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Professional Development and Educational Technology Integration

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Introduction

There should be no question as to the emphasis institutes of higher learning and their cousin school districts have placed on instructional personnel employing technology in daily classroom curricular practices. Pressures from the communities concerned about their area schools, the corporate world with interests in productive and prepared workforces, and the various school administrations provide a great push for technology to be fully adopted into the regular classroom environment. Issues invariably arise with these attempts at technology infusion. This paper's purpose is two-fold; to review the current literature with regard to professional development and technology adoption in public schools and to use this information to examine a recent attempt by a school district's middle school (grades 6 through 8) in the Commonwealth of Virginia at having its professional staff use technology in the presentation and exploration of curriculum.

Winchester Public Schools (hereafter known as WPS - as discussed in the case introduction below) developed a comprehensive three year professional development plan that emphasized technology adoption at a pedagogical level.

Daniel Morgan Middle School (DMMS), the one middle school in the district, was required to implement this plan. I examine this plan using the current literature. I will argue that the current literature on technological innovation and professional development for technological skills can be split into five phases (corresponding to implied phases of a technological implementation); requirements, design, implementation, assessment and maintenance. I then place this model atop the WPS/ DMMS innovation to determine areas of success and areas of weaknesses in the innovation. While WPS employed abundant resources (technological equipment, computer labs, money for technology expenditures, devoted technology-focused personnel) and an innovative teacher training program to achieve its well-outlined goals, it failed to meet the implicit goal of technology adoption outside of the implementation period, thus not establishing a continuation of usage.

The Case: Daniel Morgan Middle, Winchester, Virginia

Daniel Morgan Middle School is a grades 6 through 8 school in Winchester City Public Schools. The school enjoys benefits from an endowment (to the city school system as a whole) left by a former prominent citizen interested in the success of the Winchester area educational programs. As a result of this endowment, Winchester can afford many of the extra resources necessary to compete as a leading school district.

In the fall of 1997, Winchester City Schools (WPS) began an important initiative. The school system set in motion a process to set for teachers to acquire knowledge and skills in the area of technology use – in the classroom, as a professional, and on a personal level.

The program introduced this initiative as "a Teacher Technology Competency Certification program to help insure that teachers gain the skills necessary to use technology effectively to improve instruction." Further, "the program is also designed to meet regulatory requirements for school systems issued by the Virginia Department of Education (Winchester City Public Schools, 1997)."

These regulatory requirements mentioned above were introduced to administrators, teachers and support personnel in the form of eight broad standards for instructional personnel in the Commonwealth of Virginia (see Appendix C: Technology Standards for Instructional Personnel). The Teacher Technology Competency Certification program was conceived by the central district administrative staff and developed by its educational technology staff (Director of Technology and four Technology Resource Teachers). The resulting product came in the form of a three level program (see Appendix A - Teacher Technology Competency Certification, parts 1, 2 and 3) requiring all professional instructional staff and administrative staff to complete level three of the program by year three (2000) of the program's initiation. The overall initiative was called the "WPS Technology Initiative" (see Appendix B: WPS Technology Initiative).

The focus of the three levels, in short, began with Basic Computer Skills and Knowledge, proceeded to Use of Technology in General Professional Capacities, and concluded with Integration of Technologies into Pedagogical Practice.

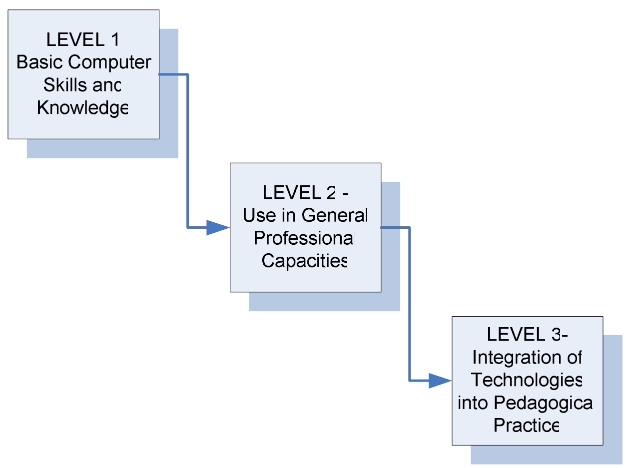

Figure 1 – Progression of levels of achievement forteachers in DMMS/ WPS Technology Integration Plan

The administration of the school district presented the program initiative, requirements and goals to the faculty of Daniel Morgan Middle in the fall of 1997. The faculty members were informed that each member had three years to complete the program. The consequences for not completing the program were not defined at that time (some mention was made that a teachers' licensure to teach in Virginia could be at risk of being revoked) – but were stated to be real nonetheless. The expectation was made clear - all teachers were to participate.

In order to support the expected middle school teachers' progression through the program, WPS developed a "Train-the-Trainer" program. This program selected some twenty teachers at a time (from all grade levels) and provided for the teachers to attend training sessions during the work-day focusing on specific genres of technologies (multimedia technologies or Internet technologies, for example). The expectation for the teachers involved included attendance at all training sessions and for each teacher to organize and hold two in-services at his or her respective school to help teachers achieve their levels. Between 40 and 60 teachers completed the Train-the-Trainer program.

At Daniel Morgan Middle, with some sixty-odd teaching staff members, by the end of year three, two teachers had not completed level one, twenty-eight had not completed level two and thirty-six teachers had not completed level three. The technology resource teacher at Daniel Morgan Middle continued to push teachers to complete their levels. She posted each teacher's level (with stars denoting level achieved next to a teacher's picture and name) and created certificates for achievement.

A Review of Literature

In this paper, I focus on the recent published work covering technology in education, as the areas of technology integration and infusion are relatively new in the worlds of Education and Social Science Academia (really the last few decades have seen a concentration on these areas). The literature on technology integration is rich, and I will attempt to complement this with the examination of professional development literature.

A Definition

To begin, we must first establish a standard definition of technology integration. Dockstader (1999) defines it as "using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways."

Benefits of Integration

An initial question to be asked would deal with the benefits of integrating technology into schools and classroom level curriculums. Why should schools go through the expense and trouble of pulling in the latest technological innovations? The first answer to this deals with the enhancement of the pedagogical learning environment. Miller (2001) cites benefits from access to primary sources to opportunities for collaboration global feedback, from encountering people from across the world to unlimited access regardless of special needs or location (Miller, 2001).

In addition to Miller's cited benefits of global access, Dockstader identifies benefits more in the realms of student thinking, research skills and content depth. He argues that we live in an age that requires students to learn technology. He further argues the need to learn with technological tools to enhance the critical thinking process. He finally contends that because technology use is intrinsically motivating, "academic engagement time" is naturally increased as a result (Dockstader, 1999).

Using both Miller's and Dockstader's above cited benefits, we develop a utopian picture of students experiencing global access to endless amounts of information, allowing for generalization of computer-based skills and providing students with the opportunity to function at higher levels of critical thinking rather than just comprehending and regurgitating facts. With Miller's and Dockstader's descriptions, the implication is developed that students will travel more (virtually – learning more about the world around them through interactions with other cultures), learn more, and be more enthusiastic about learning through the educational process as a result of technology.

Next, technology offers assistance to the pedagogical professional – providing access to information and materials for global and local connections. Miller (2001) notes

Technology can facilitate the professional growth and instructional preparation of educators by facilitating:

- professional connections and collegial collaboration,
- access to subject-area content for curriculum and activity plans,
- differentiated instructional planning,
- connection to students beyond class hours, and
- communication with parents or guardians.(Miller, 2001)

Interestingly, Miller, in addition to citing access to and manipulation of curricular content (bullet points one through three) also focuses on online community development for the complimentary purpose of contact with face-to-face students and parents. This area could be examined in future research projects - in the areas of effectiveness and efficiency.

Finally we turn to efficiency issues. Miller (2001) argues that "technology can positively affect education by relieving us of some of the more time-consuming administrative tasks and letting us gain more insight from the enormous amounts of data we routinely collect (Miller, 2001)." The use of data is pertinent in assessment and decision-making and recent technological innovations provide educators with useful tools for the access of, management of and analysis of data.

More generally Brand (1997) tells us that "(i)ncreased access to information through new technologies, along with the need to prepare children to compete in an emerging information-based global economy, promises to fundamentally reshape school practice as we move into the next century" (Brand, 1997). We begin to look at technology in schools as a necessity rather than a luxury.

Irwin and Robinson (2000) made the observation that "(w)e're in the midst of a technological tornado in which technology's impact on communicating and thinking is not unlike what the printing press brought to humankind in the Middle Ages" (Irwin and Robinson, 2000). This "technological tornado" constantly changes moment by moment where information is distributed globally under the measurement of seconds. Each day the global world of business introduces faster and more efficient ways of exchanging information and the world of education will need rise to meet this standard.

Obviously a case can be made to pursue technological innovations in schools. These innovations provide assistance to teachers and students through the learning process. The specific pedagogical benefits are quite numerous - from access to data to efficiency increases to interest to higher-level thinking skills to meeting business demands to establishing varying communication methods. While the question of why is easily answered, the question of how is not. Many considerations will need to be taken into account when approaching a technological innovation. The literature helps to identify these considerations.

Considerations

Which Comes First?

The first consideration to be examined covers the general change process and the order of pursuit of elements of the technological innovation. Vojtek and Vojtek (1997) refer to this as the chicken or the egg debate: whether to spend money on hardware and software "to get computers into student's hands" whilst ignoring budgets for training and integrating. The public opinion of staff development is that it is extra – and therefore unnecessary. Staff development is often the first area to be cut from a budget. Vojtek and Vojtek also point out that staff development benefits are very difficult to measure (Vojtek and Vojtek, 1997).

In order for teachers to be trained, the equipment and the tools must be present. But purchasing a large quantity of equipment and handing it to a teacher can be quite daunting for the teacher. Various naturally evolving bureaucracies would more quickly embrace an easily measurable technology purchase rather than a more difficult-to-assess technology integration and implementation (much less tangible progression).

So the first part of this consideration could stem from the ease of task. It is much easier to sign a purchase order to acquire hardware and software than it is to establish a comprehensive plan for teachers to begin using the technology in question.

From the teacher's point of view, the issue is quite clear.

Deluzain and Baines (1998) found that teachers were ill-prepared for the integration of technology. Over time, with practice and naturally evolving collaboration (to be discussed in more detail below), the staff demonstrated the ability to adopt the innovation. This adoption would not have been successful had the teachers not demonstrated professional initiative (Deluzain and Baines, 1998). Essentially, the school was lucky. Guhlin asserts that the "process of integrating technology into the curriculum must begin with teachers" (Guhlin, 1996). What does this mean? More of this will be covered below, but it cannot be over-emphasized that the teacher is central to the success of a technological implementation. This point is universally asserted in the literature (Guhlin, 1996; Vojtek and Vojtek, 1997; King, 2002; Vojtek and Vojtek,1999; Cooley, 1998; Dyrli 2000; Rice and Milller, 2001).

So Vojtek and Vojtek answer the question of which comes first, the hardware and software or the teacher training: "Implementing hardware and software solutions in schools and staff development for teachers MUST go hand-in-hand - simultaneously" (Vojtek and Vojtek, 1997).

Professional development in and general use of (to begin with) technology become essential components of a technology integration. This brings us to a secondary consideration resulting from this tendency - the acquisition of technology because it is there.

Technology for Technology's Sake

Guhlin quotes Bill Onley as saying, "I feel like technology is a train. For awhile, I could keep up, but now it's going faster and faster" (Guhlin, 2002). What becomes difficult to separate is the desire to stay modern with the latest technological innovations from the technological innovations that are of actual pedagogical value. Vojtek and Vojtek (1997) argue that we "must use technology as one of the many tools available to help students master defined content and performance standards . . . (l)ikewise, we must know when a technology is the most appropriate tool to help students learn or demonstrate a particular concept or skill" (Vojtek and Vojtek, 1997).

A dangerous result of exploring the latest technological trends is the sacrifice of curricular choice for technological access. What I mean here is the practice of wanting to use technology in a unit of study in a classroom so much so that the teacher begins adapting the curriculum to meet the technology.

Van Horn (1997) provides an instructive illustration of this – where a teacher would choose to explore an integrated unit with students on rain forests because the video discs and software in existence on rain forests are available and of a high quality. In this case, the teacher must ignore a few obvious points – that he or she could capitalize on the numerous deciduous forests near the school property (or generally speaking, any environmental conditions native to any given local school) or completely disregard that curriculum scope-and-sequence dictates otherwise (Van Horn, 1997). Suddenly form dictates function – or to put another way - tool dictates content. The tool or method of delivery should never become more important than the subject matter.

To avoid this, schools must provide training and effective integration practices. This brings us to our next issue, where schools are connected but aren't informed about what to do and where to go. (Dyrli, 2000) So what does an integrated classroom look like?

What Does Integration Look Like?

In order to plan for integrating technology into the school curricular practices we must maintain a clear understanding of how a technologically integrated curriculum is developed. Taking the above points of concerns over technology driving curricular choices, we can now examine structured plans of integrated technological practice. Dockstader states that an "integrated program gives students real-world experience and coordinates all curriculum and technology goals"(Dockstader, 1999). These curricular goals must be balanced between the two - the subject and content area and the tools of delivery. Dockstader further elaborates that "computer skills must not be taught in isolation, and the curriculum must be carefully designed to take advantage of rich information for more depth" (Dockstader, 1999). Dockstader identifies the following steps for integration:

- Choosing a core area
- Deciding what technology skills will fit within it
- Choosing a lesson the computer could enhance
- Developing the lesson in software or multimedia
- Using the lesson
- Evaluating how it went and refining it for future use. (Dockstader, 1999)

If we examine the above steps – albeit simple and seemingly obvious – we notice that the first step identifies the core area – the subject matter already in existence in the curriculum as part of the scope-and-sequence that is to be enhanced by technological presentation and interaction (see above section for the discussion of content over tools). The other steps identified by Dockstader all build upon the first step and use the core subject as deciding factor in the lesson development (choosing tools for delivery and exploration, developing criteria for success, etc). These steps follow closely any general lesson-planning methodology often taught in teacher-training programs. The technology thus becomes a tool of instruction delivery and is only one component of the lesson.

Schools as Learning Communities

Much research has been done in the area of schools as learning communities. King (2002) notes that learning communities in schools "help teachers interrogate, integrate, and apply knowledge and values in the process of continual improvement" (King, 2002, p 1). These learning communities make schools more community-oriented, focusing on collaboration between educators, partnerships between schools and communities, and community-building by educators for students and teachers alike (Schmitz, Jon, and Brown, 2000). These concepts play a large part in educational change implementation. As King notes,

> If innovative approaches to professional development stress only individual teachers' learning, while neglecting to help a whole faculty to integrate their learning for the collective advancement of students in that school, organizational learning is diminished. (King, 2002, p 244)

So, not only should the Learning Community be considered in the context of how to institute change but also how the interrelated individuals as members of the faculty constitute components of change. The community of teachers needs to be at the forefront of change planning. This concept is discussed further below.

Staff Development Methodologies

After examining issues surrounding what technology integration looks like and its interaction with classroom curricular development, we are now ready to examine the issues of actually approaching staff development.

Vojtek and Vojtek (1999) describe the most prevalent methods of staff development in the area of technology usage and integration as the "pinball method."

> First of all, as in a pinball game, educators are allowed to learn computers when they willingly let go, and are ready to be plummeted into a barrage of staff development opportunities that allow them to explore what technology can do. Once they are flung into motion, they continue to bounce around from skill to skill, usually without anymore direction than simply bumping into someone or something that sends them spinning in yet another direction. This seems to be where many of our teachers still reside, somewhere on the board, bouncing around, without the knowledge of how to integrate technology into the classroom to improve student learning. (Vojtek and Vojtek, 1999, p 2)

This arbitrary and non-focused approach to staff development is quite teacher-centered merely focusing on skill acquisition by teacher self-initiation. It is commonly accepted – and evidenced by the above discussion – that a structured approach to staff development is a necessary process (Vojtek and Vojtek, 1999) whether the goal of the staff development activity is for technology integration or any other educational change. We need to avoid the pinball methodology and rather focus on a layered approach, where ideas and skills are developed and established and are directly related to the processes and contexts already established in the school culture. Keefe and Howard have developed such a process, the School Improvement Process (Keefe and Howard, 1997).

Keefe's and Howard's School Improvement Process attempts to develop organizations built on "a set of shared values and norms, personal mastery, critical reflection, and collaboration." At its core, the process is made up of a leadership team comprised of several school faculty members who guide the entire faculty in the development and implementation of a comprehensive school improvement plan (Keefe and Howard, 1997).

This plan involves three basic steps:

- identify school mission and vision statements (focus on students and student learning)
- identify school goals that operationalize the school mission and vision

- identify component areas of the school system that must be addressed to achieve the goals and objectives (Keefe & Howard, 1997).

Faculty involvement is crucial for the success, not just in the initial stages but throughout the development of goals and needs and methods for addressing those goals and needs.

Issues of Logistics

Certainly logistical and capital acquisition and support become an issue needing consideration when determining direction with technological implementations (Miller, 2001). The costs run deeper than just capital acquisition. Time, energy and materials in addition to the actual equipment and maintenance carry a heavy burden for the already funding-strapped school systems.

Fortunately, there has been much progress in the acquisition of technologies in schools, bridging the digital divide. According to the National Center for Education Statistics 2001 report, "(b)y the fall of 2000, almost all public schools in the United States had access to the Internet: 98 percent were connected (National Center for Education Statistics, 2001)." The report further noted that by the same time, "the ratio of students to instructional computers in public schools had decreased to 5 to 1 (National Center for Education Statistics, 2001)." The US Department of Education reported in 2002 that "(p)ublic schools have made consistent progress in expanding Internet access in instructional rooms,1 from 3 percent in 1994 to 77 percent in 2000 and 87 percent in 2001 (US Department of Education, 2002)."

These statistics bode well for what schools have attempted to do in the wake of demands for up-to-date equipment. Evidently, the task of equipment acquisition is well under way.

School Culture/ Reculturation

An additional consideration – one that I will argue is passed over in the planning and integration design phases below – is the consideration surrounding the reculturation of the faculty to accept technology into the teaching practice and community. As Cooley (1998) points out,

> to learn to use hardware, software, and communication technologies can require that a teacher totally transform his or her instructional technique. This transformation can be very stressful for many teachers (Cooley, 1998, p 6).

This transformation is quite significant. Switching from the use of one method of instruction to another can prove to be quite difficult for the veteran or new teacher alike. Cooley points out that "the school culture represents a major barrier to the acceptance and implementation of technology" (Cooley, 1998, p 6).

So how do we change implementers go about shaping the school culture to accept the new technological innovation? Guhlin argues that “the process of integrating technology into the curriculum must begin with teachers” (Guhlin, 1996). He continues in this by arguing that teachers must “earn the right to use computers in their classrooms” by demonstrating “how they are being used instructionally with students” (Guhlin, 1996). So teachers have to begin the process by demonstrating an interest and the aptitude for adopting the change. Guhlin stresses the need for training to be provided to teachers to show the benefits and techniques for use (Guhlin, 1996). Actual training will be discussed in more detail below. Basically, the teachers should become owners of the change.

McGillivray (2000) stresses the need to include the other members of the interested parties – the administrators, the community at large, and the families. McGillivray further stresses that “if any of these groups do not believe that technology is a good thing for student learning, they will fight its use, either through passive or aggressive techniques” (McGillivray, 2000, p 1).

Political maneuvering is necessary here, bringing in to the innovation’s implementation all interested parties. As noted, the innovation’s implementation will fail should these parties’ involvement not be addressed.

McGillivray focuses on the principal arguing that his or her role is absolutely essential. The principal must model the desired behavior – the technology's use (McGillivray, 2000). "Teachers must have someone to model how to integrate technology into the classroom on an ongoing basis with their students, as well as provide feedback to them. No hands-off consultants" (Guhlin, 1996).

Irwin and Robinson provide some steps/ advice to changing the culture of a school for the implementation of an innovation. They are

- Start the integration with current resources
- Work closely with community, parent groups, staff and the school
- Expect obstacles – plan for overcoming them
- Build partnerships
- Create relationships with community businesses – as they are vital for success (Irwin and Robinson, 2000)

All of these points suggest elements of relation building and politicizing. Any person affected by a change should feel ownership of the change. Acceptance is often dependent upon a person's consultation and early involvement.

The Process for Integration

Michael Fullan (2001) describes a three phase approach to the introduction of an innovation or change into a professional educational environment. These include an *Initiation Phase,* an *Implementation Phase* and a *Continuation Phase* (Fullan, 2001). I have identified that other phases can be developed within this three phase format. In an attempt to organize this information into a logical flow, I will borrow a distinction from the world of business. It must be noted that in no way am I implying that business management methodologies are the answer to educational technological innovation introduction.

The world of project management (as identified by the Project Management Institute) has determined that any project has five distinct phases.

- Requirements Phase
- Design Phase
- Implementation Phase
- Assessment Phase
- Maintenance Phase

The five phase model expands the Fullan (2001) model out in the initial phase (Initiation) and the final phase (Continuation). Initiation can be split into Requirements and Design as the two phases contain quite different concepts. Requirements outlines the initial needs for the innovation whereas Design develops the plan for the innovation. The needs assessment is an aspect of this approach in the Requirements phase. The Continuation phase is split into Assessment and Maintenance. It is my assertion that the Design and the Maintenance phases prove to be the most neglected of the innovation process.

Requirements Phase

The *Initiation* phase as identified by Fullan (2001) is "the process leading up to and including the decision to proceed with implementation"

There are eight factors associated with the *Initiation* phase

- Existence and quality of innovations
- Access to information
- Advocacy from central administration
- Teacher advocacy
- External change agents
- Community pressure/ support/ apathy
- New policy - funds (federal/ state/ local)
- Problem-solving and bureaucratic orientations (Fullan, 2001)

These factors are important for the success of the *Initiation* stage. The *Requirements* phase emerges as the first half of Fullan's *Initiation* stage.

The primary purpose of this phase is to gather all necessary requirements (the needs) in order to fully understand what the plan will need to address. The stakeholders will need to be represented here (students, teachers, administrators, parents, community, businesses, etc) and will need to be queried for input. The easiest method to begin this phase is to perform a needs assessment.

The needs assessment is vital to establish where the system is currently, where it has been and where it needs to go. Guhlin notes that "our school districts have a need to establish a baseline of technology needs and chart patterns of growth and achievement" (Guhlin, 2002).

As this stage is the initial jump in the actual planning, as noted previously, faculty should be involved in technology planning (Rice and Miller, 2001; Meltzer and Sherman, 1997).

Design Phase

The next phase to explore – after having established the requirements for the implementation – is the *Design Phase.* This phase is set to establish the actual methodologies to be employed in implementing the innovation. This phase becomes very important in determining the schedule, resources and personnel needed and in the evaluation of the success of the implementation itself.

Related to this phase, there exist several important considerations while developing a strategy of educational innovation implementation. Meeks (1999) argues that there are

> two sides to a successful technology installation. One side addresses the "things" involved in the project - electrical upgrades, conduit for cable pathways, cable trays, cabling, computers, TVs, and so on. The other addresses the "people" portion - how teachers and students use what's put in place. (Meeks, 1999, p 18)

Change implementers must be aware of both human and material-related factors. The first set of considerations deal directly with what Guhlin terms as "educator technology competencies." In reference to initiatives in Texas, Guhlin lists teacher attitudes as having an impact on professional development strategies that increase these educator technology competencies (Guhlin, 2002). Teachers are still the focus of the Design Phase – becoming the primary factor to target changes (as could be assumed). Let's spend time examining specifics in targeting the classroom teacher during technology implementations.

Miller (2001) notes that "educators seem to be motivated by four different and sometimes conflicting rationales" (p. 42) with regard to embracing innovations. These rationales are as follows:

- Institutional Transformation (technology is a tool for reform)
- Individual Growth (as another tool in the cache)
- Professional Support (indirect effect on learning - direct on professional organization of teacher - "increased personal productivity and communication")
- Societal Inevitability (dependent societal growth and development) (Miller, 2001)

Institutional Transformation is seen as affecting the process of teaching and learning, focusing specifically on radical changes in schools. Individual Growth, also contained in the process of teaching, deals rather with "incremental adaptation." Professional Support deals with the promotion of an educator's growth as a professional. The fourth, Societal Inevitability, is external to the educational system, its drive originating "from developments in the general economic and cultural environment" (Miller, 2001, p 2).

So we must learn to design our implementation to transform teachers based on these internal and external motivational factors. We must develop to help teachers feel the success of personal and professional growth, support for professional growth (with incentives) and support to meet the demands of our changing society. "How do we reconcile these conflicting perspectives and motivations? The trick, however difficult, is to embrace all four rationales" (Miller, 2001, p 4).

Next, after considering the motivational factors and placing those in our design strategy, we move to the actual beginning point of integration – the curricular choices. Vojtek and Vojtek (1999) tell us that "staff developers will need to task analyze, prioritize, and develop a hierarchical sequence that teachers can progress through to acquire the knowledge and skills they need to help students" (Vojtek and Vojtek, 1999, p 3).

As mentioned above, technology integration at the classroom level - when we actually see what it looks like – should have the curriculum rather than the technology at its core. This is no different at the overall technology strategy at the school or system level. We could design the implementation by first looking at what technologies are the most recent and look at how to implement those into the current system, or we could rather spend our efforts on examining the needs as defined in the curriculum and attempt to match tool to need. Vojtek and Vojtek sum this issue up by asserting that it is important for schools to align "the technology and information standards with content and performance standards" (Vojtek and Vojtek, 1999, p 4).

Once the implementation method has been designed to meet the needs and anticipated reactions of personnel involved, the next course is to examine the impacts on resource and infrastructure. One consideration under this grouping is the anticipation of access should the technological innovation involve networked communities or the World Wide Web. This is not as simple an answer as one might think. There are questions about access to inappropriate materials and the prioritizing of technology in schools that have other infrastructure concerns (Santo, 1996).

Although school conditions have improved, strides still need to be made. The high-tech industry (and industries that use such technology) maintains a rapid pace for innovation adoption and therefore has high expectations for schools. Essentially, a good practice to follow is to assume that technologies (hardware and software) change every six months (Crouse, 1997). This basically implies that technological innovations must be approached and designed in such a fashion to account for future needs associated.

Because of this phenomenon, schools need to involve technology experts and consider infrastructure early on. Any solution adopted necessitates scalability and flexibility. Otherwise, should the structure aspect be ignored for the people aspect, then failure is likely to ensue. Meeks notes that "the truth is that the installation of technology "things" has more in common with how you build a building than how you educate children” (Meeks, 1999).

So we must balance carefully the two – the management of change among personnel and other people involved and the management of the change of the resources and infrastructure being used by the people as a result of the outcome.

Training should be a large part of the designed implementation. “According to the U.S. Congress, Office of Technology Assessment (1995), the lack of teacher training is one of the greatest roadblocks to integrating technology into a school’s curriculum" (Brand, 1997, p 1). As Miller notes, "one component of every technology plan should be training people to use generic productivity tools to ease their administrative and professional loads" (Miller, 2001, p 5). While this may seem obvious, it is important to reinforce allowing time for teachers to adopt basic technology in their standard professional practices (Pardini 2002; Schwab and Foa 2001; Olson and Craig, 2001).

So the basic task here is to determine the best method of delivery – to insure that teachers retain basic skills and are prepared to integrate the technological innovation into professional and pedagogical daily practice. It is important to examine a variety of delivery models as teachers have vastly different backgrounds, abilities and interests when it comes to the field of technology in education (Pardini, 2002).

One method reported as successful employed the use of parents – trained in technologies – as technology volunteers in the schools (McGillivray, 2000). The parents who volunteer are given a specific purpose – to become experts in that innovation so that the teachers who are lacking in time don't have to be. Of course, the assumption is that over time the teachers will pick up the skills that the parents had mastered and thus become more self-sufficient.

Another similar method uses master technology teachers (or train the trainer programs) so that teachers are trained in specific technologies (often as in-services during the normal school year) and then are responsible for parsing this knowledge out to the general teaching staff at his/ her respective schools (Schwab and Foa, 2001). The deliverables from the Train-the-Trainer programs are often "technology-based lesson plans, instructional units, and other teaching tools — often available online" that "give teachers specific, concrete, exemplary ways to use technology in day-to-day teaching" (Pardini, 2002). This method of staff development helps to "build the kind of permanent infrastructure that produces long-term, widespread results (Pardini, 2002)".

Additional unconventional methods of teacher staff development in the area of technology do exist and have been proven to be successful. One such unorthodox method uses students as trainers of teachers (Owen, 2000).

In addition to student-designed initiatives and peer-focused programs, Miguel Guhlin notes that schools can find ways to save money on technology training. These include

- Find talent within your city.
- Find materials on the World Wide Web.
- Train each other.
- Share what you know.
- Tap into your technicians. (Guhlin, 1996)

Most districts can access these simple pre-existing resources and little effort is required. These should be considered in the overall implementation design.

One last part of any design involving the motivation of teachers for a change – especially daunting ones as in the case of technological innovations – depends on proper incentives for the teachers and staff involved (Schwab and Foa, 2001). The design of the implementation must take into account the needs of workers to be rewarded (and often publicly rewarded) for effort.

Implementation Phase

The next phase of the implementation of the technological innovation is the actual Implementation phase itself. At this point, the basic overall requirements have been gathered from all parties and the design of the process of the implementation has been established taking into consideration both human and technological implications.

Fullan (2001) describes this phase as "the process of putting into practice an idea, program, or set of activities and structures new to the people attempting or expecting to change" (Fullan, 2001). This is the actual realization of the planning and designing.

There exist, according to Fullan, several factors affecting the success of the implementation phase, notably various characteristics of change, local influences and external factors (Fullan, 2001). These have been outlined below,

Characteristics of Change

- Need
- Clarity
- Complexity
- Quality/ Practicality (Fullan, 2001)

In order to successfully implement a change, the actual justification for the "Need" of the implementation has to be established. With the Requirements Phase outlined and accomplished, the need should be quite clear. As part of this stage, the clarity of the implementation needs to be made to the staff involved and the beneficiaries of the change. Complexity should have been considered in the requirements phase and thus addressed. The issue of "quality" will be examined in more detail during our review of the Assessment Phase.

These communities play a vital role in the regular functioning of the pedagogical environment. They essentially are responsible for

- Intellectual renewal
- Providing a venue for new learning
- Providing a venue for cultivating leadership (Grossman et al, 2001)

There is a component of naturally occurring professional development and general peer-inspired learning. The development of the teaching staff is dependent upon this type of collaborative model – emphasizing a general professional community of learners and leaders.

Olson and Craig point out that "teachers filter all experience . . . through their personal practical knowledge" (Olson and Craig, 2001).

The development of the "narrative authority" (defined by Olson and Craig (2001) as the process of constructing and reconstructing knowledge through experiences) for individual teachers is important for the development of staff and professional development. Olson and Craig further explain that "knowledge communities are the places where each individual's narrative authority is recognized and developed" and that in these communities, "it is possible for individuals' narrative authority to be articulated, examined, and confirmed, expanded, or revised in light of others' experience and others' reflections and responses to our experiences" (Olson and Craig, 2001).

So the knowledge community is a naturally occurring repository of professional knowledge that greatly aids the professional development specific events and ongoing subtle development. Each teacher takes valuable information away from the knowledge community, assisting in his/ her assimilation of new skills and, in our case, meta-knowledge of the innovation being implemented. Fostering this knowledge community is a study unto itself, but suffice it to say that allowing teachers to collaborate as a community will bring about this type of informal support and peer group (Skelly, 1992).

To complete this portion, let's turn to Louis, Marks, et al. (1996), for the characteristics that they term are "distinctive of and critical to" a professional community:

- Shared norms and values
- Focus on student learning
- Reflective dialogue
- Deprivatization of practice
- Collaboration (Louis et al, 1996)

The professional expectations of teachers as educators and learners are set parallel to the professional expectations of teachers as professionals. The implementation strategy should use this existing collaborative community in its strategy.

As stated above, the implementation should not necessarily use technology to assist in the adoption of technology as an innovation, but it can. Deluzain and Baines warn against just requiring teachers to just adopt technology – eventually becoming more adept with time (Deluzain and Baines, 1998). Some basic technological innovations (usable by nearly anyone) exist to provide easier methods of presentation to help in the implementation (especially in the area of continuous learning) (Guhlin, 2001).

The Kentwood School District used a 30 hour training program for all staff that encouraged learning in some of the more basic technological skills (Kentwood, 1997). Time for practice proved to be a priority here.

Finally, the implementation can use the ever-growing Internet as a venue for passing information, collaborating with others (locally and globally) and posting information (Vojtek & Vojtek, "Net"working).

Having capitalized on pre-existing professional communities, and having used methodologies of teacher development that the staff was already familiar with, the implementation theoretically should prove to be successful. But, the measured success cannot be established absent a formal assessment phase.

Assessment Phase

The Assessment Phase provides a very real benchmark to measure the success of the implementation. Just as teachers are held to academic standards for their classroom curriculums, so should the leadership be held to standards with regard to strategy and implementations.

The measurement of success directly correlates to meeting the initial requirements. In fact, essentially the requirements become a checklist for establishing fulfillment.

Broadly, Killion establishes a good benchmark for success with technology specifically in mind. He asserts that "in some ways the technology should be as invisible in the learning process as possible to allow the content and the process of learning to remain in the forefront "(Killion, 2002).

The purpose of the implementation was to meet a specific need. That need should be at the forefront of this phase. Technology is not the end unto itself, but rather the addressing of a very human need – educational or administrative – is the end.

Maintenance Phase

The last phase in the life cycle is the Maintenance Phase. This phase is often forgotten in the strategic planning of an innovation as the actual Implementation Phase is viewed as the all-important phase. While it is true that Implementation – the actual performing of the change – is very important, we cannot forget that should a change be made and no processes are established to support the continued use of that change, then the change and the effort expended are for naught.

Fullan (2001) rightly terms this very important phase as Continuation. He describes the importance of the Continuation Phase by citing two reasons common for failure of implementation related to Continuation issues.

- Lack of interest
- Lack of funding

Without these two, the implementation will ultimately fail.   Thus money and district interest become key supports for success (Fullan, 2001).

Guhlin points out that is necessary to provide "continuous learning that allows teachers around the clock access to learning resources rather than seat time during specified hours" (Guhlin, 2002). Obviously this provides for flexibility for a teacher to adopt change on his or her schedule, and may as a result help teachers to more willingly embrace the change.

Specifically with regard to technology adoption by teachers, the issue becomes a bit more difficult.

So how does a school provide the necessary training and support? Schwab and Foa note that having a technical support person is very important but not sufficient. They explain that "having a technology curriculum integration expert on staff will prove to be just as important" (Schwab and Foa, 2001). A curriculum integration expert (or a technology resource teacher) provides the appropriate level of teacher-based technology/ curriculum training, making the skill set in technology relevant to pedagogy.

Essentially, in order for an implementation to effectively continue after the actual change is made, a school district must have its administration behind the change; money available to continue support; the principal fully in support; training set up (flexibly) to meet the teachers needs; and support staff in place to help with basic skills and reinforce the relevancy of the skill set. As you can see, this phase is extremely important.

Analysis of the Case

Now we return to our case study – as introduced at the beginning of this paper. In light of our established implementation phases, we can scrutinize the WPS' Technology Initiative and Daniel Morgan Middle School's (DMMS) progress. The State of Virginia published standards established the core of the Requirements for this implementation (*Appendix C: Technology Standards for Instructional Personnel*) – the essential requirement being WPS needed to adopt a policy directing instructional staff to incorporate technology into professional and pedagogical practice.

DMMS took on the Design of the implementation from the technology leadership group in the system (the Director of Technology with the four Technology Resource Teachers). This phase – with the Requirements Phase – unfortunately did not include participation from the staff and faculty directly affected by the implementation.

The Design – as evident in the level three criteria – reflected an emphasis on the school curriculum over using specific technologies as the core focus (especially in level three). In fact, flexibility was allowed as part of the program, allowing teachers to choose any of very generic technologies to accomplish any worthwhile tasks. Levels one and two emphasized a personal productive need for mastery of technology – whereas level three worked with a pedagogical need. Level three required that all teachers participate in an integrating technology class to provide support for planning and teaching a unit appropriately integrated with technology. Thus, the curriculum maintained its presence as the center of planning.

The design of the implementation unfortunately did not capitalize on the pre-existing motivations, as noted above by Miller (2001). It must be noted that the level systems do indirectly correlate to Miller's motivations but there is no evidence that the purpose of the three levels was to meet motivational needs as much as they were present to meet specific professional progression to mastery of technology integration. It would have been possible to emphasize individual learning, or professional productivity, or societal changes to have brought several more reluctant teachers on board. Unfortunately, the rationale for the change related directly to a mandate from the State.

To DMMS' credit, the design did include the use of the learning community to establish a network of expertise (via the Train the Trainer program) for implementation and as noted later for continuation. The DMMS administration and technology staff saw the limitations of time and resources to reach the full faculty population. With the advent of peer trainers, smaller more effective groups could be easily established and various subject matter experts essentially were dispersed throughout the school buildings as informal resources and references.

The logistical needs as defined in the Design Phase were already present or easily acquired. Full systems proved to be easily accessible by any teacher as deemed necessary. DMMS and the school district also engaged additional outside trainers for the Train-the-Trainer sessions. This use of outside trainers ensured respect of expertise by the trained staff.

During the Implementation Phase itself, begun as noted by the initial principal lead meeting outlining overall goals and processes, emphasis was placed on individual motivation. The primary incentives for teacher success relied wholly on fear of an unknown consequence related to possible effect on state teacher certification status and recognition by the rest of the faculty. DMMS and the school district invoked no other motivations or incentives to encourage teacher participation or compliance. As individual teachers achieved levels, names and pictures were placed in visible locations for teachers and students to see.

The community of professionals and learning assisted in sharing the skills and knowledge necessary to complete the levels. Not only the technology-trained teachers – prepared as part of the Train-the-Trainer program – but also the teachers with a natural propensity for technology informally aided in the progression of the less-willing or less-abled teachers.

DMMS and the school district never performed a school-wide assessment after the Implementation Phase. The data proved easy to gather – who achieved levels at the end of three years and at what rate. The actual state-level requirement remained untestable in that teachers' use of technology (initial use or increased use) could not be easily ascertained without relying on qualitative and subjective data. As a result, the simple answer is that DMMS experienced some success (eventhough there certainly were lags in acquisition of levels two and three by nearly half of the staff) with the implementation – at least on paper having teachers acquire technology skills to a measurable level – except that the overall increase in integrating technology into pedagogical practice remained to be testable.

The biggest issue with DMMS' design of its implementation probably lies with its lack of a formal maintenance plan (or continuation). While the money continued to be available, the implementation focused on the period up to the achieving of the third level by the various personnel. DMMS offered trainings and in-services on specific skills – but no incentives or new Train-the-Trainer inductees. The technology resource teachers remained a valuable resource and advisor to teachers who wished to incorporate more – but essentially a teacher could achieve the third level and then return to the beginning practice methods before the implementation. The following years demonstrated no formal emphasis (by principal or administration at the district level) to continue individual teacher adoption or use of new technologies in the pedagogical practice. It is easy to argue that technology is not a hill top that one reaches but rather the never ending side of a hill that one never sees the summit. Technology is always changing and our school districts need to plan for the continued adoption and use of technologies by our educators.

Skipping back up to the assessment phase, was this implementation successful? In the sense of its specific requirements, for some, yes it was. It, however, did not demonstrate a high percentage of teachers achieving level three by the three year mark. Essentially, it met the need to train teachers in the use of specific technology – for personal use, professional use, and pedagogical use. The implicit goal of this implementation (and the explicit goal of the base requirements of the state), however, demanded that teachers continue to use technology more in their regular pedagogical practice – not just for the duration of the implementation. This particular goal did not make it into the overall plan, per se. As a result, the maintenance plan did not demonstrate this needed process.

Conclusions

As technology is an always changing part of our regular lives and our professional lives, to maintain pace with society, the world of education must constantly adapt its practice and methodologies to accommodate and use these new and emerging technologies. Teachers must consider newly introduced tools when planning curriculum. Schools must keep abreast of latest technological innovations to discover solutions to problems schools face.

This paper was about one system's attempt at adapting to change –as dictated by the state-level education department. This paper's purpose was to establish an accepted standard of technological implementation in schools by using current literature on educational technology adoption to evaluate the successes and weaknesses of a recent attempt at technological innovation and implementation by a school district in the State of Virginia.

Winchester Public Schools (as discussed in the case above) developed a comprehensive three year professional development plan that emphasized technology adoption at a pedagogical level. With the use of the current literature, I split the phases of educational implementation into five phases; requirements, design, implementation, assessment and maintenance. Using this literature-based construct, WPS failed to create a culture for the continued research and adoption of technology into pedagogical practice at the classroom level, while it achieved its specific goal of proven teacher acquisition of technology skills for general personal, professional and pedagogical practice.

While WPS employed great resources and an innovative teacher training program to achieve its well-outlined goals, it failed to meet the implicit goal of technology adoption outside of the implementation period, thus not establishing a continuation of usage.

Future research in the areas of successful continuation/ maintenance practices after technological implementations is needed. Reculturation and motivation as directly applied to technology usage by individual teachers would also prove to be a useful area to research further.

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Appendices

Appendix A: Teacher Technology Competency Certification

From: http://www.wps.k12.va.us/tech/trt/wpstech/homeframe.htm

The Winchester Public Schools is instituting a Teacher Technology Competency Certification program to help insure that teachers gain the skills necessary to use technology effectively to improve instruction. The program is also designed to meet regulatory requirements for school systems issued by the Virginia Department of Education.

The skill requirements for certification are based on the Department of Education's eight Teacher Competencies. These competencies are organized into a series of three competency levels.

LEVEL I: Core Technology Skills
This level incorporates basic skills including a knowledge of terminology, fundamental computer operations, and introductory word processing. Evaluation includes a written test covering terminology and a performance test of computer skills.

LEVEL II: Professional Productivity Skills
This level covers the skills essential to make the teacher more productive and provides the groundwork for integrating technology into the curriculum. Skills covered include the use of word processing, spreadsheet, database, graphics, and communication software. Competency will be demonstrated by compiling a portfolio of products.

LEVEL III: Curriculum Integration
This level focuses on integrating technology into the curriculum. Competency will be demonstrated by compiling a portfolio of lesson plans incorporating the use of multiple technologies. These plans will document a teacher's competency and be included in a system-wide resource collection to be shared with other teachers.

The Technology Competency Certification program will integrate tightly into the evaluation process. Beginning with the 1998-99 school year, teachers will have a three-year period in which to document their competency in each of the three skill levels. As teachers join the system, they will begin a three-year period during which they will work to meet the program requirements.

A variety of inservice offerings will be made available to provide training and assist teachers in obtaining certification. The amount of coursework required will depend upon the teacher's current skill level. For example, some individuals may be able to satisfy the requirements for Level I simply by arranging to take the tests while others may need to take several courses to build their basic skills. The system's Technology Resource Teachers, based on an individual teacher's prior coursework and skill level, will assist teachers in selecting appropriate courses.

Each building principal will be responsible for insuring that each teacher is on track to meet the requirements by the end of the third year. Specific tasks required to satisfy the requirements of each level may be used by teachers as performance objectives in the evaluation process as appropriate.

The Technology Resource Teachers will be responsible for maintaining a folder for each teacher in their building. This folder will contain the Level I tests, Level II and III portfolio items, and a check-off sheet covering the requirements for each level. Submitted portfolio items will be evaluated by the TRT, working with the building's lead teacher and principal to insure requirements are met. Information on teachers' progress in meeting the program's goals will be furnished to the principal by the TRT at the beginning of the school year and the folder made available for use by the teacher and principal in planning performance objectives for each year. The Technology Resource Teacher will assist teachers in selecting and developing appropriate portfolio materials.

Appendix A – Part 1 – Level One

Level 1: Performance Assessment

http://www.wps.k12.va.us/tech/trt/wpstech/perform.htm

- The Basic Skills
  - Turn on the computer.
  - Shut down the computer.

- Working with the Desktop
  - Format/Erase a floppy disk.
  - Display a menu.
  - Close a menu.
  - Display the directory/contents of a hard disk.
  - Resize a window.
  - Move a window.
  - Scroll through a window.
  - Create a folder.
  - Rename a folder.
  - Delete a folder.
  - Display the directory/contents of a CD-ROM disk.
  - Display the directory/contents of a floppy disk.

- Basic Word Processing Skills
  - Start a Word Processing program.
  - Create a new document.
  - Enter text.
  - Use "Help" to set margins.
  - Change the margins
  - Change the font.
  - Bold, italicize, and underline text.
  - Create superscript and subscript.
  - Insert characters.
  - Double space text.
  - Align text--left, center, right.
  - Delete characters.
  - Check for and correct spelling errors.
  - Copy a block of text within a single document.
  - Move a block of text within a single document.
  - Copy a block of text to a new document.
  - Save a file called, "Practice" to a floppy disk.
  - Rename file on the floppy disk to "Practice 1".
  - Find a file on a floppy disk.
  - Open a file stored on a floppy disk into an application.
  - Copy a file from the hard disk to floppy disk.
  - Name a disk, "Practice Disk2."
  - Delete file, "Practice 1," from floppy disk.

   - Make a backup floppy disk.
   - Open a second application.
   - Quit all applications.

- Printer Operations
   - Load paper.
   - Change ribbon or cartridge.
   - Select a printer.
   - Change page orientation.
   - Print a file.

Level 1: Terminology
http://www.wps.k12.va.us/tech/trt/wpstech/terms.htm

AUXILIARY STORAGE - Used to store programs and data when they are not being used in main memory.
- Backup - Creating an extra copy of files for safekeeping.
- CD-ROM - A compact disk that stores 600 Mb of data and has read-only memory which means data is displayed but not manipulated.
- CD-RW - Compact Disk-ReWritable. A recordable optical technology that enables unlimited write operations.
- Floppy Disk - Removable auxiliary storage that uses flexible magnetic media.

COMPUTER SYSTEM - Set of devices that provide for the input, storage, processing, and output of information.
- File Server - Specialized computer system that stores and retrieves information for other computers linked via a network.

HARDWARE - The physical equipment of a computer system.
- CPU - Central Processing Unit. The "brain" of the computer.
- Digital Camera - Point and shoot device that captures still images electronically.
- Disk Drive - Device that reads and/or writes information on a removable disk.
- Hard Drive/C:Drive - Auxiliary storage system that uses a rigid disk to store magnetic media.
- Ink Jet Printer - Device that produces images and text by spraying a fine, controlled pattern of ink.
- I/O Devices - Devices, such as a mouse, keyboard, or monitor that allow the input or output of data.
- Laser Printer - Device that prints images and text by using a high intensity light beam.
- Modem - Device that allows computers to communicate over telephone lines.
- Monitor - The device that delivers an on-screen image.

- Mouse - A hand-held input device that relays signals to the monitor.
- Peripheral Devices - Any hardware that is attached to a computer via a port.
- Port - Point of connection on a computer system that provides for the use of peripheral devices.
- Scanner - Device used to capture printed images and text electronically.

MEMORY
- Bit - A binary digit: "0" or "1".
- Byte - A set of eight bits. Used to store a single character.
- Gigabyte (Gb) - Approximately one billion characters.
- Megabyte (Mb) - Approximately one million characters.
- RAM (Random Access Memory) - Electronic memory that temporarily stores programs and data within the computer system. Stored information is lost when the computer is turned off.

NETWORK - Set of computer systems linked for the purpose of sharing information and devices.
- Browser - A program that enables the user to navigate the World Wide Web.
- Internet - Public, world-wide computer network.
- LAN (Local Area Network) - Set of computers linked within a room or building for the purpose of sharing information and devices.
- Search Engine - A program that locates needed information on the Internet.
- URL (Uniform Resource Locator) - The address of a web site.
- WAN (Wide Area Network) - Set of computers linked between buildings or throughout a community to share information and devices.

SOFTWARE - General term for sets of program and data files that allow the user to accomplish a task.
- Application - A software tool that has a specific function.
- Database - An application which uses records and fields to organize and sort data.
- Data File - Set of information used or manipulated by a computer program.
- Program File - Set of computer instructions.
- Spreadsheet - An application which uses cells, rows, and columns to perform number calculations and to create graphs.
- Word Processing - An application which creates, edits, and prints text and graphics.

MISCELLANEOUS
- Binary Code -Number system based on powers of two.
- Icon - Picture representing a file, device, or command on the desktop.
- Logon/off - Process of signing onto/off of a computer or network.

Appendix A – Part 2 – Level Two

Level 2: Portfolio: Professional Productivity Skills

http://www.wps.k12.va.us/tech/trt/wpstech/portfolio.htm

I. Word Processing Desktop Publishing (3 documents)
Select 3 examples from your own work. A scanned image and a picture from a digital camera must be displayed within at least one of your documents.

- Letter to parents/students
- Class Handout
- Test
- Assignment Sheet
- Any document designed for instructional use
- Computer Overhead Transparency
- Memo

II. Database (2)
Select examples of your own work which illustrate two (2) databases. Each database must contain a minimum of 4 fields and 10 records.
Sample Ideas:

- Class Roster
- Database of URLs
- Mailing List
- Database to be used by students
- Inventory of Supplies/Materials/Books

III. Spreadsheet (1)
Select an example of your own work which illustrate the use of a spreadsheet program. Printout must show a spreadsheet (including a function or formula) and embedded graph.
Sample Ideas:

- Class Roster
- Database of URLs
- Mailing List
- Database to be used by students
- Inventory of Supplies/Materials/Books

IV. Presentation (1-five card linear design)
Select an example from your own work which is a presentation of at least 5 slides/frames.

- PowerPoint
- HyperStudio
- Kid Pix Slide Show
- ClarisWorks Slide Show

V. Telecommunications (4)
Select and print out examples of the following:

- E-mail that you have sent
- Lesson plan you downloaded from WWW with date and location on the page
- Teacher-Created Bibliography of 3 electronic resources using MLA Style Guide
- Internet search engine results printed out with date and location on the page

VI. Hypermedia (1-five card nonlinear design)

Select a multimedia document created by you. Elements must be linked in a nonlinear way.

- HTML document with at least 5 web pages containing at least 5 links
- HyperStudio stack with at least 5 cards
- PowerPoint with at least 5 slides

Appendix A – Part 3 – Level Three

Level 3: Units

http://www.wps.k12.va.us/tech/trt/wpstech/units.htm

All licensed personal must complete a portfolio to satisfy requirements for level III technology standards. The portfolio must contain hard copy (printed copy on paper) of the requirements below.

Portfolio will contain two multi-day units developed using the WPS curriculum integration model. As a basic component of the unit, students will:

- use at least one application from t nhe basic tool category.
- use an additional application from one of the other technology tool categories.

Curriculum Integration Model
Objectives: What the students will learn.
Standards: Virginia Standards of Learning and/or local curriculum goals
Strategies: Instructional methods and tasks used for teaching.
Resources: Tools, materials, and people that teachers and students will utilize.
Assessment: Formative and summative measures by which student learning will be monitored and evaluated.

These components are highly interrelated: a change to one of them affects the others.

Four Software Categories

- Basic Tools
  - All Subjects
    - Word Processing
    - Database
    - Spreadsheet
    - Hypermedia
    - Concept Mapping
    - Presentation
  - Sample Math Tools
    - LOGO
    - Mathematica
    - Calculators
    - Geometer's Sketchpad
  - Sample Science Tools
    - Probeware
    - Image Processing
- Reference Materials - Software that provides databases of information.
  - Databases of information on CD:
    - Encyclopedia, atlases, almanacs, etc

    - World Wide Web
  - Unique Characteristics:
    - Multimedia
    - Interactive
    - Hypermedia cross-referencing
    - Boolean Search
- Simulations and Educational Games - Software that provides a simulated experience or drill and skill.
  - Simulations
  - Games - Drill and Skill
  - Virtual Reality
  - Unique Characteristics:
    - Multimedia
    - Interactive
    - Can be problem-based
- Structured Learning Environments - Software that is designed to teach the user specific information and skills. The experience can be very
- structured (from pre-test through post test) or it can be more of a guided discovery.
  - Traditional Integrated Learning System (ILS)
  - Exploratory
  - Unique Characteristics:
    - Multimedia
    - Interactive

Review of Terms

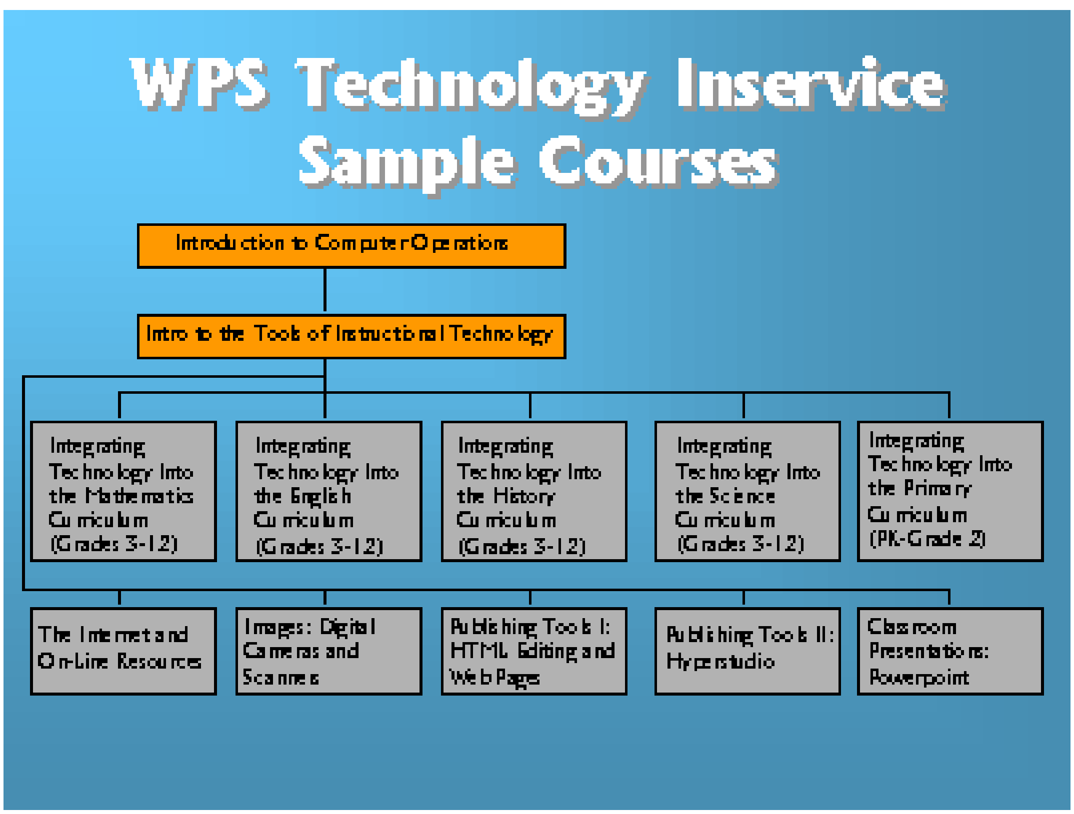
- Multimedia - Any presentation or software that combines several media such as graphic, sound, video, animation, and/or text.
- Hypermedia - A linking strategy that lets you jump between related information (by clicking on a button or text) within a document or amongst multiple documents or, if on a network, amongst documents on different servers. The information maybe multimedia (include graphic, sound, video, animation and/or text).
- Bollean Search - A search of a database which allows you to use certain operators (such as "and," "or," "not") between text strings so as to narrow the search. For example you could search for "men" and "cook" or "clean" not "married."
- Virtual - Quality of effecting something without actually being that something; thus, "virtual Bob" is a man with another name who gets just as many chores done around the house as the real Bob.
- Virtual Reality - Computer simulation aimed at giving users experiences as close as possible to those they would have in the real world. Some VR systems project 3D images through a head set with a visor.
- Integrated Learning System (ILS) - Software that delivers curriculum instruction from pre-assessment of students' skills, to direct instruction, and finally to post-assessment.

Appendix B: WPS Technology Initiative (Fall 1997)

From: http://141.104.22.210/Div/Winchester/tech/techinit/

Inservice Instructional Staff to Meet Technology Standards

- Instructional Staff Members Must Be Fluent Users of Technology to Effectively Use it to Improve Instruction
- To Insure the Integration of Technology Throughout the Curriculum, All Instructional Personnel Will Be Trained to Meet the Eight Technology Standards
- Inservice Courses
    - All licensed Personnel will be Required to Meet the State Competencies as an Integral Part of the Recertification Process
    - Courses Offered Will Provide the Necessary Training and Prepare Teachers to Integrate tghe Technology SOL into Their Lessons
    - Introductory Courses Provide Training in Computer Operations and Terminology
    - Content Specific Courses Provide Training in Integrating Technology Within A Specific Area
    - Specialized Courses Provide Training in Specific Areas Withinm The Curriculum or on the use of Specialized Tools
    - Courses are Offered Throughout the Year Aftger School and During Short Summer Sessions
    - Trainers are WPS Resource Teachers, Shenandoah University, and Lord Fairfax Instructors



Increase Access to Up-to-Date Technology

- Students and Instructional Staff Must Have Ready Access to Appropriate Technologies
- Provide Every Classroom Instructor with a Networked Computer System and Software
- Provide Internet Access to All Instructional Areas
- Replace Obsolete Technology. Provide Increased Access Within the Classroom
- Handley Initiative - Place an additional 50 computer systems, software, and display systems in classrooms; replace writing lab ad math/ cs lab with up-to-date hardware and software; complete building network and link to Internet
- Daniel Morgan Initiative - complete placement of computer in every classroom; replace "A" wing IIGS lab; study alternatives to traditional lab placements. Replace B and C Wing Labs with functional equivalents; complete building network and link to the Internet
- Elementary Initiative - complete placement of a computer in every classroom; study alternatives to traditional lab placements, replace IIGS labs with functional equivalents; equip remodeleld Quarles school with up-to-date software ad hardware; complete building network and link to the Internet

Integrate Technology Across the Curriculum

- The Application of Technology Musty be an Integral Part of the Curriculum
- Provide Elementary and middle School Technology Curriculum Committees to Assist With Curriculum Revisions to Insure Technology Integration and SOL Mastery
- Provide Staff Assistance to High School Departments With Curriculum Revisions to Insure Technology Integration
- Provide Sufficient Inservice to Support A High Level of integration
- Provide Funding to Continue to Provide Access to Up-to-Date Technology Tools
- Provide the Necessary Technology Support Staff to Enable A High Level of Integration

Appendix C: Technology Standards for Instructional Personnel

From: http://www.pen.k12.va.us/VDOE/Compliance/TeacherED/tech.html
(Virginia Department of Education)

8 VAC 20-25-10 et seq.
Statutory Authority: § 22.1-16 of the Code of Virginia
Effective Date: March 4, 1998

8 VAC 20-25-10. Definitions.

The following words and terms, when used in this regulation, shall have the following meaning unless the context clearly indicates otherwise:

- Demonstrated proficiency means a demonstrated level of competence of the technology standards as determined by school administrators.
- Electronic technologies means electronic devices and systems to access and exchange information.
- Instructional personnel means all school personnel required to hold a license issued by the Virginia Board of Education for instructional purposes.
- Productivity tools means computer software tools to enhance student learning and job performance.

8 VAC 20-25-20. Administration of technology standards. N

A. School divisions and institutions of higher education shall incorporate the technology standards for instructional personnel into their division-wide technology plans and approved teacher education programs, respectively, by December 1998.
B. School divisions and institutions of higher education shall develop implementation plans for pre-service and in-service training for instructional personnel. The implementation plan shall provide the requirements for demonstrated proficiency of the technology standards.
C. Waivers shall be considered on a case-by-case basis of the 18-hour professional studies cap placed on teacher preparation programs for institutions requesting additional instruction in educational technology.
D. School divisions shall ensure that newly-hired instructional personnel from out of state demonstrate proficiency in the technology standards during the three-year probation period of employment.
E. Course work in technology shall satisfy the content requirement for licensure renewal for license holders who do not have a master's degree.
F. School divisions shall incorporate the technology standards into their local technology plans and develop strategies to implement the standards by December 1998.
G. Institutions of higher education shall incorporate technology standards in their approved program requirements and assess students' demonstrated proficiency of the standards by December 1998.

8 VAC 20-25-30. Technology standards.

A. Instructional personnel shall be able to demonstrate effective use of a computer system and utilize computer software.
B. Instructional personnel shall be able to apply knowledge of terms associated with educational computing and technology.
C. Instructional personnel shall be able to apply computer productivity tools for professional use.
D. Instructional personnel shall be able to use electronic technologies to access and exchange information.
E. Instructional personnel shall be able to identify, locate, evaluate, and use appropriate instructional hardware and software to support Virginia's
F. Standards of Learning and other instructional objectives.
G. Instructional personnel shall be able to use educational technologies for data collection, information management, problem solving, decision making, communication, and presentation within the curriculum.
H. Instructional personnel shall be able to plan and implement lessons and strategies that integrate technology to meet the diverse needs of learners in a variety of educational settings.
I. Instructional personnel shall demonstrate knowledge of ethical and legal issues relating to the use of technology.