call for technicians whenever anything goes wrong.

School users are further well-known for trading reliability and ease of use for advanced functionality. Also, many school users will use only a fraction of the tools and features available in the applications they use. IT professionals know that systems can be configured to perform many more functions than are typically used. Such configurations can increase the complexity of using the systems and make them less reliable from the perspective of the user. In many cases, teachers would prefer IT systems that are less complex and provide fewer features if what is provided is very reliable (it is always available) and robust (it is reliable even when many users are connected). Recognizing this can help IT professional avoid using time and resources to deploy and train users on features that will not be used.

In this chapter, I describe some of the strategies that are useful for providing effective IT support in schools.

Standardization of IT

Schools are characterized by large numbers of users all with similar technology needs. For example, in a school enrolling 500 students in the middle grades and providing one device for each student, IT staff will need to prepare 500 identical devices. Deploying identical devices is particularly important for school populations as teachers must plan for all students to have similar capacity and they need to be able to support their students. Of course, the widespread use of *Google Workspaces* reduces the need to license and configure many types of software than previous generations of IT professionals found necessary. Updating Chromebooks, for example, requires only a few mouse clicks; far less work and much quicker than updating a full operating system.

Generations of technicians in schools managed devices that had full operating systems through imaging and freezing. Imaging means a technician would configure a computer in the manner they needed, then make a copy of the hard drive. Similar devices in the fleet that needed the same configuration would then receive a copy of that imaged hard drive. The technicians then updated the name of the device to allow for easier remote management and ensured software was properly licensed before deploying the device. The widespread adoption of could-based systems has reduced the need for IT staff to customize installations for different teachers and other professionals, which has reduced the task of managing devices.

Freezing means the system is configured as the technician intends, then put into the frozen state. Whenever the computer is restarted, it returns to the frozen state and all changes that have been made (except for some documents if the system is properly configured) are discarded. While this approach to managing computers has become lesson common for a number of reasons, it is still used in some circumstances to reduce maintenance demands on fleets of computers in schools.

Triage

IT systems fail; all IT professionals (and all IT users) know this. The reality is that the "to do" list for IT professionals in schools is often too long to allow immediate resolution of failed system. Further adding to the reality is that not all failed systems can or even should be fixed, and many IT professionals find teachers are very reluctant to abandon old systems that provide a useful and familiar instruction application.

When triaging and scheduling work in schools, IT professionals seek to keep existing systems operational while planning for updates and replacements that will reduce the need to keep aging systems operational. This sometimes requires balancing reaction repairs to proactive improvements, and time used for one is not available for the other.

> When being interviewed for any IT position in a school, you can expect to be asked how you prioritize what gets fixed.

All IT professionals understand that one of the most important things to do to do after starting a new position in IT support is to identify "the complainers." These are the people who give the best feedback on the functionality of the systems, they raise concerns immediately (as opposed to other users who try to manage with less-than-optimal technology), and they tend to be the individuals who use the systems the most and for the most purposes. The IT professional who can satisfy this group will generally be perceived to be responsive and effective.

IT professionals must develop skill in triaging calls for IT support to decide what gets immediate attention and what waits until later. Unfortunately, there are no rules that guarantee the correct triage decisions will be made. Many factors which are described in this section affect triage decisions, and the situation given high priority one day may be given a lower priority another.

Safety

It is an unfortunate reality that IT can be used to create unsafe situations. If there are threats, bullying, or other potential unsafe situations and your expertise is needed to document, investigate, and remove those threats, that needs to be given highest and immediate priority.

> During the weeks when an assistant principal was dealing with a particularly serious cyberbullying situation (it was sufficiently serious that the police were involved), he would ask me to "help fix the color printer in his office" if I was working with or near students or teachers. He did not have a color printer, so we arranged this code so he could request immediate help without drawing attention. When he used that phrase, I knew that I should secure whatever I was working on and go directly to his office.

Legality

It is also unfortunate that IT can be associated with situations that can present legal liability. These may be associated with unsafe situations, but they can also be associated with human resource issues or other circumstances in which safety is not threatened but data needs to be secured or actions documented. These also receive highest priority. When dealing with issues related to safety or legal issues, no IT professional should be working without school administrators participating in the decision-making; ideally, they would be present when any work was being done and they will both direct the IT professional and also receive frequent and detailed updates on what is happening.

Large Numbers

One standard criterium for prioritizing IT troubleshooting in all organizations is "fix the problem that will get the most users back up." This rule of thumb applies in school as well.

One-Time Events

Teachers often arrange for their students to have special one-time only opportunities. Before the COVID pandemic, field trips and guest speakers were common one-time events. As video conferencing platforms gained popularity in the years before COVID, these events were increasingly technology-based. Because these events cannot be easily rescheduled and because they represent very valuable opportunities for students, these should be given high priority when they are scheduled.

Students

Because schools are hierarchical organizations, certain stakeholders can be understood to be of higher priority. It seems reasonable that school administrators should be given the highest priority as they are the most politically empowered individuals. It is difficult to justify this decision, however. Whenever I am faced with prioritizing and one of the problems has direct

impact on students, then that one goes to the top of my priority list. It should be noted that not all who are in leadership positions or teaching positions agree with my priorities.

> In several interviews for technology leadership positions, I have made it clear that students and teachers receive priority when I triage IT problems. I could tell by the expressions of the administrators on the committee, that they did not agree. Those expressions were also my cue that I should be brief with my answers through the end of the interview.

Beginnings and Ends

School schedules are periodic. At the transition between school years and marking periods, there are some information tasks that must take priority. For example, ensuring class rosters are accurate, attendance can be recorded, and grades can be reported are among the tasks that must be reliably and quickly accomplished at these times. For this reason, ensuring the student information system is functional and accurate is the highest priority at those times. Because these are scheduled well in advance, many IT professionals will be sure to minimize scheduling other high-demand events to coincide with beginnings and endings of school years and marking periods.

Ticketing and Scheduling

Two IT functions in school that are necessary for the efficient operation of IT departments in schools are a help ticketing system and a system for scheduling shared resources. These functions are not unique to schools and the platforms used for ticketing and scheduling for other organizations can be deployed in schools as well. The one difference between deploying these platforms in schools and in other organizations is that the budget for these types of platforms is the limited budget in schools. Especially in smaller schools, IT professionals in schools may use open-source platforms or they may use freemium editions of paid versions.

Ticketing

In many organizations, when users encounter problems with technology, they are expected to use an online platform to report the problem. Because the ticketing system sends the report to the IT department, there are multiple advantages, including improved communication within the IT department and communication between IT professionals and other stakeholders and centralized inventory and repair documentation:

- **Users can report** malfunctioning devices with little effort, so the system facilitates communication from users to IT staff. Most IT managers place a link to "create a ticket" in multiple places that computer users frequently visit (the school web page, the LMS, and other portals), or they create an email address to accept help tickets. Ideally, the ticketing system is part of the collection of tools that use a single sign-on scheme, so submitting a ticket does not require one to log on to a different system.

- The **technicians can triage and assign** malfunctioning devices and decide the best use of their limited resources. While the individual who submits the ticket can usually assign a priority to the repair, the technicians can override those settings, and repairs

that will affect a greater number of users or that restore critical systems can be given higher priority. Within IT departments, there are individuals with different levels of skill and different levels of access. This is not always understood outside the department. Using a ticketing system allows the IT professionals to assign the correct person to the problem.

- A **history of each device** is maintained. Devices that are troublesome and require repeated repairs are known. Likewise, technicians can track similar problems throughout the fleet. This is particularly helpful when a design or hardware (or software) problem affects the same model; steps taken to resolve a problem on one unit are likely to resolve the same problem on other units. In this point and the previous point, there are examples of how the system facilitated communication among the IT staff.

- Ticketing systems also provide a database on which the **inventory** can be kept up to date. This helps IT professionals understand their fleet and it helps leaders understand the need to plan and budget for replacement devices.

- The total **number of repairs** performed by technicians and the time they spend on them can be recorded in the ticketing system. This information is used to assess the efficiency and effectiveness of the systems, so that support can be improved by refining systems and by supporting those who manage, train, and support IT staff. In this point and the previous point, there are examples of how the system facilitated communication between IT staff and school administrators.

There are potential difficulties with using help ticket systems as well.

- Help tickets do take **time to process**. If a teacher has a malfunctioning projector (for example) and they need it immediately, then they need assistance immediately. Submitting a help ticket to a system that doesn't result in an immediate response is unlikely to be done for this situation. Such requests do interfere with scheduled work and can decrease the efficiency of IT repairs efforts.

- If the problem interferes with **network access**, the users may not be able to submit the help ticket. This can contribute to excessive frustration among users.

- One of the other difficulties with help ticketing systems is that some **can generate an inordinate number of email messages** which can end up interfering with the effectiveness of the communication. It is not unusual to hear users complain, "there are so many emails, I just ignore them" when giving feedback on the ticketing system used by IT support.

Scheduling

Prior to the wide-spread adoption of one-to-one initiatives, most computing resources in schools were shared. As a result, it was necessary to adopt a strategy for scheduling time in the computer room, presentation spaces with high-quality projectors, and similar resources that

existed in small numbers. Since one-to-one computing has become the norm in schools, the need to share computing resources has reduced, but there are still situations in which individuals or groups may need to reserve time when they can use shared computers or devices. Increasingly, the shared computing resources are human resources rather than computing resources. For example, teachers may schedule time with technology integration specialists or other IT professionals to provide additional support while they and their students are creating with unfamiliar technology.

To facilitate scheduling or reserving these shared technologies, IT professionals install and maintain room booking systems. Effective tools for this purpose make the schedules public, so they can be viewed on the internet without logging on or passing through other barriers. The most effective schedules will be mobile-compatible, so the harried teacher who is finalizing plans for the day can say to a student, "hey, go check the schedule to see if we can print our posters in the computer lab today." Once a student confirms the resource has not been scheduled by another, the teacher can log on to the system to add a reservation, but not edit others' reservations. Further, each account can have specific permissions so that he or she can reserve only the resources appropriate for the user. For example, only those who have received training in using the 3-D printer are allowed to schedule time on it, or only those teachers whose courses necessitate special software can reserve certain computer rooms.

One of the difficulties that is commonly encountered with using scheduling tools in schools is the unusual time increments that characterize the daily schedules in many schools. While many scheduling tools are designed for businesses that are likely to break days into 15-minute increments, schools break days in various chunks, and it is not unusual for different days to be divided into different chunks. Further, some schools have multiple bell schedules, for example in schools enrolling students in grades 7-12 (which are common in some regions) will have one schedule for students in grades seven and eight, and another for students in grades nine through 12. IT managers can increase the use of scheduling tool by making them easy to use, including allowing users to select time blocks on the schedule that correspond to the daily schedule blocks used in the school.

Customer Service

Many school populations (including administrators and teachers) object to the use of "customers" when referring to others in schools. While the term may seem inappropriate for the collaborative and interdependent stakeholders in schools, the concept of customer service and the characteristics of customer-service oriented IT professionals are applicable in schools as much as they are in businesses that serve customers in the traditional sense of the word. A customer-service orientation is grounded in empathetic communication with one's clients and the clients' perceptions that their problems are being resolved in a timely manner.

For IT professionals working in schools, creating a customer-service orientation is challenging because of the differences in language describing technology operations and malfunctions (see the story about environments on page x) and the belief of some that their needs are of highest priority. Of course, these are not unique to school populations, but are particularly acute in schools. In this section, I describe how a customer-service orientation can be nurtured throughout the process of reporting a problem through its resolution.

Reporting the Problem

One of the perennial problems for all IT professionals is that users often do not accurately describe the problems they are encountering. This problem can be particularly acute in schools as the systems are much more variable than business systems and the teachers and students use IT for diverse activities. For these reasons, when IT users in schools identify and report a problem, the IT professional who first deals with it must make sure they accurately understand the symptoms; this is the first step in providing good customer service. One barrier to this understanding is the use of vernacular or inexact or inaccurate language.

One of the advantages of more users being experienced with video conferencing is their capacity to connect and share screens with remote technicians. This will ensure both the technician accurately understands the symptoms and the user is confident the technician understands them. Of course, this assumes the system works enough to allow the video conferencing system to operate.

> A teacher reported was using an app installed on iPads for students to access a specific cloud-based instructional platform. The teacher reported, "the app won't take" on one of the iPads. The IT technician who received this help ticket called the teacher to ask for more details. The teacher reported "it just won't take" and the technician was unclear if the app was installed or not or if the student was unable to log on to the app. In this case, the teacher was unable to provide an accurate description of the problem, so the technician accepted responsibility for figuring it out. The technician asked, "where is the iPad right now?" and "when will your students need it next?" and indicated they would "take a look" before the teacher planned to use the app again with students.

While they should avoid demonstrating insincere empathy, IT professionals should confirm to the reporter that the problem exists and that it is interfering with the ease of use or effectiveness. When the user believes that technicians agree the computer is not working as expected and that this is a problem worth solving, they will have a sense that technician is providing good customer service.

Understanding the problem does require the IT professional to be an active listener and, in many cases, to observe the difficulty that the user is experiencing. Once the difficulty has been accurately identified, IT professionals who demonstrate good customer service skills assume responsibility and give the reporter an approximate timeline. When a color printer stops working as a teacher is preparing for an open house, they will appreciate hearing "it needs more toner, I'll be right back with it" or "the power supply failed, this printer needs to be replaced" rather than simply "yes, its broken, we will take a look at it." Even if the news is not what the teacher wanted to hear, at least they can make alternative plans for their classes, if necessary.

Resolving the Problem

As will be detailed in Chapter 7: Making IT Decision in Schools, keeping IT systems functioning in schools requires the systems be understood from the perspective of teacher and students (to decide what is appropriate), school administrators (to decide what is reasonable), and IT professionals (to decide what is proper). When it comes to deciding if malfunctioning computers can be repaired, if they should be repaired, and how they should be repaired, IT professionals must make decisions.

IT professionals have a long history of "blaming the user." While the root cause of some malfunctioning devices is users not knowing what to do or what to expect, blaming them is one way to assure your customer service reputation will suffer.

Because so many IT problems one encounters in schools are unfamiliar and because the teachers and students who are the primary IT users in schools are so diverse in their interests and needs, the steps necessary to resolve them are often unique. This requires IT professional to be adaptable to the specific needs. Adaptability includes both recognizing the needs as being unique and worthy of being solved as well as being knowledgeable and creative in solving the problems.

Avoiding Cold Closure

Cold closure refers to the practice of resolving IT problems, and closing the ticket, without communicating to the individual who reported it (and in some cases to the larger audience) that the problem has been resolved. Most ticketing systems will send an email to the individual who submitted it when and IT professional "closes" it after it has been resolved. This is intended to signal that the issue has been resolved and the system is operational.

Relying on the ticketing system to communicate to the reporter the system is fixed can be problematic for several reasons:

- If the ticketing system generates multiple messages, the message may be ignored.
- The potential for "ticket closed" emails to be ignored is even more problematic in educational populations who have difficulty managing email messages and also for those who submit multiple help tickets.
- Help tickets are often ignored or resolved, but not closed. If multiple teachers, for example, report problems with printing it may be resolved, but closing the multiple tickets is not done (as the over-worked technicians focus on resolving problem rather than managing tickets). These tickets may stay open for a long time (weeks or months) which contributes to the sense that "IT never responds to tickets," or old tickets are cleaned out all at once which generates irrelevant messages to those who reported problems.

The ambiguous communication that can result from relying on the ticketing system to communicate with individuals about close tickets can be particularly problematic in school populations because of the miscommunication of the nature of the problems between educators and technicians. For this reason, the best customer service-oriented IT professionals in schools seek to be as "warm" as they can be when closing tickets. The metaphorical temperature of how an issue is closed is based on the nature of the communication and the degree of confirmation. A cold closure relies on technology to communicate the ticket is closed and there is no confirmation that the ticket is closed. When the communication is more personal (ultimately delivered in-person) and when the IT profession confirms the issue is resolved (ultimately by observing the teacher use the operational system), the metaphorical temperature increases, and perceived level of customer service improves as well.

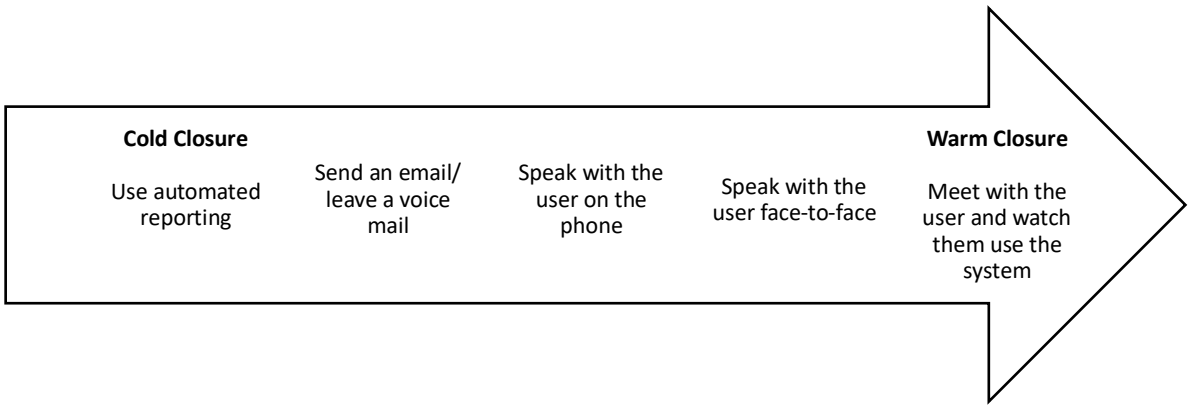

Figure 1. Cold closure to warm closure

The message communicated in the closure matters to users' perceptions of customer service as well. When the technician believes the issue has been resolved, they should make sure the user is clear that it has been fixed. Especially in situations in which there may be inaccurate or incomplete understanding of the symptoms, the IT technician may perceptive the problem has been fixed, but the symptoms may remain for the user. In this case, the user may assume the problem has not yet been resolved. Good customer service is promoted by closing repair jobs by telling the user, "this has been fixed, if it comes back, let us know immediately."

Interactions

"Difficult" interactions between IT users and IT professionals are not unique to schools. The difficulties can arise from users' frustrations that IT is interfering with their abilities to do their work, the perceptions that their priorities are not receiving proper attention, and other factors. In many cases, the IT professionals contribute to the difficulties by failing to understand the symptoms described by the users, the tendency to project their level of familiarity on to users (things we find easy, they find difficult and that is your problem, not theirs), and the tendency of many IT professionals to blame the users. The most customer service-oriented IT professional will display:

- **Empathy without being patronizing—**Users who report IT problems want the sense the technicians understands the problem and it taking is seriously, but over scripted statements like "I'm sorry that happened" that appear insincere interfere with the perceptions that the technician is displaying good customer service.

- **The ability to not take criticism personally—**All IT professionals are going to encounter users who are frustrated at malfunctioning technology and who are unable to manage that frustration, so they will direct unwarranted criticisms towards the IT professionals who is present to resolve the issue. The best IT professionals realize the situation and will overlook unwarranted personal criticism. Of course, workplace bullies are not uncommon, and the best school and IT leaders will recognize those individuals and address them before drastic human resource interventions are necessary.

- **Clear and professional communication—**IT professionals who display good customer service skills are active listeners; they will ask questions to seek clarification and use comments and cues to have users who are reporting problems to give them sufficient details that they accurately understand the symptoms. Many also find this active listening increases the users' sense of empathy from the technicians. IT professionals who display good customer service skills can also explain what the problem is and how they intend to fix it along with a timeline in clear and appropriate language. Most IT users do not care to hear all the details of the problem and the solutions, especially if the details are filled with jargon, but they do appreciate knowing what they can expect.

- **Calm and approachable tone—**When users believe IT professionals are pleasant people with whom to interact and they will not be criticized or ridiculed, they will perceive the IT professional to have greater customer service skills.

5: Users in Schools

The users in schools are unlike the IT users in other businesses and industries. Those differences have important implications for how systems are perceived. As with all IT designs, the perceptions of users are the most influential factors in IT configuration and management decisions.

Compared to information technology users in business, IT users in schools are much different. They bring different skills to the IT they use; they need more flexibility in what they do and how they do it more often than business users, and their needs change over time. These characteristics arise from the facts that students have emerging literacies; it is not unusual for primary grade students to be only learning to read and the keyboard is new to them, so many computer interfaces and input options (including typing) may be very difficult for students to use. Even with clear curriculum guidelines, teacher and students may have different information and computing needs than they had previously and they may be different from those of teachers and students in similar courses. School years are also periodic. Just when all the elementary school students are becoming familiar with the technology and they are becoming facile using it, the school year ends, and teachers (and IT professionals) must prepare for a new group of technology newcomers.

It is important for all IT professionals who work in school to understand the nature of the users and their specific needs. Every decision made and every action taken by IT professionals (regardless of their role) affects end users either directly (by providing troubleshooting, training, and other support) or indirectly (by selecting, installing, and configuring systems and interfaces). As will be described in this chapter, the unfamiliar IT needs of school users and the limited capacity of large parts of the school populations to use technology can pose difficulties for IT professionals new to schools.

Assumptions about the users' capacity to operate the devices, adapt to changes, and operate the systems effectively all affect how systems are designed. For those who have experience managing IT in organizations where all the users are adults and those who have completed typical IT programs in schools (including trade schools, community colleges, and universities) make very different assumptions about IT users than are true of school users. Many IT professionals who honed their craft in organizations other than K-12 schools find school users are unfamiliar and the strategies that produce usable systems in other organizations are less effective in schools than they are in other organizations.

In this chapter, I describe the characteristics of IT users in schools. I also describe the nature of IT activities undertaken in schools.

Comparing Users in Organizations

The careful reader will notice that I am beginning this chapter with some assumptions about the typical IT users in organizations other than schools. I begin with these to introduce the characteristics of humans that seem to affect their abilities to use computers. Many IT professionals have not previously contemplated this aspect of IT system design. I find the

differences between IT users in other organizations and IT user in school can be summarized in five characteristics:

- Business users tend to be **competent in basic skills** such as literacy. When building systems for business users, IT professionals can assume the users have some basic digital literacy and can operate a computer, they can read the screen and directions, and interact with the graphical user interfaces so they can accomplish the tasks they were hired to do. When referring to school-aged learners, I like to use the term "emerging competence" to characterize students. As they become more competent readers and writers, they will become more competent users of IT as well.

Story from a School: When upgrading the active directory servers in a school that enrolled students in grades K-12, the new technology coordinator did not change the minimum complexity requirements of passwords for the organizational units containing student users. When they first logged on to computers, they were prompted to change their passwords and were met with the complexity requirements. Students in the primary grades who were just learning to read and had little experience with keyboards found the task of creating a password with eight characters, and a combination of letters, including capitals, numbers, and special characters unmanageable. The students were effectively locked out of the computers because they were incapable of typing in passwords. See the resolution on page x.

- IT users in businesses tend to have **clear and specific needs and equally clear and specific IT requirements.** Business users need certain software and to access specific data to complete their assigned work. If the hardware and connectivity are sufficient to run their software and access their data, then users are satisfied. Members of the accounting department do not care if they cannot edit video on their workstations (for example). In schools, many different users with much different software needs may use a specific computer during a school day. The same hardware used by students to run the accounting software for business class during one block in the schedule may be used by students in the digital arts class to edit video during the next block. As cloud-based computing and internet-connected notebooks have become popular, the need for school IT professionals to manage different software for different student users has been reduced. There does remain situations in which teachers cannot accomplish their curricular goals without sophisticated technology, however, and they cannot always predict the systems and IT capacity they will need.

- The IT needs of employees in business and industry tend to be task-based, whereas the **IT in schools must be sufficiently flexible to allow for interest-based uses.** The information sources that must be accessed and the applications provided (on the cloud or on the machine) vary depending on the interests of the student and the curriculum choices of the teachers. A further reality of deploying IT systems in social settings is that the best-made plans are only plans; many educators do not really understand what they need until they experience it with students, so teachers sometimes ask that systems be reconfigured after IT thought the job was done.

- In business and industry, **users are selected for the role**. Employees have selected themselves for the work (by applying) and were selected for the position (by being hired). Both gateways ensure those who use computers for their work have the necessary skills or the ability to gain them and are motivated to learn and use the systems. If this proves to be not true, there are options for the employer and the employee. If training or other support does not resolve the problems using the computers, the employee can be removed from the position.

  For the public schools I assume most readers have interest in serving, attendance is compulsory, and schools are obligated to provide education to all students. For these reasons, IT professionals in schools must accommodate a wide range of users, and schools in which a student is denied access to the IT they need may violate that individual's right to an education.

- The final fundamental difference is **the relative stability of business users compared to school users**. In schools, users' skills change over time in a periodic way. The students who struggle to use keyboards early in the school year, become more facile as they gain experience. When the next school year begins, those students are replaced with others who lack the experience. As curriculum changes, the IT needs are likely to change as well. Teachers who are introduced to new teaching methods and resources are anxious to try them. Families move into town and their children have different needs from the other student. All of these are situations in which IT professional must vary from their original plans to meet unanticipated needs.

> The candidate for a vacant technology coordinator position was being interviewed. When asked, "How would you respond to the teacher who returns from a conference and asks for help configuring systems to use a tool they learned about?"
>
> The response was, "Well, we set user devices up in the summer, and if they don't tell me before we start, then it has to wait until next year." That candidate was not hired.

In reviewing the differences between IT users in k-12 schools and other organizations, the differences are largely based on variability. In organizations other than k-12 schools, IT professionals can predict the skills of the users and their IT needs within clear and narrow bounds. In schools, IT professionals must provide IT for a diverse population of users who have diverse interests and IT needs.

School Users

IT professionals design systems for students, educators, and business-like users in schools. In addition, they are often asked to configure systems for public users; this group includes both visitors into the school (those who arrive to participate in meetings or those at school-sponsored events) and those who are members of the community who bring in their own devices.

Students

Students, of course, comprise the greatest number of IT users in schools. When considered together, k-12 students represent a group with very disparate skill sets and needs. School and technology leaders must consider the nature of the students and their learning needs (and well as the teachers' needs that are grounded in their students' needs) when making final configuration decisions.

The youngest students have emerging literacy and numeracy skills, and their hands are too small to fit on full sized keyboards in the manner they are designed. Even if their hands could fit the keyboards, they are not yet typists, so their ability to use the typical input devices on IT can be limited, but they tend to be curious IT users and anxious to learn to use the devices they know are used by others. The youngest students' use of IT tends to be highly prescribed by their teachers. They often use web sites intended to facilitate learning of academic skills, and some teachers integrate computer devices into the activity centers in their classrooms. Many primary teachers are cautious about using IT in their classes, as there are many other valuable and necessary skills that students must learn especially at this age.

While the youngest students in schools are just learning to read and write, the oldest students are adults (most students turn 18 during their senior year in high school) and are likely to be engaged in independent projects and to have the need to gain experience using the same software that professionals use. Older students tend to be creators of information with school IT as well as consumers of information. In addition, these students tend to self-select into certain courses and many schools have added independent projects as graduation requirements in recent years. The IT professional may find students complete "internal internships" by learning entry skills alongside and with active mentoring from the employed IT professionals. The specific resources they use depend on their plans for post-graduation as well as their course work.

> For several years, I both taught and managed the IT for a small school. It enrolled about 350 students in kindergarten through grade 12. There were two days per week that I had first and second graders (many of whom could not read) who came to the computer room; I led them through multimedia or and coding projects with their teachers helping me. When they left, I taught calculus-based physics. When those students left, I went into the wiring closet and managed the multiple servers that were used for user authentication, data storage, and the school's library.

Most schools do not have the diversity of students using computers that I managed in that school described in the box, but the students' and teachers' needs are the conditions to which school IT professionals must direct their work. IT professionals cannot ignore them when making IT decisions.

Teachers

Teachers are the second largest number of school IT users, and they are the users who have the most diverse IT needs. In addition to using computers for instructional purposes, teachers use their devices to create materials, manage student data, and complete school operations tasks. In addition to their work-related tasks, most school acceptable use policies allow teachers to use their school-owned devices for professional tasks not directly related to their jobs. The list of such activities includes completing courses for credit which are necessary for recertification or for advanced degrees, participating in professional organizations, and

engaging in personal learning activities. One of the challenges for school IT professionals is teachers' (and other adults') use of school-owned devices for personal purposes. While one may be under no obligation to "save my pictures before you reimage my computer," no IT professional wants to be the person who deletes personally important files.

In general, educators use whichever productivity suite is supported by the IT professionals to create classroom materials, such as worksheets, study guides, and presentations. Increasingly, *Google Workspaces* files are the dominant suite used by educators. In addition, they use whatever learning management system is supported to extend and enhance their lessons with virtual classrooms. Managing classroom activity requires they have robust and reliable access to the student information system as well. Whereas previous generations of teachers kept paper copies of attendance (and sent hand-written lists of absent students to the office), today's teachers mark attendance on the online student information system and those in the office see the report almost instantaneously. Further, they access human resource systems and documents, requisitions, and other operational systems and documents via their school-owned devices. In these needs, educators are very similar to the IT users in other businesses and industries as they are well-known and predictable.

Meeting the IT needs of teachers is complicated by several factors. First, teachers do not often have the language to accurately describe what they want or need. Their difficulty in describing IT systems affects both their abilities to communicate how systems should be reconfigured to meet their needs as well as their ability to describe malfunctioning systems. For IT professionals, this means they must listen carefully and actively. In addition, they must repeat back to teachers what they are hearing. Often, clear communication requires the teacher demonstrate exactly what the system is doing that is problematic.

> A teacher of 3rd grade came to me one day when I was serving as the technology coordinator in the school where she taught. She said, "There is no voice on the computers in the lab." At the time, voice to text was beginning to appear on some systems, so I started explaining that these were older machines (they were repurposed desktops from a local company, and we had installed Linux on them) and I would investigate what we could do. She interrupted me and said, "No, there is no voice on them." It took me about 5 minutes for me to understand that what she really meant was that there were no speakers. She wanted her students to use a reading program in which they had to hear what animated characters were saying. I suggested she get her students headphones so they could listen themselves.

Second, teachers cannot tell if the systems function in the manner they anticipate until it is actually used at scale with students. In most IT design projects outside of school, the use case is relatively well known, so the progression from design through testing to production can be done in situations that closely resemble the end use case. While such testing can be done on a limited scale in schools, the unanticipated circumstances that are introduced by students can cause the most carefully planned IT systems to fail "in the wild." IT professionals must be prepared to redesign systems and projects in response to what educators discover when they use IT with students.

> Story: I once coached a technology coordinator who was fond of saying, "I built what they asked for, if they asked for the wrong thing, that is not my problem." I tried to get

him to realize that indeed it was his problem. The money the school had invested in the devices and software; and the time he and his staff had spent were all wasted when the systems remained unutilized or underutilized. Careful listening to understand educators' needs and ensuring the final product is what they need and not what you or they thought they needed before they started are essential skills for IT professionals working in schools.

Third, many teachers seek flexibility in their classrooms. For a number of very valid reasons, many teachers vary the physical organization of their classrooms during the school year. Elementary teachers use "centers" and these often change depending on the time of the year or the availability of resources. Others change seating arrangements depending on the units they are studying, and others vary classrooms to introduce novelty. IT professionals must be willing to accommodate teachers need for flexibility and understand these changes are likely to be rooted in valid teaching needs rather than whim.

Teachers and IT professionals often find they have much different goals and needs when it comes to IT systems. Teachers need flexibility and adaptability, but IT professionals know that flexibility and adaptability can result in systems that are unreliable and unsecure, so they are reluctant to build such systems. Time is limited, and IT professionals seek to build systems when demand is low during the summer. Teachers may discover unanticipated needs only after the school year begins, so they may request changes after IT professionals have completed the upgrades, updates, and changes they thought were needed. Educators may also request quick turnaround times on IT requests. For the (typically) understaffed IT staff in schools, unanticipated changes and short timelines can be frustrating and can delay other projects.

Just as teachers must accommodate to changing instructional needs with short-term changes to their practices, school IT professionals must be prepared to make changes to their systems with less notice than they would like. This does not mean that IT professionals must make every change a teacher asks for, but it does mean they must engage in discussions and adopt reasonable timelines for changes deemed necessary for teaching and learning.

Business-like Users

As opposed to the systems designed for flexible use by students and teachers, the system built for school operations purposes are task-oriented, so they can be designed and tested in the same way IT for business users are. These systems include business operations such as financial and human resources management and some educational functions such as the student information system, learning management system, and library databases. Some instructional tools, especially those that are web-based (which many are in the 21st century), can also be managed from a task-centered perspective as well, but these are appropriate for a small part of the curriculum.

In the 21st century, many of these IT systems have become cloud based which means they are accessed on web servers owned and managed by vendors. For example, accounting staff are likely to access cloud-based systems for bookkeeping and processing invoices. Administrative assistants are likely to access cloud-based systems to report academic reports to local regulatory agencies. Increasingly, athletic schedules are managed on online systems. Building information management systems are used by facilities professionals to control heating, ventilation, and air conditioning; fire and security alarms; and other systems as well. School IT professionals work

with vendors to ensure web browsers and extensions are properly configured and they data are accessed only by those who are authorized.

Because of the transition to cloud-based data systems, school IT professionals spend more time managing networks for secure and reliable connections than previous generations of IT professionals who managed on-site data centers. IT professionals also spend time configuring single-sign on or managing individual users accounts on the cloud-based systems used for school operations. The cloud-based systems will be those that have been vetted by the school and technology leaders to ensure they comply with school policy aligned with the Children's Internet Protection Act (CIPA), then these become the tools supported by the school and IT professionals.

Public Users

Schools are places where the public is occasionally invited. Some events that find the public on campus place no demands on IT systems. Audiences at athletics events, concerts, and other performances do not expect to have access to wireless networks, for example. Other events may find individuals or groups from outside the school community that have valid reasons for connecting their devices to the school's network:

- Consultants from local service agencies may participate in individual educational plan (IEP) meetings or they may provide services to students and find it necessary to connect to internet-based testing instruments or instructional materials.

- Presenters at workshops or training events many need to connect to internet-based systems. For example, trainers from the vendor providing the student information system may need to connect to it.

- Educators attending professional meetings or conferences held on campus may need to access their professional email or *Google Workspace* files during the event.

- Students from other schools who are participating in educational events held on campus may need access to the internet during the event. For example, students attending a robotics event may need to download software updates for their robots during a competition.

- Faculty, staff, and students may bring their own devices into the school for their own use or for auxiliary use in classrooms.

In each of these situations, it is necessary to connect devices that are not owned by and configured by the school's IT professionals to the school's network. This does pose a risk to the school's networks as they cannot be sure what software is running on the devices that others connect. If the network in improperly configured, then these devices may introduce malware or other threats to the school's network, but skilled system administrators can minimize the risk.

Users' Perceptions of Change

Education is a practice that has an interesting relationship with technology, especially information technology. Whenever a new technology arrives, there are teachers who perceive it to be an intrusion. This is a reasonable response as the new technology will be causing them to

reassess their practices, change some, and abandon others. Many interpret this as an accusation that what they were doing was deficient. It also causes them to change practices they found very familiar and comfortable. Even those who are open to new practices and technologies will find they face decisions about what to include in their courses. By understanding how innovations are adopted and the factors affecting technology acceptance, school IT professionals will be prepared to design, support, and train users when new technology is introduced.

Diffusion of Innovations

Despite their resistance, educators do have a responsibility to adopt those technologies that facilitate learning in their field, and they have a responsibility to prepare students to use the information technologies and information sources they will need to participate in society. Everett Rogers was a scholar who is well-known for studying innovations and how they adopted by populations. Rogers (2003) identified several types of users based on the rate at which they adopt the innovation. Some are early adopters and will introduce new technologies into schools, but others, the last 25% of users (named the laggards) will adopt it only when other options are untenable. There are many reasons why some users are more reluctant than others to adopt innovations, and those tend to be grounded in users' perceptions of them. Some innovations are perceived to require too much effort to learn, some would require users to abandon recently developed methods (and recently purchased technology), and others are socially unacceptable. As IT professionals update and change systems, they will be met by all types of users that Rogers identified. Innovators will make frequent requests for changes, and laggards will resist change for as long as possible.

Table x. summarizes the factors Rogers identified as affecting individuals' decision to adopt innovations. It should be noted that several of Rogers' factors depend on the perceptions of the individuals. While most users will concur on the complexity of systems (at least on the relative complexity of various systems), all of the other factors depend on the interpretation of the innovation in the context of existing methods. No matter how convincing innovators or other adopters may find the rationale for adoption, until the individual makes the decision, it will be unused. The other reality the emerges from studying innovations is that users do change their minds. Technological innovations initially rejected may be adopted later, once the individuals' perceptions change.

Table 3. Factors Affecting the Adoption on Innovations

Factor	Description
Relative advantage	When educator believe new technologies improve their performance, they are more likely to adopt it
Complexity	When systems are complicated to use, they are less likely to adopt them.
Compatibility	If the system aligns with what the user believes they should be doing, they are more likely to use them.

Trialability and Observability	User are more likely to use those systems they can see "in action."

Wikipedia, the online encyclopedia that was begun in 2001, had a reputation as an unreliable resource as it is edited by volunteers. Many who were responsible for managing school IT at the time blocked access to it on their internet filters; I was one of those who did. Over time, educators and IT professionals realized *Wikipedia* is about as reliable as other encyclopedias and there are many advantages to using it, including a wider collection of articles that are updated more frequently compared to printed encyclopedias. It is unusual to find schools that continue to block *Wikipedia* today. Teachers' and IT leaders' perceptions of *Wikipedia* changed over time, and they changed both the configuration of the systems and the role it played in their teaching.

Technology Acceptance

When an IT professional arrives in a school, there will be a level of use that has been established, and they are likely to be asked (by both leaders and members of the school community) to abandon some aspects of the system, improve some, and leave others as they are. The challenge for these new arrivals is that these lists are never consistent. What some want to keep desperately, others want to abandon immediately; and this is true for both hardware and software as well as for strategies and procedures for managing the IT.

In schools, like all organizations, the intent of IT systems is to promote efficient and effective operations to achieve the strategic goals of the organization. Technology researchers who investigate how technology is used differentiate compulsory use of technology from voluntary use of technology. In school settings, the requirement that teachers take attendance with the student information system is an example of compulsory use, while their decision to integrate technology into their instruction is an example of voluntary use. Activities like taking attendance can be mandated, and users trained how to accomplish the tasks, voluntary decisions to integrate it into teaching when other options are available is a more complex decision.

The question "What factors affect the decision to use technology?" has focused of technology researchers for several decades. By designing systems that address the factors associated with the decision to use technology, school IT professionals will find their systems are perceived to be more effective for compulsory uses and they are more used for voluntary purposes.

In 2003, technology researchers defined the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, and Davis, 2003). There are several versions and extensions of technology acceptance research, but UTAUT is the one that is most-used to understand technology use in educational settings.

According to the UTAUT, four factors are directly associated with users' acceptance of technology and their patterns of technology use: performance expectancy, effort expectancy, social influences, and facilitating conditions. In addition, four factors are indirectly associated with technology acceptance. Since it was first introduced, UTAUT has been refined and additional factors have been added which allows for more accurate predictions of decisions to use technology. For example, UTAUT2 (Venkatesh, Thong, & Xu, 2012) added enjoyment, price value, and habit as factors affecting decisions to use technology, and UTAUT also clarified

the indirect influence of age, gender, and experience. As technology acceptance has been applied to different situations and populations, some of the factors have been modified, but the four factors originally associated with technology acceptance are consistently found to predict IT use.

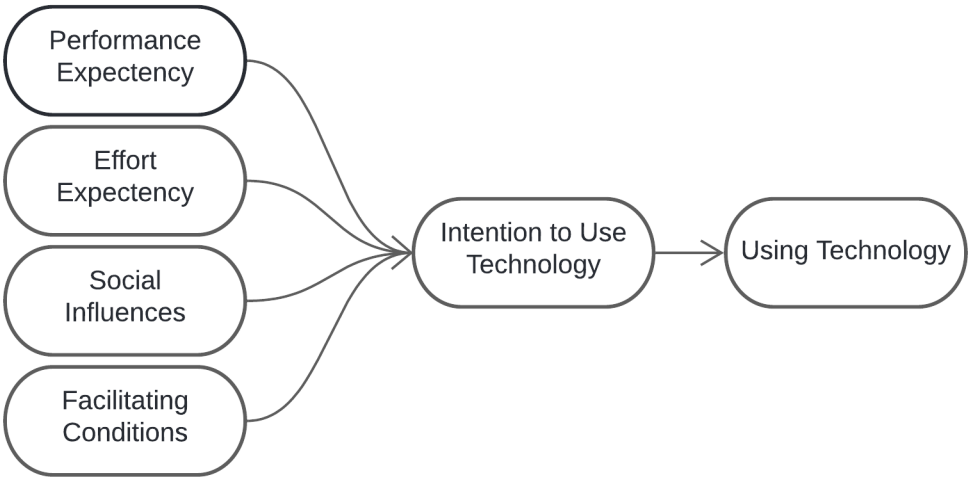

Figure 1. Factors directly associated with technology use (adapted from Venkatesh, Morris, Davis, and Davis 2003)

Perhaps the most important contribution of the researchers who use technology acceptance to study technology use is the reality of users' perceptions. This does pose a challenge for IT professionals as perceptions may be contradictory. IT professionals' perceptions may contradict users' perceptions, and different users may have perceptions that contradict other users' perceptions. Fortunately, there are instruments that have been developed and validated so IT professionals need not invent their own strategies for determining how well their systems align with these characteristics.

Performance Expectancy

This is a measure of the extent to which an individual believes the technology system will affect how well they will do their job; when PE is greater, they believe it helps them to be effective in their work, and they are more likely to us it.

Effective performance is rooted in outcomes and relative advantage. For educators who are using IT in their instruction, outcomes will be defined by their goals in the classroom. One challenge for school IT professionals is that outcomes may be different for different teachers or for different parts of their curriculum or even for different students. Teachers who believe that their job is to prepare student for standardized tests may perceive technology differently compared to those educators who believe their job is to prepare students to create high-quality public performances. Of course, the same teacher may have very different and even seemingly contradictory goals. As a mathematics teacher, I may want my students to have access to a web-based platform that gives practice problems designed to improve basic computation skills. This "teaching by computer" method may have very specific system requirements. I may also want

my students to have access to multimedia tools that allow for scripting so that they can explore fractals (for example).

Relative advantage includes the educators' perceptions of the IT systems compared to other options. If they believe they can achieve their goals (whatever they are) more quickly or that learning is improved when they use the IT system compared to other IT or compared to no IT, then PE is improved, and they are more likely to use the IT.

Effort Expectancy

This is a measure of the individual's perceptions of how easy it is to use the IT systems. Perceived ease of use exerts strong influences on decisions to use technology in the periods after initial training has occurred, but before the user becomes highly familiar with and skilled using the system. When first learning to use a technology system, the simple work of remembering what one is supposed to do interferes with the ease of use, which indicates the importance of initial training when new IT systems are deployed in schools.

Ease of use can also be perceived differently by different stakeholders. One of the realities that is clearly supported by research using UTAUT as a framework is that it is the users' perceptions that determine effort expectancy. It is not uncommon for school IT professionals (who we know are understaffed) to configure systems that allow for efficient management, but these efficiencies may make the system less easy for users to operate. If IT professionals believe a system is easy to use, but the users do not, then their perceptions matter more, and systems must be modified.

Social Influences (SI)

Educators are affected by what others do just like all other humans are; when it comes to using IT, it seems educators are particularly affected by others. SI has complex roots emerging from the individual's sense that others (whom they judge to be important) expect them to use the IT, as well as the individual's cultural experiences and expectations, and the social status that can be gained by using the technology or the status to be lost by the failure to use it.

These influences may be contradictory. For example, if a CIO who has little teaching experience recommends a new platform, it may not be accepted by educators because of negative social influences. Alternatively, educators may advocate IT professionals install and configure IT systems similar to those used by their colleagues in other schools. New educators may be influenced to use technology based on the role of IT or the tools they used in their teacher education program, which may be very different from what they encounter in their first professional position. Younger educators may also have different cultural experiences, including an acceptance of IT, that are dismissed by older colleagues who minimize the role of IT in the classroom. (The stereotypes contained in that example are recognized. While research does suggest there is a weak association between age and IT acceptance and gender identification—younger and male tend to have greater acceptance—IT professionals cannot justify drawing any conclusions about IT use based on age or gender identity in today's schools.)

Social psychologists recognize three types of social influences. Social influences that result in compliance are typical of settings in which individuals are obligated to act in a defined way to gain reward or avoid punishment. Educators who are required to use a particular online grading system may comply with the request, but not use the advanced features of the reporting system. When individuals feel a strong identity with another individual (or with a group of individuals) then the individual will seek to model the actions of that individual or group. The

social influences resulting from those identifications tend to be stronger than the social influences of compliance. The strongest social influences arise when the individual internalizes the social influences and thus, they become perceived as natural and the individual holds the same expectation of others.

Facilitating Conditions (FC)

There are a range of technical and organizational factors that contribute to an individual feeling supported in their use of IT systems. For educators, these factors include financial resources, troubleshooting and repair expertise, training opportunities, as well as perceptions that they can influence technology decisions. In school where educators perceive all these areas are sufficiently provided by the school and technology leaders and they procedures they have in place, then they are more likely to use the technology.

The Challenge of Perceptions

While it is true that it is users' perceptions of the factors related technology acceptance, their perceptions can sometimes be wildly inaccurate. Teachers are also a group of users who can be very quick to label systems as "broken" and to reject any attempts at support they perceived to be taking too long as interfering with their ability to do their jobs.

Improving users' perceptions of the functionality of IT systems requires school and technology leaders address several aspects of the entire IT system. First, they must improve the functionality of the devices. This includes updating and replacing older devices. Second, teachers and other users must be trained in basic troubleshooting steps that can be done without posing a risk to the system. If a user can resolve simple problems without the intervention of IT, then they can return to productive IT user more quickly. Third, there must be on-going communication and collaboration to ensure expectations are known and that malfunctioning devices are identified. And repaired or replaced before they adversely affect perceptions of the system.

6: Technology in Teaching

While IT professionals are not primarily responsible for teaching with IT, they are responsible for the IT that teachers and students use during many varieties of instruction. They are also responsible ensuring the technical specifications are met, contributing to the training necessary for users to operate the systems. Being familiar with curriculum goals prepares IT professional to better understand that work.

One of the most surprising realizations for adults who begin working in schools is that what is taught is not what they were taught or what they think should be taught. Curriculum is a part of school that is affected by many factors; some are very local (individual teachers are ultimately responsible for what it taught in their classrooms), others are school-wide or district-wide, yet others are state-wide or national. In the United States, there is no nationally mandated curriculum, and concepts like "fourth grade mathematics" are variable and open to interpretation. In some states, there are textbooks that are approved for use; in those states, all Algebra 1 teachers (for example) must select one of the approved textbooks to use in their courses. Obviously, textbooks publishers are very motivated to have their books on those lists in states with large populations. As a result, the curriculum expectation in those states can exert strong influences on curriculum beyond the jurisdictions. In addition, some open educational resources are becoming more widely adopted, thus they are heavily influencing curriculum decisions.

Despite these variations, there are some generalizations that can be made about curriculum and instruction, and some trends that can be recognized across schools, grades, and subjects. These generalities and trends are described in this chapter. Of course, IT professionals are not responsible for using technology to teach, but it is important they have some understanding of the nature of technology-rich teaching so they can effectively participate in system selection, design, and configuration decisions.

The Potential Roles of Technology

Since IT was first introduced into schools, educators have explored the role digital electronic computers should play in teaching and learning. What has become clear is there is no single role that IT should play in schools. Four adjectives can be used to capture the approaches to using technology that have been developed: teaching about technology, teaching by technology, teaching via technology, and teaching with technology. IT professionals must be prepared to recognize each comprises different types of interactions, and they must be prepared to design systems that facilitate each and to support teachers and students engaged in each.

Teaching About Technology

Teaching *about* technology was common when computers first arrived in educational markets. Called "computer literacy" at the time, it focused on teaching students the names and functions of the components of systems rather than how to use them. Although this has largely been abandoned, this was a very reasonable approach at the time as few individuals had computers in their homes and one of the most important aspects of IT was knowing the system one needed and setting it up to function. Whereas computer users today can purchase systems

that automate much of the configuration (for example, when I replaced my years-old printer recently, both my Macintosh computer and my Windows PC recognized the new peripheral and installed the drivers without me taking any action), previous generations needed to know how their peripherals connected the computer and how to install and configure the driver software to make them operational.

Although teaching computer literacy as described above is not common any longer, many schools continue to teach lessons in which the systems are the curriculum. For example, when teaching lessons about digital citizenship, cybersecurity, and coding, educators are teaching about technology.

Training users how to operate the systems they will encounter is also teaching about technology. Ensuring students know how to use *Google Workspaces* applications, the full text databases available through the school library, and the tools used by math teachers for graphing are examples of teaching about technology within the domain of educators. Ensuring teachers know how to use the student information system, email, and other systems is an example of training within the domain of school IT professionals, and IT professionals are often excepted to both deliver training to students, teachers, and other users and prepare how-to articles or videos to support them.

Teaching by Technology

When using test-preparation software, skills-building websites, typing tutors, and similar tools, students are experiencing teaching *by* technology. For previous generations of technology-using teachers, "edutainment" software was a popular method for teaching by technology. This software found students playing games in which they earned points by quickly answering mathematical calculations (for example).

One of the more popular uses of teaching by technology for educators today is the use of test preparation platforms. These are cloud-based and customizable, so teachers can create class lists, define the content they want the system to present to students, and to set other variables. Students log on to the system and work through the lessons selected by the teacher. Later, the teacher can log on to the dashboard and see each student's progress. Data specialists employed at the school may also access these dashboards to generate reports for various stakeholders, although access to the data in the reports must comply with FERPA protections of privacy.

Most educators recognize this approach is useful for only a limited type of lessons that can be effectively delivered by technology. Once the teachers or other educators define the lessons to be presented, the system and its algorithms (including the errors programmed into it and the biases of the designers) determine the experience for the students. These systems generally rely on students demonstrating learning by providing answers to fact-based questions in which the answers can be clearly identified so it can be evaluated by software. These systems also depend on algorithms to determine what happens when students do not provide the expected answers.

The publishers and vendors who produce platforms for teaching by computers seek to take advantage of the economy of scale. Once the system is produced, they can sell it to many schools and the very substantial development costs are distributed over the many clients. For this reason, these platforms tend to be written to address very general curriculum goals, and in many cases, the vendors seek to influence curriculum decisions, so they create a market for their product regardless of the degree to which the lessons reflect what is needed by the students.

Teaching Via Technology

Teaching *via* technology describes teaching in which the lesson could be done with or without the technology. The technology may increase the efficiency of some activities, but IT does not influence what students do or how they think about the material being presented.

Consider, for example, a mathematics classroom in which students solve problems on paper. When students review their work in class, the teacher may ask students to show their solutions for all in the class to see. In the 1970's and 1980's, my classmates and I carried the paper on which we had done our calculation to the front of the classroom where we transcribed our solution onto the chalkboard for the class to see. I asked my students to do the same when I taught math in the 1990's (although the board was a whiteboard and students used color markers to write on them). Around 2010, I was asked to purchase a document camera and projector (about $3000 worth of hardware at the time) so that a math teacher could project images of the paper on which students had performed their calculations onto a screen for the class to see. In that case, the experience of doing math was not changed by the technology as students were performing calculation by writing numbers and drawing lines on paper. The students and teacher did avoid the time needed to copy the solutions on to another medium, but the students did not engage with math any differently.

Video content is another example of teaching via technology. Whereas video content was displayed to the entire class at one time before computers arrived in schools (and it still in in many) instances, students today often have the option of watching video content on their own. In the 2010's many teachers explored "flipped classrooms" in which instruction was delivered via video and students watched them for homework, then class meetings were used solve problems and apply what was taught via video. There are advantages to teaching via technology that do affect how students learn in some cases. If students can access video content away from class (for example when they are doing homework), they can get additional explanations just at the moment they need it, which is advantageous, but the presentation is still like a lecture and the student cannot get clarification from a video-based explanation.

Teaching With Technology

Teaching *with* technology has been called technology integration in many sources. This finds teachers incorporating technology into the lessons they would teach without technology. In addition to adopting technology to present the lesson, teaching with technology often finds the teachers adapting the lesson. They will both make planning decisions about the lessons based on the technology tools available and vary the lesson depending on the capacity of the technology.

Consider, for example, the math teacher who decides to use an online graphing calculator rather than graphing on paper. That teacher may be able to introduce more sophisticated graphs more quickly than those who plot functions on paper, or they may be able to create sliders or similar controls that allow students to see how changing those variables affect the plots.

Of the four approaches to technology-based teaching, teaching with technology is the one that necessitates the greatest adaptability from educators and flexibility from IT professionals. Whereas the other approaches are used for lessons in which there are clearly defined educational goals and technology needs, teaching with technology requires design that accommodates many variables including uncertain goals, needs, and customization and individualization of product in which students demonstrate their learning.

One interesting and effective method of teaching with technology is the use of simulations. These are especially effective in mathematics and science education and allow

students to participate in otherwise unavailable experiments and demonstrations. Of course, the boundaries between these types of teaching do blur. For example, a teacher who uses video to show students footage of underwater ecosystems is probably teaching with technology rather than teaching via technology.

Standards

Curriculum (what teachers are supposed to teach) is an interesting part of school design. Ostensibly, there are things that each seventh-grade student (for example) should know, but it is very difficult to define "what students should know" outside of the context of school. The statement, "the book is written at an eight-grade reading level" is best interpreted as "most students who are about 14 years old can understand this book." Curriculum is also divided into subjects that are artificial as well. In the real world, one encounters problems that necessitate understanding many concepts and applying many skills that were taught in isolation in schools.

In the last few years of the 20th century, professional organizations, such as the National Council of Teachers of Mathematics (NCTM) began publishing "standards" which were their version of what comprises appropriate curriculum. In the decades since, the number of organizations publishing standards has increased to the point where teachers cannot reasonably expect to teach all of them. Since about 2010, the *Common Core State Standards* have been widely (although not universally adopted) across the United States. Exactly what is meant by "adopted by" varies. In general, adoption means the state educational agency has mandated schools administer the tests they specify, and the test publisher claims it is aligned with the *Common Core State Standards*.

When this book was drafted in early 2022, the *Common Core State Standards* had fallen out of favor (which is the fate of every such initiative). While education leaders where not referring to the Common Core to the degree they had a decade earlier, the testing mandates, started under the *No Child Left Behind* and continued as the *Common Core State Standards* emerged illustrate how education has become politicized in the United States, and many decisions and actions are made to achieve goals that are not necessarily aligned with the needs of learners.

Some educators have criticized all aspects of standards-based education. They question:

- **Do the standards accurately reflect what students should learn**? It has been pointed out that employers and higher education are more concerned about graduates "soft skills" than they are about the content knowledge of graduates whom they hire, yet standards-based initiatives tend to focus on content.

- **Do the tests accurately measure what they claim**? Because the tests are written and administered by publishers who were awarded contracts by departments of education in states, they are propriety, so independent review of them cannot be undertaken to verify the validity and reliability of them.

- **Do the tests predict "success**?" The purpose of many tests is to predict the degree to which students will be successful (whatever that means) once they graduate. "Career and college ready" was the mantra of the *Common Core State Standards* initiatives, but that is a weak concept, and the claims were that the tests curriculum and tests achieved this outcome even before graduates were in their careers or college.

The exact standards that teachers are expected to follow when designing their courses and lessons varies depending on the priorities of the school leaders, the expectations of local agencies, and other factors. In many cases, the priorities change. For example, a series of low scores on math assessments may lead to a renewed focus on teaching math. In other cases, high-profile public events will lead to demands that certain curriculum areas be given higher priority.

While IT professionals may not deal directly with teaching to standards, they will be asked to provide access to software, devices, and cloud-based platforms that are deemed necessary for students to "achieve the standards." Further, data specialists who are among the IT professionals employed in schools, will manage data and generate reports to help local educators disseminate and use that data.

The International Society for Technology in Education Standards

Among the professional organizations that publish standards is the International Society for Technology in Education (ISTE), which is the leading professional organization for educators and IT professionals with interest in educational technology in k-12 schools. ISTE first published standards in 1998 and *the National Educational Technology Standards* focused on what students should be able to do with computers. Since then, the name was changed to *ISTE Standards*, the contents have been updated twice, and the organization has expanded the stakeholders for whom it defines standards. When school and curriculum leaders plan and design technology-based instruction (teaching about, by, via, or with technology), the *ISTE Standards* are likely to be the documents that they are trying to address. For this reason, IT professionals in school should have some understanding of the contents.

As of 2022, ISTE promotes technology standards for students, educators (primarily teachers), educational leaders, and instructional coaches, as well as standards for computational thinking. IT professionals are expected to support users whose practice is informed by these standards and to design IT to facilitate the work. The standards do assume the curriculum is intended to extend beyond simply operating computers and developing declarative knowledge and simple skills. ISTE standards promote:

- **Active learning—**While active learning is differently defined by different educators, in general, it comprises a range of teaching methods in which students are not sitting and listening to lectures, rather they are engaged with the curriculum and constructing knowledge as they solve or attempt to solve complex problems rather than simply recall information that has been presented to them.

- **Citizenship—**ISTE advocates that all users in schools understand, promote, model, and demonstrate ethical use of technology and the application of technology to important problems.

- **Collaboration—**Central to our emerging understanding of human learning and to our understanding of how problems are best-solved is the idea that learners and problem solvers work together and incorporate diverse perspectives. Collaboration is typically a component of the strategies that are included in active learning.

Job tip: It is not unusual for IT professionals to be asked about "how will you support achieving the standards" in job interviews. To be prepared for such questions, become familiar with the ISTE standards. Visit the ISTE web site at: https://www.iste.org/

Standard Testing

In the 21st century, it has become expected that educators be "data-driven." Ostensibly, they make all decisions based on relevant information. In almost all cases this data comes from tests. While the reliability and validity of the tests and data are dubious, students take far more tests than previous generations of students did; those tests are often administered via web-based interfaces. The trend to computer-administration is nearly complete for those tests that are widely administered. In early 2022, the College Board announced the SAT will be transitioning to computer-based delivery only in the coming years. IT professionals are expected to support computer-based testing for all purposes and to generate and disseminate reports of the data that are collected via the tests.

There are two types of tests that are typically administered to students: standardized and standards based. For IT professionals who are designing systems to administer the tests, there is no difference; devices must be able to establish reliable and secure connections to the servers where the test is housed, user accounts must be created, and testing conditions managed. For the data specialists, there may be differences on the strategies for reporting results.

Just so you don't have to ask the difference once you get into a school, standardized and standards-based tests are differentiated by the comparisons contained in the results. An individual's score on a standardized test is compared to all the others who took the test, so it is reported as a percentile. Scoring in the 50th percentile means half the students scored higher and half the students scored lower. Standards-based tests compare individual's performance to what they were expected to learn. Results of these test are reported with some variation of "no evidence," "almost meeting the standard," "meets the standard," and "exceeds the standard."

Neither type of test is inherently better than the other. Each has its own purpose, and neither gives a more accurate measure of what any individual really knows than the other.

High-Stakes Testing

In the United States, high-stakes tests are associated with the standards that were adopted by states uder the *No Child Left Behind* act and the *Common Core State Standards* initiative. The term "high-stakes" is traced to the efforts in the early years of the 21st century to ensure that 100% of students passed the tests (a statistically and practically impossible condition to meet). Schools that did not make "adequate yearly progress" towards that goal were sanctioned, thus the results were "high-stakes."

While the original efforts have been replaced, and the exact testing requirements depend on the tests that have been adopted within the jurisdiction, high-stakes testing is still very common. Since their inception, these testing requirements have generally expanded to include more subjects than they did originally, and tests are administered to a greater number of students then they did originally.

For several years at the middle of the second decade of the century (when these tests were first administered via computers), school IT professionals and school leaders were making decisions and installing systems that met the system requirements of the tests they were mandated to administer. Both network capacity was improved to meet the requirements and user devices that had sufficient processing and video requirements were purchased and configured. In the years since, technology advances have generally outpaced the advances in system requirements for the tests, so school leaders rarely find they have insufficient capacity to administer the tests.

Because of the importance some stakeholders ascribe to these tests, it is not unusual for school leaders to take steps to ensure technology resources be reserved when the tests are being administered. IT professionals may be expected to be present while the tests are being administered to troubleshoot problems and the system administrators may be asked to limit other uses of the network during testing. For example, public SSID's may be disabled or *YouTube* may be blocked on the school network to restrict uses that may interfere with the network capacity needed for testing.

Diagnostic Testing

There are testing protocols that have been incorporated into many curriculum programs that have been adopted by schools. The rationale is that all decisions about curriculum and instruction must be made to create measurable changes in students. Many educational theorists reject this assertion, and the evidence supporting the claims that more data is associated with "smarter" students is dubious, but the reality persists. As a result, IT professionals are called upon to manage access to cloud-based testing systems, which may require adding extensions to web browsers, managing users, and ensuring the networks is configured to allow access.

Electronic Portfolios

If a school does collect data other than test scores, it is likely they encourage students to document learning in electronic portfolios. In schools where project-based learning, internships, and other authentic learning methods are used, students develop skills and knowledge far beyond what can be measured on tests, so students capture evidence of their learning in a portfolio.

Portfolios are commonly organized around the competencies that the curriculum is designed to promote. These tend to be much broader outcomes than are typically found in statements of learning outcomes; students may be expected to demonstrate how they have become an effective communicator or a skilled problem solver I their portfolios. Electronic portfolios are also widely used in situations in which students are preparing to study or employment in specific fields. For example, art students compile portfolios as do students who must demonstrate their abilities in health care or other skills-rich fields. After the educators have arranged the organization of the portfolio, which becomes a template for the students; students capture images, video, or other artifacts of their learning to customize theirs. Finally, they reflect on the meaning and importance of the artifacts and how it demonstrates their new learning.

In those schools where they are used, electronic portfolios contribute to a more complete and comprehensive evaluation of what students know and can do than those schools that rely only on test scores. Because of the personal nature of electronic portfolios and the fact that artifacts are often images and video, IT professionals in these schools will be asked to facilitate students' use of their own devices to document learning. Such steps to allow students to use personal devices includes opening an SSID for students to connect phones and tablets and ensuring cloud services allow the devices to connect and the files (even large files) to be uploaded. IT professionals may also be asked to configure the learning management system so that work submitted there can be integrated into electronic portfolios.

> Electronic portfolios can be an interesting addition to the teaching and assessment strategies in schools. When planning them, teachers often expect that their assignments will be among the artifacts, and they will insist (for example) "students must put a poem they wrote in it," but the purpose of an electronic portfolio is for students to describe their own perceptions of what has been meaningful and what they believe in their best work. The more prescribed the requirements, the less meaningful the portfolios will be and the more likely they are to be abandoned.

Multimedia

Generations of students have created presentations using a series of programs that combine text, images, audio, and video (thus the "multi" in multimedia). Many trace the beginnings of this type of educational software to *HyperCard* and *HyperStudio*, programs that were available for Macintosh computers marketed in schools in the early 1990's. Interest in multimedia grew when video cards, color displays, audio cards, and speakers along with the computing capacity to play video became widely available in the middle of the 1990's. These activities continue to be popular in schools, so anyone interested in working as an IT professional in a school should be aware of the current trends in the field.

Because schools are public institutions, they are compelled to follow the requirements of the *Americans with Disabilities Act.* This means teachers who create multimedia for use in their classrooms must ensure the materials are accessible. Accessibility of multimedia means, for example, video is closed captioned, slides have unique names, descriptive alternative text is added to images, and flashing content is avoided.

Slide Shows

Slide shows created with *PowerPoint, Google Slides*, or any of the popular web-based tools are very widely used in schools. Teachers create them to support instruction, and students create them as projects. While these were originally stored on local drives, students and teachers in the 21st century have adopted the practice of sharing and embedding web-based presentations in virtual classrooms.

Given the ubiquity of cameras and microphones on digital devices, it is easy to forget that the capacity to capture high resolution images, video, and audio is a relatively recent addition to the computing capacity of devices in schools. The web cameras integrated into Chromebooks and laptops are used to capture audio and video that is integrated into slides shows, and these presentations are created, edited, shared, and embedded by students in every school.

IT professionals can expect to be asked to support accessibility checkers in the productivity suites they deploy. These tools (which may be built into the applications or may

require add-ons to be installed) will identify parts of the presentations that are not compliant with ADA requirements. For example, they will identify missing metadata, missing navigation aids, missing alternative text on images, and other aspects of the files. Some aspects of the files (for example color contrast) cannot be checked via accessibility checkers and IT professionals will be asked to support other tools.

Video Editing

Among many users, multimedia has been replaced with video, so video editing has increased in importance as an education technology in recent years. Whether teachers are creating video to supplement instruction or students are creating video to demonstrate learning or student performances are captured on video, there are situations in which the original footage needs to be edited. Many approach video editing with an underestimate of the time needed to produce acceptable video, and many also overestimate the need for professional-quality editing.

There are multiple web-based options for editing video. For example, *YouTube* provides some capacity to edit video that has already been uploaded to the platform. Two challenges that arise from using web-based video editing platforms are the limitations imposed by the applications and the need to transmit video to the platform for editing.

On devices with full operating systems, video editing software with far more tools and features than web-based editing platforms can be installed. *iMovie* is a video editing application that is installed by default on Macintosh computers, and it is widely used by that community of computer users. Especially in high schools, there is often interest in teaching students how to use professional video editing software. This software allows for sophisticated editing and can incorporate multiple video and audio tracks, filters, and other sophisticated features.

IT professionals in schools must be prepared to support whatever video editing capacity is necessitated by the curricular goals of the school. Considering the range of instructional goals and the needs of educators, a single video editing tool is unlikely to meet the needs of all users in a school. Middle school students, for example may be able to meet their video editing needs through a web-based platform, but the theatre department in the school may need a professional application to produce video version of their performances.

Video Conferencing

During the pandemic of 2020, video conferencing became a vital platform for remote teaching. The long-term use of video conferencing in schools is difficult to predict. Even if teaching via video conferencing does not continue to be widely used for instruction, there are purposes such as some professional development training and meetings that can be as effective when done remotely as when they are done in-person. Educators have also discovered that video conferences can be used to enhance in-person classes. For example, students can record a video conference in which they discuss cases studies or make presentations, then share recordings of those meetings to share with the class or for the instructor to assess.

IT professionals can expect to play several roles in supporting video conferencing. In addition to providing user devices with camera and microphones, they ensure sufficient network capacity, recommend platforms, provide training, and troubleshooting resources. One of the important considerations when using video conferencing is the privacy of students and their caregivers. While educators may want students to appear on screen during the video conferences and they may have good reasons to ask for that, it can pose a threat to their privacy. Many schools have also adopted recommended procedures to minimize the potential that uninvited

guests find, join, and disrupt their video conference meetings. IT professionals played an important role in researching, defining, configuring, and training users to minimize this threat.

Coding

Coding, which refers to teaching students how to write computer programs, has a long history of focusing the attention of computer-using students in schools. When computers first arrived in schools, multimedia was not yet possible and even word processors and spreadsheets were not fully developed, so programming was how students created on computers. Beginners all-purpose symbolic code (BASIC) was invented at Dartmouth College in 1964 and was used for the time-sharing schemes that allowed multiple users (including students in public schools) to write programs that were executed on mainframes computers. Versions of BASIC were also available for desktop computers, so one of the first uses of computers in schools was to teach BASIC programming.

Coding continues to be an activity taught in schools. It can be its own subject in school (such as high school students enrolled in Advanced Placement Computer Science courses), it can be incorporated into other lessons (such as middle school math students coding with Scratch in mathematics courses), or it can be the focus of special events (such as the Hour of Code).

While technology integration—the use of technology to teach other lessons—has been the dominant use of technology in education for several decades, there are organizations that have advocated including programming activities in the curriculum. It is reasoned that programming can teach various thinking skills (the evidence for this is not strong) and that programming can demystify technology by giving students experience controlling it. Regardless of the rationale, many students enjoy learning to program.

IT professionals can be expected to support both web-based coding platforms and integrated development environments and those installed on computer hard drives as well. In many cases, the exact requests will depend on the preferences of the individuals who are instructing students.

Scratch

Scratch is a popular platform to introduce students who are aged eight to 15 to coding. Originally released in 2007, the team at the Media Lab at the Massachusetts Institute of Technology that produced and maintains *Scratch* have released two additional versions, and there have been other related projects such as *Scratch Junior* which is targeted at students aged five through eight. Many trace the origins of *Scratch* to the Logo programming language developed by Seymour Papert in the 1960's.

Scratch 2.0 (the version released in 2013) introduced the online version, and most Scratchers (the nickname *Scratch* users have for each other) log on to the online project editor to select control blocks, set variables, and customize sprites as they design their projects. That editor also allows Scratchers to publish and share their projects so that other can use them or even edit them. Especially if you are interested in working in elementary schools, being familiar with *Scratch* is valuable knowledge.

Create an account and explore Scratch here: https://scratch.mit.edu/

The Hour of Code

The Hour of Code is a project in which schools host events at which students participate in coding activities. It is not unusual for these projects find students taking “field trips” within the school building. Normal classes are cancelled so that students can have special instruction, hear guest speakers, and otherwise focus on coding. While Computer Science Education Week (an event encouraged by and sponsored by a collection of organizations and businesses) and Grace Hooper's birthday (Hooper was a programing pioneer) are popular times to schedule events, local organizers may schedule events to meet their school schedules.

Pre-Professional Courses

Many high schools, including vocational or trade high schools, offer a range of computer science, digital media, or business applications courses in which students develop advanced IT skills. The specifics of these offerings depend on the history and popularity of the department and the nature of the local business community. If an art teacher is hired who has special skill in digital photography, for example, the school may offer a course to take advantage of their skill and interest, and IT professionals will be expected to support the hardware and software needs of this course.

Many high schools have computer science departments that offer Advanced Placement (AP) computer science courses which are designed to prepare students to take the exams published by the College Board. While these are promoted as being equivalent to college courses, and students often enroll with the expectation that they will earn college credit for passing the exam, those decisions are made by colleges, and they have been increasingly reluctant to grant credit for passing scores on the Advanced Placement exams.

It is unlikely that students enrolled in a comprehensive high school or even a vocational high school will be prepared to pass professional licensing exams after these courses, so they are best described as pre-professional courses. Despite this label, school leaders and faculty do strive to replicate professional computing environments, so computers with full operating systems and professional software titles are generally necessary in the classroom where these courses are taught. One of the other challenging situations for IT professionals related to support teaching about technology are the situations in which schools teach courses designed to prepare students for positions in information technology fields. Especially difficult is situations in which students must learn to manage networks. Obviously, these courses are taught on networks that are isolated from the network used by other users in the school.

> Some search committees are interested in hiring professionals who have an interest in coaching extracurricular activities. Be prepared for a question like "Would you be interested in helping out our robotics team?" It is best to be positive, but cautious. If you would be interested, it is best to answer "Yes, but only if the meetings fit with my other duties." Even if you are not interested, it can be a good question to ask at the end of your interview. Something like, "Do your students compete in programming or robotics competitions?” shows interest in the schools and students beyond the position for which you are being interviewed.

Makerspaces

Makerspaces have been introduced into many schools in recent decades. In some schools, maker spaces were introduced after wood shops and similar classrooms were removed. In some schools, the traditional industrial arts remain and are supplemented with makerspaces.

In makerspaces, students are encouraged to build solutions to problems. Depending on the age of the students and the interests of the teachers who work in makerspaces, they can include a range of building tools, including 3-D printers, robots, and coding. While the faculty who are hired to teach in these spaces typically have expertise in configuring these devices, and they work closely with IT professionals to ensure they have the necessary technology and can manage it so as not to interfere with the availability of the devices for students, but also to ensure the network is secure and reliable.

Assistive Technologies & Accessibility

School IT professionals often collaborate with special education teachers, leaders, and consultants to select, install, configure, maintain, and manage assistive technologies necessary for students who need them. These devices include items such as Braille printers, keyboards for specialized input, specialized displays, assistive listening systems (for individual students and for groups in presentation spaces), and other devices. In many cases, these devices are needed only by specific students, so many of the selection and configuration decisions are made by others and are made to meet the needs of the one individual using the device. School IT professionals may be asked to understand the configuration and operation enough to provide troubleshooting support for these devices. In schools that enroll older students, many of the assistive learning devices that students use have been in service for many years as they were obtained when the student started school, and they have used them throughout their school careers.

Many IT professionals find this to fall outside of their area of expertise, but schools are organizations that cannot deny any student access to education (except in very exceptional cases). Because of this, school IT professionals do have responsibility to provide adequate support for these users and devices, and denial to do so will likely represent a violation of school policy.

In 1990, the *Americans with Disabilities* act became law in the United States. This civil rights law is intended to ensure all individuals have access to public resources regardless of their disability status. For educators, this means the materials they use in class (such as textbooks, videos, and presentations) must be available to all. For the resources created by publishers, obtaining alternative versions of resources is not a problem as they understand this requirement and have prepared the necessary versions. For example, it is usually easy to obtain audio or Braille versions of textbooks from traditional publishers. For those materials created by teachers, it is necessary they take steps to ensure their materials are accessible. It is also necessary to take steps to confirm resources from publishers are accessible. For example, the presentations that are included in the instructor resources that accompany textbooks are not always accessible.

> *Microsoft Office* (along with most other productivity applications) has an accessibility checker tool that identifies properties of the file that make it inaccessible. Before distributing a *PowerPoint* presentation to students, for example, a teacher should make sure the file "passes" the accessibility check. When introducing accessibility and the checking tools, I often have teachers check the presentations provided by their textbook publisher and we find many do not pass.

Copyright Issues

One of the most challenging issues related to digital information in schools is copyright. This is especially true in the time since one-to-one initiatives became common. One rationale for adding computing devices for each student to the budget was that textbooks (traditionally a very expensive resource) would no longer be necessary. While textbooks that are available as open educational resources, thus available for reuse and editing at no cost, many educators who teach without textbooks rely on other types of information, and some of those uses violate copyright protections.

When educational resources were print, the work of making physical copies of copyright-protected materials was expensive. In most cases, it was cheaper to purchase addition copies of a novel for English class, for example, than it was to make photocopies of a single copy. Regardless, many teachers were found standing at the photocopier (which is likely connected to the network and also allows scanning to either network drives or email addresses and is managed by the school IT professionals) and other to make copies of materials for students before, during, and after school.

> A former colleague used to tell the story of getting pulled over for speeding on the way to work one morning. According to his story, the officer said, "If you give me a good excuse, I won't write the speeding ticket." He replied, "I'm a teacher and I have to make copies for my students." It is unclear if he was violating copyrights with his copying, but he did not get the ticket. I do not recommend trying to see if the excuse convinces a police officer to not write a ticket.

When educational media was analog, for example video on VHS tapes, many teachers had their own collection of pirated video materials. Despite the fact the video degraded over time, teachers valued their collections because they represented a significant investment of time and money, and using this video in class was easier than the previous generation of projected films. The costs of copying digital files, on the other hand, is effectively zero. Unless the files are protected with digital right management locks (which many educational videos are) digital files can be copied with a mouse click and the new file uses a miniscule part of existing resources. For these reasons, it is very easy to make copies of files that one is not entitled to make.

Because copies can be made using the devices they manage, many IT professionals are expected to define procedures to reduce illegal reproduction of copyright protected files, help users understand the importance of following copyright regulations, and addressing violations of copyrights. Consider these situations which are all violations of copyright:

- Scanning paper versions of books or magazines and distributing the digital copies to students;
- Downloading images from the Internet and incorporating them into your materials;
- Extracting a digital audio file (commonly called "ripping") from a compact disk and using it as background music in a presentation;
- Accessing textbooks publishers' web sites to download and use the instructors' resources or other supplementary materials without using the textbooks;

- Purchasing a single subscription to a database, then distributing the materials to students.

While ensuring teachers are following copyright laws is unlikely to be the responsibility of most IT professionals, they do have a role in pointing out when copyright has been violated to protect the school and themselves. They also work closely with librarians to promote responsible use of digital resources and to ensure the library materials are available to all users both on campus and off campus as their licenses allow.

Fair Use

There are situations in which educators (and others) are allowed to make copies of works that are protected by copyrights, and these uses are referred to as fair use. Many teachers claim that they are entitled to use any materials in any way they see fit, and reason, "I'm not selling it" or "It's for educational purposes." Fair use does not allow teachers to copy anything for any purpose, but it does allow for limited educational use as long as it is a small part of the whole and that the copies do not interfere with the copyright holder's ability to be compensated.

> If I am a subscriber to a magazine and I take a screenshot of a graph in an article to add to my slide show that I present in class, it is likely that is allowed under fair use. If I take the entire article and distribute it to my students year after year, then it is not protected by fair use.

One of the important distinctions between fair use and violating copyright has to do with the size of the audience to which it is distributed. If a copyright protected work is used for a presentation made to a small group (for example if a popular song is incorporated into a student's presentation that is show to classmates) then—while technically a violation of copyright—it is unlikely to be problematic. If that same presentation is posted to the school web site or *YouTube* channel, then it is problematic. Of course, the responsible use of digital materials is one aspect of good digital citizenship, so student should understand their responsibilities regardless of the size of the audience.

Creative Commons

Lawrence Lessig, a law professor at Harvard University, founded the Creative Commons in 2001. This non-profit organization supports authors who apply Creative Commons licenses to the works they create. While materials published under any Creative Commons license (as of 2022 there are six different licenses, seven if one counts the license that places work in the public domain) are available at no cost, they are still copyrighted, but—depending on the license—others may use the materials in various ways.

All Creative Commons licenses, except for public domain in which the creator places the work in the same class as works in which the copyright protection has expired, require the creator be attributed. All licenses allow others to make copies of the works and to distribute them, but there are some restrictions on those copies. The restrictions have to do with the commercialization of works (some works cannot be used for profit-making purposes), the creation of derivative works (some materials cannot be edited), and the licensing of derived works (some derivative works must be licensed in the same way as the original.)

Table 4. Creative Commons Licenses

Name of the license	What is allowed
CC BY	"This license lets others distribute, remix, adapt, and build upon your work, even commercially, as long as they credit you for the original creation. This is the most accommodating of licenses offered. Recommended for maximum dissemination and use of licensed materials."
CC BY-SA	"This license lets others remix, adapt, and build upon your work even for commercial purposes, as long as they credit you and license their new creations under the identical terms."
CC BY-ND	"This license lets others reuse the work for any purpose, including commercially; however, it cannot be shared with others in adapted form, and credit must be provided to you."
CC BY-NC	"This license lets others remix, adapt, and build upon your work non-commercially, and although their new works must also acknowledge you and be non-commercial, they don't have to license their derivative works on the same terms."
CC BY-NC-SA	"This license lets others remix, adapt, and build upon your work non-commercially, as long as they credit you and license their new creations under the identical terms."
CC BY-NC-ND	"This license is the most restrictive of our six main licenses, only allowing others to download your works and share them with others as long as they credit you, but they can't change them in any way or use them commercially."
Definitions from https://creativecommons.org/about/cclicenses/	

7: IT Decision-Making in Schools

My rationale for writing this book is grounded in the premise that schools are unfamiliar places for many IT professionals. In this chapter, I focus on the nature of decision-making related to information technology in schools.

In schools, IT decision-making is complicated by several factors. First, many educators are technology-savvy, but often not in relation to enterprise systems. They may have deep understanding of what they want technology to do in their classrooms, and this is grounded in the fact they use their personal computers in their work. They may even have successfully installed consumer network devices in their homes and manage multiple devices on those home networks. While that is a worthy accomplishment and it does indicate an impressive level of technological knowledge, it does not scale to enterprise networks in the manner they might predict. In some cases, those educators who "know enough to be dangerous" and can attempt troubleshooting or offer advice that makes situations worse.

> During one week when I was managing IT for a small rural school, I encountered two examples of how educators do not understand the nature of enterprise systems. On Monday, a teacher brought me a sale paper for a local box store retailer (it was early in the holiday gift buying season). She told me she had $300 left in her classroom budget, and she wanted to buy a laptop that was on sale for $250. On Tuesday, I was getting ready to install the replacement for the 48-port switch that had failed causing a whole floor of the school to lose connection. A teacher asked what I was doing when she saw me carrying the switch into the closet where it was installed (literally a closet… this was an old school building). When I said, "this is the new switch," she reacted with surprise and said, "I thought you were replacing something like a light switch." Both teachers described here are individuals who could accurately be labeled "tech-savvy" because of their use of IT in their classrooms and their web presence.

A second factor complicating IT decision-making in schools is the fact that IT professionals have experience in school, and they have concepts of what teaching is. This can be especially true if the IT professionals have recent experience in higher education or workplace training where the lecture methods are exceedingly common. Providing the IT for lecture-based teaching methods, in which the instructor talks at a group of students who are facing the front of the classroom is a relatively easy task. A single workstation with a projector and speakers connected so that text, images, audio, and video content can be seen meets the need.

Increasing numbers of educators are coming to realize that lecture-based teaching methods are ineffective, and they are exploring and using other strategies. These new methods can conflict with the concepts IT professionals have, and the IT for active learning classrooms is much more complicated and flexible than that for lecture-based classrooms.

A third factor complicating IT decision-making in schools is school administrators who are ultimately responsible for planning and decision-making are often far removed from classrooms and have incomplete knowledge of enterprise-level IT. Their conceptualization of teaching and the role of technology in the classroom may be grounded in their teaching

experiences, which are likely to have been brief and using primitive technology compared to that available to today's teachers. Most school leaders are also quite savvy technology users, but for their own productivity, not for teaching and not for providing reliable, robust, and secure systems for large numbers of users.

> iPads and other tablets are popular devices amongst school leaders. They are very portable, easy to use, and can be used as they walk around school buildings. These devices are designed to improve the productivity of a single user and are notoriously difficult to manage from a centralized location, thus they are avoided by many school IT managers. They are also notoriously difficult for some of the traditional classroom uses such as typing papers. Some of these difficulties are less problematic now than when the devices first arrived on the market, they still are little used in schools. This did not stop leaders in many schools from initiating large-scale table purchases. They reasoned, "my tablet helps me be productive, so they will help everyone be productive." They were unaware, however, of the differences between the tasks they do with technology and the tasks students and teachers do and they were unaware of the configuration and management challenges.

Planning and designing school IT systems is a complicated process. It occurs on different levels with the school organization, involves different stakeholders who have different types of expertise, and that requires collaboration and clear communication.

The Nature of Goals

Almost all management and leadership teams focus their work by establishing goals. It is reasoned that decisions and actions in the organization must be directed towards the desired state described by the goals. Just like in all organization, goals and the actions undertaken to achieve them do exist on several levels. It is important to examine the nature of the goals when defining and achieving them requires the participation of stakeholders with different types of expertise. In all organizations decisions are made for several purposes, and goals are set at three levels to guide decision-making and improve performance.

Strategic Goals

At the broadest level, organizations have strategic goals which describe the purpose of the organization, and the conditions leaders expect to be true. They are usually captured in the mission statements that are adopted by the leaders at the highest levels. In schools, the strategic goals are focused on graduating students who are "smart." The specific language depends on the local priorities and preferences, but most will agree that the purpose of schools is to help young people learn. The challenge for educators and school leaders is defining what exactly represents "smart." There are many types of knowledge and some of the proxies commonly used to define it (like test scores) are notoriously unreliable and tend to focus on only one type of knowledge. In addition, closers inspection reveals cultural and other biases that are unrecognized.

School leaders regularly convene strategic planning meetings at which they define the strategic goals that will focus their efforts. The goals defined in these meetings are typically intended to address problems that are identified by regulatory or legislative changes, local or

regional political situations, data indicating academic weaknesses, emerging teaching practices, or the preferences or expertise of leaders. For many reasons, strategic goals are typically updated each year for schools even if the mission statements are not.

In the vocabulary of planning, organizations that achieve their strategic goal can be labeled "efficacious." The chief information officer of a school can expect they will both frame their departmental goals in terms of strategic goals and to support other departments as they support the same goals.

Logistic Goals

Strategic goals are necessarily broad, and they are accomplished only through the cooperation of disparate departments. Especially in schools, strategic goals are also open to interpretation; what is seen as success in reaching the strategic goal may be seen as failure to others. While educators and support staff, including IT professionals, may keep the school's strategic goals in mind as they go about their work, those goals are rarely sufficiently focused to guide daily tasks.

The daily work of IT professional is defined by logistic goals which are the things they need to accomplish as they are designing, improving, configuring, and managing IT systems. While strategic goals are typically defined by the school leaders, with the input of other stakeholders, the logistic goals are typically established by departmental leaders. For school IT professionals, most logistic goals are defined in collaboration with educators or business office staff.

When defining logistic goals, the best planners ensure there is a clear connection between the strategic and logistic goals of the organization. When the goals are aligned in this way and the goals are being achieved, planners would label them "effective."

Efficiency Goals

School IT departments are typically understaffed, so IT professionals working in schools will define goals and design systems to improve the efficiency of the operations of the department. These can include technology solutions (for example ticketing or messaging systems to speed up triage and repair and defining replacement plans to ensure devices are in good repair), training solutions (both those to help users be more independent and those to improve the skills of technicians), and procedural solutions (for example, assigning technicians to specific places or a regular schedule so that users can get support at known times).

Typically, the efficiency goals are defined by the members of the IT department, and they have the most control over their definition and the systems to improve their efficiency and productivity. Ideally, there is alignment and connection between the different types of goals in organizations. When IT professionals meet their efficiency goals, they will be more effective in meeting the logistic goals they have set with other stakeholders, so that the school can achieve the strategic goals.

Dimensions of IT Decision-Making

If technology is going to be used to achieve the strategic and logistic goals of the school, then decisions must be made that address multiple dimensions. Each of these dimensions are separate from the others: there are different professionals making decisions about efficient operations within each and they bring different expertise to those decisions. Those dimensions and the decisions and decision-makers within each are not independent, however. Teachers decide the appropriate design of the IT for their instructional needs. IT professionals are responsible that to ensure the technology has been properly configured so that it functions as expected. School administrators are responsible to ensure the system is reasonably implemented and can be maintained given the budget and other limitations (see figure 2).

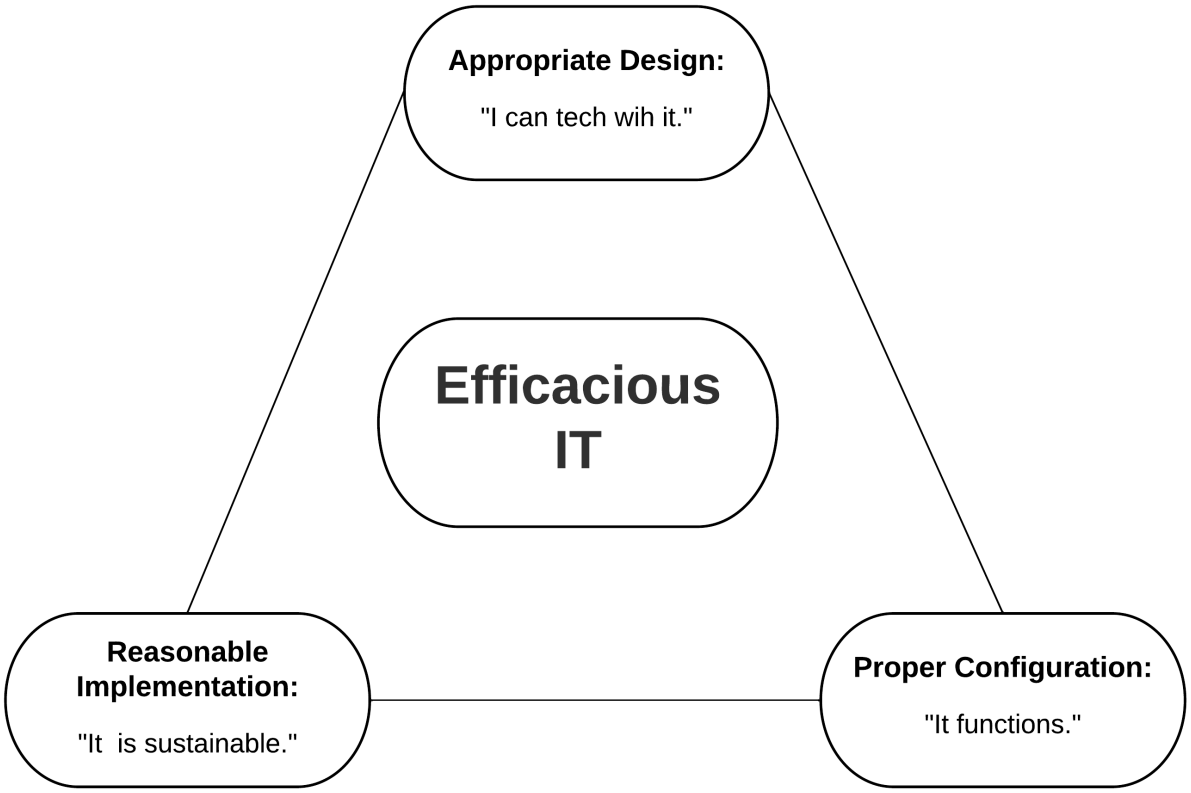

Figure 2. Dimensions of efficacious IT in schools

Because the decisions made within one dimension can determine what can be done within the others and also the efficiency of operations within it, the decision-makers within each are interdependent. Unless the decisions affect only the efficiency of the professionals working within the dimension, then multiple perspectives and different stakeholder are involved. The composition and operations of steering committees that make such decisions and set logistics goals related to IT in schools are addressed in the following section. Here, the focus is on appropriate designs, proper configuration, and reasonable implementation of IT systems.

The term “stay in your lane” has become common in schools and other organizations in which leaders share decision-making and ask members to evaluate the situation and possible

solutions to problems and recommend steps that are incorporated into strategic plans and actions. When these members are attempting to affect decisions in a domain that has not been included in their area of responsibility, then leaders will recommend they "stay in your lane." While this phrase that is not well-received ("after all," it is reasoned, "why ask me to be a leader and recommend actions if you are going to reject them?"), the design of school IT systems depends on three very different types of expertise so "staying in your lane" is sound advice as it is unlikely any one individual has sufficiently broad expertise to make informed recommendations in more than one.

Teachers and other educators make decisions about the nature of the technology they and their students need; this input can be called "appropriate design." IT professionals make decisions about what is installed and how it operates. While this is informed by the input of the teachers, IT professionals determine the "proper configuration" of the technology. School leaders make decisions about what is allowed to be done and they set resource limits; this ensures the IT is reasonably implemented. These groups do not make decisions in isolation, and they make better decisions when they communicate and integrate the needs of others into their decisions. At the end of the day, however, teachers teach, IT manages IT, and leaders oversee the entire endeavor. The most efficacious, effective, and efficient IT systems exist in schools where decision-makers "stay in their lane," but ask lots of questions to understand that rationale for others' recommendations.

Appropriate Design

Schools are places where learning is supposed to occur. Educators, including teachers and curriculum leaders, are the professionals who are responsible for defining what should be taught and how it should be taught including the role of technology in the students' experience. IT systems in schools must be configured in such a way that teachers believe it allows them to teach what they must teach in the manner they should teach it.

The appropriate nature of the IT system design is determined by teachers' perceptions that:

- The available information technology affords the experiences students need. Educational experiences comprise an increasingly diverse collection including accessing information; interacting with classmates, faculty, staff, and others outside the school (when appropriate); and creating and disseminating products and performances in which they demonstrate their learning.

- The technology is sufficient to meet their needs. Sufficiency includes both the computing capacity, for example the software they need is operational on the available computers, and the number of devices.

- The technology is easy to use for both students and teachers.

While planning is an activity with which all educators and professionals in other fields find very familiar, the work of creating IT systems for school users is best described as design

rather than planning. Plans usually have clear goals in mind and specific measures established before the work begins. Later, performance is assessed, and new plans are established. In design, the goals, strategies, and measures emerge as the project is underway. Further, the project in undertaken with the intent of updating the work as it proceeds. Because it is an iterative process, the versions of the system that are developed during design are understood to be temporary. The best feedback to incorporate into the design process is framed in a theory; technology acceptance (see pages xx-xx) is one such theory that has proven effective in many schools.

While teachers are the primary population to create appropriate designs for educational technology, they do this in collaboration with other professional educators and IT professionals. Technology integration specialists (see pages xx-xx) are educators with greater than usual expertise with IT, so their insight is valuable during while defining appropriate designs. IT professionals are also responsible for the proper configuration of the systems, so their participation is necessary as well, but educators must establish the appropriate design of the IT systems for teaching and learning. Once the needs have been designed, IT professionals are responsible for properly configuring the systems.

Proper Configuration

What emerges from the appropriate design process is a collection of IT tools and features the educators deem necessary for the IT to meet the intended educational goals. It is the role of the IT professionals to ensure that technology is properly configured to both provide that need, plus reflect the responsible configuration of the system. Remember, we do not want IT professionals running schools and we do not want educators to be running IT systems. Proper configuration of the IT systems ensures they meet industry standards and they are secure, reliable, and robust.

First, devices and data are secured to minimize threats. Securing systems is work that has accepted procedures regardless of the nature of the organization. The same strategies for physically securing the IT systems (e.g. keeping wiring closets locked, ensuring cooling systems are functioning, and uninterruptable power supplies are installed as needed) in a businesses an organizations are used to secure school systems. The same strategies for providing virtual security of the devices (e.g. using malware protection, firewalls, and other threat protections) as deployed as well. Security also extends to data; properly configured systems prevent users from accessing data they are not supposed to access. The nature of this work has changed as data and applications have merged to software and platforms as service rather than data centers on campus; the need to both establish the identify of users and make sure they access only what they are authorized to are as important as ever.

Second, properly configured systems are reliable; they are available whenever they are needed. Some threats to reliability can be avoided, for example by scheduling software updates and hardware upgrades to occur during times when school is not in session. Other threats to reliability—for example failed devices—cannot be avoided, but regularly upgrading devices and ensuring firmware and other software is updated reduces device failure. One advantage of using

cloud-based systems for productivity suites and data management systems is those are largely built on virtual servers which can be made redundant at much lower cost and much quicker than physical servers.

Third, properly configured systems are robust which means they have the capacity to meet the load. As one-to-one initiatives have gained popularity in schools, the need to increase the capacity of wireless networks to manage the connections of dozens of devices and provide sufficient bandwidth so no users experiences network latency (the term IT professionals use for "a slow network") has become one of the most important aspects of properly configuring IT in schools.

Story from the real world: I was once called in to help troubleshoot a malfunctioning network in a school: When the first few teachers and administrators arrived in the morning, the network worked well, and productivity was high. When students arrived and began connecting their laptops (which were provided by the school) to the network, things quickly slowed to a crawl. Despite the fact devices were connected (i.e. we could ping both internally and externally), they could neither send nor receive data. The first technicians to diagnose the problem concluded it was the result of a malware infected computer which was sending out enough data to use all of the school's bandwidth. He reasoned performance was degraded as soon as they devices arrived and connected. We were unable to see any node on the network sending excessive data, however.

We were able to look closer to find that a single device on the network was assigning IP addresses and routing almost all the traffic for the several hundred student laptops and scores of desktop computers in the school. That single device was not robust enough to manage all the tasks it was assigned. Once the configuration was changed and the management of network was dispersed to multiple devices, the performance of the network returned to normal.

Appropriate design can sometimes interfere with proper configuration, especially when educators ask for excessive flexibility in how they access and use the IT. Proper configuration can also interfere with appropriate design, especially if steps to make systems secure pose insurmountable barriers to accessing the systems. Of course, some appropriate designs and some proper configurations may be deemed unreasonable by the school leaders who are ultimately responsible for school operations.

The art teacher responsible for the youngest grades in an elementary school wanted to be able to connect an iPad to the projector in her classroom so that she could do demonstrations and display works so that all students could see without the need to crowd around one table. The IT professional responsible for her building insisted she leave the projector in a single spot and refused to connect it to any device other than the

desktop on her desk. The art teacher bought an adapter to allow the iPad to connect to the projector via a long HDMI cable. The PC remained connected via the VGA connection, but she switched the input to HDMI when she used her iPad. In an example of poor customer service, the technicians refused to provide any additional support for the projector in the art teacher's classroom as she had departed from the recommended configuration.

Reasonable Implementation

School boards hire superintendents and other high-level administrators to make the ultimate decisions about what happens in the school. These leaders are charged with ensuring all decisions, including those related to appropriate design and proper configuration of IT systems are reasonable. Reasonableness is defined by:

- **Budgets—**All decisions must fall within the available budgets and the anticipated budgets into the future.
-
- **Human resources expectations—**Master contracts and employment laws in the regions where the school is located affect what is allowed in schools.
-
- **Adopted policies—**Other regulations and laws are usually reflected in the policies that are adopted by the school board.

When school administrators make decisions about what is reasonable, they may override all the other decisions made by teachers or IT professionals, and it may be uncomfortable for the leaders to communicate those decisions, but making the decisions is relatively easy. They have the money, or they don't; this is confirmed by the business manager. The procedures violate policy, or they don't; this is confirmed by the school's legal advisers.

The more difficult decisions about reasonable implantation can arise when there is conflict between the appropriate designs and the proper configurations. How these conflicts can be reasonably negotiated and resolved is the focus of the next sections. In those case, we see the political factors that affect many decisions in schools. Most IT professionals do not have direct interaction with those elected to govern local schools, but the policies and procedures they define and even the discussions that have affect the culture in which school employees work and priorities that affect school leaders' decisions.

Design Cycle

We know IT systems must be appropriately designed, properly configured, and reasonably implemented. These characteristics are not necessarily the same and can be contradictory.

A fundamental aspect of managing school IT systems is designing them for the purpose of continuously improving them. In general, appropriate design must be the primary goal of the

design, but proper configuration is also essential, and school administrators always have the ultimate decision-making authority. By following the design cycle presented in figure x, steering committees can design for improvement, and school administrators can decide which perspective should be given priority at any point in the design process.

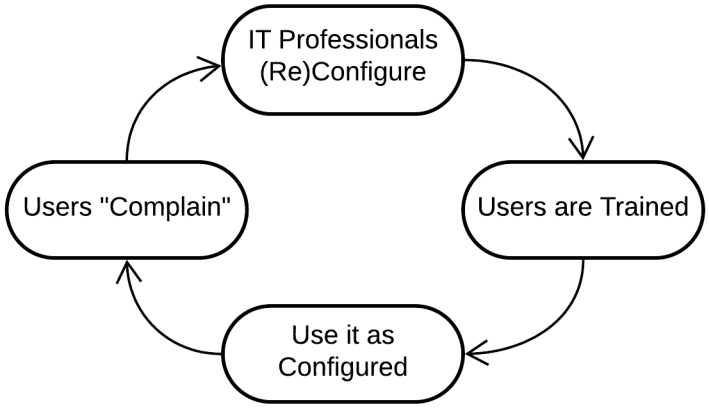

Figure 3. Design cycle

The design cycle begins with technicians configuring systems according to their knowledge of proper configurations, limits of their skills, the extant infrastructure, budgets, time, and other locally relevant circumstances, especially their understanding of the appropriate design. Once the system is built, technicians must ensure teachers and others understand how to operate it, and they have an obligation to understand and follow those procedures. If teachers and students are using the system as designed by the technicians, but they find the design is not what they need, then they "complain." The factors associated with technology acceptance (see pages xx-xx), specifically ease of use and effectiveness, are used to frame the improvements that are needed, so they are not really complaints. If the school has a well-functioning steering committee, then they will meet to define the new configuration that will ensure the new version of appropriate design is realized.

This design cycle many be used either formally or informally and different component of the total IT system in the school can be at different stages of the cycle at any moment. Further, each stage of the process may require multiple iterations before process is sufficient for the next stage to begin. The degree to which a stage is completed before the next iteration begins appears to correlate with teachers' effort expectancy.

At different stages of the cycle, all stakeholders must defer to decisions made by different stakeholders. Technicians make initial design decisions, so educators must defer to their expertise and use systems as the technicians design them to be used. When educators find aspects of the system that interfere with technology acceptance, then technicians must defer to educators' perceptions and change the system to improve their acceptance. School administrators are hired to manage school operations and to ensure conditions are appropriate for teaching and learning. When progressing through this technology planning cycle, school administrators must recognize the stage and ensure the recommendations of the correct stakeholders are being implemented.

When the planning cycle is active and completed on a continuous manner, the practice is associated with improved perceptions of facilitating conditions. A principal captured the effect of focusing on technology acceptance during the planning cycle. “When we talk about technology at faculty meetings, I used to hear endless griping about how stuff was never fixed. The technicians stuck to their plans and were reluctant to modify things.” After introducing the design cycle and insisting “complaints” be expressed as those aspects of the system that made it hard to use or that interfered with teaching, the perceptions of the system seemed to change. He observed, “We have opened communication about the role of the system in our school and the conditions necessary for it to serve our purposes” (Ackerman, 2018).

The password story ended this way: The teacher complained to the principal that the password requirements were too complicated and that her students were being denied computer-based lessons because they were taking so long to log on. Some students had given up, and refused to even try logging on; it was too frustrating.

The principal deferred to the technology coordinator who said it was too risky to have simple passwords for those students, so he did not modify the password requirements.

The teacher asked the principal to join her students in the computer room when they were next scheduled to be there. After spending 10 minutes seeing the frustrations and helping students get logged on, he insisted the technology coordinator allow passwords the students could use.

The technology coordinator created an organizational unit in the user management console of the network software and set the permissions for the users in the group that left him confident the system would be secure if the passwords were compromised.

In this case, the teachers identified “easy log on” as the appropriate configuration. The principal decided “easy log on” was reasonable. The technology coordinator configured the organizations unity so that it properly protected the system while allowing easy log on.

Acceptable Use Policies

The leaders of all organizations take steps to protect themselves and the organization from liabilities and damage resulting from the inappropriate use of IT systems. At the highest levels, the organization’s governing body (school board are generally responsible for adopting policy) will adopt policies to protect the organization by ensuring they comply with relevant laws and regulations, and to minimize threats to the IT systems which represent a significant expense. As long as policies are lawful, and policies are usually written with significant input from the governing body’s legal counsel, then policy defines what IT users can do using it’s IT systems and violation of policies can lead to termination of employees.

While policy is the ultimate rules that must for followed, users of IT typically follow procedures which are more easily understood, and which have been defined to facilitate management of the systems for everyday use by teachers, students, and others. If it is discovered that IT procedures violate policy, they will be overturned. In schools where collaborative IT planning is observed, new procedures that meet the needs of the IT professionals, but that aligns

with policy will be defined with the input of multiple stakeholders, including school administrators, which reduces the likelihood that procedures will be overturned. Revising policy takes a significant amount of time and policy makers typically revise IT (and other policies) on a regular basis (usually with years between revisions).

While the acceptable use policies adopted by school boards are the ultimate policy that must be followed, those can be written in language that is difficult for laypeople to understand. This is especially true regarding children, who we know comprise the majority of school IT users. In response, IT professionals and educators will collaborate to create "acceptable use policy" documents that are written in language that is appropriate for the students.

Having students and adults sign AUP's is a largely symbolic activity in schools. The signature does indicate students, parents, educators, and others have been made aware of the policy. Whether one has signed an AUP or not, they are obligated to follow policy and failure to follow the policy can result in school administrators taking actions to ensure policy is followed. Because it is symbolic, it does not mean that AUP's are meaningless. These can present a valuable opportunity for teaching students about cybersecurity, cyberbullying, privacy, and other situations in which IT may be misused, and lessons focused on the school's AUP are often included in the curriculum in part to address the International Society for Technology in Education's standards related to digital citizenship.

Steering Committees

School administrators, the licensed professionals hired by school boards to implement their decisions and policies, have ultimate responsibility for all decisions in the school. Efficacious administrators understand they do not have sufficient expertise to make appropriate and proper decisions. They also understand reasonable implementation will also necessitate they make decisions about the limits to what technology can be purchased and what professionals can be hired. In addition, they will be negotiating and resolving situations in which there is disagreement over what priorities should be selected when making decisions.

To reduce the conflicts between what teachers want, what technologists need, and what the budget and policy allows, school leaders convene steering committees to recommend decisions and actions. The individuals who sit on technology steering committee are usually selected because have a strong vision for the organization, broad understanding of the operations of the organization, and an interest in identifying technologies that appear to be fill the gaps in how the organization is functioning and the technology that is available.

Steering committees are diverse groups comprising representatives from across the community. They have a strong vision for the organization, broad understanding of the operations of the organization, and an interest in identifying technologies that appear to be fill the gaps in how the organization is functioning and the technology that is available. It is in the work of steering committees that teachers and technicians and administrators share their own perspectives and find solutions that are mutually supportive. All teachers want technology that is secure, reliable, and robust, but there are also things they and their students must be able to do. All IT professionals want the systems they build to support teaching and learning, but they also must insist they are aligned with good principles of IT management and that they can be supported with existing capacity and expertise.

The work of the steering committee is to simultaneously negotiate appropriate design and proper configuration and reasonable implementation so that system improvement is manageable

within the existing technological capacity, predictable for teachers, and sustainable at the necessary scale.

Permissions Problem

IT professionals know the danger of using computers when logged on with an account that has administrator permissions. When logged on with an administrator account, users have access to controls to change configurations, install software, and manage other users. All of these have potential to be set improperly. Most IT professionals have two accounts; they user a regular account when doing their day-to-day work and only log on with administrator credentials when they intend to make changes, then they log off as soon as they are done.

In general, school administrators should not be given IT administrator credentials. The potential they can inadvertently misconfigure systems is too great. In fact, no school administrator who understands the importance of secure, reliable, and robust IT systems would want to have administrator access to the systems.

Responsible IT leaders will take steps, however, to ensure the IT systems can be administered in their absence. This can include having multiple individuals with administrator credentials and it can also include making administrator credentials available to school administrators. Especially when new individuals are hired as school administrators or chief information officers, the best leaders will review plans to respond in situations such as these that arise:

- The primary system administrator becomes incapacitated by a stroke (which happened to me when I was the primary system administrator for a school; fortunately, I was able to return to work before major IT malfunctions).

- An IT professional with administrator credentials is denied a promotion and walks off the job when informed he wasn't promoted.

- The technology coordinator for a small school is on a vacation in a remote region and the IT system becomes dysfunctional while he is gone.

8: Getting Hired

Throughout the book, I have added some call out boxes with suggestions on how to prepare for being interviewed for information technology positions in schools. In this final chapter, I turn attention to the details of getting hired to work as an ITRR professional in school, specifically, I turn attention to finding openings, the application procedures one is likely to encounter, what to expect during interviews, and what to expect after you are hired.

The reality of finding and securing jobs in education is a very localized process. Individuals will find the contents of this chapter may not accurately describe the process for getting hired in schools will not describe their local situations. Individuals interested in working in schools are encouraged to investigate the details of getting hired by local schools by talking to teachers or other school employees in the area or reaching out to the human resources professionals at a local school to ask where they post openings.

Job Openings

Employment vacancies in schools arise for the same reasons vacancies arise in any organization. Leaders may decide additional workers are needed to keep systems operational (the may new expertise or they may need more of the current expertise), so they create new positions. Other openings arise when individuals leave because they are terminated, they resign, they are transferred to other positions in the school, or they retire. The volatile nature of enrollments and funding, which has been exacerbated by the effects of the pandemic, has made school employment unpredictable. Positions may remain vacant to save limited budgets, or they may remain vacant because qualified applicants cannot be found. At the same time, some schools have added technicians to the IT staff to support the infrastructure necessary for the increased reliance on online or remote teaching. They have also hired instructional technology specialists to support teachers as they design and deliver lessons using video conferencing and other distance learning methods. The degree to which the additions are going to be permanent in unclear.

Schools are also institutions that have short-term openings to fill in when employees take family or medical leave. In addition, short-term positions funded by grants are not unusual in schools. While part-time positions sometime become permanent, many veterans of school work caution that often the duties of part-time positions expand while the pay does not.

As public institutions, and institutions in which employees are often unionized, school leaders often must follow specific procedures for filling openings. For example, it is sometimes necessary that open positions be advertised to internal candidates, and those candidates to be considered before the opening is advertised to external candidates. Schools are also institutions that have been seeking to recruit candidates that will increase the diversity of the faculty and staff. Recruitment does not mean candidates that increase diversity are hired preferentially.

When being interviewed for IT positions in schools, candidates are sometimes told the reason for the opening. Some interview committees are open to answering questions about what motivated the opening.

Job Search

When positions come open in schools, the vacancies are advertised. Previous generations of educators and school employees looked in newspapers to find job openings in local or

regional schools. Today, education jobs (like job in many other fields) are posted on online job boards. Using these job boards, those searching for positions can find openings for many schools in one place. The specific job boards used tend to be regional; if one school uses a particular job board, it is likely nearby schools will use the same one.

Other job sites used by schools are sponsored by and even supported by local agencies or by professional organizations in state or regional organizations. Some of those postings are cross listed on some of the large commercial job sites, often with links to the specific job site and posting used by the school. In addition, most school web sites include an "employment opportunities" section, which is probably a link the openings they have listed on the job board they use.

Applying

Once a candidate has identified an opening for which they want to apply, they will follow the application procedures specified. Previous generations of applicants submitted hard copies of their application materials, and in some instances, applicants are still directed to submit hard copies. It is far more common for applicants to submit application materials online.

Some job boards that are used by schools include an option for applicant to upload or create resumes, cover letters, and even to upload letters of recommendation, transcripts, and license or credentials. Once these are uploaded, they can be used to apply for any position on the site. Other schools maintain their own application platform, and completing an application requires one to submit materials on the school's platform. (One of the frustrations for applicants is the fact that many of these platforms require information about previous employers and similar information to be added to the forms they provide. This can take represent a significant effort for some; enough to dissuade some applicants.)

Regardless of the platform used to apply for openings, when applying for an IT job in a school, you can expect the application process will include several documents:

- Your resume should summarize your work experience and highlight your IT experiences especially those that are required for the position for which you are applying. Some find applicants who add other technology skills to their resume give a more complete overview of their skills that those who do not. Remember your resume will probably be read by those who do not understand the skills you list.

- Your cover letter should specify the position for which you are applying as well as your qualifications. The five-paragraph essay is a good model to follow. 1) Specify the job you want. 2) Introduce yourself. 3) Summarize your work experiences related to the position. 4) Summarize your technology skills. 5) Express interest in being interviewed.

- You are also likely to be asked to provide written references from three who are familiar with your abilities as an IT professional as well as a collaborative worker.

- Evidence of your education. This may be unofficial copies of transcripts, copies of professional licenses, digital badges, or other credentials.

When preparing documents for your application, it is particularly important that that you draw close connections between your experience and preparation and the role for which you are applying. Even with a clear job description, it is not always clear to the individuals who are reviewing applications exactly what qualification and experiences are most relevant. Be clear and direct about your qualifications without being overconfident.

Schools are organizations that are often open to hiring those who are new to the profession or those returning to the workforce. If you are in either of those positions, be clear about your skills and your willingness to learn.

> It is a good idea to learn more about the school where you are applying before you accept an interview. Spend some time on their web site to familiarize yourself with the curriculum, activities, and culture. Some applicants will search for those on the interview team on social media prior to the interview. I have recommended those who I know searched for me on social media. When I apply, I generally avoid finding them on social media. I never follow folks who I know will interview me after I have applied.

Interviewing

Typically, vacancies are filled through a hiring process that is determined by the human resources professionals in the school. A typical process will include:

- An initial screening of applicants to identify those who meet the minimum requirements for the position.
- A search committee comprising individuals representing many different stakeholders will select applicants to be interviewed.
- First round interviews are scheduled with the selected applicants. Increasingly, the committees are expected to ask all of the candidates the same questions, and often these are approved by human resources professionals to ensure they are appropriate. When filling positions that require interaction with students, it is not unusual to find students on the search committee.
- The search committee will recommend the top candidates for a final interview. This interview is typically with a smaller group, often the person to who the candidate will report, and others who will be close colleagues.

In interviews, no one is allowed to ask about certain aspects their personal lives. Questions about your marital or family status, religion, sexual orientation, or gender identify are not allowed. Those types of questions are deemed protected information and cannot be used for hiring decisions in most public organizations. Some career advising professionals recommend candidates not disclose such information. In their application materials or in their answers to questions. They reason, “if they can’t ask about it, you shouldn’t talk about it,” and that is advice intended to protect the search committee as well as the applicants.

A colleague recounted a story in which they inadvertently disclosed they are transgender in an interview. As they said, "the committee all stopped as if they heard some great secret, they should not have been told."

Those characteristics do not affect your ability as an IT professional, so just avoid them. If those are important part of your life and they come up in your answers it is best to respond with general references. For example, "I'm interested in a career that allows me to support my family," is better than "I'm interested in a career that allows me to support my wife and children," which identifies your marital and parental status as well as the gender identity of your partner.

Understand the interview committee is likely to comprise a diverse group of representatives from the school community, and some of them many do not understand your answers. If is often well to pay attention to the roles of the people who are on the committee and direct answers about technology questions to those with technical expertise.

Once the hiring committee has asked their questions, they often ask the candidate if they have any questions. It is worth doing some research to ask about events that have occurred in the recent past, but not difficult events.

Depending on the local hiring policies, some interview processes are intended to be advisory only. The final personnel decisions, including formal offers, salary decisions, and similar details are addressed by human resource professionals and often school boards or other governing bodies.

I was once asked in an interview what I knew about the high school at which I was a candidate. I responded, that I knew they had a long winning streak in football about 10 years earlier, and that I was the player who recovered the fumble that set up the touchdown that ended that streak. The committee got quite and looked at one individual. I said, "You are a football coach aren't you?" "Yes," he responded, "I knew your name was familiar."

Schools are notorious for "ghosting" candidates. Applicants, even those who have been interviewed, may never get an update on their status. While this is frustrating for applicants, they have little recourse. Inquiries to human resources professionals are often not returned or the standard "we cannot discuss personnel issues" reply is sent. There is little on can do about this, but it is god to be prepared for this eventually.

Getting Hired

Once a candidate is formally offered a position, they are usually granted a day or two to decide if they are going to accept it. Once offers are accepted, contracts are signed, and a start date is scheduled.

In the 21st century, it has become very common for school employees to undergo a background check and be fingerprinted before they begin work. In some jurisdictions, the costs associated with this must be paid by the employee. In what seems an unnecessarily redundant procedure, some school employees find they must undergo (and pay for) multiple background checks. If, for example, they are hired to work at an afterschool program that is paid for through a grant rather than the school budget, they may be required to have a separate background check for that position.

Beginning Work

Once individuals are finally hired, they begin the work. The on-boarding procedures for IT professionals include completing required training, getting access to IT, and understanding supervision and evaluation. All organizations include some required training as part of the on-boarding process. In addition to the trainings common in other businesses and industries (for example training intended to prevent harassment), school employees are required to participate in FERPA training, mandated reporter training, blood-born pathogen training, and other training. Depending on the role one is hired to fill, newly hired IT professionals will be trained in the details of the systems they will be supporting and its connection to the greater IT infrastructure.

Schools are organizations in which licensed educators are the chief executive officers. The superintendent of schools is ultimately responsible for all aspects of school operation. The personnel in schools can be divided into those who are responsible for academic activities (including licensed educators and unlicensed educators) and those responsible for non-academic activities. IT professionals are usually included in the non-academic staff, although some such as technology integration specialists are licensed. In general, it is no appropriate for licensed educators to be supervised and evaluated by individuals who are not licensed.

As was discussed in chapter x, IT decision-making (which includes how to supervise and evaluate IT professionals) is a collaborative effort. When openings are advertised, it is usually specified to whom the hired individual will report. It is not unusual for IT professionals to be supervised by multiple individuals. This seems unusual to those who are familiar with other organizations, but it makes sense in education. A school IT professional must be competent with the technology (which is evaluated by the chief information officer) and they mist interact with school populations in an appropriate manner (which is evaluated by a licensed educator).

Summary

Schools are interesting and rewarding workplaces for IT professionals, but they can be challenging as well. The differences between business and industry and schools can make the strategies and methods they developed less effect than they might predict when applied in schools. Reflecting on the differences as described in this book will prepare IT professionals to get hired and be successful in their careers supporting teaching and learning.

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