

Teacher's LAB: A Platform for Teacher Learning

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B.A. Environmental Studies
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Submitted to the Program in Media Arts and Sciences,
School of Architecture and Planning,
In partial fulfillment of the requirements for the degree of
Masters of Science in Media Arts and Sciences
at the **Massachusetts Institute of Technology**

June 2001

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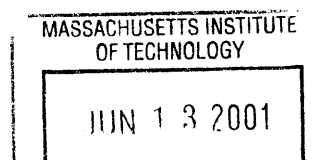
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Abstract

The Teacher's LAB software application is a development platform for innovative classroom activities. Educators can use the tool to construct and share representations of their day-to-day classroom practices. Through the process of representing, constructing, and sharing, teachers engage in critical reflection about their own practice. In my pilot study, this reflection helped teachers recognize essential educational building blocks. I call these elements *pedagogical patterns* and argue that understanding these patterns is a key dimension of teacher learning. Teacher's LAB promotes this understanding, helping classroom teachers become more reflective practitioners. Furthermore, using the software to share pedagogical patterns challenges the isolation of working teachers by allowing them to co-construct lessons with their colleagues. Educators and curriculum developers can collaboratively develop an expanding pattern language of pedagogy, leading to improved educational practices and new opportunities for learning.

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Teacher's LAB: A Platform for Teacher Learning

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Acknowledgements

Teacher's LAB was developed in the Explanation Architecture group and I begin by thanking the group's exceptional leader, Prof. Daddy Brian Smith. The students in the group each enhanced my experience at MIT: Erik Blankinship, Tammy Lackner, Tara Rosenburger, Jeana Frost, Tim Hirzel, and Nell Breyer. Missy Corley provided the Rueben sandwiches and so much more. I will miss our weekly group meetings.

Without my super-star UROP, Ben Balas, the Teacher's LAB software would not exist. He is not only an accomplished programmer but also a thoughtful collaborator.

During my pilot study, I had the good fortune to work with several talented teachers in Boston-area schools. They welcomed me into their classrooms and provided valuable feedback. Kathleen Dunn, professor emeritus of teacher education at Simmons College, was also an excellent resource and I thank her heartily for her feedback and support.

My readers, Mitch Resnick and Eric Klopfer, both provided excellent feedback on an earlier draft of this paper.

I received a wide range of comments after presenting an early software prototype at a Media Lab NiF lunch. I also received useful suggestions during my poster presentation at Euro-CSCL 2001 in Holland.

Media LAB sponsors provided useful feedback throughout the Teacher's LAB project, but I am especially thankful for the thoughtful and practical advice I received from the good folks at McGraw-Hill.

I extend a special thanks to the marketing and public relations personnel at the Nike Corporation, especially Vada Manager, Director of Global Issues Management and Beth Gorny, Nike.com spokeswoman. Ms. Gorny can be reached for comment at (503) 671-5830.

Cameron Marlow, Aisling Kelliher, and Jamie Rollins were a constant source of friendship and support, especially after the stabbing.

The Media Lab is a great place to have conversations with interesting, thoughtful people. In particular, I would like to thank Brian Smith and the students in his Cognition and Instruction seminar, Mitch Resnick and Sherry Turkle and the students in their Systems and Self seminar, Seymour Papert and the students in his Future of Learning seminar, and Marvin Minsky and the students in his Society of Mind seminar. These courses provided forums for lively dialogue that expanded my understanding of thinking and learning. I only wish that more of the insights from these discussions had found their way into this thesis.

This thesis was funded in part by a generous fellowship from Ericom.

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Chapter 1: Introduction

I worked for three years as a classroom teacher, but I never really knew what my colleagues were doing. I would talk to other teachers in the faculty lounge or chat over chicken nuggets in the school cafeteria, but then the bell would ring and we would all disappear into our respective classrooms. We spent most of our professional time alone with our students. My first year teaching, I had to figure how to teach on my own, even though the school was filled with experienced educators. At faculty meetings, we would discuss issues like the proper disciplinary response to gum chewing or the school policy on the allowed length of girls' shirts. We never discussed teaching techniques. Although we had occasional professional development workshops, most of the learning was done on the job, with fortunate junior faculty getting informal support from a more experienced teacher.

This predicament was not unique to my former school. As an educational researcher, I have talked to dozens of teachers who share this experience. Teacher education programs and in-service professional development are generally perceived as being far removed from the day-to-day practice of teaching. Teachers are hungry for ideas that "really work in the classroom" but there is not an effective way to disseminate these practical ideas. When teachers discover an effective technique, they do not have a forum to share the wealth. This predicament is frustrating, especially for the numerous people who become teachers because they are passionate about learning and ideas.

As a response to this frustration, I designed the Teacher's Learning Activities Builder, henceforth referred to as Teacher's LAB. Teachers can use the system to develop and share graphical, spatially rich representations of their teaching practice. This construction process helps teachers gain a better understanding of their practice and the practice of their colleagues. Instead of discussing the gum chewing policy, teachers can engage in the co-construction of new learning activities. By identifying basic pedagogical

building blocks, the educators using Teacher's LAB can become more reflective, thoughtful teachers.

The Teacher's LAB software prototype is a system for building and sharing lessons. It allows teachers to create spatially rich diagrams that chronicle the activities that transpire in their classrooms. Teachers can create lessons by modify and sequencing the templates into a series that represents a classroom activity. I will describe this process in greater detail in subsequent chapters, but I want to provide a quick peek at the software prototype [Figure 1].

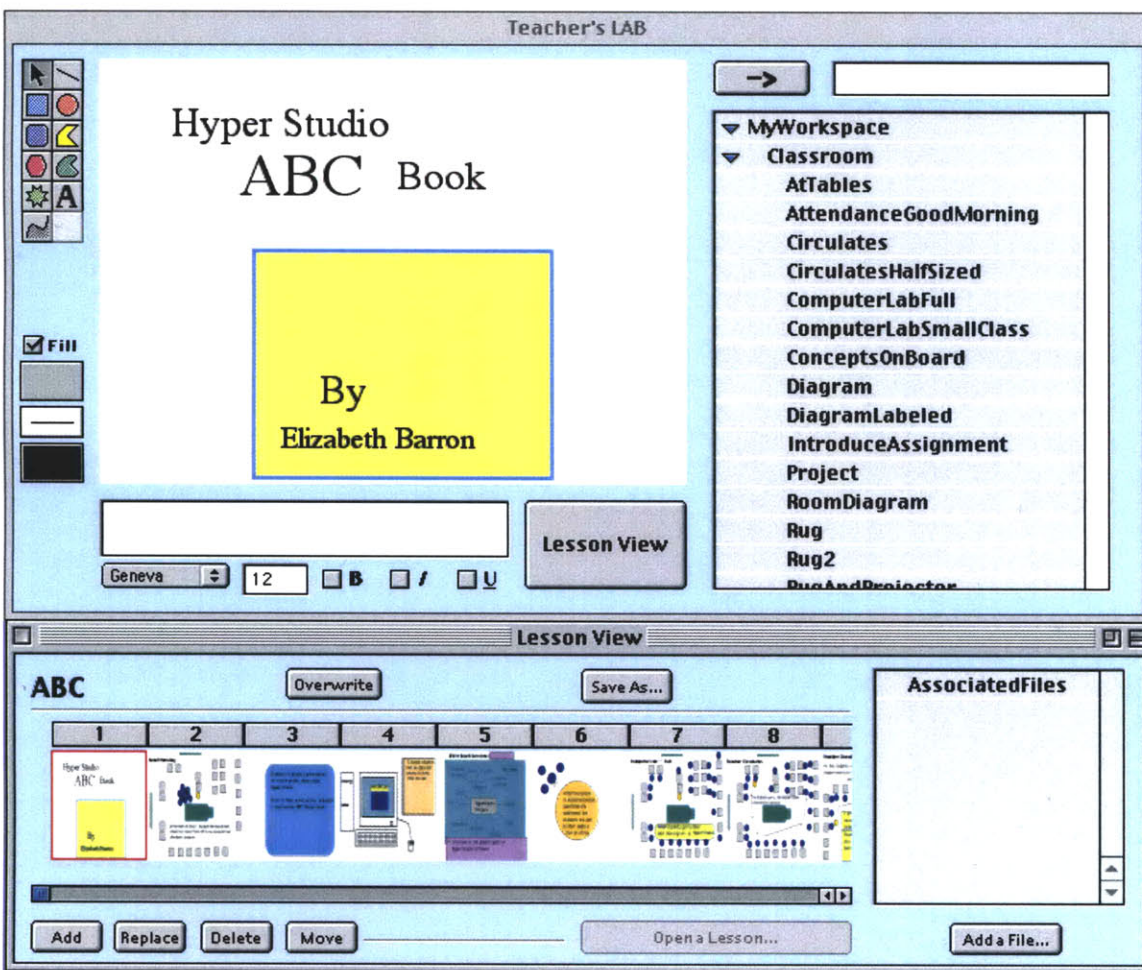


Figure 1. The Teacher's LAB interface supports the construction of diagrams that represent teaching practice.

The main window displays the graphical slides (top left), the MyWorkspace window stores templates (top right), and the Lesson window holds the sequence of slides in a completed lesson (bottom). The construction tool panel (top, far left) makes it possible for teachers to build original slides or create new templates. This basic structure was designed to support the construction of artifacts that represent classroom practice and by extension promote teacher learning and reflective practice.

But the development of the software prototype was only the beginning. I deployed the system in three Boston-area schools, two public and one private. Based on my pilot study with a half dozen teachers, I attempted to answer the following questions:

- 1) Can Teacher's LAB be used to accurately represent teaching practice?
- 2) Can Teacher's LAB help teachers construct artifacts that represent their own practice?
- 3) Can Teacher's LAB help teachers share teaching practices?
- 4) Does Teacher's LAB help teachers learn new ways to think about their teaching practice?

My initial results were promising, suggesting that the software does indeed promote representation, construction, sharing, and learning. As teachers used the system to develop lessons, they began to think differently about their teaching.

But the process of interpreting representations, constructing artifacts, sharing lessons, and learning new pedagogical approaches had an unanticipated result. Teachers began to notice essential educational building blocks, which I call *pedagogical patterns*. These patterns are used in many variations by countless teachers in endless combinations; they are key components of effective teaching, the basic building blocks of educational practice. Ordinarily, teachers use these patterns without being aware that they even exist. However, Teacher's LAB helped the participants in my pilot study recognize these patterns and use them more effectively. By

understanding these basic patterns, teachers can gain more control over their teaching becoming more reflective, thoughtful educational practitioners.

In the chapters that follow, I describe the Teacher's LAB project in detail. I begin with an extended example of Teacher's LAB in action. This example recounts the experience of two teachers who participated in the Teacher's LAB pilot study. Next, I describe the theoretical justification for the system, paying particular attention to the pattern language concept. This chapter is followed by an account of the design of the Teacher's LAB software application. The penultimate chapter addresses the Teacher's LAB pilot study and reports preliminary results. I conclude with a summary of my argument and some possible directions for future work.

Chapter 2: An Extended Example

2.0 Overview

The best way to understand the Teacher's LAB project is to use the software to build a lesson. To communicate the gist of this process, I provide an example of two teachers who participated in my pilot study. Over the course of a few months, I worked with two teachers from different schools, Ms. Oakes and Ms. Duke¹. I helped them use Teacher's LAB to create original lessons. Each teacher developed lessons, but more importantly the lesson creation process led to discussions about teaching. Building an artifact helped these teachers become more reflective about their teaching practice. Although these teachers work at different schools and have never met face-to-face, the software helped them share ideas. When they saw each other's lessons they immediately recognized teaching techniques that they share in common.

To illustrate Teacher's LAB in action, I begin with a tour of two lessons, one created by Ms. Oakes, the other by Ms. Duke. I helped both teachers use the software to create representations of lessons that they teach each year. Both teachers work in a school computer lab, and this setting features prominently in the resulting Teacher's LAB representations. Ms. Oakes leads a class in which her students use HyperStudio² software to create multimedia presentations about Ancient Egypt. Ms. Duke's lesson focused on the seasons and used Inspiration³ brainstorming software. After a tour of the lessons, I will address the effect the construction process had on the way that each teacher thinks about her practice.

¹ The names of the teachers have been changed.

² HyperStudio is a commercial multimedia authoring program that is used in K-12 classes. It is a more user-friendly version of HyperCard, the early authoring program for the Apple computer.

³ Inspiration is a commercial brainstorming package. It is mostly used to help students diagram their thoughts.

2.1 Constructing Artifacts: Two Example Lessons

2.1.1 HyperEgypt

After observing Ms. Oakes teach a lesson on HyperStudio, we built a representation of the lesson in Teacher's LAB. I developed this representation with Ms. Oakes, and she felt that it was an accurate representation of what actually happened in her classroom. The following is the lesson window that contains the first part of this HyperStudio activity [Figure 1].

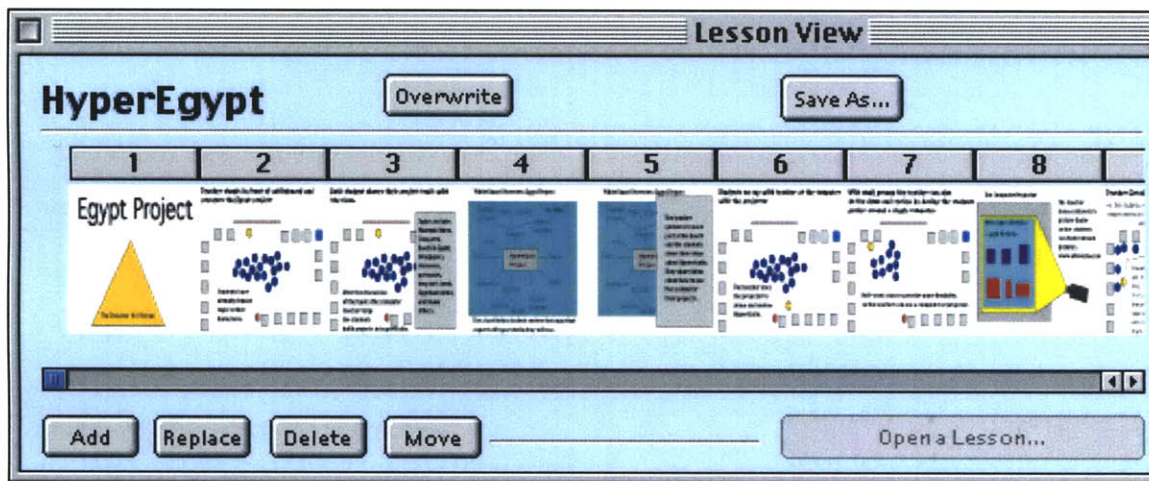


Figure 1. The Lesson window contains a sequence of slides that represent a classroom activity.

The sequence of slides tells the story of how the lesson unfolds through time and space. In this instance, the lesson begins with a discussion of topics that were assigned in homeroom [Figure 2].

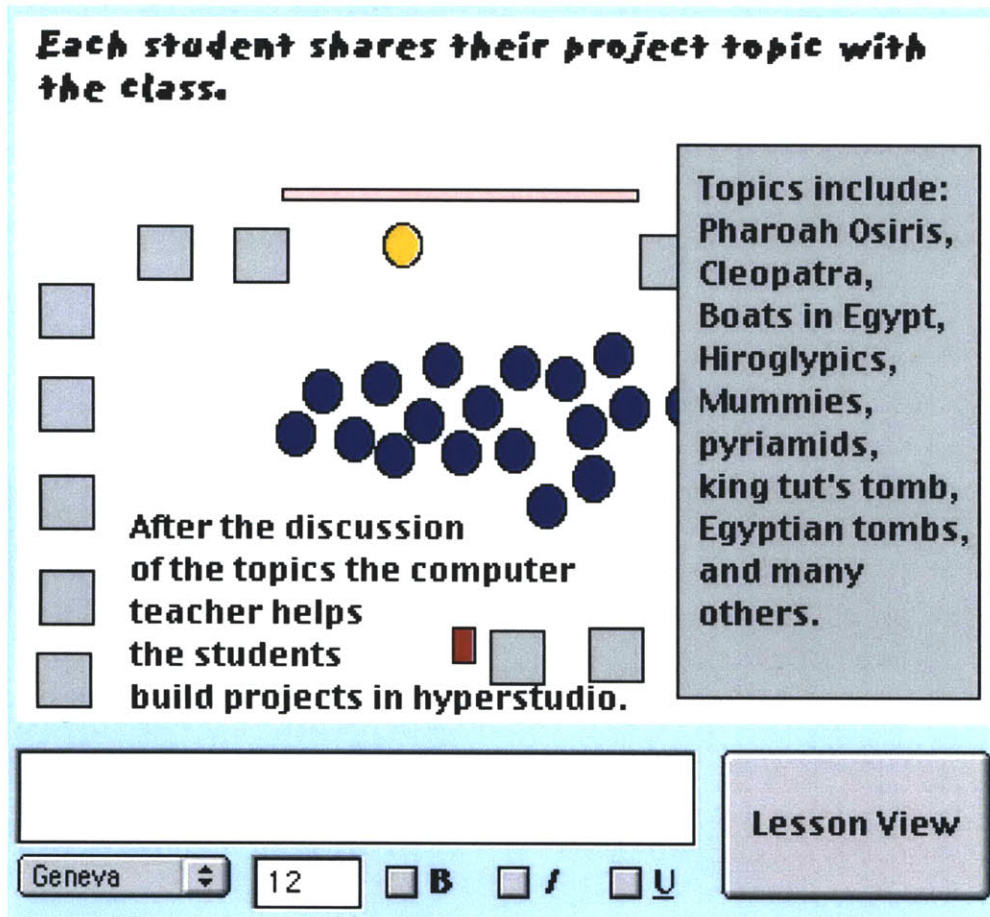


Figure 2. A full sized view of one of the slides in the lesson. The blue dots represent students, the yellow dot represents the teacher, and the gray squares represent computers. Notice the emphasis on the spatial layout of the classroom.

In a subsequent slide, the teacher creates a diagram on the board that summarizes HyperStudio's main functions [Figure 3].

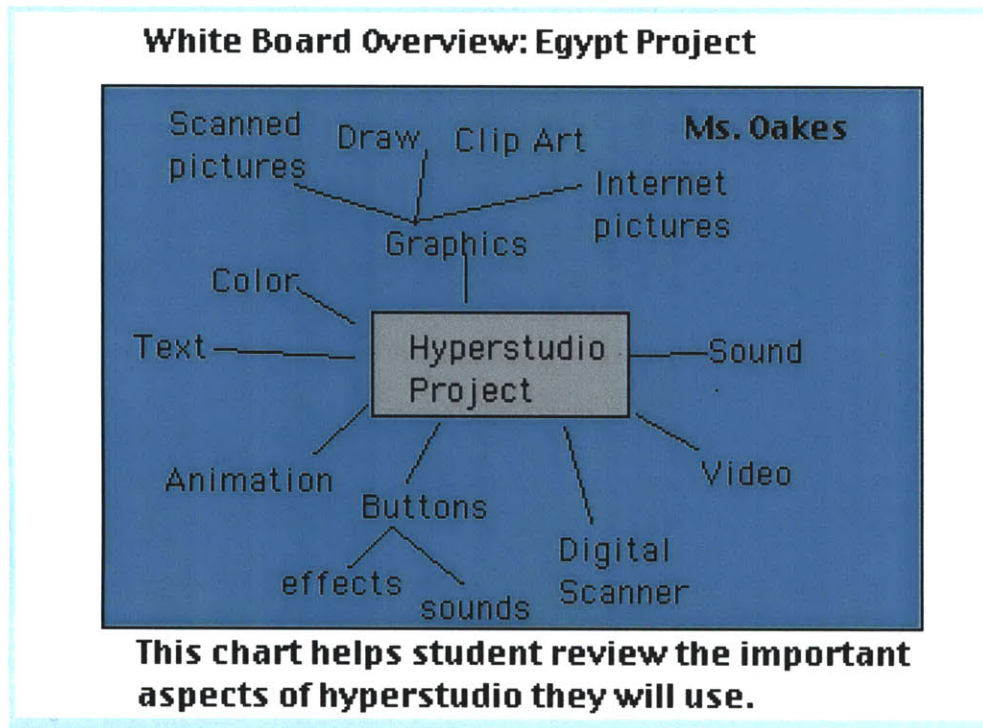


Figure 3. This full sized slide depicts the writing on the class whiteboard.

The teacher then uses the LCD projector to demo HyperStudio and the image search engine at AltaVista [Figure 4].

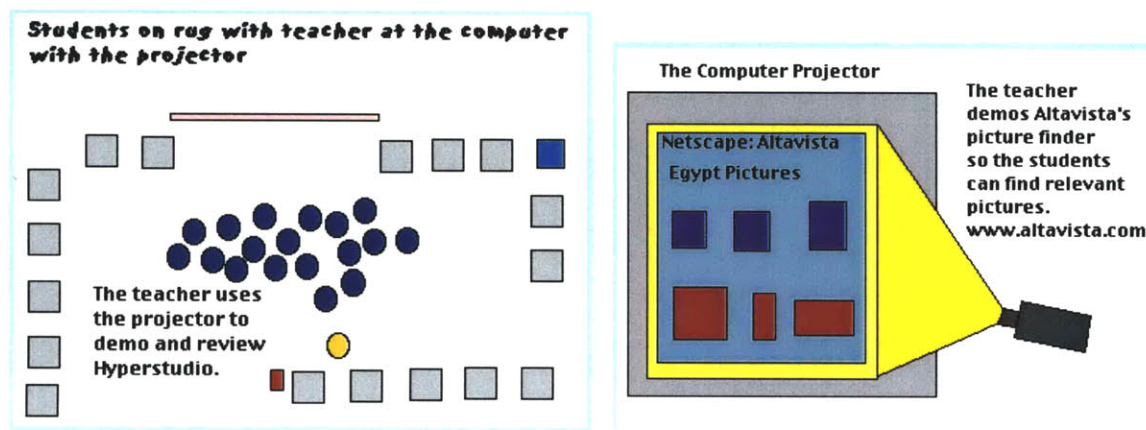


Figure 4. A spatial layout illustrates how Ms. Oakes uses the projector to demonstrate software (left) and another slide shows a view of the projection screen itself (right).

Once students have the information they need to start their projects, they return to their computers and begin working. The teacher circulates and helps students when they have problems [Figure 5].

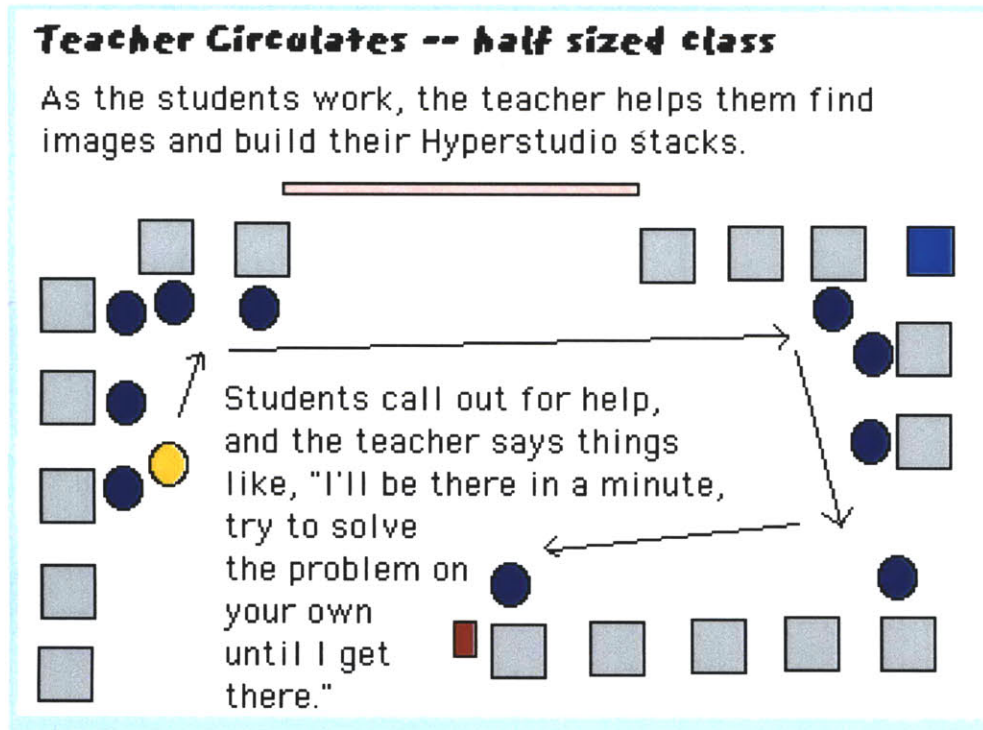


Figure 5. This spatial layout also includes arrows that indicate how the teacher moves through the classroom.

Students work until it is time for them to return to their homeroom. In homeroom they will continue to do research on Ancient Egypt that will be incorporated into their HyperStudio projects. In subsequent classes, Ms. Oakes annotates the diagram she drew on the white board as students learn to use more HyperStudio features [Figure 6].

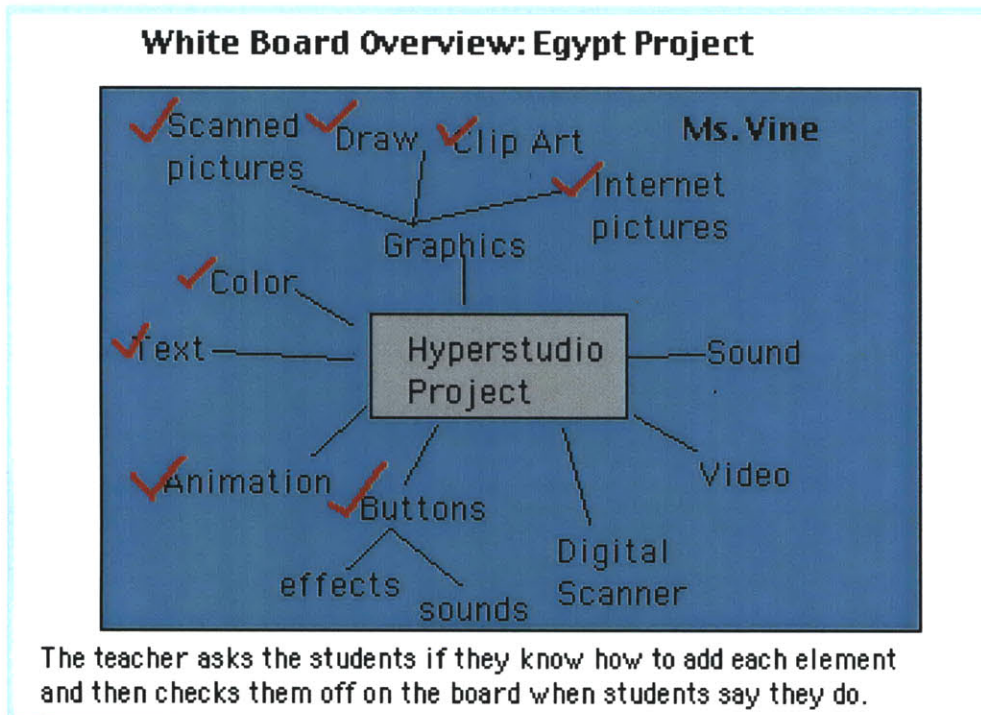


Figure 6. Ms. Oakes reuses this picture of the whiteboard, but modifies it to reflect the changes she made as the lesson progressed.

The project continues for several class periods as students complete their projects. This summary of Ms. Oakes's lesson provides highlights from a unit that took several weeks of to complete.

2.12 The Seasons

I also spent time in Ms. Duke's classroom, and worked with her to create a lesson on the Seasons. Here is the lesson window containing the completed lesson [Figure 7].

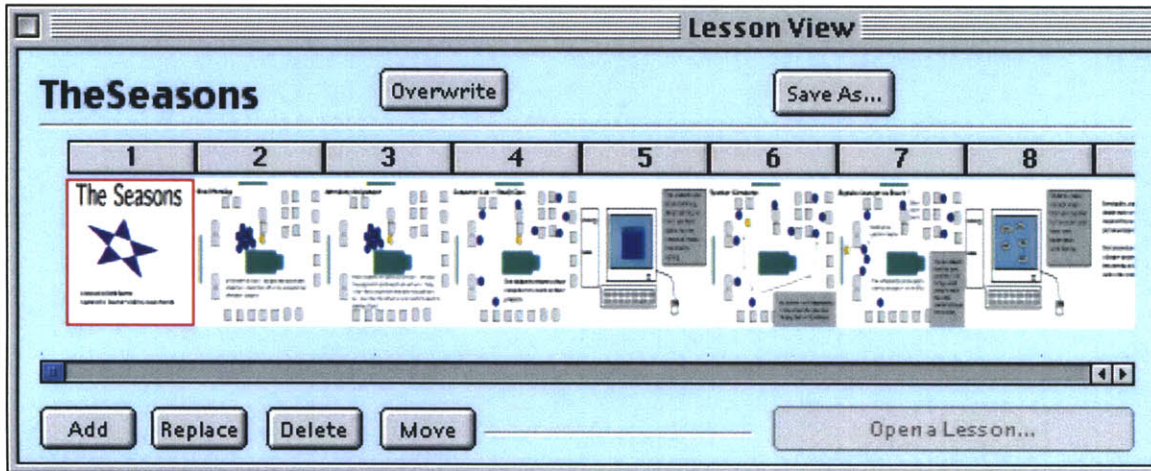


Figure 7. The lesson window offers an overview of the lesson. A glance at the lesson provides a quick summary of the spatial arrangement of the classroom throughout the lesson.

Like Ms. Oakes's lesson, Ms. Duke begins by gathering the students together away from the computers. The students are introduced to the assignment and the software they will use and are invited to discuss the topic [Figure 8].

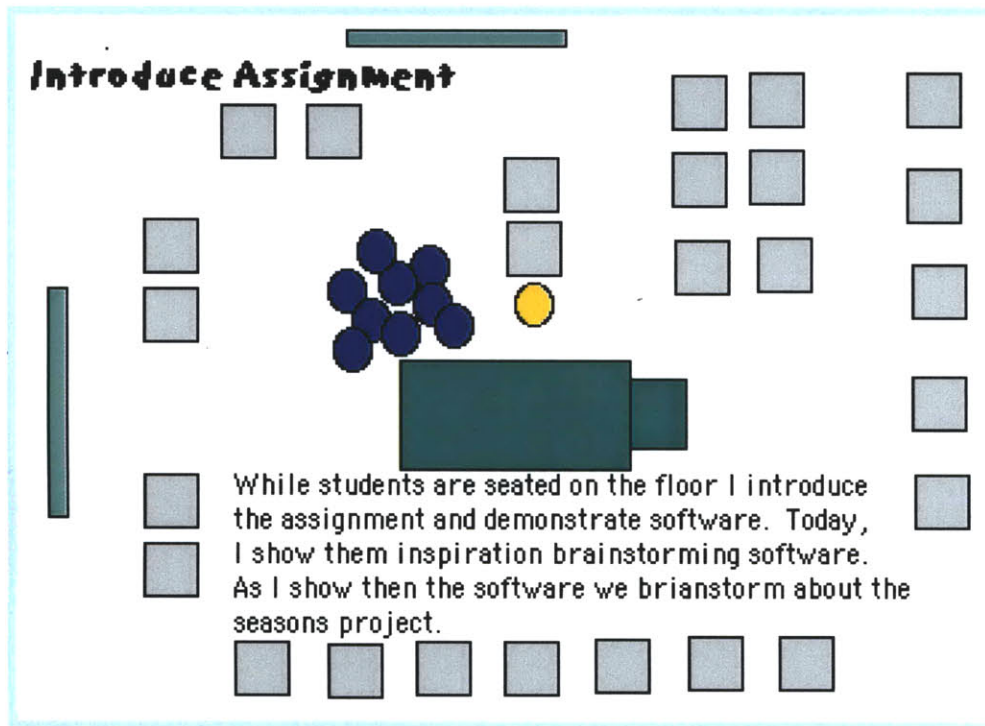


Figure 8. Ms. Duke does not have a projector, so she has to gather the students together tightly so that they watch a software demonstration on a single computer screen.

Before the students begin working independently, Ms. Duke plays a classical music CD to inspire the students to think about Spring [Figure 9].

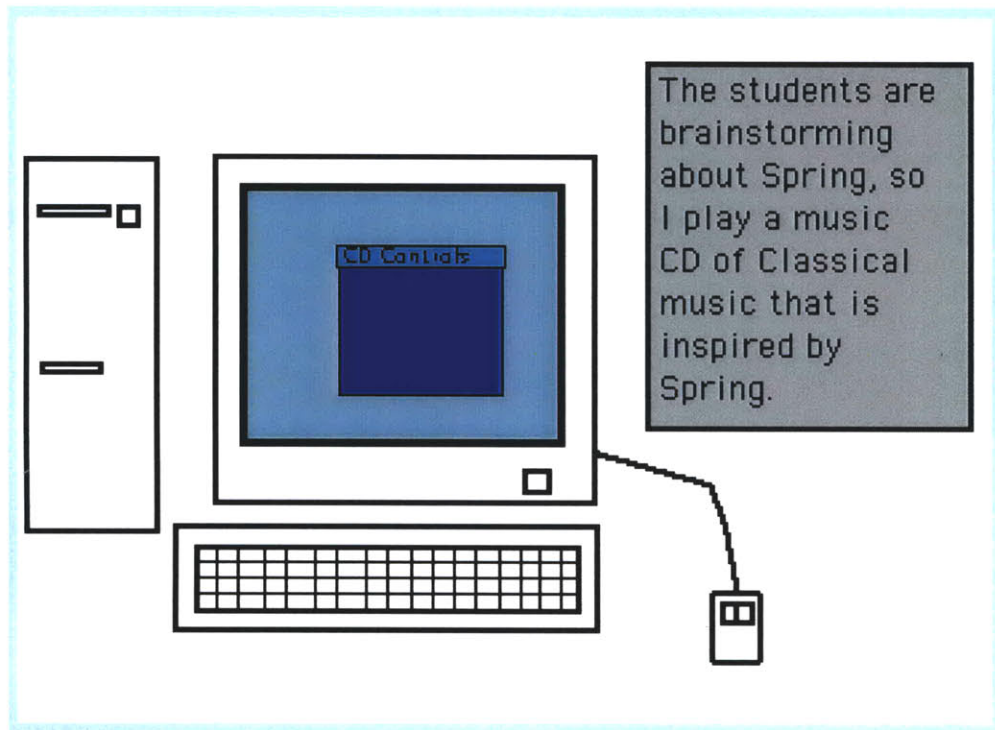


Figure 9. Spatial diagrams are complimented by examples of materials that are used during the lesson, in this case a computer and CD player.

While the students listen to music, they use the Inspiration software package to help them organize their brainstorming. Ms. Duke circulates and helps students as they work [Figure 10].

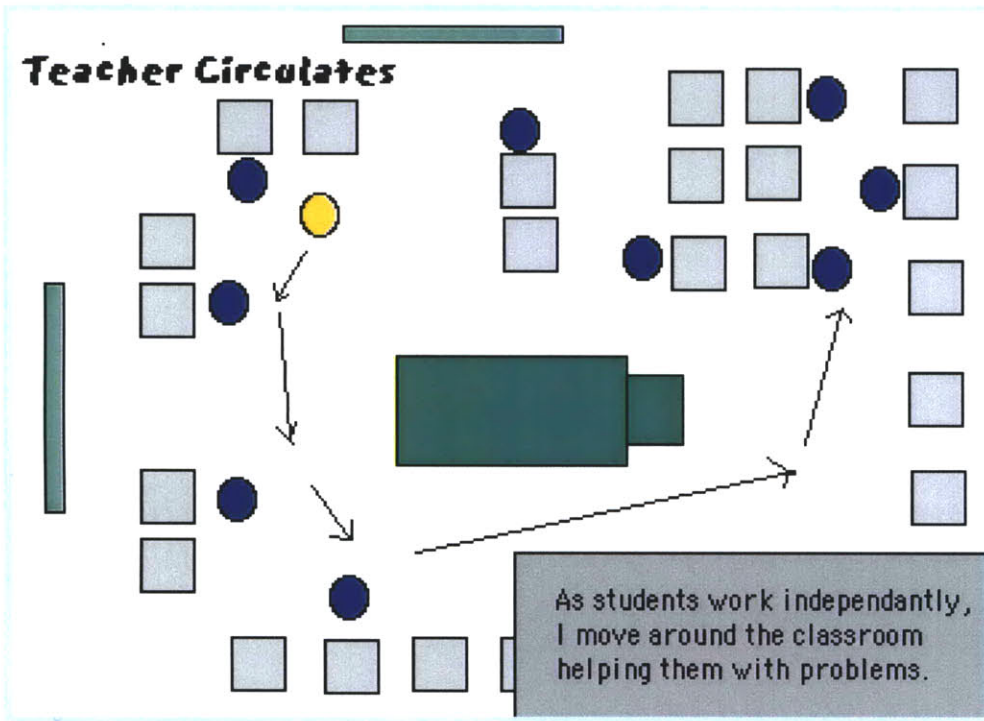


Figure 10. Spatial diagrams help communicate what the teacher is doing at each stage of the lesson.

Periodically, several students have the same problem. In this situation, the teacher uses one of the white boards to help a small group while other students continue to work independently [Figure 11].

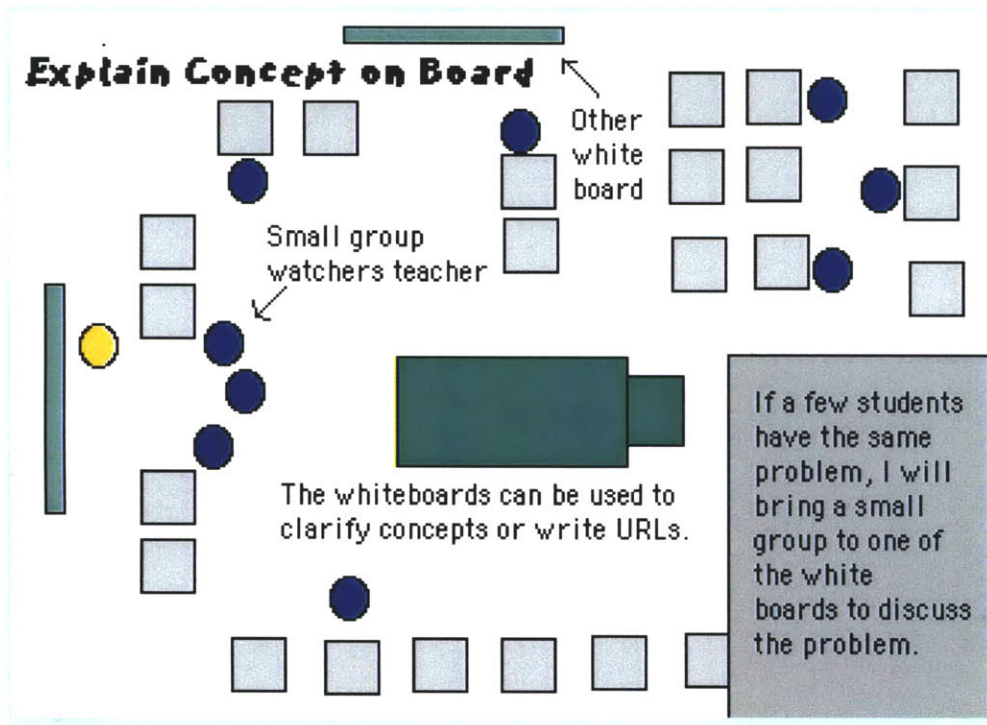


Figure 11. Spatial diagrams are particularly effective when multiple activities are happening in the classroom simultaneously. In this case, the teacher helps a small group while other students continue to work independently.

As the students work they develop concept maps using the Inspiration software [Figure 11].

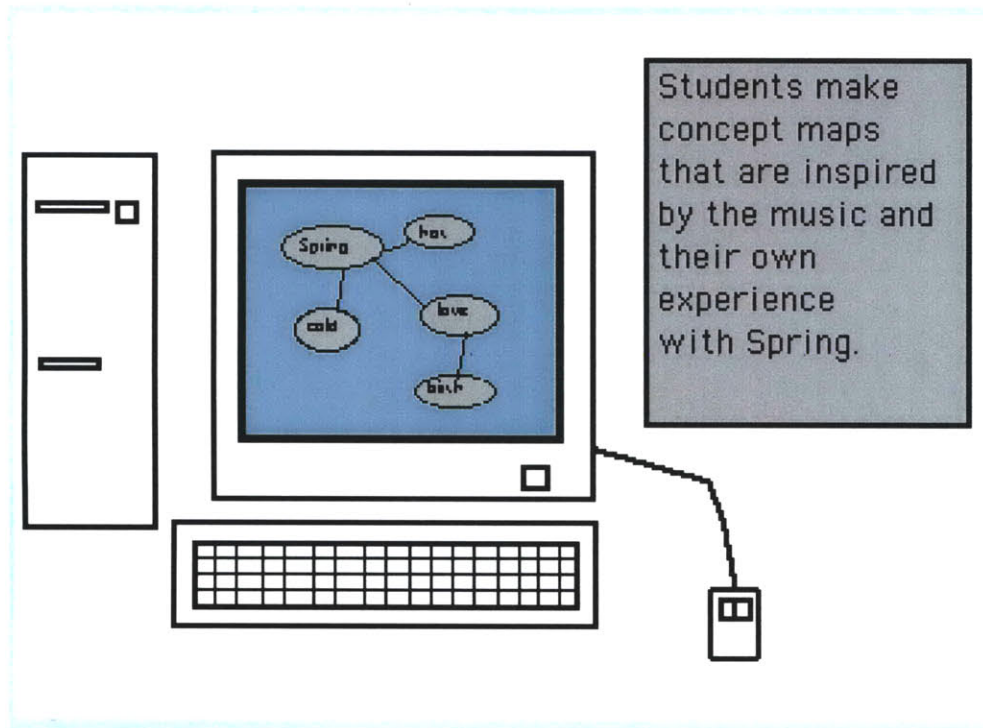


Figure 11. Another view of the computer communicates a feel for the software that the students are using.

Later these concept maps will be used as the basis for a writing assignment that will happen in the students' English class. This summary of Ms. Duke's lesson provides highlights from an on-going lesson in which students use writing, art, and music to express their feelings about the seasons.

2.2 Represent, Construct, Share, and Learn: Patterns for Pedagogy

What did Ms. Oakes and Ms. Duke learn from creating these lessons? First of all, these lessons helped structure conversations about teaching. As I worked with Ms. Oakes and Ms. Duke, they provided justifications for what they do in the classroom. Ms. Oakes told me that that the lesson needed to begin with a picture of the students gathered on the rug. "I like to set the tone at the beginning of class by gathering the students on the rug," she explained. This observation came as a direct result of having to build a

representation that depicted the start of class. She had to explain her practice so that it could be accurately represented in Teacher's LAB. The diagrams provided anchors for discussion. In my conversations with teachers, they often pointed to a slide and said things like "right here I am making sure that all the students understand the assignment" [Ms. Duke]. The lesson provided visual markers to structure conversation.

But constructing an artifact also made it possible for Ms. Oakes and Ms. Duke to share ideas. Although they teach at different schools, they immediately recognized similarities in their teaching. Sometimes these similarities were difficult to verbalize. When Ms. Duke saw Ms. Oakes's lesson on Egypt, she excitedly exclaimed, "she has it set up like me....she is doing the same stuff". When I asked her what she meant by "stuff," she had some difficulty answering. She pointed to the diagram in Teacher's LAB that represents the basic pattern that Ms. Oakes uses to start a new lesson. "It seems that we probably have a very similar style to get things started," Ms. Duke explained.

Although I was hoping the two teachers would learn from each other's lessons, I did not anticipate their excitement at seeing each other's work. Ms. Oakes and Ms. Duke each had a strong sense that she was using the same techniques as her cross town colleague. In particular, the two teachers felt that they started class the same way [Figure 12].

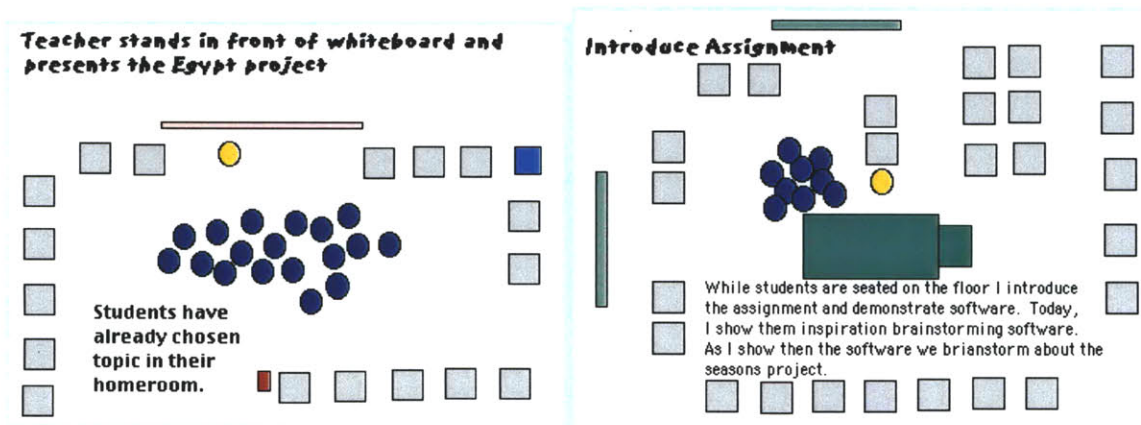


Figure 12. The two diagrams that represent the spatial arrangement of the class when Ms. Oakes and Ms. Duke start class.

These two diagrams indicate that both teachers group their students on the floor at the start of class. However, for Ms. Oakes and Ms. Duke, these diagrams seemed to evoke much more than a basic spatial arrangement. While the students are on the rug, it is possible to lead a group discussion, diagram concepts on the board, or demonstrate software. This basic spatial arrangement made possible a host of educational practices and the Teacher's LAB diagram served as a symbol for all of these practices.

By recognizing a set of practices that they share in common, Ms. Oakes and Ms. Duke identified a key *pedagogical pattern*. The diagram of students gathered on the rug served as the core of the "Starting Class" pattern. Although they were not even aware that they were using this pattern, when they saw it represented in Teacher's LAB they immediately recognized something familiar. Teacher's LAB provided a language for Ms. Oakes and Ms. Duke to describe the set of activities they use to start their class each day. The core diagram represents an arrangement that is conducive to several related teaching practice, all of which extend the basic "Starting Class" pattern. The arrangement provides a way of addressing the entire group while avoiding the distraction of the computer monitors. While the students are gathered on the floor they can be given instructions, engage in discussions, or watch software demonstrations.

The "Starting Class" pattern was identified because Ms. Duke and Ms. Oakes

noticed that they shared an essential element of their practice in common. In addition to the "Starting Class" pattern, Teacher's LAB help them identify another similarity in their teaching practice. The second essential technique that they identified I will call the "Independent Work" pattern [Figure 13]. Both teachers have their students work independently at the computers while the teacher circulates providing individual help. This gives students the opportunity to explore but also provides individual support when students encounter problems. Once again, a core diagram helped represent a whole set of techniques that a teacher can use in the classroom [Figure 13].

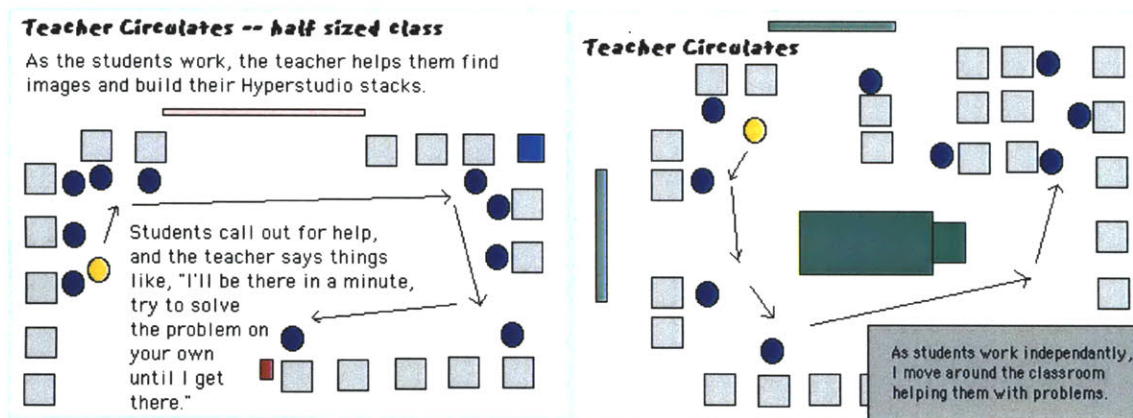


Figure 13. For both teachers, the diagram of the teacher circulating represented a core element of the "Independent Work" pattern.

Although I worked closely with the teachers to develop lessons, I was surprised that they had such an immediate recognition of each other's patterns. This recognition was stimulated by the construction process and the spatial layout of the lessons. Ms. Oakes and Ms. Duke began to reflect on their teaching practice because they had shared artifacts that could incite discussion. After discussing several Teacher's LAB lessons, Ms. Duke gained a greater appreciation for what she does each day in the classroom. By revealing key pedagogical building blocks, Teacher's LAB helped her reflect on her own process:

When you really break it down, that is when you say, jeeze, I am doing a lot, and I am not even aware half the time that I am doing it!

The software helped Ms. Duke recognize how much she does each day while she is teaching. The Teacher's LAB lesson provided an artifact that let her reflect on her teaching process in new ways.

Teacher's LAB provided Ms. Duke and Ms. Oakes with a visual language for describing their teaching practice. This language consists of pedagogical patterns that they use everyday but have trouble describing in words. With Teacher's LAB, they were able to break down teaching practices into key building blocks. This helped the teachers gain a better understanding of their teaching practice and made it possible for them to collaborate in new ways. They recognized similarities between their teaching and began to borrow ideas from each other.

Ms. Duke and Ms. Oakes become more conscious of the techniques they use in the classroom. Teacher's LAB helped them construct and share educational patterns, which made it easier for them to learn from each other. In particular, Ms. Duke liked Ms. Oakes's whiteboard diagram of the features of HyperStudio. Indeed, she liked the idea so much that she incorporated the diagram into her own HyperStudio lesson, expanding her use of the "Starting Class" pattern. Ms. Oakes, on the other hand, loved Ms. Duke's use of music to inspire students. She incorporated this idea into her teaching, expanding the effectiveness of her "Independent Work" pattern. As the teachers built lessons and learned from each other, the patterns they used became more nuanced and expansive. Two teachers began to recognize a pattern language for pedagogy that helped them become more reflective practitioners.

Chapter 3: Theoretical Foundations

3.0 Objectives

Teacher's LAB is an experimental attempt to create a new language for understanding teaching. The software helps teachers break their teaching practice into key building blocks, which I call pedagogical patterns. Even though teachers use them everyday, recognizing these patterns is not an easy task. It requires a tool like Teacher's LAB that can structure discussions about teaching. At this stage, recognizing and developing patterns also requires a researcher willing to spend time with the teachers who are using the tool. I did not just give the teachers a software package. Over the course of many school visits, I engaged teachers in discussions about their teaching and helped them use the software.

The design of Teacher's LAB and my interactions with teachers, were both informed by a diverse body of research. This research provides the foundation for the main contribution of the Teacher's LAB project: the development of a pattern language for pedagogy. The notion of a pattern language is taken from architect Christopher Alexander (1977). I argue that Alexander's work in the field of architecture can be extended to education, supporting a new approach to the design of professional development systems for teachers. In order to extend the pattern language concept to the field of education, I draw on Donald Schon's work on professional practice (1983), Ball and Cohen's research into enacted curriculum (1996), and Alan Schoenfeld's work on metacognition (1987). These researchers provide an understanding of the process of teacher learning that is essential to the development of a pattern language for pedagogy. But first, I provide a description of other systems that use technology to support the professional development of teachers.

3.1 Existing Systems

Teacher professional development is an expansive and diverse area of research. A complete review of existing professional development systems is beyond the scope of this thesis, however, I will provide a summary of three popular approaches that use technology to support teacher development. Like Teacher's LAB, each approach attempts to use technology to enhance teacher learning.

3.1.1 Lesson Plan Databases

Perhaps the most common way that teachers share ideas is through the traditional lesson plan. The Internet has made it possible for teachers to access thousands of lesson plans from literally hundreds of on-line databases. The following screenshot is from the TEAMS site for distance learning which links to several lesson plan databases [Figure 1].

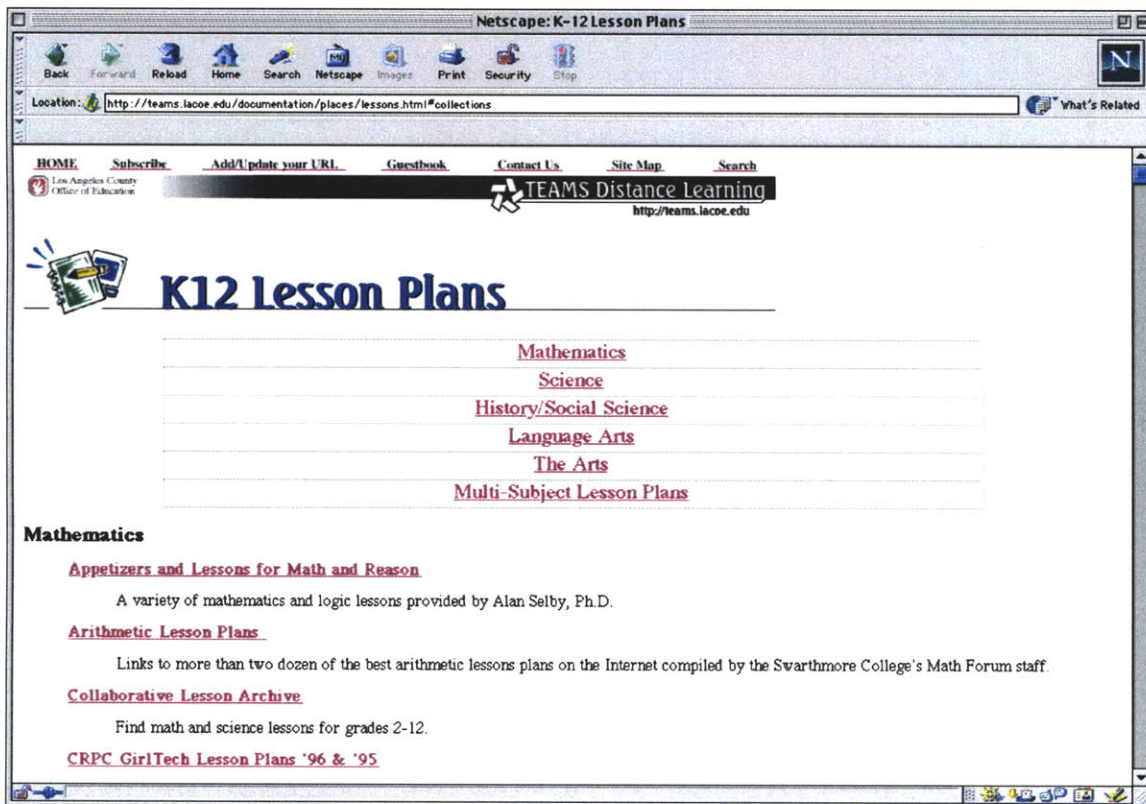


Figure 1. <http://teams.lacoe.edu> provides links to dozens of lesson plan libraries.

These sites make it easy for a classroom teacher to search for relevant lessons. A search on the ERIC lesson plan database for "the seasons" retrieved several lessons [Figure 2].



Figure 2. Results for a search of the ERIC lesson plan database for "the seasons."

Lesson plans in these databases can be submitted by academics, teachers, or other educators. The lessons are stored in the traditional lesson plan format. Here is an example of one of the lessons on the seasons [Figure 3].

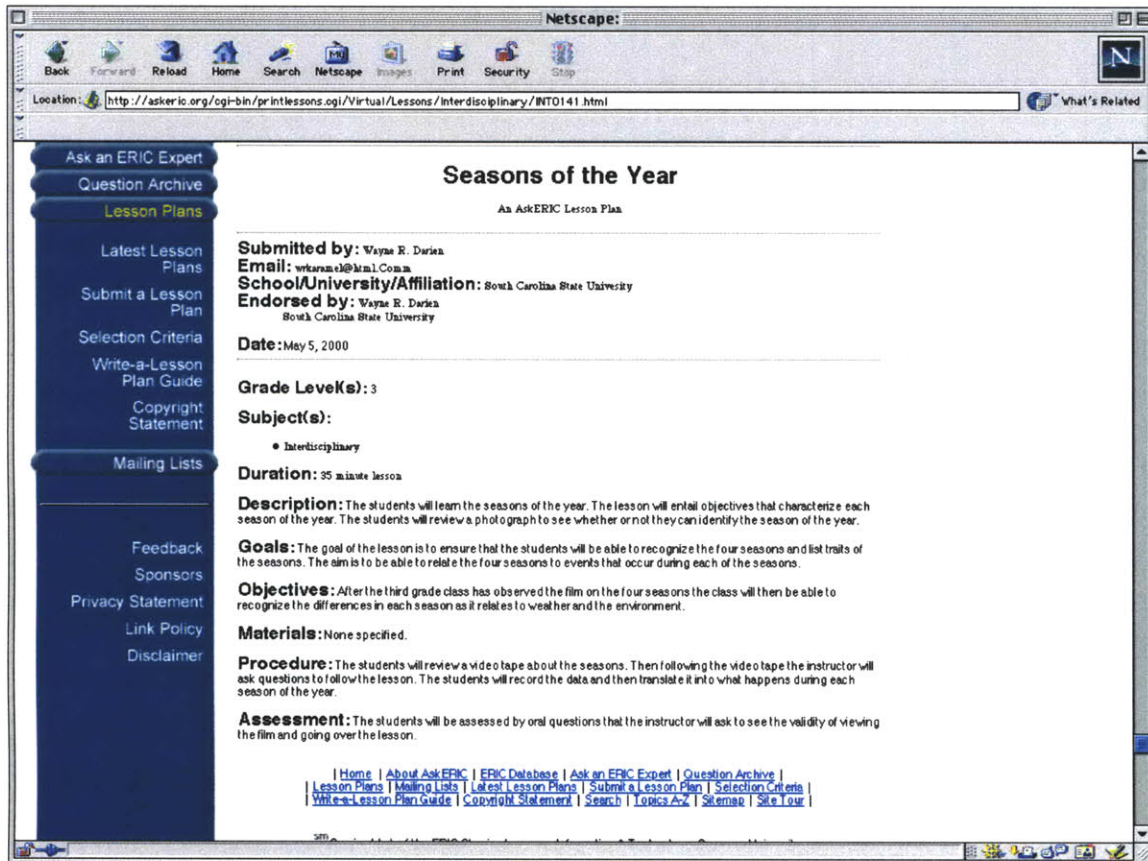


Figure 3. A traditional lesson plan about the seasons.

This lesson includes information about the duration, description, goals, objectives, materials, procedure, and assessment of the activity.

Lesson plan databases and Teacher's LAB are similar projects in that both encourage teachers to produce and share their own materials. Traditional lessons and Teacher's LAB lessons both provide an opportunity for teachers to learn from the process of creating a lesson as well as from reading a lesson created by a colleague. In this model, teachers become producers and consumers of new educational ideas which allows an on-line community of educators to define which lessons are most relevant educationally. By definition, a lesson that is downloaded by many teachers is broadly relevant. But traditional lesson plans do not represent the context of teaching practice. Teacher's LAB fills this gap by providing a visual, spatial approach to representing classroom activities. Visual imagery is a useful tool to structure

discussion about teaching practices (Smith, 2000, pp. 750). Furthermore, a spatial approach illustrates the activity that happens in the classroom, instead of merely providing a sequence of events. Teachers know how the lesson is enacted, because Teacher's LAB represents pedagogical patterns in addition to curriculum. Pedagogical patterns show a teacher *how* to teach a lesson in addition to including what to teach. The additional information provides teachers with a blueprint for implementing the lesson in a classroom.

3.12 Communication Technology

Several professional development systems combine existing communications technologies to support teacher learning. These systems rely on chat rooms, email, message boards, and on-line databases to facilitate conversations about teaching. Perhaps the best known of these systems is Tapped In, a system developed at the Center for Technology and Learning at SRI International [Figure 4]. Tapped In shares many of the same goals as Teacher's LAB. The researchers who developed Tapped In recognize that the structure of school limits informal collaboration, denying teachers “opportunities to access and discuss exemplary reform-based materials, co-construct and publish resources for new teaching practices, and collaborate on the creation of locally relevant solutions” (Schlager, et al., 1998). Like Teacher's LAB, Tapped In attempts to address these issues by providing technological support for teachers.

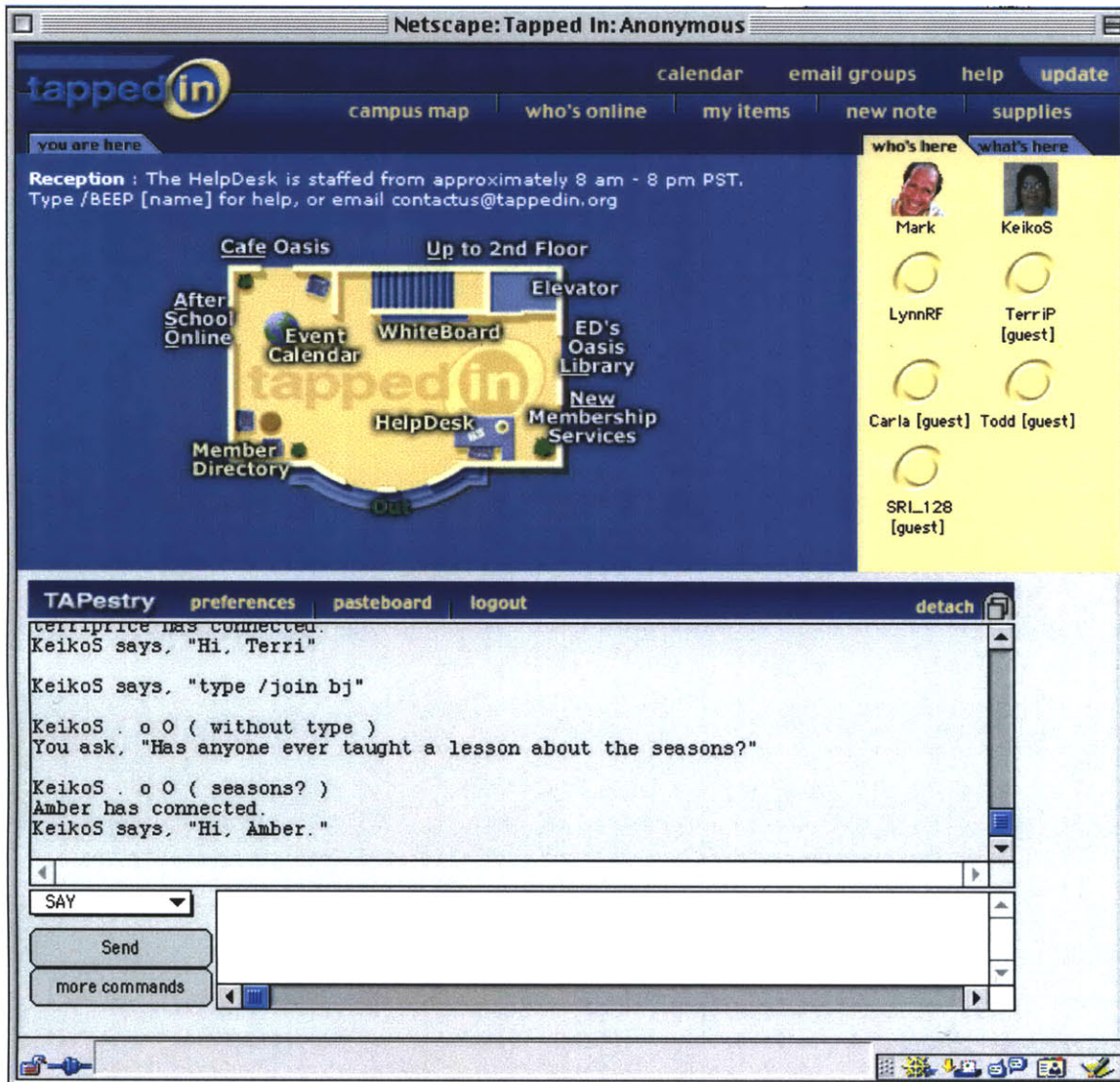


Figure 4. Tapped In provides a virtual meeting place for teachers that is based on synchronous chat and file sharing.

Although the Teacher's LAB project also encourages communication between teachers, I base this communication around the construction and co-construction of artifacts. These artifacts allow teachers to contribute to a growing database of pedagogical patterns. Tapped In promotes discussion about teaching, but Teacher's LAB takes this one step further by helping educators develop and share representations of their practice. Teachers are not just talking, they are building and sharing. Furthermore, Teacher's LAB focuses on the construction of spatial representations of classroom practice.

Although Tapped In recognizes the importance of spatial representation in their web site navigation, they do not support the development of spatial representations of teaching practice.

3.13 Video Libraries

The final approach I will address is probably the most similar to Teacher's LAB. Several research efforts have focused on compiling video databases of teachers in action. The idea behind these efforts is to capture video records of educational best practice. Then teachers can use the resulting video library as a resource to support their own teaching. These research efforts hope that viewing video of master educators will help teachers improve their teaching practices. In most cases, these video libraries are compiled as part of a larger program of educational reform. Tammy Chaney-Cullen and Thomas Duffy use video to change teacher "beliefs and practice" so they can adopt a constructivist approach to mathematics education (1999). Magdalene Lampert and Deborah Ball use video to support progressive educational reform and "learning for understanding" (1998). Elliot Soloway and his colleagues at the University of Michigan use video libraries to help teachers transition to project-based science teaching (2001). In each case, these programs model alternative teaching methods that teachers are encouraged to adopt.

Like Teacher's LAB, the video library projects attempt to identify essential teaching practices that can be used as models for teachers. A closer look at Soloway's project illustrates this similarity. Soloway's system presents teachers with three video clips: Getting Started, Designing in small groups, and Sharing with the whole class [Figure 5]. These video clips are quite similar to the pedagogical patterns represented by diagrams in Teacher's LAB in that each clip shows an essential element to successful teaching. In both Teacher's LAB and Soloway's project, teachers are exposed to pedagogical patterns and they are encouraged to relate those patterns to their own teaching practice. Through debate and discussion, both systems help teachers think differently about what they do each day in the classroom.

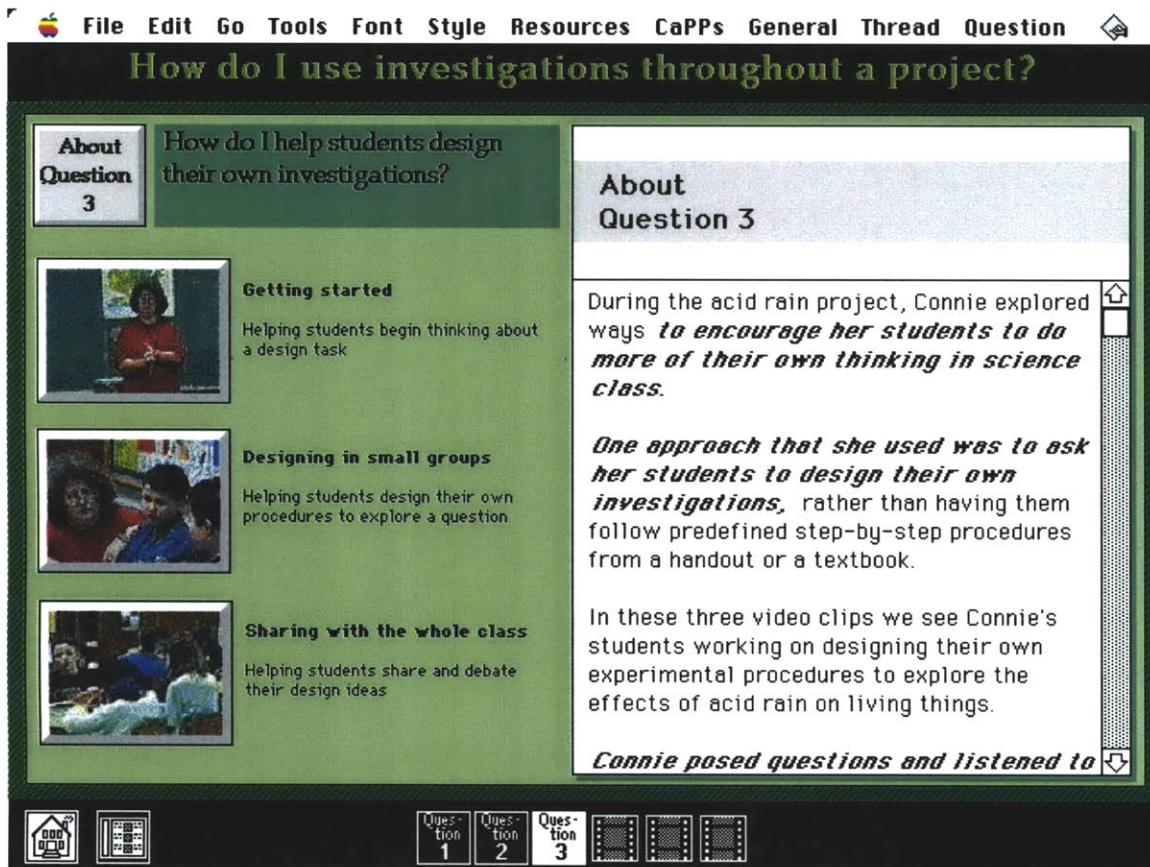


Figure 5. Soloway, et al.'s system to use video to help teachers transition to project-based science instruction.

Like Teacher's LAB, Soloway's system could be used to promote a pattern language for pedagogy. However, Teacher's LAB is fundamentally different because it allows teachers to actively construct this pattern language. Teacher's LAB invites educators to develop representations of their own practice. I argue that this process of building is essential to the learning experience that Teacher's LAB promotes. Video projects tend to have a content agenda such as constructivism, "learning through understanding," or project-based science. Teacher's LAB reverses this process by inviting teachers to construct the patterns that are most relevant to them. However, the process of developing these patterns helps teachers question their current practices and encourages them to develop new techniques. Building an artifact that represents practice promotes reflection and teacher change.

Teacher's LAB does not promote a particular educational reform agenda, but does assert that teachers who are reflective and thoughtful will have more success in the classroom. In order to construct representations of their teaching practice, teachers need to think critically about what it is that they do in their classrooms. By constructing an artifact that represents their practice, educators gain perspective on what they do. Teacher's LAB lessons are an example of what Sherry Turkle calls objects-to-think-with (1995, pp. 47-49). They render a process concrete so it become easier to understand. In this case, actually constructing this object is what differentiates Teacher's LAB from educational research that uses video libraries of best practice.

3.14 Teacher's LAB

The three approaches to professional development outlined above, all seek to promote teacher learning, and therefore are offered in the same spirit as Teacher's LAB. Indeed, Teacher's LAB can be used like an on-line database of lessons plans to help teachers share activities, like Tapped In to promote discussion between teachers, or like the video library projects to create a repository of best practices. However, Teacher's LAB uses a different approach to accomplish these same goals. Teacher's LAB encourages active construction of artifacts that represent teaching. This construction process helps teachers reflect on their teaching practice. A focus on the spatial dynamics of educational practice supports this approach, and Teacher's LAB relies on diagrams that illustrate the spatial context of classroom practice. As teachers use the system, they collaboratively construct pedagogical patterns. It is the creation of these patterns that is at the heart of the Teacher's LAB project and is ultimately what distinguishes Teacher's LAB from other systems.

3.2 A Pattern Language for Pedagogy

To explain the concept of a pattern language for pedagogy, I return to Christopher Alexander's original work. In 1977, Alexander and his colleagues at UC Berkeley's Center for Environmental Structure published *A Pattern*

Language. The book presented a new approach to architectural design which the authors described as "a language, for building and planning...towns and neighborhoods, houses, gardens, and rooms" (Alexander, et al., p. ix). They defined this language as a series of important architecture patterns which represented the essential building blocks for architectural design:

The elements of this language are entities called patterns. Each pattern describes a problem which occurs over and over again...and then describes the core solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice (Alexander, et al., p. x).

Alexander is interested in solutions to architectural problems, and I am interested in educational problems, but in both cases it is possible to use the pattern language concept. Before extending the concept to pedagogy, I will clarify Alexander's original idea by taking a closer look at one of his architectural patterns.

Chapter 190 of *A Pattern Language* is entitled "Ceiling Height Variety" and begins with the principle that a "building in which the ceiling heights are all the same is virtually incapable of making people comfortable" (Alexander, et al., p. 877) According to Alexander, ceiling height is a measure of social distance, and the height should be varied according to the level of intimacy appropriate for a particular room. Thus,

[i]ntimate situations require very low ceilings, less intimate situations require higher ceilings, formal places require high ceilings, and the most public situations require the highest ceilings: for example the canopy over a double bed, a fireside nook, high-ceilinged formal reception room, Grand Central Station (Alexander, et al., p. 879).

The Ceiling Height Variety pattern defines important design principles that can be applied and re-applied when designing buildings. The pattern is meant to be combined with other patterns such as Light on Two Sides of Every Room (159), Opening to the Street (165), Alcoves (179), and Marriage Bed (187). Indeed it is desirable to design environments in which "many patterns overlap in the same physical space" resulting in a building that "is

very dense; it has many meanings captured in a small space; and through this density, it becomes profound" (Alexander, et al., p. xli). Individual patterns become part of a poetic design language when they are combined to form an organic whole.

A Pattern Language outlines a flexible framework that provides designers with essential building blocks and a method for combining those building blocks into finished products. Although the content of his book is about architecture, the theoretical framework Alexander develops has the potential to be relevant to other disciplines. The concept has already inspired new approaches to object oriented software design (Gamma, et al. 1994). The Teacher's LAB project extends the concept to education by beginning the process of building a pattern language for pedagogy. This language will include patterns that embody the practices used by successful classroom teachers and a method for combining these patterns to plan new classroom activities. Alexander provides a model for how this might work, and my hypothesis is that overlapping patterns can produce both buildings and lessons that are poetic and profound.

A Pattern Language was published as a book, but the book format is not the ideal medium for a pattern language. Alexander explains that "the language is in truth a network," and despite the sequential arrangement in the book, "there is no one sequence which perfectly captures it" (Alexander, et al., p. xviii). Furthermore, Alexander emphasizes that his particular pattern language might "be related to the countless thousands of other languages we hope that people will make for themselves" (Alexander, et al., p. xvi). However, once a book is published it is impossible for people to add patterns to Alexander's collection. Perhaps if Alexander were developing *A Pattern Language* today, he would solve these problems by using digital media. Digital media could facilitate the ordering of patterns into multiple, networked arrangements and allow individuals to contribute their own patterns to an existing collection.

The Teacher's LAB software takes advantage of these digital affordances to create a pattern language for pedagogy. This is particularly important for

educational patterns, since educational practice will never be perfected. There is always room to create innovative new approaches to implementing classroom activities. This is why I am not advocating a particular pattern language, but rather a dynamic, extensible collection of patterns that teachers, researchers, and curriculum developers can collaboratively construct. Stuart Brand's *How Buildings Learn* stresses the importance of dynamic design changes, even in the domain of architecture (Brand, 1974). In architecture and pedagogy, pattern languages should remain open so new generations can expand the scope of the language's expression. Indeed, both buildings and lessons are often improved as they are modified by successive people, gaining a character that can only result from collective activity unfolding through time.

3.3 The Teacher-as-Learner

The Teacher's LAB project promotes the development of a pattern language to represent solutions to pedagogical problems. The Teacher's LAB software platform is designed to help teachers learn how to use this language. I begin with the assumption that teachers are learners. This learning does not stop when pre-service education ends. On the contrary, teachers do much of their learning on the job and encouraging life long learning is essential to quality education. Teacher's LAB supports the continued learning of in-service teachers, providing a platform that helps working teachers to construct, share, and reflect.

Furthermore, the software seeks to balance the disproportionate attention that is given to the dynamics of student learning. Teacher learning is essential, but educational theory and practice often emphasizes student learning and neglects the learning needs of teachers. As a graduate student in education at Columbia Teacher's college, I listened to numerous lectures on the importance of project-based learning and constructivist pedagogy. The irony was that the professors were promoting progressive teaching techniques through the most traditional means -- the lecture. Implicit in this was the idea that children need new approaches to learning, but that

teachers have no problem learning through traditional techniques. But if cognitive science based, project-based or inquiry-based approaches are the best way for children to learn, why shouldn't teachers learn using these approaches, too?

Although he spends the majority of his book, *Schools for Thought*, discussing the cognition of students, John Bruer recognizes that teacher cognition is key to his efforts to advance educational change:

We are only beginning to appreciate the specialized knowledge that skilled teachers possess....Understanding how teachers use their knowledge and skills to solve complex pedagogical problems is a first step toward the development of training programs that would prepare teachers to teach from a cognitive perspective (Bruer, 1997, p. 279).

Bruer's research review provides a cognitive model of how students learn but he realizes that his book will never change teaching unless teachers can learn how to use his model in their classrooms. Teachers must learn to teach in new ways, before students can learn in new ways. Teacher learning is key.

Helping teachers learn to use a pattern language requires techniques for making teachers more aware of their own teaching practice. Teachers are already using pedagogical patterns, they are just not aware of this fact. The Teacher's LAB software is designed to represent the broader contextual field of classroom practice so that a teacher might exclaim, like Ms. Duke, "I am doing a lot, and I am not even aware half the time that I am doing it." Teacher's LAB helps make these patterns explicit by engaging teachers directly in the building, interpretation, and discussion of pedagogical patterns. This process is designed to help teachers learn how to use the language fluently to improve their practice.

Teachers perform a daunting number of tasks. In addition to subject-area mastery, the successful teacher needs to understand a variety of teaching and classroom management techniques. In order to be successful, teachers cannot merely apply a body of theoretical knowledge. Like other

professionals, teachers engage in what Donald Schon calls knowing-in-action. Schon explains that:

the workaday life of the professional depends on tacit knowing-in-action. Every competent practitioner can recognize phenomena -- families of symptoms associated with a particular disease, peculiarities of a certain kind of building site, irregularities of materials or structures -- for which he cannot give a reasonably accurate or complete description. In his day-to-day practice he makes innumerable judgments of the quality for which he cannot state adequate criteria, and he displays skills for which he cannot state the rules and procedures. Even when he makes conscious use of research-based theories and techniques, he is dependent on tacit recognitions, judgments, and skillful performances (Schon, 1983, pp. 49-50).

Teacher's LAB draws on educators knowing-in-action and attempts to make this knowledge explicit. Teachers may already use pedagogical patterns, but reflecting on these patterns gives teachers more control over their practice. The process of constructing an artifact that represents one's own teaching practice, requires critical reflection. This process is designed to help teachers become what Schon calls a reflective practitioner.

3.4 Overcoming Obstacles to Teacher Learning

Reflective practitioners are able to practice a profession and reflect critically on their own practice. They engage in a continual dialectic between action and cognition. Becoming a reflective practitioner is not easy, especially considering the obstacles faced by most teachers. Teachers have limited time and find themselves isolated in their classroom. Furthermore, they are expected to use new textbooks or other curricular materials even though these materials do not include any information about how they should be enacted as part of classroom practice. These obstacles inform the design of Teacher's LAB. They must be addressed if the Teacher's LAB project is to successfully promote teacher learning using a pattern language of pedagogy.

3.41 Professional Isolation

Perhaps the most daunting challenge is the professional isolation faced by teachers. Unlike most other professionals, teachers “spend a preponderance of their workdays...isolated from professional colleagues and others with whom they need to collaborate” (Schwab, et al., 1992, p. 241). Bruer notes that “[o]utstanding teachers' performances rarely have appreciative audiences” since most “teachers work in a classroom where they are the only adult” (Bruer, 1993, p. 279). In the school setting, there are temporal and spatial obstacles to the types of professional collaboration that is most conducive to learning:

Indeed, school can be characterized as a workplace where collaboration is required and valued but the workers are isolated from one another for the majority of the workday (behind the doors of their classrooms) and constrained by the largely arbitrary and inflexible school bell (Schwab, p. 242).

Any attempt to improve in-service teacher education must address the isolation of teaching professionals.

Teacher's LAB addresses the problem by inviting teachers to construct and share artifacts that describe their practice. The Teacher's LAB web site enables teachers to trade lessons and patterns. In addition to trading lessons, educators can construct lessons collaboratively by using bits and piece of each other's content. Since Teacher's LAB represents classroom practice, teachers can peek into each others' classrooms by browsing each others' lessons. By creating a Teacher's LAB lesson, an educator can gain an appreciative audience for her work and begin a discussion with a professional colleague. As in the case of Ms. Duke and Ms. Oakes, this discussion can lead to an exchange of practices. Teacher will not feel as isolated if they can share the patterns that define their practice with other educators.

3.42 Curriculum that Ignores Practice

A second major obstacle to teacher learning is the lack of curricular materials that are sensitive to actual classroom practice. Deborah Ball and David

Cohen report that new curricular materials are rarely translated successfully into classroom practice (Ball and Cohen, 1996). Curriculum developers tend to make the erroneous assumption that curriculum materials can operate nearly independently on students (Ball and Cohen, p. 7). This naïve view assumes that teachers simply deliver curriculum content, when in reality teachers must learn how to use novel materials in the context of their teaching practice. Innovative course materials can only be effective if teachers learn how to use them, which is one of many reasons that the Teacher's LAB project focuses on promoting a process of on-going reflection and learning for working teachers.

I join Ball and Cohen in advancing the view that curriculum needs to be developed and used in the context of actual classroom practice. Ball and Cohen distinguish traditional curriculum which is defined narrowly as content, from *enacted curriculum* which describes curriculum as it is actually used in classrooms:

While 'curriculum' is often taken to refer strictly to the textbook or curriculum materials, the enacted curriculum is actually jointly constructed by teachers, students, and materials in particular contexts (Ball and Cohen, p. 7).

By creating partnerships between teachers, curriculum developers, and researcher, materials "could be designed to place teachers in the center of curriculum construction and make teachers' learning central to efforts to improve education" (Ball and Cohen, p. 7).

Although Ball and Cohen argue for a new mode of curriculum development that foregrounds curriculum enactment, they do not provide a clear picture of what this would actually entail. They only suggest that "we know far too little about how written materials might support teachers' learning" and then they provide a challenge to other researchers: "it seems clear that devising such materials would require considerable imaginative design and inquiry" (Ball and Cohen, p. 8). My own response to this challenge is the Teacher's LAB project and an emerging library of pedagogical patterns.

Lessons created in Teacher's LAB are designed to communicate a particular curriculum and to expound this curriculum in the context of classroom practice. Connecting curriculum to pedagogical patterns results in the enacted curriculum that Ball and Cohen advocate, since the patterns are representations of classroom practice. A teacher using a Teacher's LAB lesson is given curriculum content information and a pattern illustrating techniques to implement this curriculum. If a reflective practitioner is able to coordinate thought and action, a successful lesson in Teacher's LAB can coordinate curriculum content and classroom practice. From the perspective of Teacher's LAB, enacted curriculum is curriculum that is integrated with pedagogical patterns.

3.5 Learner-Centered Design that Promotes Metacognition and Reflective Practice

Teacher's LAB is not designed to advance a particular theoretical perspective on education reform or classroom practice. The tool does not promote the constructivism of Jean Piaget or the constructionism of Seymour Papert. Nor is Teacher's LAB a system crafted to spread Roger Schank's goal-based scenarios, John Bruer's cognitivist approach, or Howard Gardner's multiple intelligences. Although all of these perspectives are of interest, Teacher's LAB is an open system that can incorporate patterns of practice inspired by any of these theoretical flavors. Indeed, the system could be used as a platform to test these approaches and my hope is that researchers, teachers, and curriculum developers of various stripes will use the system to evaluate, improve, and expand the overall scope of classroom practice.

Although Teacher's LAB can represent most any educational perspective, using Teacher's LAB does promote and scaffold a particular type of teacher learning. Traditionally, software design has focused on ease of use. Instead of the user-centered perspective, I join Elliot Soloway and others in advocating a learner-centered design methodology (Soloway, et al., 1994). Instead of focusing only on ease of use, learner-centered design scaffolds cognitive development and learning. From this perspective, Teacher's LAB

is not a tool to create lessons as efficiently as possible, but rather a tool to encourage particular types of reflection about teaching. Implicit in this goal is the assumption that critical reflection is desirable and that a metacognitive approach is the best pathway to teacher learning. Regardless of the educational approach a teacher favors, I assert that they will be most effective if they reflect thoughtfully on their own practice.

To support this claim, I draw on Alan Schoenfeld's work on metacognition (1987). In one study, he compared the problem solving process of math students with that of a professional mathematician. Even though the students knew more about the relevant geometric theorems, Schoenfeld found that the professional mathematician was a more effective problem solver because he was better at regulating his own thought process:

The students decided to try something and went off on a wild goose chase, never to return. The mathematician tried many approaches, but only briefly if they didn't seem to work. With the efficient use of self-monitoring and self-regulation, he solved the problem that many students -- who knew a lot more geometry than he did -- failed to solve (Schoenfeld, p. 195).

This suggests that an ability to reflect on one's own thought process is as important as specific subject area knowledge. Metacognition helps a problem solver tackle situations he has never seen before.

Extended to teacher learning, Schoenfeld's work suggests that teachers do not need a set of pedagogical patterns to follow blindly, but rather a way of thinking more deeply about their own teaching practice. Teacher's LAB is designed to promote this reflection, so that teachers can address novel problems when they arise in the classroom. Metacognition facilitates what Schon calls reflection-in-action which is "central to the art through which practitioners sometimes cope with the troublesome 'divergent' situations of practice" (Schon, p. 62). These types of divergent situations are common in the classroom. The structure of Teacher's LAB helps educators move beyond knowing-in-action, so that they are able to fluently recognize, build, interpret, and discuss pedagogical patterns.

Chapter 4: Implementation

4.0 Design Objectives

The Teacher's LAB project is designed to help teachers learn to use and construct a pattern language for pedagogy. This provides a new approach to professional development for teachers. For this approach to be successful, the system must combat the professional isolation faced by teachers, promote the sharing of representations of enacted curriculum, and encourage metacognition about teaching practices. These concerns define the design objectives of the Teacher's LAB software package. The software was created to support the broad goals outlined in the pervious chapter. More importantly, the software provides a means of bringing these ideas to classroom teachers in a concrete form. Creating a software prototype makes it possible to test ideas in action. The results of this test will be presented in the following chapter, but first I will give a step-by-step overview of the design of Teacher's LAB, paying particular attention to the way that the system supports the production and use of a pattern language for pedagogy.

4.1 The Construction Window: Building Patterns

The Teacher's LAB construction window allows educators to create visual representations of classroom activities [Figure 1]. The prototype has vector art tools that make it possible to draw layouts of classrooms, pictures of students, and drawings of instructional materials [See Figure 1]. A text tool allows users to augment the diagrams with written passages. Future versions of Teacher's LAB may include tools to streamline the process of drawing common objects, but the tools in the prototype are intentionally general because I wanted to study teacher-created lessons before making changes that may limit the scope of practices that can be represented with Teacher's LAB.

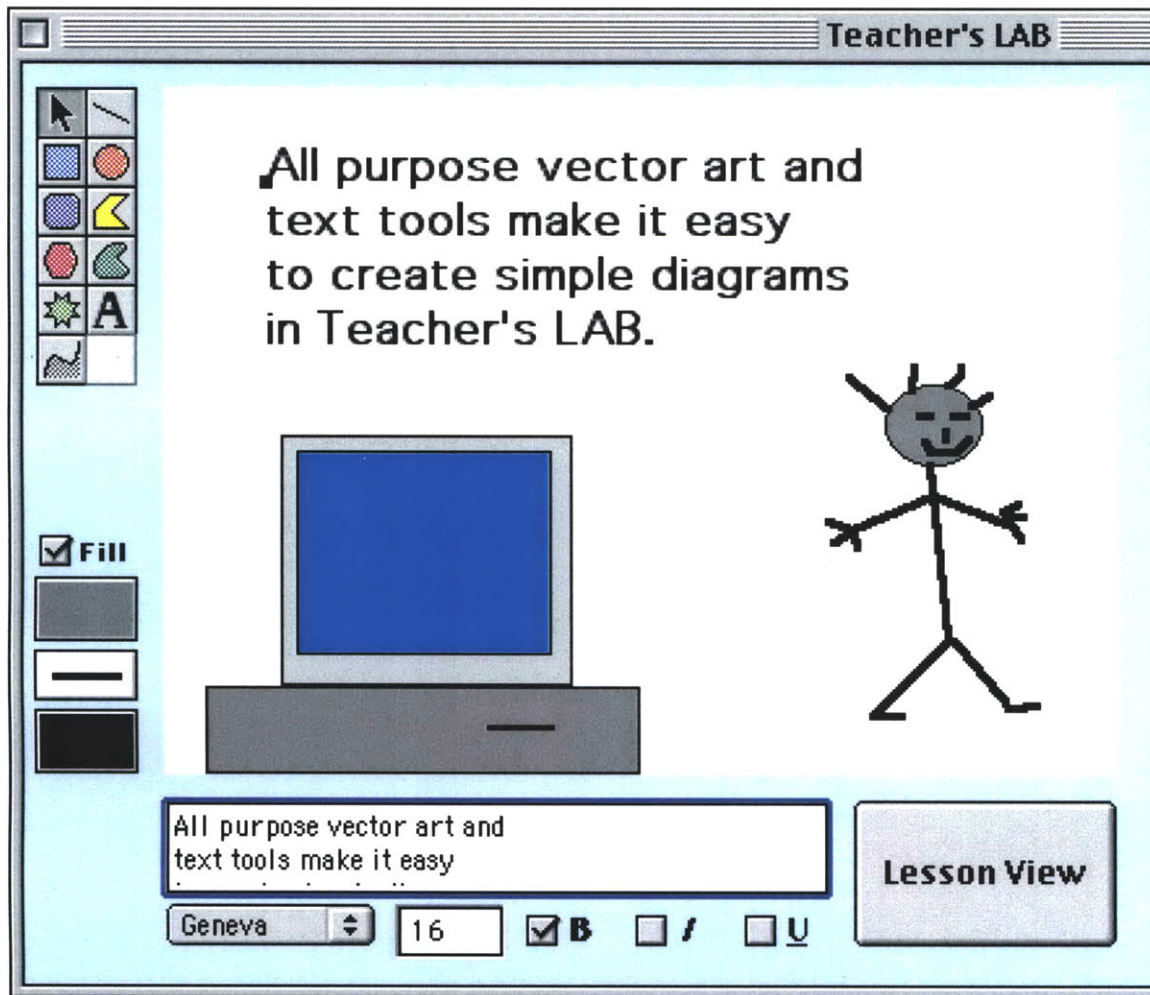


Figure 1: The Teacher's LAB construction window includes vector drawing and text tools so that educators can create original patterns.

Since traditional lesson plans are text-based, it is novel for teachers to be invited to make diagrams representing their teaching. Teacher's LAB encourages teachers to reflect on a broader range of activities. In particular, teachers create diagrams of the spatial layout of their classroom and chronicle how this space is used as a lesson unfolds. For example, a teacher can use the system to represent how they circulate through the classroom helping students [See Figure 2].

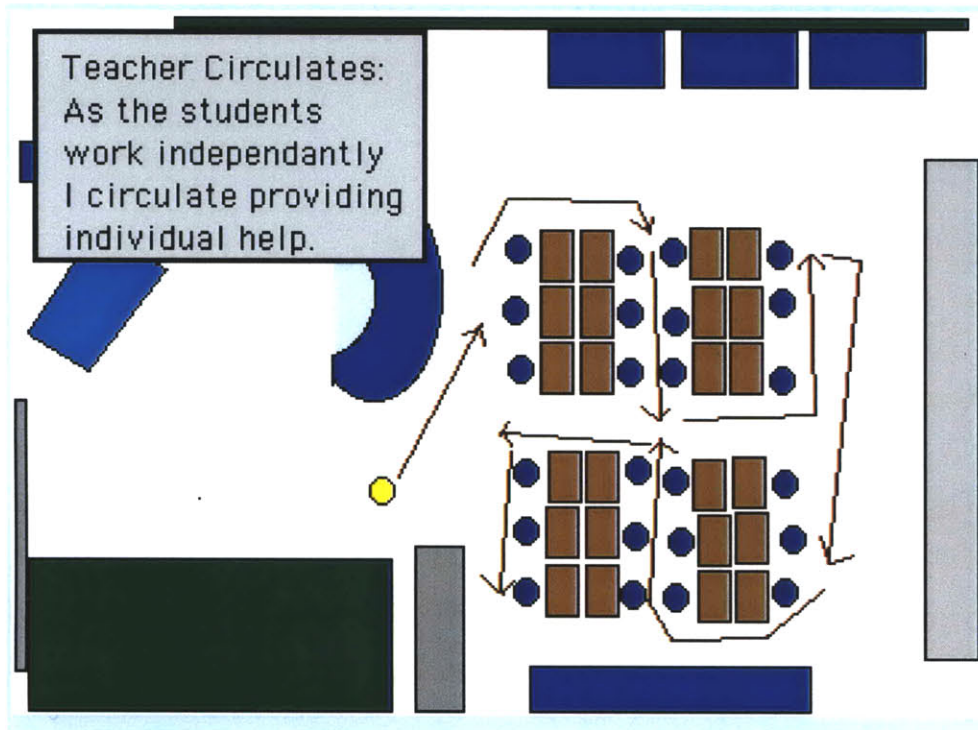


Figure 2. A diagram illustrates the way a 2nd grade teacher at the Guild School in Boston navigates the classroom space to help her students.

The diagram in Figure 2 represents an important pedagogical pattern that is used by many effective teachers across the country. Despite its importance to successful teaching, descriptions of these types of practice are usually omitted from traditional lesson plans. This pattern is another example of the "Independent Work" pattern described in the second chapter. This is a very basic example of the pattern and it would be possible to provide a more detailed version of the pattern that would require several diagrams to elaborate.

A visual, spatial approach represents some of the knowledge-in-action that is so difficult for working professionals to articulate. A diagram can include information about what to teach, but it can also provide guidelines about how to teach. Curriculum content combined with patterns of practice results in representations of the enacted curriculum advocated by Ball and Cohen. The construction window includes a pallet of tools for building the diagrams that form pedagogical patterns.

4.2 MyWorkspace: Essential Patterns

By design, a single pedagogical pattern only conveys a limited meaning. In the example above, the pattern illustrates the importance of the teacher circulating through the room and helping students as they work individually. This is just one of many patterns that a successful teacher may use. As in Alexander's *A Pattern Language*, it is important to have a collection of patterns that can be combined endlessly. Teacher's LAB does not define this collection but does provide a structure for teachers to develop a collection of patterns that best represents their teaching practice. As an educator uses Teacher's LAB, they are able to store slides that they can use to create the patterns that are most essential to their teaching. These slides are stored in the MyWorkspace window. Sometime a single slide, like the "teacher circulates" slide, can form the basis of a pattern. Other times, a slide might be an element that can expand a core pattern, for example a slide representing the class whiteboard might expand the "Group Discussion" pattern. Either way, the most important slides for creating patterns are stored in the MyWorkspace window so that it is easy for teachers to select and modify essential slides whenever they need to use them for a new lesson. The Teacher's LAB prototype provides five categories that organize the slides in the MyWorkspace window. Although classroom layout, for example, is not normally considered a part of curriculum, the representation of enacted curriculum requires a broader contextual field. Highlighting classroom, materials, student, teacher, and theory is one way to promote reflection on this expanded domain of practice. The design of Teacher's LAB encourages teachers to think about the **classroom** environment they construct, the **materials** they use, their **students'** thinking, their own thinking as a **teacher**, and educational **theory**. Slides are divided between these five categories so that patterns are organized into important domains of practice. I chose these five categories as a starting point because they resonated with my own experience as a teacher. From my own experience, they seemed to cover the essential elements of classroom practice. When I was teaching, my

lessons were sometimes motivated by each of these five categories. Furthermore, educational literature tends to focus on these categories by addressing classroom management, the use of materials, student cognition, teacher development, or educational theory. It seemed natural that these categories would organize the slides that teachers would use to build pedagogical patterns. However, I did not anticipate the way that teachers would actually use these categories. In the following chapter, I will evaluate the choice of these categories and suggest some alternatives that might do a better job supporting the development of pedagogical patterns.

But before this evaluation, I will explain the basic process that a teacher uses to add slides to their personal workspace. Once a teacher creates a slide that they think is essential, they save it into the MyWorkspace list box by naming it and clicking the arrow [Figure 3].

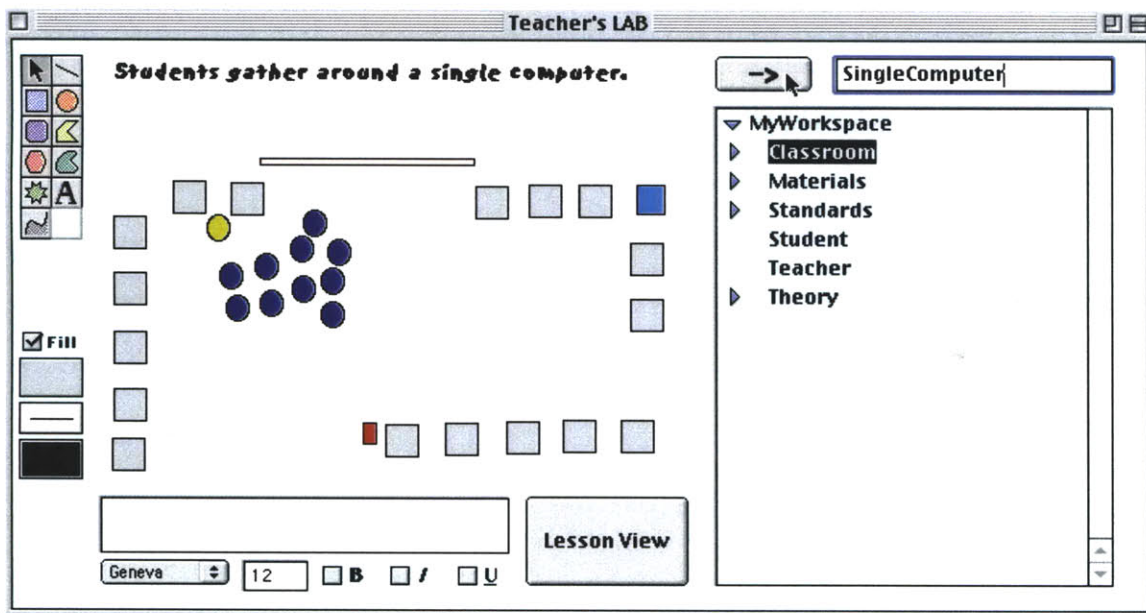


Figure 3. Teachers can create, name, and save new templates in the MyWorkspace window.

In this example, a computer teacher drew a diagram of her students gathered around a single computer. Since she plans to use this configuration regularly, she decided to name it SingleComputer and add the slide to the classroom section of my MyWorkspace. SingleComputer becomes part of the

collection of slides that in this case includes CirculatesHalfSized, Project, and RugAndProjector [Figure 4].

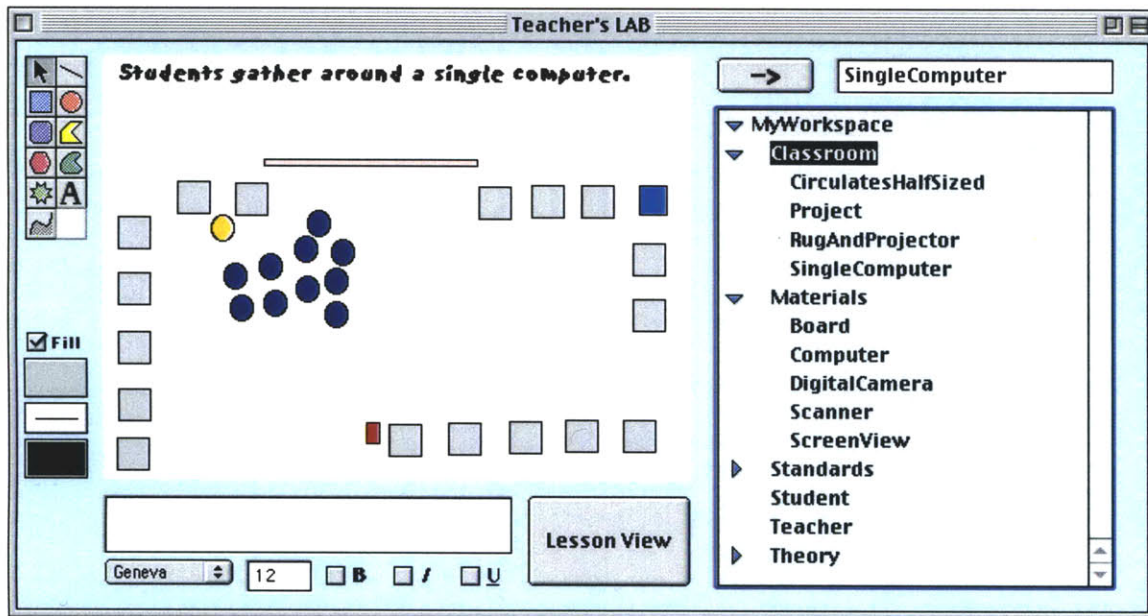


Figure 4. The new template becomes part of a growing library.

Anytime the teacher wants to use these slides to create a lesson, she only needs to double click the name of the slide and modify it so that it can be integrated into the new lesson.

The MyWorkspace window is designed to save teachers time by allowing them to quickly reuse the slides that are most important to their teaching practice. Although valuable in its own right, saving time provides an incentive for teachers to reflect on their practice. To create a collection of slides and to use these slides to construct essential patterns, a teacher must think metacognitively about their own practice. Each day, a teacher spends hours structuring classroom activities. From these hours of practice, the teacher identifies and constructs a group of patterns that are most essential to this teaching. This means that the teacher needs to reflect on their teaching until they can identify the basic building blocks of their professional practice. This process promotes teacher learning because it requires teachers to engage in reflection-in-action. The contents of the MyWorkspace window is the concrete manifestation of this process of reflection.

4.3 Lesson View: Using Patterns

The MyWorkspace window provides a resource of patterns for designing new lessons. Sometime a teacher needs to combine a few slides to complete a pattern, but the basic elements of the teacher's personal pattern language are readily available in the MyWorkspace window. But to put these patterns to use, a teacher needs to use the lesson window. Teachers can open a new lesson window, select and modify patterns, generate new content specific to a particular lesson, and create a sequence of slides that defines a new lesson. Here is an example of a lesson based on the teaching of a K-1 special education teacher [Figure 5].

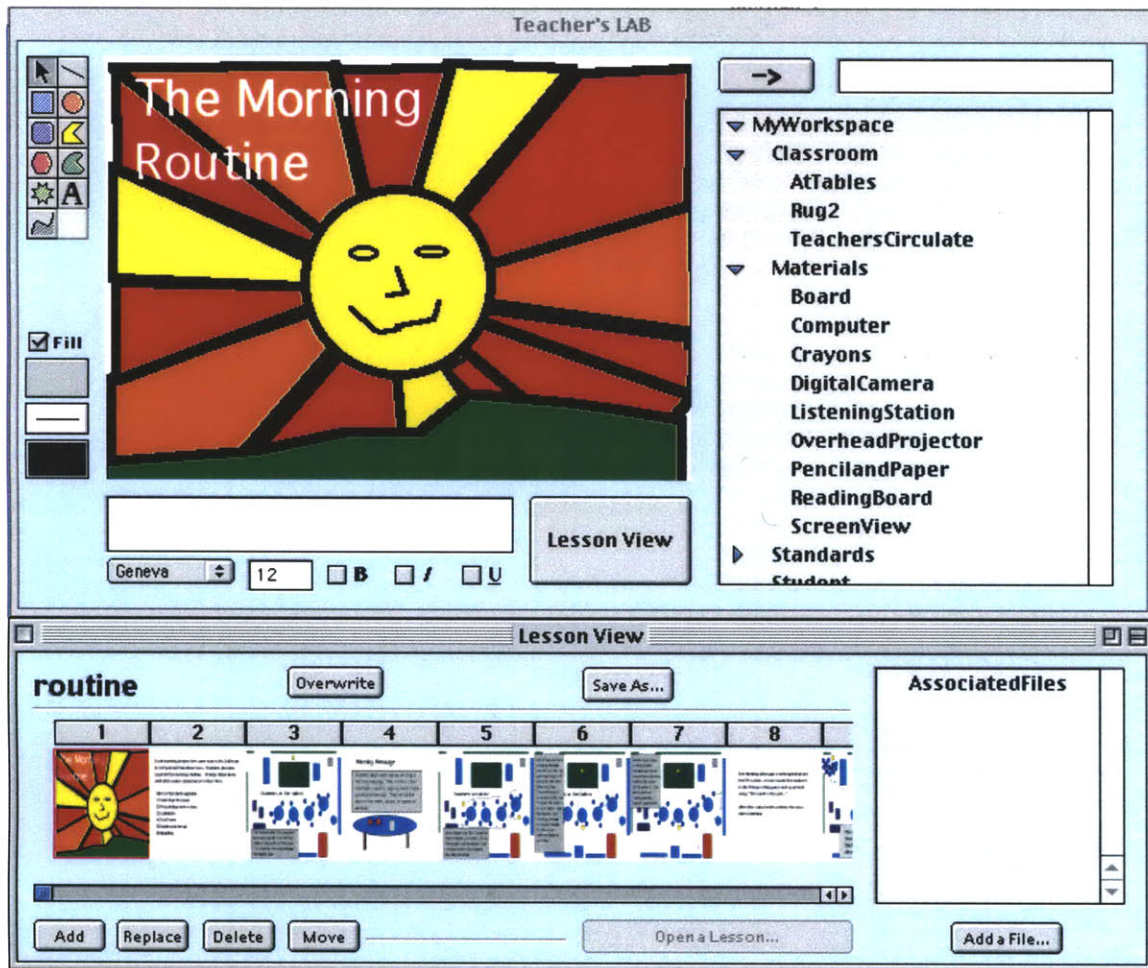


Figure 5. The Lesson window organizes slides into a sequence that represents a classroom activity.

This lesson details the morning routine of a Kindergarten-2nd grade Special Education teacher at a Boston Public school. The bottom window is the Lesson View and it contains a completed lesson. The title card was designed for this particular lesson, but most of the slides in the lesson were created by modifying slides in the MyWorkspace window. Using content from the MyWorkspace window meant that it took less than 30 minutes to create the lesson. As a teacher develops more templates, building new lessons becomes increasingly rapid. It is possible to view the lesson by clicking on each slide in sequence so that the diagrams and text descriptions are displayed in the main window.

The lesson window is where teachers transfer their personal pattern language into an actual design. This is where general patterns of best practice can be synthesized into a plan of action for actual practice. In the lesson window, the teacher plans the activities that they will actually teach. Teacher's LAB is designed to encourage educators to move along the continuum of theory and practice. Teachers can use the tool to create speculative pedagogical patterns, develop lessons using those patterns, and then teach those lessons in a real classroom setting. This process can become a feedback loop as actual classroom practice provides new inspiration for general patterns. The tool is designed to help teachers slide along the theory-practice continuum while they reflect critically on their teaching.

4.4 Sharing: Publishing to the Web and Swapping Lessons

If Teacher's LAB only allowed teachers to create personal pattern languages, it would miss a huge opportunity to promote collaboration between teachers. Built into Teacher's LAB is a structure for sharing lessons so that collective pattern languages can emerge from teacher interactions. Teachers can use the software to develop and share the lessons that they create. The completed lesson serves as the basic unit for sharing. This means that collaboration is based on sharing an artifact, *i.e.* a completed lesson. This can supplement teacher learning systems that provide teachers with opportunities for dialogue in chat rooms or message boards. Indeed, Teacher's LAB has the potential to enhance on-line dialogues between teachers by providing shared artifacts that can help structure discussion.

The Teacher's LAB prototype helps teachers publish their lessons to the web. This was the quickest solution to the sharing problem and my goal was to get teachers sharing lessons as soon as possible. The process of creating an HTML lesson is completely automated [Figure 6].



Figure 6. Generating an HTML lesson makes it possible to publish lesson on the Web.

Once the lesson is converted, teachers publish the lessons to the Teacher's LAB community portal. I managed this web site, providing editorial comments and organizing content. Although this is not a scalable solution, it allowed me to keep close tabs on what each teacher was doing for research purposes. Since I was working with only a half dozen teachers, the web site had an intimate feel and allowed teachers to see what their colleagues were doing [Figure 7].

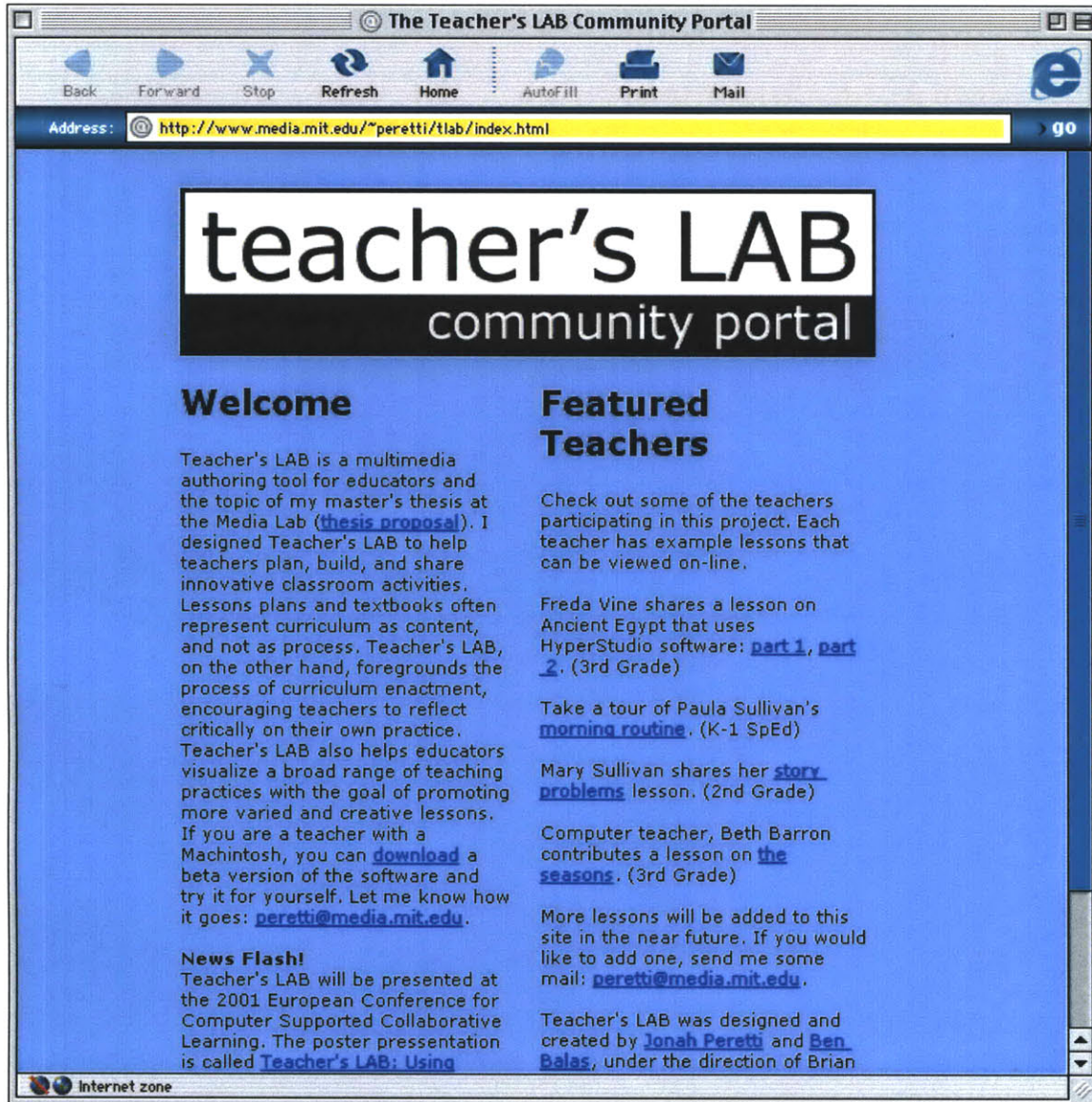


Figure 7. The Teacher's LAB community portal created an on-line meeting place for teachers. They can use the web site to share the lesson they create.

The "Featured Teachers" section of the web site provides access to selected lessons. These lessons were created in Teacher's LAB, converted to HTML format, and uploaded to the web. Here is the "Morning Routine" lesson pictured in its on-line form [Figure 8].

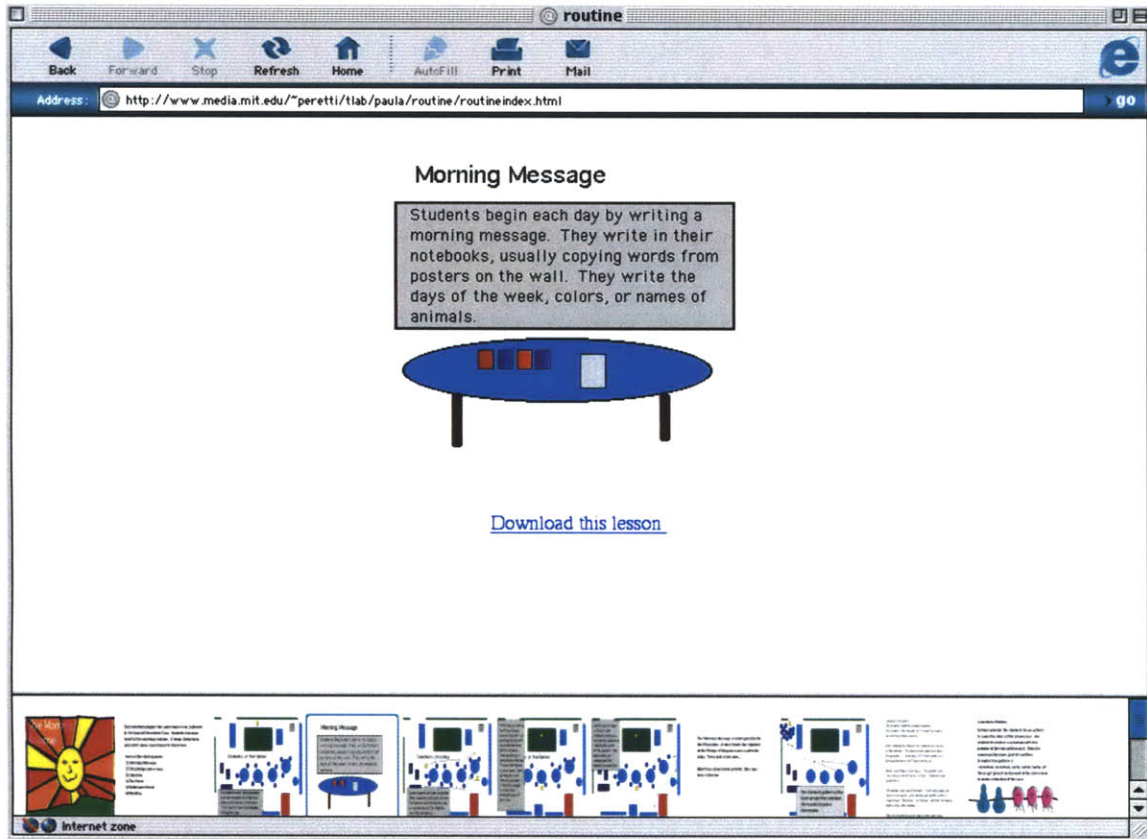


Figure 8. An HTML version of a Teacher's LAB lesson, viewed in Internet Explorer.

The lesson is browsable by clicking on the thumbnail images contained in the bottom frame. This is similar to the process used to view a lesson in the Teacher's LAB application, but in its on-line form the lesson is read-only so educators can only browse the lesson. However, if they like the lesson, they can download the Teacher's LAB file and gain the full functionality of the software application. Ideally this design promotes the following sequence: 1) a teacher visits the web site, 2) she views lessons on-line, 3) she downloads the lessons she wants to use, and 4) she integrates pieces of the lessons into her own teaching practice. After this process is completed, she can upload the new lessons she created, so the process can begin again. Over time, a single lesson could contain elements developed by dozens of teachers. A lesson that has evolved through time is an artifact that embodies a history of collaboration between several teachers.

Chapter 5: Evaluation

5.0 Introduction

In the last few months, I have spent my time working with Boston elementary school teachers. The Teacher's LAB project included six teachers from three different schools, two public and one private. The teachers at these school became partners in my research. They invited me into their classrooms, allowed me to watch them teach, and provided insights that shaped the direction of the Teacher's LAB project. I introduced these educators to Teacher's LAB in stages. First I showed them examples of lessons created in Teacher's LAB. Then I worked with the teachers to develop lessons that they taught in their classrooms. Finally, the teachers used the tool independently to create lessons. Throughout this process the teachers provided useful feedback, which expanded my understanding of teaching and lead to improvements in the design of the Teacher's LAB project.

My evaluation of Teacher's LAB is based entirely on informal interactions with this small group of professional teachers. My evaluation techniques are qualitative: I draw on the lessons created in Teacher's LAB, classroom observations and interview material. The interpretation of this data suggests that the Teacher's LAB software can enhance teacher learning, although I do not provide a control group of teachers using other systems. At this stage of the research, I am more interested in exploring a new design concept that has the potential to contribute teacher development.

The beginning of my evaluation addresses three main issues: representation, construction, and sharing. These issues are preconditions to successfully accomplishing the ultimate goal of creating a pattern language of pedagogy. So my field work progressed in stages, with the following questions organizing my inquiry:

- 1) Can Teacher's LAB be used to accurately represent teaching practice?

- 2) Can Teacher's LAB help teachers construct artifacts that represent their own practice?
- 3) Can Teacher's LAB help teachers share teaching practices?
- 4) Does Teacher's LAB help teachers learn new ways to think about their teaching practice?

These four questions are fundamental to the Teacher's LAB project. Supporting representation, construction, sharing, and learning is a prerequisite to the ultimate goal of creating a pattern language for pedagogy. If Teacher's LAB can address these four questions, it has the potential to become a platform that supports the development of an expanding pattern language for pedagogy.

5.1 Representation

Teacher's LAB provides a graphical way to represent classroom activities. Initially, I was worried that teachers familiar with traditional text-based lessons would have difficulty understanding graphical lessons. I developed several lessons that I based on real world classroom observations. Then I presented these lessons to teachers and interviewed them about what they saw. In every case, the teachers immediately recognized what was going on in the classroom. When I asked Ms. O'Connor if she understood the way that the lesson was presented, she replied, slightly offended, that "A moron could figure that out". When I asked Ms. Oakes if she could teach a lesson based entirely on the Teacher's LAB slides, she answered affirmatively and emphatically: "Absolutely!"

Indeed, the graphical display seemed more intuitive to the teachers than the traditional lesson plan. A second grade teacher named Ms. Davis informed me that she,

liked visually seeing the location [of the students].
Being a visual person it helps me picture what is
going to happen in the lesson....it is an easier
lesson to follow.

Other teachers echoed this sentiment, saying that it was nice to see "everything laid out" or that it was "easier to tell what is actually happening" than in a text-based lesson. This enthusiastic initial response was encouraging. Teacher could immediately understand the basic Teacher's LAB format.

5.2 Construction

Once it was clear that Teacher's LAB could represent classroom practices, I began to help teachers use the tool to build lessons of their own. I worked with Ms. Duke and Ms. Oakes to create the lessons on the seasons and HyperStudio, respectively [see chapter 2]. I also worked with Ms. Davis to create a lesson on "Story Problems" that was designed to help students understand word problems. The lesson included slides that represented the movement within the classroom environment. In particular, the students moved between the rug, where they had discussions, and the desks, where they worked independently [Figure 1].

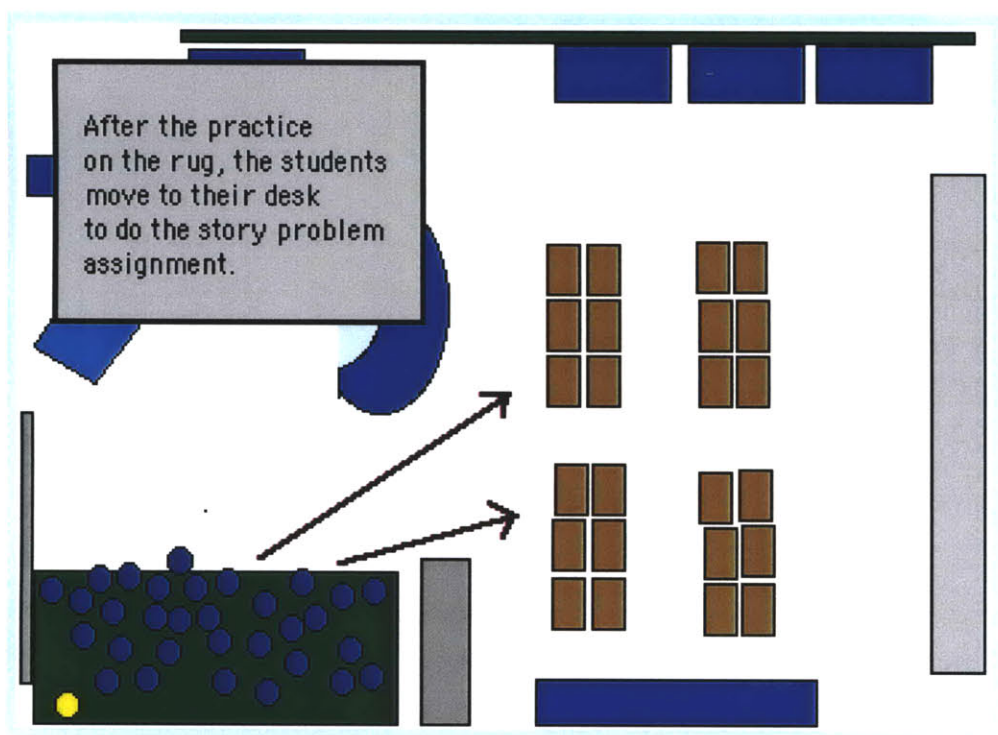


Figure 1. The students move from the rug to the desks.

But Ms. Davis's lessons also included content that she used in her lesson, including this word problem [Figure 2].

The teacher tells a simple story about going to the store to buy fruits for her family. Then she asks the students questions:

How many bananas did I buy?
How many children do I have?

The answer to both these questions is 4, since she bought one banana for each child. She suggests reasoning strategies and reminds the students that details are very important when solving story problems.

After asking more questions, the teacher asks students to say how they knew the answer. They take turns explaining their reasoning.

Figure 2. An example story that was used by Ms. Davis in her Story Problems lesson.

Ms. Davis's lesson included both curriculum content and descriptions of how she used that content in her classroom.

I also worked with Ms. O'Connor to create a lesson that describes the "Morning Routine" of her Kindergarten-1st grade special education class. Her students would arrive in the morning and eat breakfast in class. As students arrive at school they begin writing the "Morning Message" in their notebooks. This is a very casual time in class when the students are adjusting to being at school. As a result, Ms. O'Connor's lesson included several slides describing the activities of the children spread around the room [Figure 3].

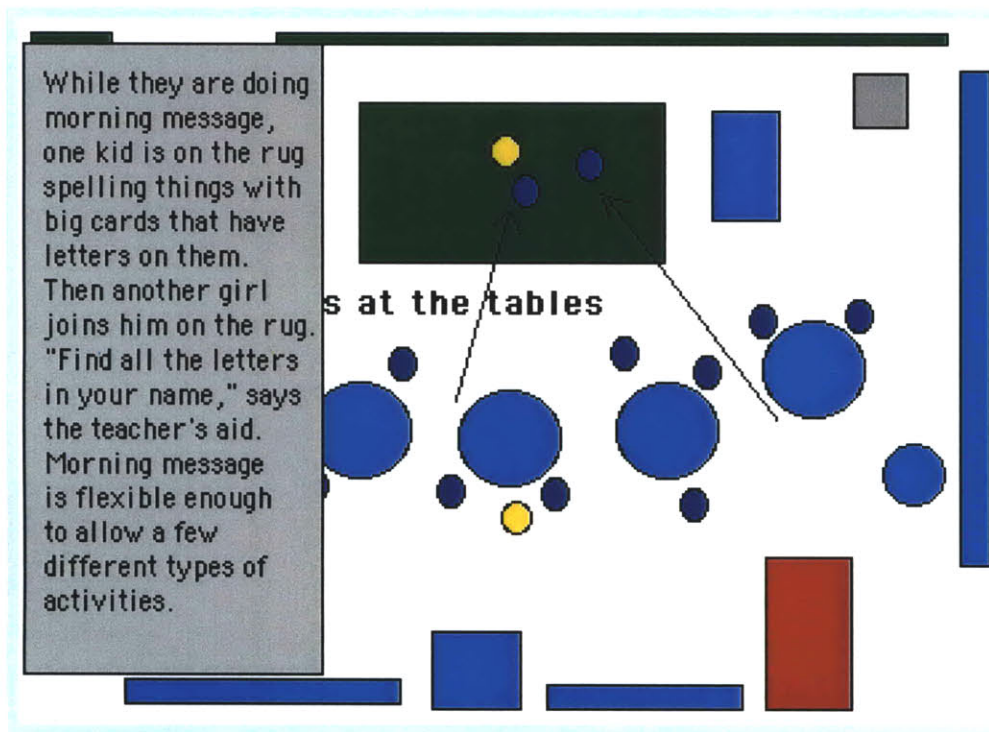


Figure 3. This is one of many slides that depicts the independent activities that occur during Ms. O'Connor's morning routine.

As the morning routine progresses, the lesson includes more structured activities.

But the previous lessons cannot be used as examples of teacher created lessons. For each of these lessons, I consulted with the teachers extensively but did most of the actual building myself. I did this so that the teachers could become gradually more familiar with the software. Also, by collaborating with the teachers to build lessons, I was able to create templates that the teachers could use later. Since Teacher's LAB is designed to help teachers reuse content, I wanted to provide teachers with some templates in the MyWorkspace window before they started to build lessons independently.

When teachers began to create lessons on their own, they sometimes became frustrated with the software. In particular, educators did not like Teacher's LAB's text tools. When one resourcefully teacher had trouble erasing some text, she just covered it with gray boxes [Figure 4].

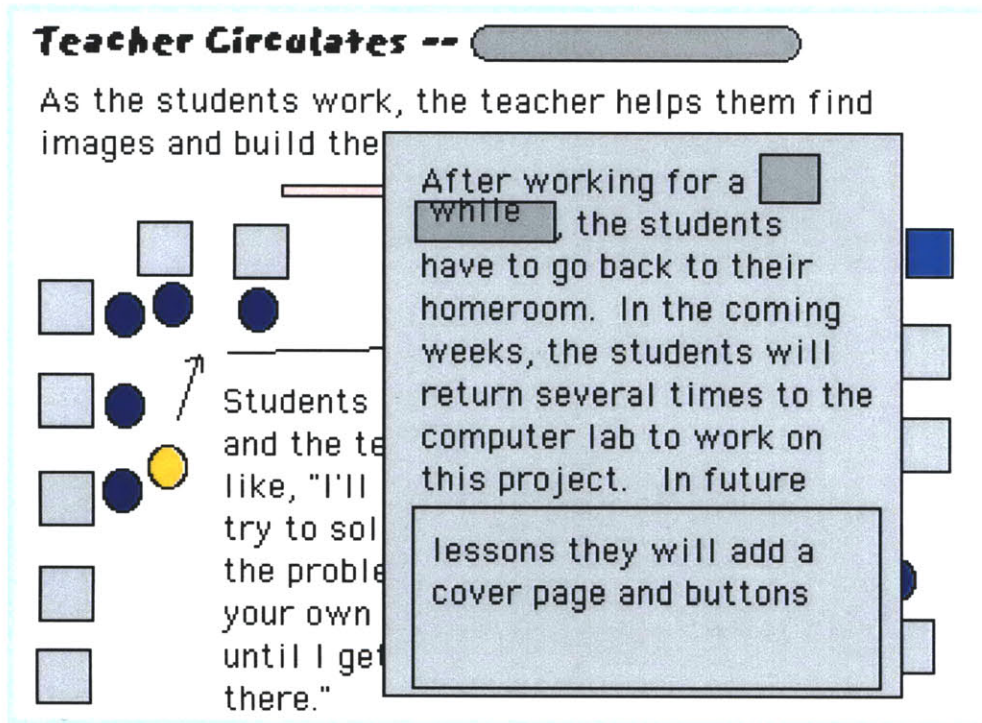


Figure 4. A frustrated but resourceful teacher used gray boxes to cover text that she would have rather erased.

This was the penultimate slide in a long lesson and it is clear that the teacher was frustrated and eager to finish. It is understandable that the text tools frustrated some of the teachers. In order to edit text, the user must click precisely on the text with the selection arrow. Once the text is selected, the user cannot edit it directly, but is forced to make changes in a box below the construction window.

This poorly designed text tool is the result of technical expediency. In an effort to get the software to teachers as soon as possible, some of the basic widgets were frustrating to use. Teacher's LAB is surprisingly stable for a piece of software being used in a pilot study, but like all software, it crashes occasionally. I felt particularly bad when I received an email from one teacher explaining that she had just finished a lesson when she,

got a fast error message which said something about an Illegal procedureAll my work was lost, which was the best that I had done. I am too frustrated to reconstruct it.

Yet despite occasional set backs, educators were able to successfully use Teacher's LAB to design lessons. User interface bugs were annoying, but they were not egregious enough to undermine the overall research goals of the Teacher's LAB project.

Ms. O'Connor, for example, was able to create several lessons in Teacher's LAB without encountering any daunting problems. Since she did not have a computer, I lent her an old Macintosh that was not being used at MIT. She took the computer home and built science, math, and English lessons. Her science lesson describes an activity in which she introduces her students to the wonders of top soil [Figure 5].

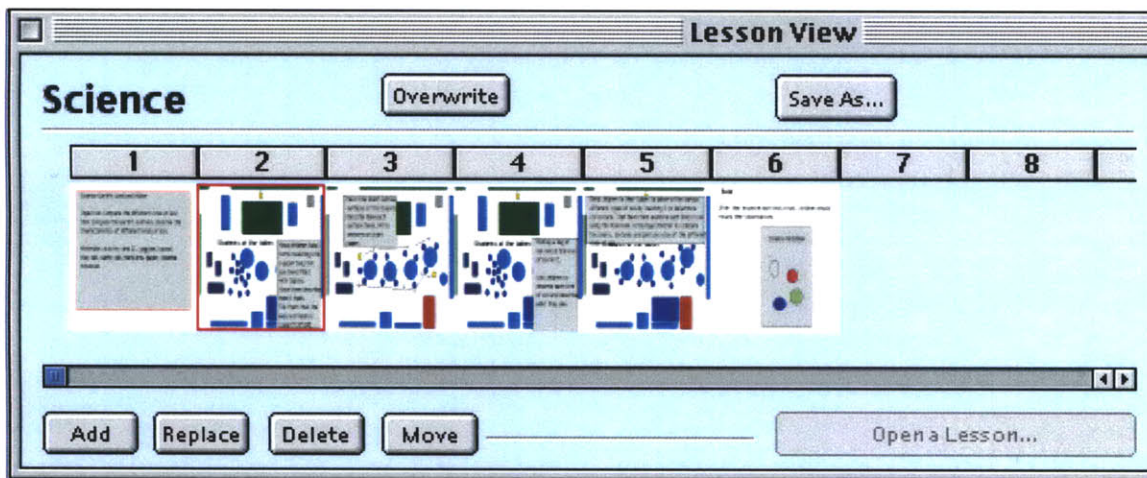


Figure 5. An overview of Ms. O'Connor's science lesson on top soil.

In this lesson students are invited to touch top soil and reflect on its texture [Figure 6].

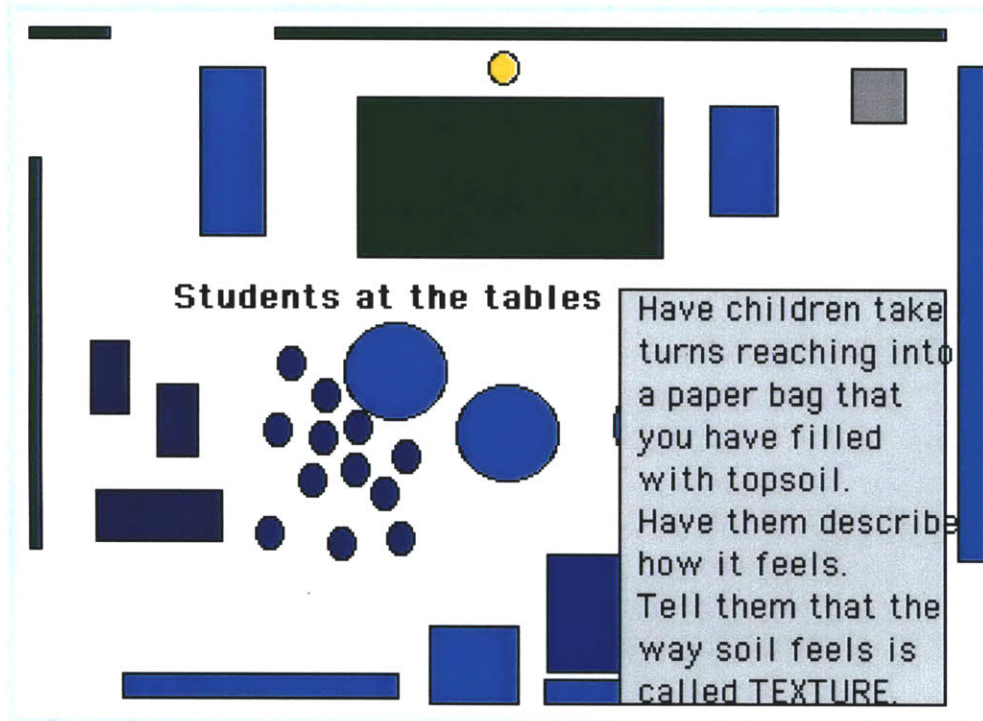


Figure 6. Students reach into a bag and feel the topsoil.

Then students form small groups and return to the tables to compare the texture of different types of topsoil [Figure 7].

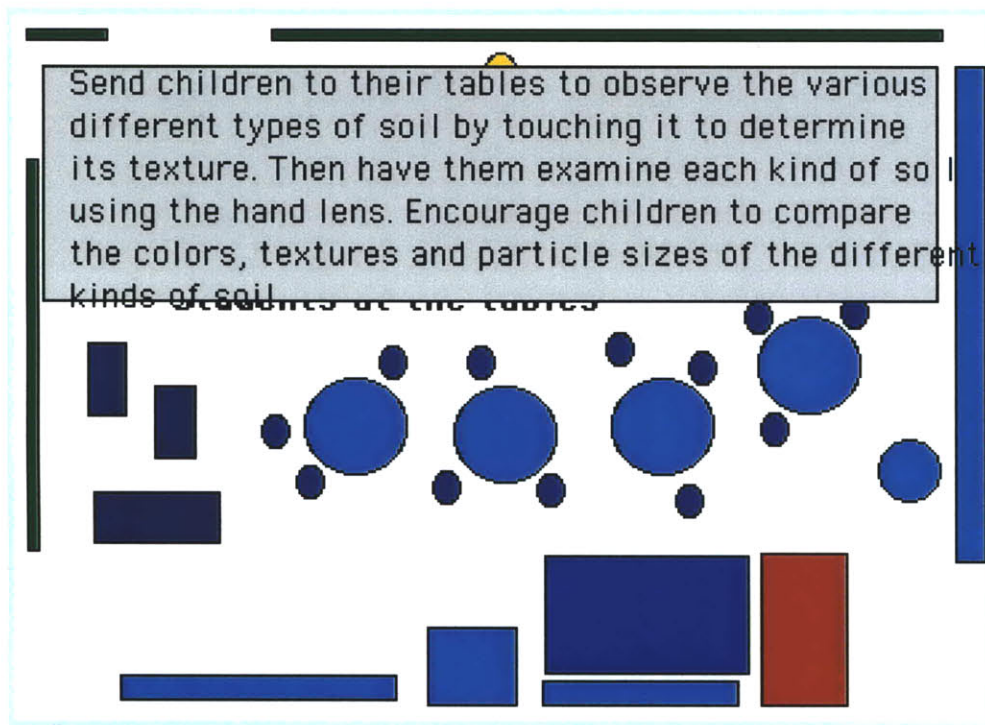


Figure 7. The students compare different types of topsoil.

The top soil lesson ends with students writing in their notebooks about their discoveries.

I will not go into detail about Ms. O'Connor's English [Figure 8] and math [Figure 9] lessons.

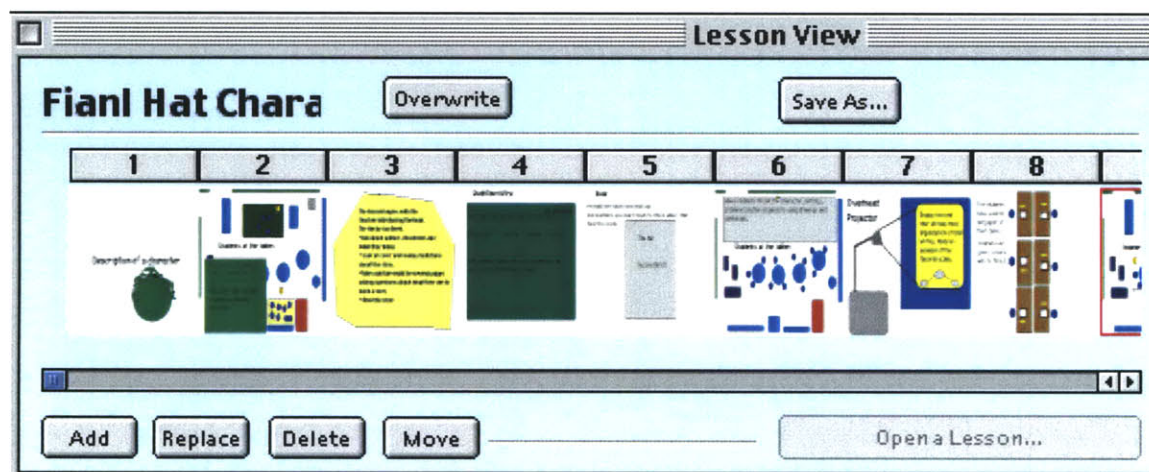


Figure 8. An overview of Ms. O'Connor's English lesson on character development.

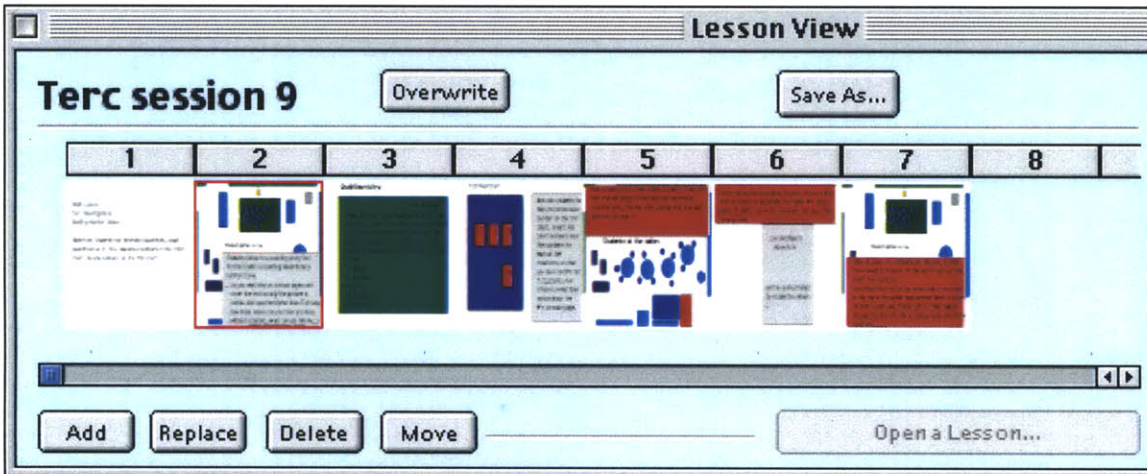


Figure 9. An overview of Ms. O'Connor's math lesson on estimation and counting.

Ms. O'Connor's lessons serve as examples of what can be done by teachers using the Teacher's LAB software. Ms. O'Connor has only minimal computer expertise, but she did not need any help to make her lessons. Browsing Ms. O'Connor's lessons, it is easy to get the general idea of what she does in her classroom. The lessons are a bit clunky because of the limitations of the Teacher's LAB construction window tools. Due to the poor text tool, for example, Ms. O'Connor's writing sometimes extends too far, making it difficult to read. But overall, it is clear what she is trying to accomplish. Ms. O'Connor and her colleagues were able to use Teacher's LAB to construct a representation of their teaching practice.

5.3 Sharing

At the end of my pilot study, teachers were just beginning to share lessons. The best example of this sharing was between Ms. Oakes and Ms. Duke. In chapter 2, I described the connection they developed while participating in the Teacher's LAB project. Each teacher was inspired by the other's lessons. When Ms. Duke developed a lesson on HyperStudio, she decided to borrow one of Ms. Oakes's ideas. This was facilitated by Teacher's LAB. Ms. Duke liked the way Ms. Oakes used the whiteboard to diagram the functions of HyperStudio, so all she had to do was modify Ms. Oakes's whiteboard slide

and add it to her own lesson. Contained within Ms. Duke's lesson is the modified version of the whiteboard slide [Figure 10].

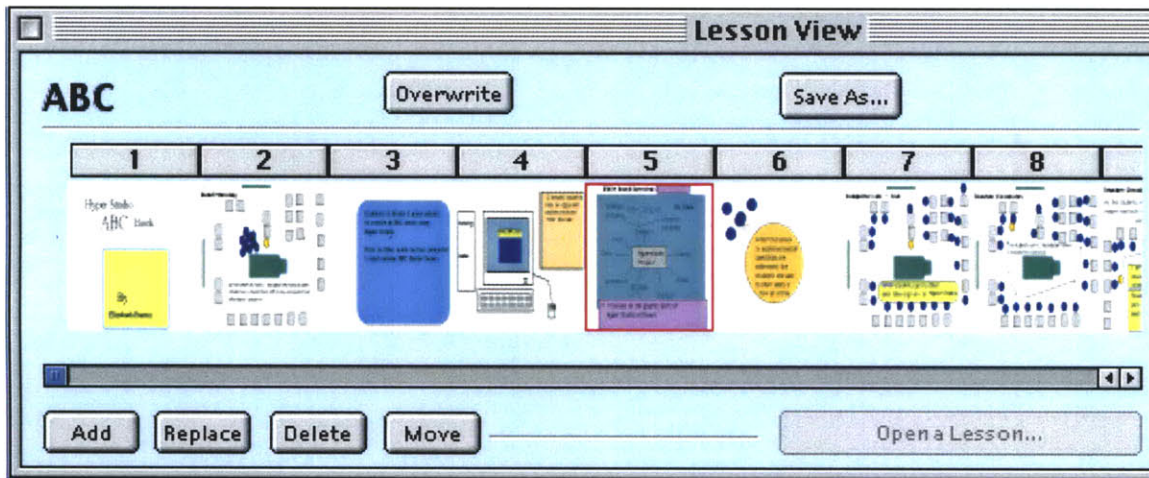


Figure 10. Overview of Ms. Duke's HyperStudio Lesson. The slide outlined in red was created when Ms. Duke modified one of Ms. Oakes's slides and incorporated it into her own lesson.

When Ms. Duke taught her HyperStudio lesson, she re-created the whiteboard depicted in Ms. Oakes's slide [Figure 11].

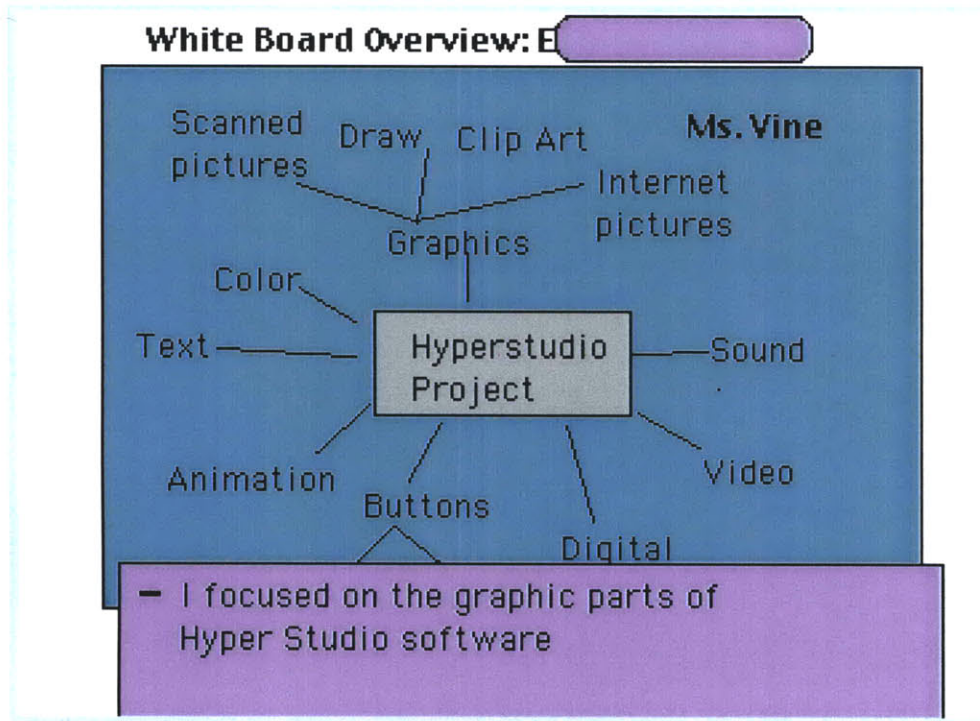


Figure 11. The slide that Ms. Duke borrowed from Ms. Oakes depicts a diagram on the class whiteboard. Ms. Oakes had trouble modifying the text, so she covered the part of the title that did not apply to her lesson.

This example illustrates the type of sharing that Teacher's LAB is designed to facilitate. Instead of borrowing a whole lesson, Ms. Duke was able to isolate one element of the lesson that she liked. Then she was able to use this element in her own lesson. She modified the slide slightly to reflect the context of the new lesson. This is a type of sharing where teachers are actually co-constructing lessons. This is part of the reason that Ms. Oakes and Ms. Duke feel an affinity for each other. They do more than just admire each other's work, they actually collaboratively develop artifacts that represent their teaching practices.

The spirit of this sharing extends beyond Ms. Oakes and Ms. Duke. Although they are the best example of two teachers sharing, all the teachers participating in the project are involved in sharing to some extent. This is because I worked with teachers to develop templates for their MyWorkspace window. This means that the process of borrowing and modifying slides is at the heart of Teacher's LAB. As teachers develop a diverse collection of

templates for their MyWorkspace window, they increase the extent to which they co-construct materials. A teacher like Ms. Duke is already incorporating self-created materials with materials developed by another teacher and an academic researcher. The Teacher's LAB project is still quite young, but these early results suggest that it would not be unreasonable to see a single lesson containing contributions from dozens of teachers and researchers.

5.4 Learning to Use Patterns

By supporting representation, construction, and sharing, Teacher's LAB creates new opportunities for teaching learning. My interactions with teachers over the course of the pilot study suggest that the Teacher's LAB software promotes new ways of thinking about teaching. Ms. Duke reported that "Using Teacher's Lab helped me focus and visualize what I wanted to see happen during a lesson...it gave me a hands on approach to the lesson." She went on to say that the software helped her realize how much she actually does in her classroom, "It is interesting to see how much you actually do!" Teacher's LAB lessons also impressed Ms. O'Connor by revealing how much goes on in her classroom:

It made me realize how much the kids do in the course of 60 minutes. Also it was neat to see the class set up on the computer. I could see what physically works in the class while planning out the lessons.

Teachers using the software began to pay greater attention to the spatial layout of their classroom and the broad range of activities that unfold in that space.

In some instances, this awareness led to the recognition of pedagogical patterns. In chapter 2, I described the way that Ms. Oakes and Ms. Duke recognized that they were using the same patterns to start class and structure independent work. Both teachers used the "Starting Class" and "Independent Work" patterns on a daily basis, but only after using Teacher's LAB did they realize the important role these patterns play in their teaching practice. Teacher's LAB helped them think metacognitively about their

teaching allowing them to discern underlying structures of activities that ordinarily would have seemed like second nature. Participating in the pilot study helped these teachers think differently about their teaching, making the notion of a pattern language for pedagogy more intuitive.

However, the current version of Teacher's LAB does not do enough to foreground the importance of patterns. The five categories in the MyWorkspace window are Classroom, Materials, Student, Teacher, and Theory. In practice, most of these categories never got used by the teachers in my pilot study. The teachers primarily used slides in the "Classroom" folder as the building blocks for their lessons. Then they used slides from the "Materials" folder to augment the Classroom slides. The teachers from the public schools lobbied for the addition of a Standards folder, and slides detailing curriculum standards were also used in some instances to compliment the Classroom slides. The way the teachers used the MyWorkspace window suggest that the Classroom folder held the primary pedagogical patterns, and the other folders were used to support these patterns.

Let us look for a minute at Ms. O'Connor's MyWorkspace window [Figure 12].

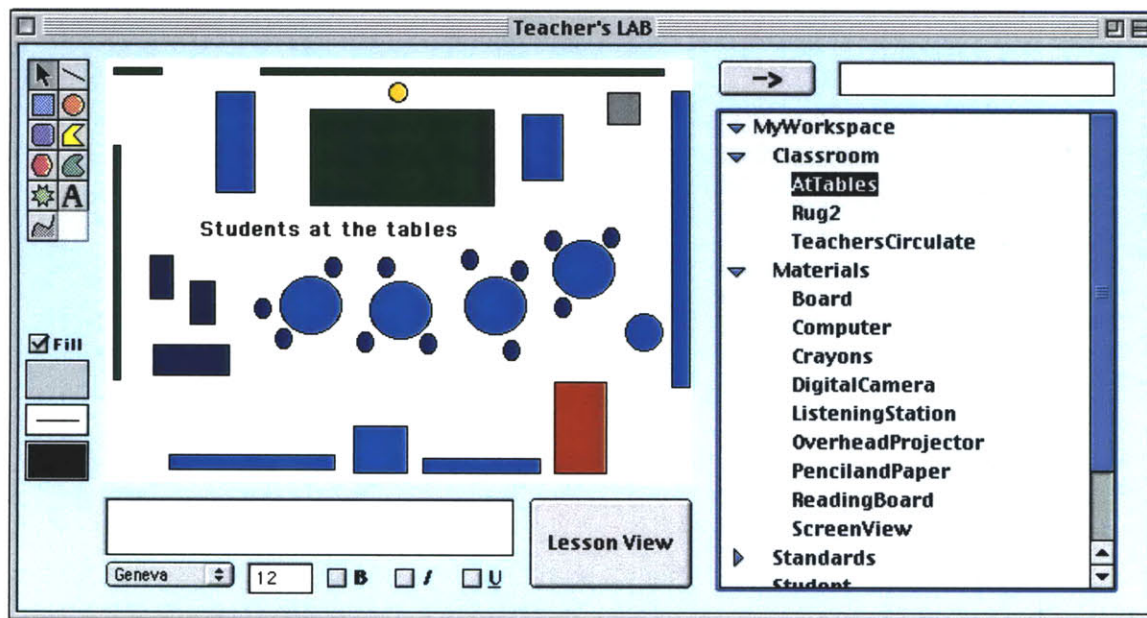


Figure 12. Ms. O'Connor's MyWorkspace folder (right).

Her classroom folder contains three basic templates: AtTables, Rug2, and TeachersCirculate. These three templates form the basis for the patterns that Ms. O'Connor uses regularly. Ms. O'Connor uses AtTables whenever she does an activity that requires group work. In other words, AtTables is the core of the "Group Work" pattern. She uses Rug2 whenever she has a whole class discussion, making the pattern essential to the "Class Discussion" pattern. TeachersCirculate is used whenever students are doing independent work, making the slide the basis of the "Independent Work" pattern. Each of these core slides defines a pattern and then is augmented by the materials that are used to implement the pattern as part of a larger classroom activity.

Unfortunately, the five original categories in Teacher's LAB make it more difficult to identify and use patterns. The name of the actual patterns does not appear anywhere in the MyWorkspace window. The authors of *Design Patterns* also struggled with the problem of naming patterns, noting that "Finding good names has been one of the hardest parts of developing our catalog" (Gamma, et al. 1994, 3). Although Teacher's LAB allows users to name slides, there is no way to name patterns themselves. As a result, teachers had to work against the categories the system provided. This struggle helped reveal a major weakness in the design of the software.

A quick solution to this problem is to change the categories to more accurately reflect the way that teachers use the software. This has the added advantage of reinforcing the concept of pattern languages for pedagogy. Here is an example of what this might look like [Figure 13].

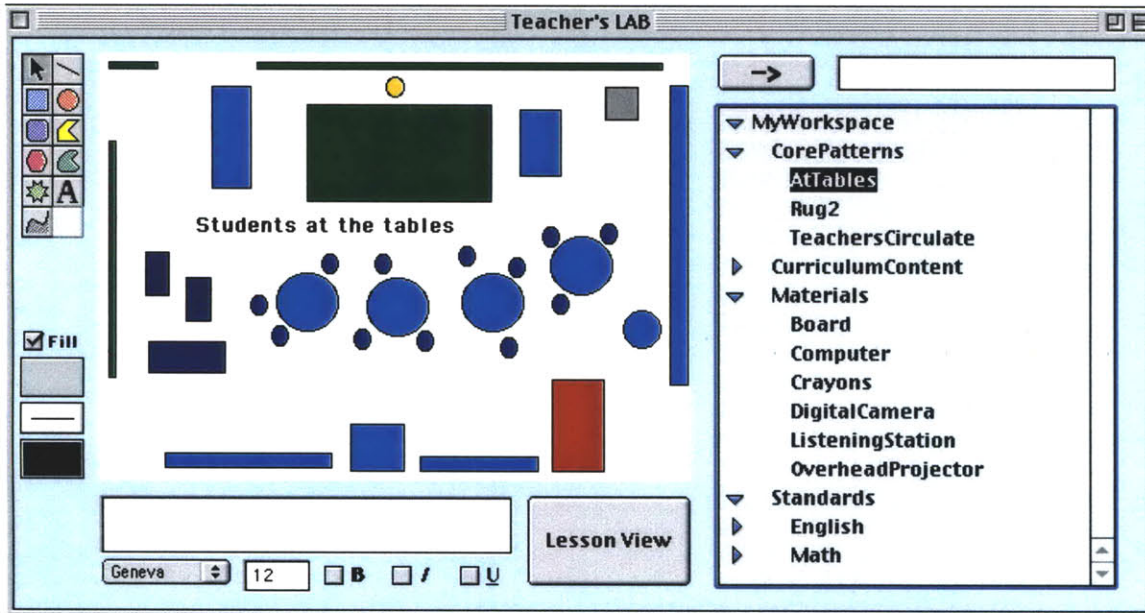


Figure 13. A new set of categories foreground pedagogical patterns.

In this example, the MyWorkspace categories have been changed to "CorePatterns," and "Curriculum Content," with "Materials," and "Standards" remaining. These categories would probably do a better job supporting the development of a pattern language for pedagogy. If the categories had been presented to Ms. O'Connor this way, she may have named the slides in the core patterns folder "GroupWork", "ClassDiscussion", and "IndependantWork". A slight change in the names of the categories would correct a fundamental design flaw. It is encouraging that despite the problems with the original design, teachers still had success identifying and developing pedagogical patterns. With improved MyWorkspace categories and the elimination of a few user interface bugs, I believe that Teacher's LAB could provide an effective platform for the development of a pattern language for pedagogy.

Chapter 6: Conclusion

6.0 Summary of Argument

The Teacher's LAB project provides a new approach to teacher collaboration and learning. In Chapter 2, I told the story of Ms. Duke and Ms. Oakes. Although they have never met, they developed an affinity for each other's teaching while they participated in my pilot study. As they used Teacher's LAB, they began to notice basic pedagogical building blocks that they share in common. I defined these building blocks as pedagogical patterns, a concept that I developed further in Chapter 3. Pedagogical patterns are part of a larger project to promote teacher learning through metacognition and reflective practice. In Chapter 4, I described how the design of Teacher's LAB supports metacognition and teacher learning by providing a platform for developing a pattern language for pedagogy. Chapter 5 evaluated the success of this design by reflecting on the experiences of the teachers in my pilot study. Despite some design flaws, Teacher's LAB helped educators construct and share representations of their own teaching practice, supporting representation, construction, sharing, and learning. To conclude, I suggest how these early results can be extended to foster the development of a more comprehensive pattern language for pedagogy.

6.1 Future Work

Christopher Alexander's *A Pattern Language* was co-written by five people with contributions provided by dozens of others. The patterns he describes are based on observations of thousands of buildings and towns. The end result is 253 patterns contained in a book that is almost 1200 pages long. The idea of the pattern language was Alexander's innovation, but it required years of work to develop the content to support his vision. Some of Alexander's students have become working architects and they have used the patterns to develop actual houses. Over the last several decades, the pattern

language concept began as an idea, evolved into a book, and culminated in the design of actual buildings.

Teacher's LAB is offered as a platform so that others can begin the process of developing a pattern language for pedagogy. This process will take a long time and require the development of a large library of content, but early results suggest possibilities for using Teachers LAB as the development platform for this long term goal. Teacher's LAB shows promise as a tool that supports representation, construction, sharing, and learning. These four dimensions are necessary to support the development of a pattern language for pedagogy.

The current version of Teacher's LAB, however, is just a prototype. The prototype was only developed enough to test an idea -- providing an existence proof for a new approach to teacher development. A second generation version of the software would be required for the project to expand to a larger group of educators. The current version only runs on Macintosh computers and the web-based file sharing system is not scalable. A cross platform version with a scalable file sharing system would allow educators from around the world to contribute lessons to an expanding library. This type of large scale participation is essential to the development of a pattern language for pedagogy.

In addition to teachers, a stable, scalable platform would facilitate contributions from academic researchers and curriculum developers. For example, I can imagine proponents of Howard Gardener's multiple intelligences theory developing a library of pedagogical patterns. Or an educational publisher might create a similar library that is based on content that would traditionally be presented in a textbook. Server technology could trace the evolution of this content so academics and curriculum developers could gain a better understanding of how teachers actually use the content in their classrooms. This would provide an excellent opportunity for researchers and curriculum developers to test and fine tune ideas. Of course, additional content contribution would also enhance the value of Teacher's LAB by providing a more diverse selection of pedagogical patterns.

Teacher's LAB is the first step toward a much larger goal. Creating a pattern language for pedagogy would require a large collective effort. This effort would be as valuable as the pattern language itself. It is the discussion and reflection that Teacher's LAB incites that holds the promise of turning an ordinary teacher into one of Schon's reflective practitioners. The time I spent with the teachers who participated in the pilot study was full of discussion about teaching and learning. My hope is that these discussions could become much larger, allowing teachers from around the world to co-construct materials and engage in discussions about educational practice. A large database of pedagogical patterns would let teachers peek into each other's classrooms. This would challenge the isolation of teachers and in some cases may even result in a connection similar to the one shared by Ms. Oakes and Ms. Duke. The discussion at faculty meetings may still revolve around the school gum policy, but my greatest hope is that Teacher's LAB can help educators engage in discussion about what matters most: teaching.

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