Organizational learning theory in schools

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Abstract

Purpose – The paper's purposes are to establish organizational learning theory as evolving from the theoretical and empirical study of organizations and to build grounded theory explaining organizational learning in schools.

Design/methodology/approach – Implementation of instructional technology as a process of organizational learning was explored at an elementary school. Findings from qualitative data revealed determinants of organization learning discussed as grounded theory, building on the relationship between social psychology and structural systemic aspects of organizational theory.

Findings – Five elements influenced organizational learning: priority of the learning in the organization, consistency and breadth of information distribution, unpredictability or uncertainty, the ease of learning new routines (how to) and the difficulty of learning new conceptual frameworks (why).

Practical implications – Assessing the type of change (routine or conceptual) and the adequacy of information distribution can predict the ease of organizational change. Identifying existing beliefs or procedures that impede new learning can explain lack of progression, and prioritizing the learning through both words and action can facilitate the process.

Originality/value – The paper develops organizational learning theory in schools as contextual indicators and conditions with theoretical roots in the structural technical and social cognitive study of organizations.

Keywords Organizational theory, Learning organizations, Educational institutions

Paper type Research paper

Organizational theory has developed as a lens for examining human organizations over many years. Beginning with Chester Barnard (1968/1938), both early and ongoing studies have offered theory building and analysis of organizations including studies of time and motion (Taylor, 1911), human resources and motivation (Mintzberg, 1973), organizational leadership (Pfeffer and Salancik, 1978; Selznick, 1957), bureaucracy (Blau, 1956; Weber, 1947), politics in organizations (Aldrich, 1979; Wilson, 1973) and structure and power (Pfeiffer, 1981; Kanter, 1977; Thompson, 1967). Along with earlier authors who summarized organizational theory (Hall, 1991; March and Simon, 1965), Scott's (1998, 1992, 1987, 1981) *Organizations: Rational Natural, and Open Systems* (4th ed.) concisely synthesized studies of structure, core technology, and politics in the field. Similarly, Argyris (1993), Argyris and Schön (1978), Katz and Kahn (1978), March (1988), Perrow (1970), Simon (1966, 1991), Weick (1979 1995) and others have offered cognitive and sociological theories of "organizing" to explore the interaction of organizational participants and leaders as well as organizational culture (Schein, 1992, 1996). Although summarized only briefly here, organizational theory with its extensive history and multiple strands has richly informed the study of human behavior and organizations for decades. Many of these ideas have been borrowed as frameworks for

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studying schools and educational leaders (Fauske and Ogawa, 1987; Greenfield, 1995; Johnson and Fauske, 2000; Ogawa 1996; Boyd, 1982; Meyer and Rowan, 1977) and for assessing organizational change in education (Fullan, 1993; Leithwood and Seashore Louis, 1998)

These perspectives provided a lens for assessing organizations and their evolution over time. From a rational systems perspective, an organization was viewed as a "factory" where processes and procedures are manipulated to increase efficiency. Using this framework, efforts for change are focused on the technical, functional aspects of the organization. The open systems perspective emphasized context and fluid relationships of organizations to their environments. Weick (1979, 1995), building from the work of Bidwell (1970, 1987), focused our attention on the loose coupling of educational organizations to their environments and on cognitive responses of leaders who mediated that environment through a process called environmental enactment. This social-psychological perspective emphasized relationships among the organization members and asserted, in fact, that an organization is its people. The socio-technical perspective on organizations has offered a blend of emphases, exploring both social cognitive systems and structural technical systems within organizations as mutually dependent:

> A change in the technical system necessarily impacts on the functioning of the social system, and a change in the social system has impacts on the technical system (Whyte, 1997, p. 57).

One theoretical model that has reflected the dual emphasis of structural technical and social cognitive systems is organizational learning theory (Cohen and Sproull, 1996; Cousins, 1998; Leithwood, 1998; Leithwood and Seashore Louis, 1998; Robinson, 2002; Senge, 1990; Senge *et al.*, 2000; Watkins and Marsick, 1993). Organizational learning theory includes both system-structural and interpretive dimensions (Daft and Huber, 1987). System-structural considerations include organizations' structures and systems for decision-making as well as sharing data and information, and interpretive dimensions involve the meaning that is assigned to the data and information. Thus, organizational learning theory encompasses both structural technical and social cognitive systems.

Organizational learning theory parallels models of individual learning grounded in cognitive and social psychology and defines learning as organizational change. Researchers agree that an organization learns through the individual learning of its members (Argyris and Schön, 1978; Kim, 1993a, b; Nevis *et al.*, 1995; Schein, 1996; Simon, 1991). From a cognitive perspective, individual learning involves storing, retrieving, transforming, and applying information; such information processing relies on memory as "a storage device where everything we perceive and experience is filed away" (Kim, 1993b, p. 39). Memory is not simply a static storage device but changes as it accommodates new information. Memories exist in individuals, and, when individuals have shared knowledge and experience, such as that evolving from participation in an organization, they may also have shared memories. Collections of memories that guide responses and are interconnected around specific experiences are called mental models.

Mental models function by activating memories and responses that were previously developed to solve earlier problems or to address previous incidents. They include knowledge, assumptions, beliefs, values, emotions, and norms that guide behaviors

and actions (Raybould, 2000; DiBella and Nevis, 1998; Jih and Reeves, 1992; Johnson-Laird, 1983). Mental models "provide the context in which to view and interpret new material, and they determine how stored information is relevant to a given situation" (Kim, 1993b, p. 39). Kim (1993a) describes mental models as having two dimensions: routines, reflecting operational components, and frameworks, reflecting the conceptual knowledge components. The routines dimension represents the "doing" components of memories; the frameworks dimension represents the "thinking" components. Routines are enacted from frameworks that reflect reasons for actions based on existing schema. Thus, mental models include both cognitive and behavioral components.

Both memory asnd mental models in organizations can be shared across groups of individuals and can inform collective as well as individual action (Schein, 1992). As people join an organization, they assimilate organizational memories and mental models that are shared by other people in the organization. These newcomers also can dynamically shape organizational memory, frameworks, and routines by negotiating new norms and introducing new ways of working or solving problems (Cyert and March, 1963; Robinson, 2002). Elements of these shared memories and mental models are retained within the organization even as individuals come and go. Organizational memory, for example, is the organization's collective knowledge, beliefs, assumptions, and norms that shape procedures, policies, and culture over time (Cohen, 1991; Cousins, 1998; Levitt and March, 1988). Thus, shared mental models include what an organization "knows", what it pays attention to, how it assesses situations, how it behaves, and what it remembers (Kim, 1993a, b; Senge, 1990). The study of how organizational mental models and memories emerge and change is the focus of organizational learning theory.

Collective learning is another term for the development of shared memories and mental models that is sometimes used synonymously with organizational learning. It is used here to refer to the learning of groups within an organization. Whether referred to as teams, collaborative work groups, or cross-functional task forces, groups "are becoming the key learning unit in organizations" (Senge, 1990, p. 236). Senge goes on to say, "despite its importance, team learning remains poorly understood" (Senge, 1990, p. 238). Leithwood (1998), Hackman (1986 1987 1990) and others (Cousins, 1998; Hackman and Oldham, 1980; Hackman *et al.*, 2002) likewise contend that group learning is important to the exploration of organizational learning in schools. Leithwood (1998) builds on the work of Neck and Manz (1994) to describe group learning as mutual adaptation of members resulting in collective patterns of action. The extent to which routines and frameworks of individual members become shared over time influences the development of group culture and vision (Leithwood, 1998, p. 213) and, in turn, can influence the culture and vision of the organization as a whole. Robinson (2002) maintains that such organizational learning can be deliberative (planned and logical) or non-deliberative (unplanned and non-logical) and argues that the study of organizational learning must focus on conditions under which overt, deliberative attempts at change can succeed. Robinson's analysis is reminiscent of March's (1988) garbage can model acknowledging the unintended, often unpredictable outcomes of decision making in organizations. These ideas and theories are used here

as a sensitizing framework for exploring individual, group and organizational learning in schools.

Purpose and method of the study

This study explored teachers' individual and shared mental models for responding to the organizational change of integrating instructional technology in an elementary school. The study also explored how shared mental models developed over time and how they influenced organizational learning. The study was conducted by the second author over eight months in an urban elementary school in a district of about 74,000 students in the western USA. Data were gathered through:

- extensive interviews with six teachers, the principal, and the district liaison for technology;
- from observations of the same six teachers using instructional technology in their classrooms; and
- from teachers' self reported cognitive mapping.

Traditional qualitative methods of content analysis were used for interview and observation notes supplemented with self reported cognitive mapping techniques for triangulation (Carley, 1997). Analysis first focused on within case mental models for each teacher and then on across case shared mental models among the six teachers. For data reporting, subjects were named for their observed ability to integrate instructional technology along a continuum of the least to the most skilled:

- Low-1;
- Low-2;
- Medium-1;
- Medium-2;
- High-1; and
- High-2.

Specific steps in analysis of mental models (Fauske and Johnson, 2003) are outlined below:

(1) Describing each teacher's cognitive and behavioral responses to integrating technology.

(2) Isolating teachers frameworks (belief, assumption, and value statements) and routines (actions or behaviors).

(3) Identifying shared frameworks and routines across teachers' mental models.

(4) Classifying shared frameworks and routines into themes and sub-themes.

(5) Interpretating findings to extend theory, inform practice and give direction for future study.

Ultimately, a grounded theory (Glaser, 1978; Glaser and Strauss, 1967; Strauss and Corbin, 1990) of organizational learning in the school emerged based on teachers' shared mental model frameworks and routines.

Summary of findings and interpretations

Mental models

Teachers' individual mental models included the routines and frameworks that each informant used to explain and respond to situations encountered in implementing technology; the individual mental models were specific, complex, and varied. Although the subject teachers did not have identical experiences integrating technology in teaching, they developed shared understandings and interpretations of this organizational change. By comparison, shared mental models were more abstract and more conceptual. Routines and frameworks that were present across individual mental models comprised teacher' shared mental models about technology as organizational change (Table I).

Information flow

Organizational change efforts commonly are directed at structures and processes for information flow within organizations, including setting goals for allocating resources, assigning roles and responsibilities, and creating mechanisms for sending and receiving information. Structures and systems are established to move information and knowledge within the organization and between the organization and its environment. Information flow in an organization can enhance or act as a barrier to organization change and learning. Three themes about information flow were identified in the subject teachers' shared mental model.

Theme 1: goals and resource allocation. Teachers' shared mental model included only vague details of organizational goals and resource allocation because systems and structures for communication between the technology committee and members of the school organization were absent. Teachers stated that the technology committee had established goals, but no one could articulate those goals. As Low-1 observed:

> So I'm making the assumption they probably have had a plan. But I'm not aware of what it is. I know, of course, we've made tremendous gains in technology since I've moved here as far as the lab as well as what teachers have available in the classroom as far as the computer aspect.

Goals that were mentioned all focused on the routine use of computers such as connecting to the internet, loading Windows on computers, and wanting students to be computer literate. Goals for improvement of teaching and learning were not mentioned.

Teachers uniformly acknowledged that funds were available for technology, primarily computers, but could not connect funds directly to organizational goals. Funds came from several sources (parent donations, the legislature, the school budget, community fund raising, and teacher donations), but there was no recognized system for allocating those funds.

Subject teachers stated that they did not have spare time during the school day to experiment with technology; observations supported the shared belief that funds were not used to release teachers for training. Because sharing information about instructional technology was not structured into teachers' daily schedules, lack of time became a barrier to information flow. In addition, these teachers were not organized into teams, leaving few regular opportunities for interaction on instructional technology. High-2 stated:

Category	Theme	Definition	Shared elements
Information flow	Goals and resource allocation	Goals, money, time, and equipment focused on technology	Little shared understanding of school level goals Funds were available Time-consuming Computers used as rewards
	Roles and responsibilities	Roles and responsibilities associated with integrating technology	A hierarchy existed for decision making Unclear about decision making internal to school
	Training	Channels and barriers to sharing technology information	Voluntary participation in school courses Lack of personnel District courses cost time and money Preferred face-to-face instruction Communication problems with external groups
Technology implementation	Problems with technology	Negative aspects of integrating technology in the curriculum	Unreliability Frequent changes Complexity
	Developing expertise	Individual and organizational competence with technology	Shared core knowledge Uneven advanced knowledge Awareness of differences among teachers Awareness of school level shared elements
	Congruence with beliefs about teaching	Effective teaching and connections with technology	Questionable learning Non-adherence to norms Learning should be interactive and fun Learning should be relevant
	Vision for integrating technology	Concrete and abstract ideas for integrating teaching with technology	Technology positively affects learning Plan to increase usage

Table I.
Categories of shared mental models for teachers integrating technology

> And part of that is just a time issue and finding the time to learn the technologies and finding out about different software. It can be very time consuming.

Teachers spent personal time before and after school, on weekends and during the summer learning about technology.

Limited student access to computers similarly impeded integrating instructional technology. There were enough computers in the lab to allow each student their own machine, but each class visited only once per week for 30 minutes. Also, most subject teachers allowed students to use classroom computers mostly as a reward when their

other assignments were completed or occasionally when recess was held inside. Information flow to students, in the form of time with computers, was minimal.

Theme 2: roles and responsibilities. Shared understanding of the organizational structure for decision making associated with teaching and instructional technology was sketchy. Teachers described hierarchically structured roles and responsibilities for instructional technology that included the district, the principal, the technology committee, and the teachers. The district role was setting technology goals, allocating district funding, and providing technical support. Procedural technology information was communicated to either the technology committee or the teachers by means of classes and meetings at the district offices. Occasionally a district technology support person would visit the school to fix problems and talk directly with teachers.

The technology committee's responsibilities included determining the school's technology plan and instructing teachers on using equipment. Teachers' shared interpretation recognized the committee as a way to facilitate work at the school that was not directly part of each teacher's role. Medium-2 explained that the school used committees "to do some research and make recommendations and then present the recommendations to the staff . . ."

Problems with exchanging information about technology were identified, externally with the district; and internally among teachers. Communication between the school and the district was muddled. Information flow was predominantly unidirectional from the district to the school; communication from the school, usually to report a problem with technology, seemed to get lost. Teachers sometimes verbally reported problems directly to district technology people during their occasional visits but received no response. Other ineffective strategies included writing the problem down in a central notebook. For example, Medium-1 said:

> And I've *told* the computer specialist [about the broken printer], that guy that comes, several times. I see him in the hall. I need to put it on a little notebook, I guess, in the hall.

Sometimes the district simply did not communicate its plans, as Low-2 explained:

> They had teacher training sessions set up but they couldn't get the lab to load so we couldn't do it. So, I don't know when that training will come about. I think that's been a lot of the frustration is that you know we'll have something arranged or you know, let's go in and train the teachers and then the lab'll go down. And then we have to wait sometimes for weeks or even months for the district people to be free.

The district sometimes communicated plans and then missed deadlines. High-2 stated, "No. I don't think they [deadlines] are ever met. I've never seen them met." Unpredictability of information flow to and from the district impeded organizational learning.

Administrative communication from the district was usually directed to the principal who was responsible for transmitting information to teachers. The principal's chosen role in integrating instructional technology was one of support teachers. Medium-2 noted:

> But *our* principal hasn't said . . . "you *have* to do this". He has said, "Here's your technology, we've done the very best we can, we're trying to get online. Here, we're trying to help you to learn this. Take these classes." And he gives an option . . . He certainly does not force you into anything.

This non-directive interpretation of district communication and policies was viewed as supportive but exacerbated teachers' confusion about the priority of the change.

Theme 3: training. Three major channels for information flow to teachers about instructional technology were shared across mental models:

(1) classes at the school;

(2) external classes or meetings; and

(3) specific people acting as information sources.

First, teachers could voluntarily attend weekly computer classes held after school. High-6 remarked:

> Training has been on a volunteer basis. And last year we had quite a good group come in. It's better than we've had in the past.

Medium-1 explained that these classes focused on building general computer skills: "how to use a floppy, how to make a file … they covered a variety".

Second, teachers attended classes and meetings held by the district. Classes offered after school and during the summer were not free, and attending classes during the day involved getting permission and locating a substitute. The cost of the classes and lack of released time limited teachers' attendance. Although the district had technology specialists, teachers believed that there were not enough personnel available for help at the school. The specialists were overwhelmed with numerous work requests, and teachers believed that high schools and middle schools received higher priority than elementary schools.

Third, certain people were identified as informal information sources for technology; these individuals were not in formal roles supported by the district. Teachers relied on informal discussions with other teachers, and face-to-face conversations were preferred over written communication, electronic or paper. As High-1 explained:

> I'll go to individual teachers … rather than, you know, you get so many notes in your boxes! So I really try to make individual contact with some teachers that I think would be able to utilize something.

The other commonly named information sources for technology were the principal, parent volunteers, and outside contacts such as spouses and friends.

Implementation of technology

Teachers' concrete experiences with technology created more detailed, specific frameworks and routines than did broader organizational change efforts. Data analysis revealed four shared elements relating technology integration to teachers' mental model frameworks about teaching effectiveness.

Theme 4: problems with technology. When subject teachers' experiences with technology did not meet their expectations, a shared framework developed that there were problems with technology:

- unreliability;
- frequent changes;

- complexity; and
- complications for teacher learning.

First, technology was unreliable. Teachers could not depend on using it although upgrades to the computer lab improved stability during the year of the study. Low-1 stated, "It's the first year it's been reliable to actually go in there and use it." Second, technology changed frequently, and keeping up was difficult for teachers. As Low-2 explained:

> See this has all been new in my teaching career. When I was a kid, overhead projectors were just coming out. There were no CD players; there were no cell phones, no push button anything. So. VCRs were still new, and they were the old beta model. So everything has been new.

Third, technology was complex. The school had various hardware models and operating systems, and each classroom had different software. Indicating the four computers in her classroom, Low-2 explained, "It's pretty complicated with all the different systems I've got hooked together."

Fourth, a shared sense of frustration about learning instructional technology was expressed during interviews and concept mapping. One explicit comment was made by Medium-1: "So put 'technology-frustrated'. They're synonyms!" Subject teachers disliked figuring things out for themselves; they wanted to be shown how to run the software. Medium-2 remarked:

> They'd always say, "Oh just play with it and you'll figure it out." Well, that was true to a certain point, but then *I* got frustrated because *that's* not *me*. I *have* to be shown what to do.

District technical support was lacking at the school, and the technology committee had dual roles as technology specialists and teachers, which caused frustration. As Medium-2 stated:

> And they're not available to us. I mean, like if I'm teaching a class and something's failing, I want help now not at the end of the day.

Subject teachers were overwhelmed by the quantity and pace of learning expected. Low-2 stated, "It's a little easy to get behind. Things advance so quickly that, you know, I used to be pretty up to date."

Theme 5: developing expertise. Despite these problems, observation data showed that subject teachers gained procedural and conceptual knowledge about technology. A total of 24 areas of growth were mentioned in interviews. Subject teachers all mentioned growth in three areas:

(1) knowledge of computers;

(2) use of word processing software; and

(3) use of the internet.

However, differences in teachers' levels of understanding were also evident in observational data. High-1 and High-2 used the technical terms accurately. For example, High-1 and High-2 not only talked about searching the internet for information and "book marking" web pages, they also demonstrated their expertise in the computer lab. Conversely, several subject teachers also used these terms, but

observation and interview data showed a lack of understanding. Some teachers could not invoke a search engine. Instead of bookmarking web pages, they threaded their way through several web pages before finding the destination page.

All subject teachers described varying technology expertise at the school and identified three groups by level of expertise. One group included resistant teachers who refused to:

- use computer grading software;
- learn how to navigate the internet; or
- accompany their classes to the lab, sending a parent volunteer instead.

Low-1 stated:

> I know that others are very resistant. I know there are some that won't even use it to do their grades … or if it's in the classroom it's there more as just a play toy for kids to use …

Teacher apathy and lack of adherence to organizational norms, such as shared expectations for teaching technology as a part of the state core curriculum, frustrated subject teachers. High-2 argued:

> Technology *is* part of the core curriculum. And it kind of bothers me that some people think, "Well, I'm just not going to teach this. I'm not going to learn this." Because we don't do that with English or Math. We don't say, "You know Math isn't my thing and I'm really to old to learn now." We don't *do* that … So why can we do that with technology which is on the state core?

Group two, including four subject teachers, used computers sporadically. As the computer lab became more reliable, these teachers planned to use it more often. Group three, including two subject teachers, integrated instructional technology daily. Low-1 noted:

> We have some teachers that, you know, they're very into especially the computer aspect of it and make use of it extensively I'm sure every day …

All subject teachers talked about needing to learn more about technology. "The use of technology is becoming greater than it has been in the past", remarked High-2. Medium-1 said, "I really felt like I expanded, but I need to go further." Even the two subject teachers identified consistently as being "at the forefront" felt that they were not using technology to its fullest capacity. As High-1 stated, "I continue to learn more and more ways that I can incorporate it in … and I'm always learning and finding out different ways that I can utilize the technology that we have."

Theme 6: congruence with existing beliefs. A shared mental model about best teaching practices for ensuring student learning existed prior to introducing instructional technology to the school and shaped emerging mental models. Subject teachers expressed concern that technology was being used inappropriately in schools, negatively impacting students' learning. Concern was voiced about the potential for students accessing "Internet sites that aren't appropriate"(High-2) and that using software took more time than simply writing a report because students and teachers had the additional task of learning the software. There was a shared understanding that computer games were not good for learning, and teachers disliked educational

software with large game components. Low-1 remarked, "The game seems to take so much time that I just really question how much good they're getting from it."

Although whole class instruction was common across subject teachers, teachers believed that lecture was not a preferred method. Teachers involved students with by asking many questions, including those that required critical thinking skills rather than simple recall of information. Shared mental models focused on student-centered approaches, including providing individual instruction, having students work in teams, and recognizing that students already have skills or information. Teacher-centered approaches were limited introducing new subjects or giving step-by-step directions.

The shared mental model also included frameworks about creating conditions for optimal learning and how technology enhanced these conditions: having fun, being interesting, and using multiple modalities. One shared belief was that when students are happy and having fun, they learn more. High-2 explained:

> If you provide an environment where children are happy and they learn to love learning, and they like being there, then they are going to learn. And I guess if you had to go down to the most basics, and I certainly have philosophies on the best ways of teaching, you know, the best ways of presenting information, but I'd say my number one goal is to have happy children.

All subject teachers stated that students have fun when they use computers, and this increased the potential for learning. Medium-2 said, "But doing it by HyperStudio, I thought, this would be a fun way for the kids to do it, they'd learn more." Subject teachers offered no empirical evidence that the students having fun with computers learned more.

Another shared belief was that students who are interested in a topic get excited and learn more. Subject teachers described strategies to make the curriculum relevant for students and to get them personally involved by making choices, such as topics for reports. Sometimes teachers created excitement by using technology to generate student interest as Medium-2 observed:

> When they're seeing success like that [creating a HyperStudio stack] … it creates an excitement to learn in them and they want to do more and more and you can grab their interest … You can get them to go as fast as you possibly can.

Teachers believed that varying their teaching strategies enhanced learning because students have different preferences for processing information. As Low-2 said:

> Children use all their senses when they learn so the more senses you can involve, the better they're going to learn the concepts and the happier we all are. It's more fun. If they can taste it, touch it, smell it, hear it, see it, they remember it.

Theme 7: vision for integrating technology. The teachers' shared mental model included a vision for integrating technology with teaching practice. Technology, specifically the computer, was described as "wonderful", "important", and "beneficial". The most common integration of computers in teaching was in the writing process. This integration emerged from subject teachers' positive experiences using word processors for their own writing, resulting in a shared belief that word processing increased efficiency and accuracy. Low-1 said, "Of course, now as I'm beginning to use it more

and more for my own work, I realize what a huge benefit it is to be able to use it." High-2 stated, "My children use word processing for virtually all of their creative writing." Teachers assumed that students would use word processing skills throughout their lives.

Subject teachers considered computers a good tool for helping students learn. There were independent drill and practice programs that supported the core curriculum, such as WordMunchers for English skills and MathBlasters for math skills. As Low-2 remarked, "Just plug it in and away you go. It's a CD-ROM so it's fairly easy to operate." However, subject teachers preferred software that did not have preconceived learning objectives, such as word processors, spreadsheets, and presentation programs. High-1 explained that these packages could be used across all grade levels and students.

Subject teachers shared a positive view of future instructional technology plans. Accessing information on the internet was mentioned often, both student uses and locating information for preparing lessons. Medium-1 said:

> I would like to see them [the students] actually get to a point where they can say, "We're doing a report on this, let's go in and find some information". And find that, you know, use that as a tool, a resource.

Subject teachers planned to communicate with parents about instructional matters using e-mail, web pages, and electronic portfolios. Three subject teachers described their "dream classroom" where students had their own computers networked with the teacher's computer. Although details were fuzzy, subject teachers felt that student would benefit from day long access to computers. Even teachers who didn't regularly use instructional technology expressed a desire to do so in the future. "So of course I want to try to use it as, you know, to benefit the children", remarked Low-1.

Interpretation and discussion

Five elements influenced the development of teachers' shared mental models and how those mental models related to the processes of organizational learning. Just as individual mental models included both routines and frameworks, shared mental models represented both system-structural and interpretive dimensions of organizational learning (Daft and Huber, 1987). System/structural dimensions of organizational learning were comparable to routines in individual learning focusing on the what and how elements of mental models. Interpretive dimensions of organizational learning paralleled individual frameworks as the why behind the routines. As individual routines and frameworks became increasingly shared across organizational members, they developed as system-structural and interpretive dimensions of the school as a whole. Insofar as the analysis of shared mental models of the six teachers are representative, the following observations described organizational, or school level, learning.

Priority of the organizational change

When verbal information about the high priority of instructional technology was communicated to subject teachers and concurred with actions observable to these teachers, a shared mental model developed that there was a high priority for change. However, when verbal information was inconsistent with observable actions, the

perceived importance of instructional technology was tempered. For example, unpredictability in allocation of funds for hardware, software, and training support contributed to a shared confusion about the imperative for implementing changes. Thus, development of a shared mental model was confounded by inconsistency in information regarding the priority of the change.

Consistent information distribution

The breadth of information distribution across the school, is an indicator of organizational learning (Huber, 1991). Information distribution is a precursor to information interpretation, the process of creating knowledge and learning from information. Several factors affected information distribution in this study, which in turn affected the breadth of organizational learning and the development of shared mental models:

- lack of access to knowledgeable support staff;
- limited time for learning technology in demanding school schedules;
- overwhelming quantity of information and pace of expected learning; and
- ineffective structures for information exchange internally and externally to the school.

Unpredictability in implementation

Subject teachers experienced using computers and software that unpredictably failed and changed. Instead of learning new dependable routines for teaching with technology, a shared mental model framework developed that there were problems with technology. This perception limited the potential for organizational learning.

Modification of routines

Teachers used instructional technology when it required a change to their routines for teaching rather than a change to their frameworks, or beliefs, about teaching. When integration of technology aligned with beliefs about teaching, organizational learning was enhanced.

Modification of frameworks

Changes in teachers' frameworks for teaching with technology-enhanced possibilities for organizational learning. When the potential for technology to improve learning was recognized, teachers adapted mental model frameworks to include instructional technology as an effective teaching strategy. As other learning applications for technology were recognized, teachers' continued to adapt their frameworks.

Implications for practice

The thick, information-rich details gathered in this study can help make sense of the relationship between individual teacher learning and organizational learning for school leaders as they facilitate change efforts. These implications echo and extend some of the most recent studies of organizational learning in schools:

- Before introducing a change, question whether the target for change involves modifying teaching routines (procedural learning), frameworks (conceptual

learning), or both. Modifying teachers' routines is easier than modifying their frameworks, and building from teachers' pre-existing frameworks is easier than creating entirely new frameworks. For example, the subject teachers changed their writing assignment routines to incorporate word processing because their frameworks included a belief that word processing was an effective teaching tool. This change to routines began to alter their conceptual frameworks for integrating instructional technology.

- Information must flow consistently and predictably without barriers, and decision making processes should be clear. Organization members must have consistent access to information before they can make sense of it. A big obstacle to organizational learning in schools is the lack of opportunities for educators to interact and develop shared understandings. Cousins (1998) suggests that information distribution be systematized so that it becomes readily accessible and that "opportunities for dense personal" exchange be regularly provided to support the interpretive dimensions of organizational learning (Cousins, 1998, p. 230). This system-structural (Daft and Huber, 1991) flow of information that in turn facilitates interpretation of information is a key factor in organization learning.
- During a change effort, some pre-existing, shared mental model frameworks can distort and deflect organizational learning. Teachers' strong norms about autonomy and effective teaching strategies can limit organizational learning referred to in Leithwood's (1998) analysis as mutual adaptation. Adaptation of group members can be inhibited by mental models that include norms antithetical to the change. For example, subject teachers used language and terminology about technology features, yet perceptions of their own autonomy lowered expectations for the immediacy of integrating technology with teaching.
- To reinforce perceptions about the priority for change, words and actions must be congruent in consistently supporting and prioritizing the change. For example, when verbal information about the high priority of integrating technology within the curriculum was communicated to subject teachers and concurred with observable actions of administrators, a shared understanding developed that the change was a high priority. This echoes Leithwood's (1998) suggestion that school leaders can facilitate group learning by making knowledge explicit. Similarly, Robinson (2002) suggests that deliberate, intentional initiation of organizational learning can readily change routines or structural systems but can also become a catalyst for changing non-deliberative or interpretive frameworks.

Persistence of existing mental model routines or frameworks is often misinterpreted as resistance. If a change seems to be stuck, it is easy to assume that organizational members are resisting the change. Alternative explanations for their behavior might become apparent through evaluating the types of change being targeted, access to information, consistency in prioritizing the change, and providing adequate time for dialogue as well as for trial and error. Mental models change by adaptation over time, and changes to interpretive frameworks, the "whys" of behaviors, are more difficult. Attention to changes in routines, which are easier to accomplish, can pave the way for

corresponding adaptation of frameworks. In this study several teachers might have moved forward with technology integration, and corresponding changes to their mental models, if they had been able to discuss concerns and solutions with other teachers and technology specialists.

Extending organizational learning theory

The study examined six teachers' participation in an organizational level learning initiative to assess the nature of individual, group and organizational learning. Although each teacher's mental model differed, there were shared elements across all teachers for both mental model frameworks and routines. Analysis of these shared elements resulted in identifying shared learning across teachers and discovering related implications for leading organizational change efforts in schools. More importantly, the analysis of six teachers' individual and shared mental models begins to illuminate the relationship between individual learning theory and organizational learning theory. To that end, five theoretical assumptions have been offered as a synthesis of prior studies and an extension of organizational learning theory applied in the analysis of schools:

(1) Individual learning is a precursor to group and organizational learning.

(2) Both individual and shared mental models include conceptual frameworks (beliefs, values, assumptions, and norms) and routines (behaviors and actions), and, although closely connected, these can change independently of one another.

(3) When mental models are shared across groups of individuals in an organization, organizational level learning can begin to emerge. Mental models that are not shared do not lead to organizational learning.

(4) Shared organizational mental models are similar to individual mental models with their conceptual frameworks and routines for action, but are expressed at the organization level as interpretive and system-structural elements.

(5) Both group learning and organizational learning, in the form of interpretive frameworks as well as systems and routines, are measurable and exist beyond the individual organization members.

Future research

Theories of mental models and organizational learning have evolved predominantly in the fields of management and social psychology with little corresponding empirical study of the phenomenon in schools. The analysis and incipient theories presented here extend the study of organizational learning as a promising lens for exploring schools. More empirical studies are needed that can contribute to the continued evolution of organizational learning theory, particularly as it applies to school.

Perhaps the greatest contribution of this work lies in exploring the relationship among individual, group and organizational learning and in synthesizing a number of studies and theories for examining organizational learning on schools. Examining the rich history and the roots of organization theory can explain much of what we know

about individual and collective learning shaped by an organization's social cognitive and structural technical systems. Many questions remain, however:

- How is organizational learning influenced by the nature of an organization's work, its core technology, and the degree to which that work is measurable?
- How does the relative emphasis of the system-structures, interpretations or routines impact organizational learning?
- To what extent do theories of individual learning and social cognitive or behavioral theories apply to groups and organizations?

Future research and theory development can begin to answer these important questions in the application of organizational learning theory to schools.

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