Fishman, B., Pinkard, N., & Bruce, C. (1998). Preparing schools for curricular reform: Planning for Technology vs. Technology Planning. In A. Bruckman, M. Guzdial, J. Kolodner, & A. Ram (Eds.), *International Conference on the Learning Sciences* (pp. 98-104). Atlanta, GA: AACE.

Preparing Schools for Curricular Reform: Planning for Technology vs. Technology Planning

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Abstract: This paper presents a theory and model of planning for the use of technology in K-12 schools. There is a need for such a model because current school technology planning efforts are often devoid of context, and lead to poorly conceived arrangements of technology that are not supportive of learning and curriculum.

Learning sciences research in schools is commonly geared toward the reform of classroom learning and teaching. These reforms are fostered through technology, e.g., [Schank & Edelson 1990], curricula, e.g., [Lento, 1996], pedagogy, e.g., [Brown et al. 1994], or most often a combination of all three, e.g., [Pea 1993], [Scardamalia & Bereiter 1991]. Research projects that depend heavily on technological infrastructure to enable new forms of classroom activity frequently need to invest a great deal of energy in the provision and support of that infrastructure. This generally entails purchasing computers, establishing networks, and rearranging classroom schedules so that technology is available at appropriate times to teachers and students who need it. An alternative is to identify schools that already have the necessary resources in place, though this at best is a frustrating exercise.

The reason for this frustration is that schools, as organizations, do not normally think about technology the same way that learning scientists do. Where researchers conceptualize technology as being in service to particular learning goals and activities, schools often think about computers as all-purpose resources, like library books. Instead of planning so that technology actively supports particular pedagogy, computers often become an adjunct to the curriculum. For example, a common use of computers in classrooms is as a reward to students for completing other work. Merely having computers in the classroom is often viewed as a "good thing," even though no one has given careful thought to how the computers will be employed. Technology is commonly viewed as a set of skills to be mastered by students, making it a discipline unto itself, instead of being thought of as a set of tools to support learning activity in a broad range of domains [Becker 1993]. The problem, in short, is that schools make *technology plans* without carefully *planning for how technology will be used!* These technology planning processes are divorced from both content and pedagogy, and often result in technology infrastructures that are not supportive of either current practice or reform. What schools get as a result of these processes are plans for "boxes and wires," which do not provide sufficient models of how to deploy that technology effectively in order to support particular pedagogical or curricular goals.

The need for a solution to this problem becomes more pressing as Learning Sciences research tries to impact larger-scale settings such as urban school districts or systemic reform projects. When researchers encounter schools with intractable and insufficient technology infrastructures, research questions and enactment of reform must be put on the back burner until solutions are found. Our experiences indicate that this can delay work by a year or longer in many cases [Fishman et al. 1997].

Approach Taken in this Research

In this paper we begin to build a theory and process to help schools take a more informed stance towards technology use that we call *Planning For Technology* (PfT). The context for this research is an urban K-8 school in a large Midwestern city. The school has a 98 percent African American population with 82 percent of the students receiving free or reduced price lunches. Our initial work with this school was on the implementation of new technologies to support teaching and learning. However, it became apparent that this work was suffering because the teachers had not yet formed a basis upon which to adopt new technology. Together, we realized that what was needed was for us to step back from implementation concerns, and start

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fresh by trying to re-define the school's goals for learning and teaching. We met regularly with the school's 39 faculty to talk about pedagogy and gain experience with technology. At these meetings, teachers were asked to write brief statements of beliefs or plans for future teaching. These documents formed a data set that helped inform our own thinking about PfT. We supplemented these data with semi-structured and informal interviews, observations, and field notes from meetings. This work began in the Fall of 1997, and we expect it to continue for the foreseeable future.

The Technology Planning Literature

Despite an abundance of reports and planning guides that describe the process of implementing technology, there has been little work to date that makes an explicit connection between the technical aspects of technology planning and learning theory or curriculum, and virtually no systematic focus on these issues among researchers in the Learning Sciences community. As an introduction to the current state of technology planning, we have identified three distinct varieties of extant technology planning literature: "Boxes and Wires," "Vision and Process," and "Pointing Towards Theory".

*Boxes and Wires***.** The least useful of the technology planning literature focuses on what kinds of computers schools should buy or what type of network infrastructure is needed, e.g., [National Center on Education Statistics, 1998]. Typical products resulting from this type of report are school and district technology plans that lack a primary focus on the curriculum and pedagogy, and instead focus only on cost and installation issues. This type of planning is necessary for making purchasing decisions, but not sufficient for technology to become embedded in the school's curricular and pedagogical practices.

Vision and Process. A second type of technology planning literature acknowledges the importance of and suggests that schools create a "vision" of technology planning that includes educational goals and objectives [Baule 1997], [Regional Technology in Education Consortia 1996]. While these guides speak about the importance of a vision, they do not provide any theoretical foundation or guidance upon which schools might begin to build their vision. Learning Sciences research demands a more explicit orientation to learning and pedagogy.

Pointing Towards Theory. Recent technology planning documents have started to reference cognitive and social theories of learning with more regularity . As a result, some districts and schools have begun to think critically about how they will teach with technology. Reports, such as the [CEO Forum 1997], provide a good snapshot of the state of research in the area of technology implementation and evaluation. This particular report highlights the need for increased attention to new approaches to curriculum and instruction, and it highlights the need for a reevaluation by schools of what constitutes "real" student learning. [Jones et al. 1995] also take a more comprehensive approach to technology planning, emphasizing the principles of "engaged learning" as a key to productive uses of technology. Some states, such as Illinois, have revised their frameworks to emphasize these kinds of planning processes, but these initiatives are slow to reach individual schools, and the Learning Sciences needs to be more aware of these resources.

Taken as a whole, the existing technology planning literature has several important drawbacks. First, technology planning literature is experiential, but not empirical. Second, this literature is not peer-reviewed. These first two characteristics make technology planning appear to be more of a craft than a science. Third, with rare exceptions, the technology planning literature is pedagogically neutral. We argue, instead, that technology planning should be bound by a context in which the most important consideration is pedagogy. Otherwise, schools become resource bound and they risk educational failure when their technical solutions fail.

Problems Caused by Poor Technology Planning

We argue that in most cases, problems associated with the process of technology planning arise because of the failure of "traditional" plans to address key factors that affect the real use of technology in schools and classrooms. Some of the most common technology planning failures are in the areas of hardware utilization, equity and access issues, professional development, and finally, but perhaps most importantly, a lack of technology-enabled curriculum designs. In the following paragraphs we address each of these areas in turn, before describing our own conception of technology planning, which we prefer to call *Planning for Technology*, or PfT.

Unused or Underutilized Computers

The most prevalent problem regarding technology planning is related to schools' tendency to focus on the most cost efficient way to obtain and organize computer hardware. Computer lab setups are efficient ways to group computers (as opposed to distributing them among classrooms) so that classes can come in to use the facility much as they would use the art or music room. In many schools we have worked in, only the "computer teacher" (who has primary responsibility for monitoring the lab) and the principal or vice-principal have a key. Thus on days when the computer teacher is absent, it suddenly becomes difficult to get access to the lab. Another side effect of computer labs, commonly seen, is that because there is a "computer teacher," subject area teachers treat the lab time as a planning period. This leaves the computer teacher in charge of the students, with the result that computer activities rarely play a substantive curricular role. Computer lab really does become art class, except kids use KidPix instead of macaroni and tempera paints.

Lack of Teacher Professional Development and Support

Our experience indicates that in many schools computers are not used due to a lack of comfort with technology by the teachers. This is essentially an issue of professional development, which is not addressed adequately in "boxes and wires" planning processes. It is crucial that teacher professional development with technology move beyond mere skills training in the same way learning scientists argue that students' computer use should. Many computer vendors offer "training" as part of their installation package, but this training is completely inadequate for meeting the needs of teachers, and it is inconceivable that a vendor would be able to link training to the school's curriculum goals.

Lack of Vision for How Technology Fits with the Curriculum

Greatly compounding the issues of poor technology use in schools is a lack of understanding of what new forms of curriculum and instruction are possible with technology. In order to form such a vision, schools need to first question their core philosophies of instruction and come to some agreement across staff or departments about how they will teach. Without this common vision, which helps to ensure that teachers and administrators are in pursuit of similar goals, it is difficult to implement a technology that works they way teachers need it to. The absence of this vision is not surprising, however, when one considers that there are few school-wide discussions in an organized setting and on a regular basis about how technology can help teachers achieve their curriculum goals. Such discussions provide teachers with opportunities to share ideas about the integration of technology and they allow teachers to benefit from the collective knowledge of their colleagues. In the absence of what might be called "planning for technology meetings," teachers are individually responsible for learning how to use technology and for determining what software will help them achieve their pedagogical goals.

The Planning for Technology Process and Model

The problems described in the preceding section are largely caused by treating technology planning as a discrete administrative task, separate from instructional or curricular concerns. We believe that in order for technology to become an effective component of classroom instruction, all members of the school must participate in a process that directly addresses the following questions: What are the school's short and long term instructional goals? What pedagogical philosophy or models will be used in instruction? What kinds of curriculum are in place or need to be in place to meet instructional goals? What technological tools can enhance the curriculum and enable students and teachers to learn more effectively and efficiently, and how are they best allocated? How should technology be allocated to achieve pedagogical goals and to allow teachers to enact technology embedded curriculum?

Our "Planning for Technology" (PfT) model provides a framework for helping schools develop the capacity to address the above questions, and implement a technology plan that directly addresses the needs of teaching and learning. The four phases of the model, processes typical to each phase, and likely products of these processes are outlined in Table 1 below. As we describe the model, we will provide examples from our past year of work that provide evidence that the PfT model is working to help teachers form a useful image of how technology can support their instructional goals. It should be noted that the PfT process is iterative, and

though there is an order in which its phases are initiated, they should not be viewed as stages that are passed through one time only. Also, this is a long-term process, which will not be completed in a single school year. As we have only completed one year of work with our school partners on the development of the PfT model, we will be able to present more evidence of our progress in the first two phases of the PfT model than from phases that are initiated later in the model.

Phases of the PfT Model	Typical Processes	Typical Products
Establish a Vision Of Teaching And Learning	• Create classroom scenarios • Conduct teacher surveys • Hold school-wide conversations • Discuss ways technology can meet teaching and learning needs • Employ outside facilitators	• Planning for Technology committee • Common vocabulary • Initial technology plans • Computer allocation policy and approach
Develop Staff's Technology Skills	• Conduct skill assessment • Hold in-service workshops • Make technology accessible	• On-going technology training program
Redesign Curriculum with Embedded Technology	• Review existing curriculum • Highlight good examples of curriculum use within school and in other places • Pilot new activities with technology	• New curriculum units and materials
Benchmark Performance And Progress	• Gather data on how technology is employed and for what purpose • Conduct periodic surveys of needs and goals • Assess student performance w/ technology • Re-visit and adjust plans	• Logs of technology use • Reports back to whole school community about the impact of technology • Revised technology plans

Table 1. The Planning for Technology Model

Phase 1: Establish a Vision of Teaching and Learning

The most important part of the PfT model is the development of a shared vision of teaching and learning which serves as a driving force for decisions regarding the use of technology. Without this vision, teachers and administrators are prone to limit their thinking about technology to "boxes and wires" or isolated computer skills. For example, in early conversations and meetings with teachers, when they were asked to describe their goals for the coming semester they focused on the acquisition of computer skills in the areas of word processing, spreadsheets, and use of CD-ROMs. These goals were not related to any particular curricular aim. Computers served as a reward to students for good behavior or performance on "regular" classroom lessons and activities. A second grade teacher described her use of computers as follows:

> Instead of actually integrating the technology with my classroom subjects, I used computers as centers where the students could have fun. We used programs like Math Munchers and The Oregon Trail.

Later in the year, after work on forming a vision of teaching and learning with technology, this same teacher expressed the role that technology might play in her instruction, this way:

> I believe that technology can enhance my mathematics instruction by reinforcing various skills, such as graphing, fractions, geometric figures and shapes, and word problems. My students especially need assistance with word or story problems. Reading can also be focused upon by including skills such as main idea, sequencing, theme, identifying a story's setting, characters, etc.

To help this teacher and her colleagues make such a distinct change in their view of technology and teaching, it was necessary to engage the entire staff in some activities to establish a common vocabulary around teaching, learning, and technology. To accomplish this, we employed a framework designed by the North Central Regional Educational Lab (NCREL) called "Plugging In"[Jones et al. 1995] that provides worksheets for teachers to assess their use of "engaged learning" and "high performance technology." These worksheets

help teachers think about their classroom practice and compare the "current realities" of their learning environment with future goals. In this way, teachers are provided with a context within which they can be exposed to a diverse array of teaching methods while establishing a new vocabulary and, at the same time, considering directions to take their curriculum and instruction.

We asked teachers to complete the NCREL worksheets both as individuals and in their grade-level teaching clusters, and then to develop brief scenarios of what their ideal classroom look like. Upon completing and sharing individual and cluster scenarios, it became evident that the staff were progressing toward a common vision of learning. As part of a follow-up activity designed to elicit individual teachers' ideas about future classroom environments, we noted that all but two teachers out of fifteen that participated spoke of classrooms that involved student collaboration or greater student involvement in the design and enactment of learning activities. In a similar activity, teachers in all but one of the groups spoke of developing greater student independence or of working toward the creation of more "authentic" learning activities for students. It is important to note that in an earlier curriculum planning activity none of these terms were present in teacher comments. Only two of the teachers who participated mentioned a desire to engage students in "hands-on" or "real-world" activities.

Consider the contrast between the way a seventh/eighth grade teacher describes her classroom at the start of the PfT process:

> Each day begins with a bell work activity. This activity introduces students to the key terms focused on in their activities. Then, we proceed to the daily agenda. During this time all specific instructions, question and answer segments, and individual or group activity guidelines are explained.

And the same teacher describing her ideal classroom after working with the NCREL materials as part of the PfT process:

> My ideal classroom is one]which is arranged to generate continuous collaboration among peers and teacher. Students are involved in group and/or cooperative learning experiences on a daily basis. These researching, writing, editing, sharing, presentations and evaluation activities derive from the collaborative efforts of the members of the group.

After a common vision has been established a group must take on the leadership responsibilities for ensuring that the newly created vision is enacted. An effective way to achieve this is to establish a planning for technology committee or team, which consists of teachers and administrators who have expressed a high level of interest in the integration of technology into the school's curriculum and who have demonstrated a willingness to help facilitate the changes brought on by the process of planning for technology. Thirteen faculty, plus the researchers, formed this new committee, and met approximately once a month during our past year of work, but established tasks that were completed by individuals or groups between meetings.

Phase 2: Develop Staff's Technology Skills

After the school has reached a better understanding of their goals for teaching and learning supported by technology, the focus shifts to preparing the staff to enact their new vision. One of the first steps is to develop the technological skills of the staff. It is wise to begin with a technology skill inventory in order to learn what teachers already know. The benefits of focusing on the skills of teachers are twofold. First, by engaging in technology workshops specifically focused on providing teachers with a set of fundamental skills, teachers develop a level of comfort that will allow them to take risks and to persist when confronted with challenges associated with technology integration. Second, developing these "basic" skills and increasing teachers' confidence with previously unknown software and hardware greatly increases the odds that teachers will employ the technology in classroom practice. Once a skill assessment has been conducted, focused workshops can be held to develop expertise in needed areas that are directly focused on what teachers want to do in upcoming curricular activities. In addition to occasional in-service workshops, we worked with staff at the school to identify a broader range of training opportunities both within and outside the district. Over time, teachers began bringing fliers they had received from potential workshops, and advertising those opportunities to their colleagues.

Along with providing workshops, allowing teachers to have access to computers outside of school is a necessary component of developing their computer skills. Instead of storing computers in closets during the summer months, as many schools do, allowing staff to use the computers at home is well worth considering, and the benefits will likely outweigh the administrative overhead. During the school year, establishing a system

for loaning portable computers also contributes to the ability of teachers to gain skill and confidence with computers.

Phase 3: Redesign Curriculum with Embedded Technology

To accomplish the goal of achieving a truly technology-embedded curriculum, the school needs to focus on making the connection between pedagogy and technology. To start, the school needs to find places in its curriculum that would benefit from the integration of technology. After specific curricula has been targeted, the next step is to find models of effective classroom use of technology within the specified curricular area. As a second grade teacher put it:

> When planning certain lessons, I now sometimes think of how a lesson would be enhanced by a certain usage of technology. The students also look forward to working on the computer and I am now planning to include larger blocks of time where they can work in pairs or alone.

Effective models might exist within the school but may also exist in other schools within the district or across the country. This is also a point at which the kinds of innovations developed by Learning Sciences researchers are best introduced to teachers. At the school we were working with, teachers elected to use science curricula developed by the hi-ce [1] group in the middle school, and beginning literacy curriculum units developed by the MEDAL [2] group, both from the University of Michigan. Regardless of the source of the ideas, it is important that the models adopted articulate well with the vision of teaching and learning developed by the staff.

Phase 4: Benchmark Performance and Progress

Implementation of the PfT process does not conclude once the staff has created an initial school-wide learning and technology vision, enhanced their technology skills, and selected or developed technology embedded curriculum units. The PfT process must be an ongoing one due to the evolving nature of technology, curriculum goals and objectives, and experience levels of school staff. To keep pace, school staff must institute a benchmarking procedure that consists of capturing data that provides insight into how technology is actually being used in classroom, how it is embedded into curriculum, and what impact the use of technology-embedded curricula has on the school's progress toward its overall instructional goals.

Simple tools like software that tracks computer use [3] can shed light on whether computer allocation choices have been made correctly. One teacher at the school we worked was concerned that she always have a computer in working order available to her classroom. An examination of logs from her classroom indicates that computers are in use for almost half of every instructional day, lending support to the urgency of her request. The school's planning for technology committee may find such information to be a useful resource in decision making. In addition to creating and reviewing computer usage logs, the technology planning committee should conduct teacher and student surveys and analyses of the school's technology infrastructure at regular intervals, to determine whether the school is still on track towards meeting its goals with technology-embedded curricula.

Conclusions and Future Directions

As the Learning Sciences "grows" its research from laboratory and small-scale classroom implementation to whole school and systemic implementation, a key piece of the puzzle is to help schools prepare to use technology effectively, especially with regard to the implementation of Learning Sciences initiatives. The Planning for Technology model and process are designed to help schools make decisions with sound pedagogical grounds, enabling them to tailor technology plans to suit their learning and curricular goals. We will continue to refine and enhance the PfT model as part of the scaling up of the Center for Learning

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[1] hi-ce is the Center for Highly Interactive Computing (http://www.hi-ce.org), led by Phyllis Blumenfeld, Barry Fishman, Joe Krajcik, Ron Marx, Nichole Pinkard and Elliot Soloway.

[2] MEDAL (Music Enabling Diversity and Literacy) is led by Nichole Pinkard and supported by hi-ce and the Center for the Improvement of Early Reading Achievement (CIERA).

[3] We have used "Detective," a Macintosh tracking tool developed by Mark Guzdial of Georgia Tech.

Technologies in Urban Schools, helping schools in Detroit and Chicago to change their science curricula using technology.

Acknowledgements

The work reported in this paper is supported by the W.K. Kellogg Foundation, and by the National Science Foundation. The authors would also like to thank the teachers, administrators, and students who have worked so closely with us this past year.

References

[Baule 1997] Baule, S. M. (1997). *Technology planning*. Worthington, OH: Linworth Publishing.

[Becker 1993] Becker, H. J. (1993, May). Teaching with and about computers in secondary schools. *Communications of the ACM, 36*, 69-73.

[Brown et al. 1994] Brown, A., Ash, D., Rutherford, M., Nakagawa, K., Gordon, A., & Campione, J. (1994). Distributed expertise in the classroom. In G. Salomon (Ed.), *Distributed Cognition* (pp. 188-228).

[CEO Forum 1997] CEO Forum on Education and Technology. (1997). *School technology and readiness report: From pillars to progress* (Year One Report). Washington, DC: Author.

[Fishman et al 1997] Fishman, B., Lento, E., Gomez, L., & Despenza-Green, B. (1997). *Implementing the Internet in a large urban school system: A case study of the CoVis Project in the Chicago Public Schools*. Paper presented at the meeting of the American Educational Research Association, Chicago, IL.

[Jones et al 1995] Jones, B. F., Valdez, G., Nowakowski, J., & Rasmussen, C. (1995). *Plugging in: Choosing and using educational technology* (EdTalk Report ED-PLUG-95). Washington, DC: Council for Educational Development and Research/North Central Regional Educational Laboratory.
http://www.ncrtec.org/capacity/plug/plug.htm.

[Lento 1996] Lento, E. (1996). *CoVis Interschool Activities: An outreach aimed at building a community of learners*. Paper presented at the meeting of the International Conference on the Learning Sciences, Evanston, IL.

[National Center on Education Statistics 1998] National Center on Education Statistics. (1998). *Technology @ your fingertips: A guide to implementing technology solutions for education agencies and institutions* (Technical Report 98293). Washington, DC: U.S. Department of Education.
http://nces.ed.gov/pubs98/98293.pdf.

[Pea 1993] Pea, R. D. (1993, May). Distributed multimedia learning environments: The Collaborative Visualization Project. *Communications of the ACM, 36*, 60-63.

[Regional Technology in Education Consortia 1996] Regional Technology in Education Consortia. (1996). Guiding questions for technology planning [WWW]. NCRTEC.
Available: http://www.ncrtec.org/capacity/guidewww/gqhome.htm.

[Scardamalia & Bereiter 1991] Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1*(1), 37-68.

[Schank & Edelson 1990] Schank, R. C., & Edelson, D. J. (1990). *A role for AI in education: Using technology to reshape education* (Technical Report 1). The Institute for the Learning Sciences, Northwestern University, Evanston, IL.