Conflicts and Concerns in an Elementary Teachers' Science Group: A Metapatterns Analysis of Emergence, Complexity, and Issues of Schooling

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Emergence and Complexification in Teachers' Professional Discourse: Case Study of a Teachers' Elementary Science Working Group

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In teacher professional discourse, what stimulates engagement in meaningful and relevant discourse? What other factors and conditions contribute to the emergence of critical foci for discourse, which also lead to further complexification? Answers to these two questions appear to be essential in furthering our understandings of how to create more powerful professional communities, as well as of a number of aspects of teacher thinking and discourse. Such aspects include: (a) the particular issues and topics (and the nature of such issues and topics), which are seen to be relevant and meaningful to teachers; (b) the conditions which allow teachers to generate and delve into critical discourse; and (c) the dynamics which lead to greater complexification in teacher discourse.

The present paper will provide a background on how four theoretical frameworks will overlap and merge in the analysis of teachers' conversations. The content and dynamics of the conversations will be examined in terms of the nature of emergent and sustained discourse, as well as in terms of the nature and implications of the content of such conversations. Although the conversations within the meetings, which extended throughout the school year, included a range of topic areas, only two topic areas will be focused upon in the present paper. These two areas are (a) issues of schooling as they impact the lives of the teachers and (b) issues of teaching in science and mathematics.

Theoretical Framework

Four theoretical frameworks intersect in the present analysis: (a) chaos and complexity theories, (b) metapatterns, (c) communities of practice as a context for situated cognition, and (d) contexts of meaning. Metapatterns (Bateson, 1979, 1991; Volk, 1998) are in many ways descriptive of and extend the concepts involved in chaos and complexity theories. Where chaos theories developed as mathematical explanations of physical and biological phenomena (Capra, 1996; Prigogine & Stengers, 1984), metapatterns have been developed as descriptive of multidisciplinary phenomena. As such, metapatterns provide non-mathematical ways of analyzing social and psychological processes. And, in some cases, metapatterns present new avenues of insights in the social sciences.

The metapatterns described by Volk (1998) include spheres, tubes, sheets, borders and pores, binaries, centers, layers, time and calendars, arrows, breaks, and cycles. Each of these patterns has specific descriptive powers in the natural sciences. However, the power of using metapatterns lies in how their meanings at the most fundamental level are held in common across disciplines and aspects of life experiences. At more superficial levels, the meanings may vary within the context of a particular discipline or experience. In table 1, the metapatterns most useful in the present analysis will be described in more detail. In this table, the meanings and descriptions associated with the natural sciences will be put aside in lieu of the descriptions most appropriate for the social sciences.

Table 1. Metapatterns relevant to social sciences (underlined terms are from chaos and complexity theories) (Volk, 1995).

Metapatterns	**Description**	**Examples**
Spheres	Sense of containment, equanimity, omni-directionality.	Sphere of influence, sphere of friends, cognitive schema.
Tubes	Linear bi-directional flow or transfer of information, connections, relationships.	Links between and within concepts, relationships between individuals, relations in networks of production processes.
Borders and Pores	Separation, regulating flow of information, containment.	Invisible borders or barriers between individuals and concepts.
Binaries	Pairings, perception of difference, separation and unity, tension, duality, simplest complexity,	Report talk—rapport talk, positive—negative, relates to initiating bifurcation, situations that are far

	synergy between parts and wholes.	from equilibrium.
Centers	Center stabilization, resistance to change, attraction, organizing, longevity and stability, radiating relations, centricity, importance.	Cognitive prototypes, central ideas, attractors, dominant themes.
Layers	Building of order, stabilizing, structure, hierarchies with stratified stability, holarchies of nested parts in wholes.	Societies and groups as either hierarchies or holarchies, holarchic layers of complexity in cognition and social groups.
Time and Calendars	Time as a binary of movement and memory, progression, arrow of time, cycle of time, counting.	Progression of arguments and discourse, patterns of discourse and cognition.
Arrows	Flow, progression, directional links, sequences.	Thematic progression in discourse, relations in social groups.
Breaks	Transformations, change, leaps, shifts, sequences of stages, dilemmas, decisions.	Bifurcation points, insights, conceptual change, branching in discourse and cognition.
Cycles	Repetition in space or time, cycles and arrows becoming spirals or helices, circulation, rhythms.	Cybernetic feedback loops, patterns in an argument, thematic progression in discourse and cognition (as spirals or helices).

In addition, metapatterns tend to overlap and combine to form additional complex relations and processes, such as those described in chaos and complexity theories. For instance, the notion of emergence is a key concept in chaotic and complex systems. Depending on the particular circumstance, emergence may involve binary centers (or attractors) leading to arrows affecting cycles through time, which spiral into emergent ideas.

When examining teachers' discourse from the perspectives of chaos, complexity, and metapatterns, placing such perspectives within the contexts of cognition, especially contexts of meaning (Bloom, 1992), and of communities of practice (Lave & Wenger, 1991; Wells, 1994; Wenger, 1998; Wood, 1990) and situated cognition (Wertsch, 1985a, 1985b, 1991). Such contexts provide the means for seeing how chaotic and complex systems manifest from the interactions within professional communities. The interactions among participants in a professional community of teachers involve a sense of continual development of meaning, practice, community, and identity (Wenger, 1998). Meaning, as described by Bloom (1992), involves a complex interaction of formal knowledge, metaphors, emotions, values, aesthetics, interpretive frameworks, imagery, personal stories, and so forth. Such a view expands our sense of meaning to include the breadth of human ways of individual and socially shared knowing and thinking. The idiosyncratic and shared meaning provides both the underlying frameworks and energy (or stimulation) for the development of communities of practice and professional identities.

Method

This paper examines the discourse of elementary teachers involved in a year-long teacher development project. Six elementary teachers, with a minimum of 4 years of experience, from public, charter, and private schools attended bi-weekly meetings intended to help teachers develop their skills at teaching science through inquiry. Part of each meeting was devoted to discussing issues and experiences in teaching science, followed by doing and evaluating inquiry activities. Although the intent was to focus on issues in teaching and learning science, many meetings started with discussions of more general issues facing teachers. These latter discussions, as well as those focusing on science teaching, comprise the focus for the present study.

All meetings were video and audiotape recorded (with a couple of exceptions, where only audiotapes were used). All of the audiotapes were transcribed. Field notes were recorded separately by a graduate research assistant and by the researcher during and shortly following each meeting.

Data analysis included applying three different analytical spaces as ways of categorizing segments of the teacher's dialogue. The first analytical space combines four clusters of theoretical concepts involving chaos and complexity, metapatterns, inquiry, and pedagogy and teacher cognition. The second space focuses on communities of practice along three dimensions: (a) meaning, practice, community, and identity; (b) talk, actions, knowledge, cognition, and content; and (c) issues, self, children, pedagogy, and subject matter content. The third space focuses on inquiry with two dimensions: (a) problem-question, method, variables-factors, data, analyses, and explanations; and (b) communication, insights, context, relations-connections, alternatives, appropriateness, uncertainty, solutions, and difficulties. Each of these analytical spaces provided a framework for coding transcript segments and for delineating extended patterns of discourse.

In addition to the conversations discussed here, other sustained conversations, which involved their own science inquiry, occurred during the meetings of the teachers, but are not addressed in the present paper. However, the extent and frequency of conversations that involved their conflicts and concerns with teaching tended to spontaneously generate. Teachers would walk into the meeting room and begin talking about their conflicts and concerns. Many of these conversations occurred before we had set up the recording equipment, and so were not available for analysis. The conversations that were recorded were either part way into those that had already begun or arose during the meeting time.

Results

The context of the teachers' group was based on distributed responsibility and control among all members of the group including the researcher. As a result, many of the emergent conversations were based on current concerns of the teachers. These concerns included issues with standardized testing, the mandated use of kits for teaching science, administrative pressures, issues involved in implementing science inquiry, and so forth. In each case, these emergent concerns led to an increase in the complexity of the content of the discourse. In one case involving science fairs, the initial discourse led to organizing and implementing the first community-wide science fair for elementary and middle school children.

In all cases where emergent conversation occurred, personal emotions and values were at the core of each issue. In addition, each emergent conversation arose from at least one binary tension, such as mandated use of kits, where teachers felt that such kits limited teacher and student engagement versus non-kit-based approaches which could lead to further engagement in inquiry.

Since metapatterns tend to lend themselves to visual representation, a variety of figures as are used to depict the content, relationships, and dynamics of the teachers' discourse. In this section, the fundamental characteristics of discourse will be examined, followed by examinations of conversations that involved teachers' conflicts with schooling and then those that involved specific concerns with teaching science and mathematics. The final subsection will explore the development of an overall model of teacher discourse.

Fundamentals of Emergent and Sustained Teacher Discourse

Throughout the year, the teachers engaged in numerous conversations arising from events in their schools and classrooms. Some of these conversations began prior to the beginning of the meetings (and prior to the set up of the recording equipment) and extended throughout the meetings. These conversations focused on two basic contexts or spheres of experience: (a) professional concerns or conflicts and (b) pedagogical concerns. Such concerns act as centers or attractors for emergent and sustained conversations (see table 2).

Table 2. A list of "centers" (attractors) that initiated sustained discourse and interest of teachers.

Center Context	Center Topics	Center Composition	Brief Description
Professional Conflicts	• Standardized testing • National and state standards • Teacher-proof curricula • Mandated use of science kits	**Binaries** • **Hierarchic** (top-bottom conflict). • Self-expertise vs. mandated actions.	• Conflicts with mandated testing. • Feelings of powerlessness. • Conflicts between Standards and meaningful teaching.
Concern with Student Learning	• Instruction and curriculum • National and state standards	**Binaries**: • **Time** – efficiency vs. depth and quality of learning. • **Hierarchical** pressures to cover content vs. professional concern for learning.	• Teachers found that letting students struggle with problems throughout the day resulted in growth in student confidence and greater understanding. • Conflict between Standards and meaningful learning.

As we can see in Table 2, each of the areas of emergent conversations has a binary at the center. Such binaries may be set up by a hierarchical situation, such as in the institution of schooling, by pressures of time as in the pressure for curricular coverage, or by a particular question or problem in teaching or inquiry. The complexities of specific emergent conversations will be explored in more depth in the following discussion. However, at this point, this key point of binaries acting as the center attractors is important in terms of developing an understanding of how extended conversations emerge and sustain over a period of time, as well as how such conversations can be initiated and fostered among teachers.

The notion of binary as center is not the full picture of emergence in conversations. In complexity theories, self-generating and self-maintaining systems need some source of energy. In human conversations, the participants provide that "energy". Although "energy" in this sense is not equivalent to the scientific sense used in complexity theories, it has a metaphorical equivalence in that the "energy" provided by the participants, which is emotional or passionate in nature, initiates and carries the conversation forward. Table 3 lists the forms, in which this passion or energy manifests.

Table 3. Requisite emotional "energy" (passion) for sustained discourse.

Category	Description	Context
Desire	A need to understand as a driving "force;" a drive to improve and grow professionally.	Inquiry Solving problem Professional actions and growth
Curiosity	An extension of desire as a motivating "force" to find an	

	explanation;	
Frustration	Dilemmas and difficulties in relating to imposed situations or to classroom events.	Standardized testing Required curricula Teacher proof curricula
Anger	Beyond frustration, imposed situations or classroom events anger teachers.	Standardized testing. Teacher proof curricula.
Caring	An emotional connection to children that compels teachers to act and to focus their thinking.	Teaching students Student problems

The emotions listed in Table 3 are apparent in the conversations explored in this paper. However, other emotions are quite possible and certainly drive conversations in a variety of human interactions. The point is that emotions in some form are necessary for sustained conversations, and that such emotions appear to arise from situations containing a binary as the central attractor. In addition, such binaries need to spark participants' emotions, in order for sustained conversations to occur. Figure 1 depicts the relations between the context of the center binary and the context of the individual. Within the context of the particular situation confronting teachers, there is a binary, which acts as the center attractor. In addition, binaries can serve to separate, as well as unify. This tendency is represented by the divergent and convergent arrows. The tube connecting the situational center and the emotional center of the individual represents the connection or relation, which sparks or energizes the individual and provides for the emergence and sustenance of discourse.

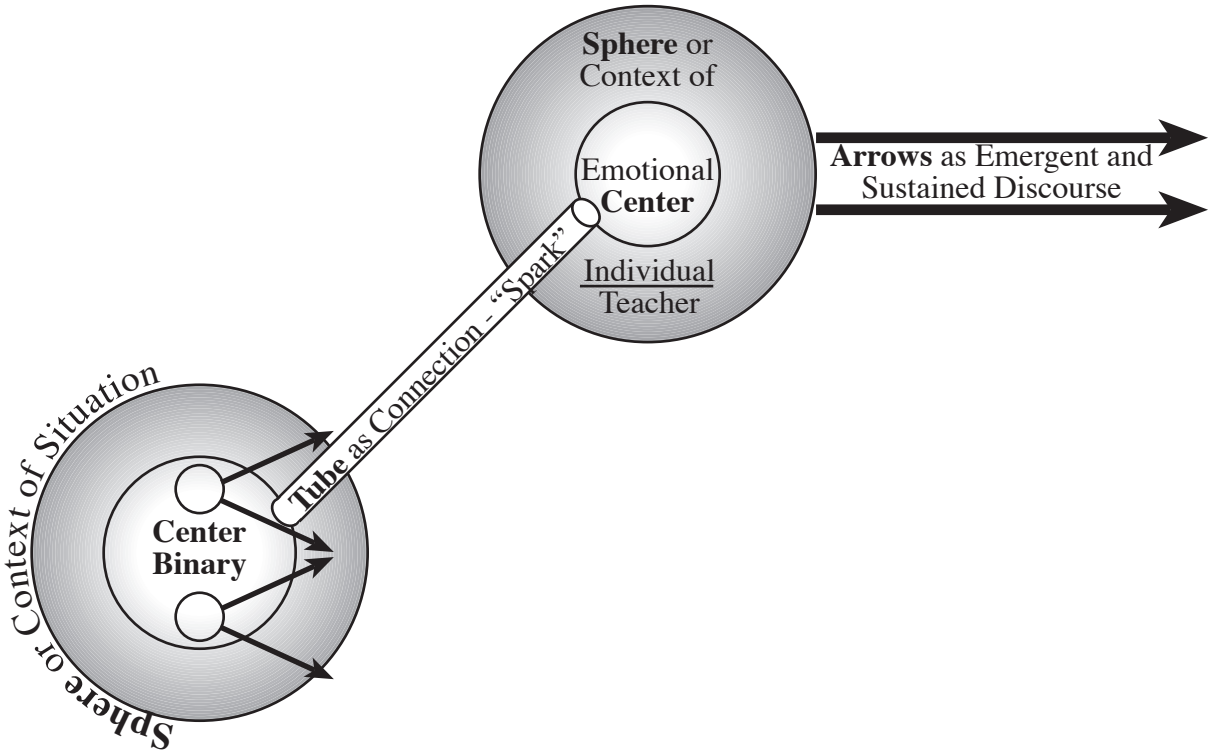


Figure 1. Representation of necessary components and relations for emergent and sustained discourse.

In the following subsections, we will explore in more detail the specific dynamics and structures of the three major areas of discourse that arose among the teachers. The first

subsection deals with teachers' professional conflicts, the next one explores teachers' concerns with students and teaching, and the last one proposes a generalized model of teacher discourse.

Teachers' Professional Conflicts

The basic context for teachers' conversations about professional conflicts stems from a hierarchy of power and control, which, in turn, establishes a binary of "us" against "them." As shown in Figure 2, hierarchies tend to present situations, in which information flows up through the layers, while control moves downward. With teachers residing at the bottom of this hierarchy of schooling, the us-them binary results in discourse that hinders the development of functional professional communities and provides for the emergence of negative sustained discourse. Such a hindrance to the development of productive professional communities can be viewed as a border or boundary between teachers and the potential for developing fully as professionals.

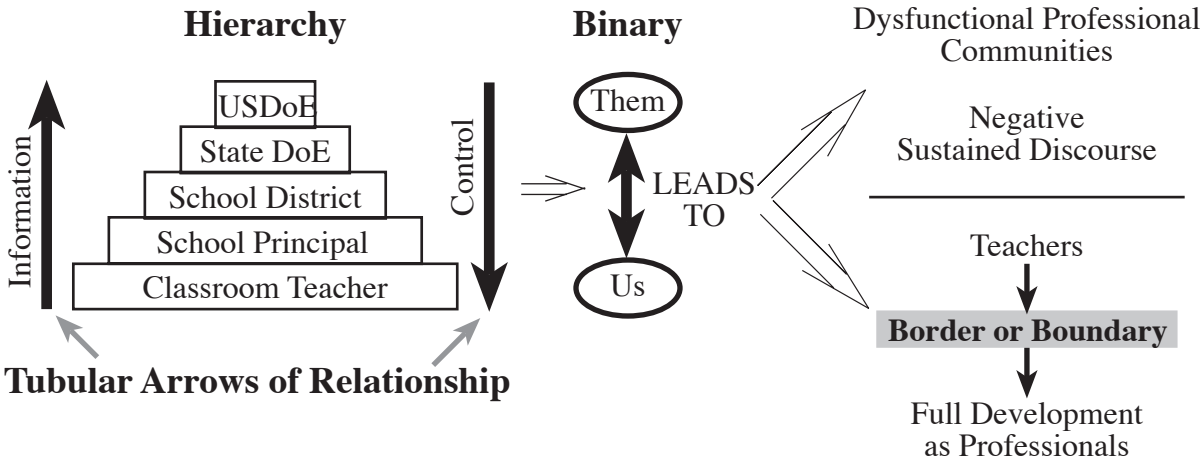


Figure 2. Hierarchical binary of schooling as basis for sustained teacher discourse.

In the following excerpt (Excerpt 1), we can see how the hierarchical, us-them binary affects teachers. Teachers were actually brought to tears out of fear of the repercussions from low test scores. Their descriptions of listening to an Arizona State Department of Education official drives home the pressure teachers feel from higher up the hierarchy. At the same time, these teachers are professionals who care about and have a great deal of insight into the backgrounds and needs of the children they teach.

Except 1. Teachers' discussion of testing as mandated by the state.

Allison	Oh, he was just saying he was in a two, a three hour meeting with somebody and what he was saying was the test is what's most important. The test, the test that our students have to, to take…
Barbara	This uh, our (???), this gentleman…
Frank	Schumacher.
Allison	Schumacher yea, out of Phoenix, so he's been traveling all around, he just said he was back from Alberta, Canada…
Barbara	Yea.
Allison	But, uh, the two big things out of three hours in sitting there that I got from him was, um, the one you need to work. You need to work with everybody's strengths and weaknesses within your department, within your grade level, within… you know… at your school and really capitalize on the strengths… And, you know, if someone is really good at language arts have them share what they do in the classroom, so you can use that and utilize that in the classroom. And, the second thing is, you know, after we talked about test scores and stuff is basically teaching to the test. You know that's what

	it's coming down to. You know you want to get the kids prepared. He went over the AIMS booklet and said… there is a lot of stuff out there that is just like that… you can buy … that you can use in the classroom that get the kids prepared for the AIMS test.
Barbara	And you know what really unfortunate is we teach to have them to better math skills and reading skills and you know what gets axed is stuff like science.
Allison	And yet you…
Frank	Social studies…
Barbara	Social studies.
Allison	Ask kids like uh, simple questions like… what's the capital of Arizona
Barbara	Right, or the U.S. or…
Frank	Right.
Allison	Um, and then…
Allison	And how do… you spell Arizona
Frank	Right.
Jeff	Jim Manley who's the teacher of the year, Arizona teacher of the Year. Now that he got that, he's always being called into all kinds of meetings … He was around a lot of the Arizona legislatures last week….
Rick	But, they don't get it, you know…
Barbara	Well we have teachers at our school, that I mean they're crying. I mean they are literally crying, because their kids are not doing well on the test. Some of them you know…
Barbara	We have the Native American kids that come off the reservation that their home life is different and they're not meeting the grades and…
Jeff	The whole culture is different.
Barbara	That's right. It's totally different.

How can teachers develop fully as professionals, when those in higher levels of the hierarchy do not respect their knowledge and expertise? It is this question that creates the border or barrier to teacher development and the establishment of productive professional communities. In Excerpt 1, the teachers were reacting to an emotionally charged situation. The hierarchical binary connected with their sense of themselves as professionals. This connection led to feelings of anger and frustration.

In another example (Excerpt 2 and Figure, Allison and Rick start a discussion of the hierarchical pressures of testing. The pressures of testing have the effect of setting up several binaries based on constrained time. In one sense, the time for students to learn the material is situated in opposition to the time to cover the material for the test. In another sense, the results of student testing may put the teachers' jobs on the line. However, the fundamental binary, as discussed earlier has to do with the establishment of an antagonist "us-them" opposition. Where some binaries unify, as well as separate, the binaries discussed here serve only to separate.

Excerpt 2. A discussion of the hierarchical pressures of testing.

Allison:	When we started out the year we didn't have our books because we put everything in storage. We were moving and we hadn't gotten the books that had the math books in it yet, which was a major problem. So I started out with math their away stuff, and the kids didn't think they were doing math, and one of the girls said to me today "Can we just go back and do those games like we did the first year?" It was all manipulatives and-
Frank:	Is it time consuming at all?
Allison:	It's very time consuming. You know, you feel that pressure, "Oh I'm not getting through all the stuff in the book that I should. What are they going to be tested on? Will I have covered everything they are going to be tested on."

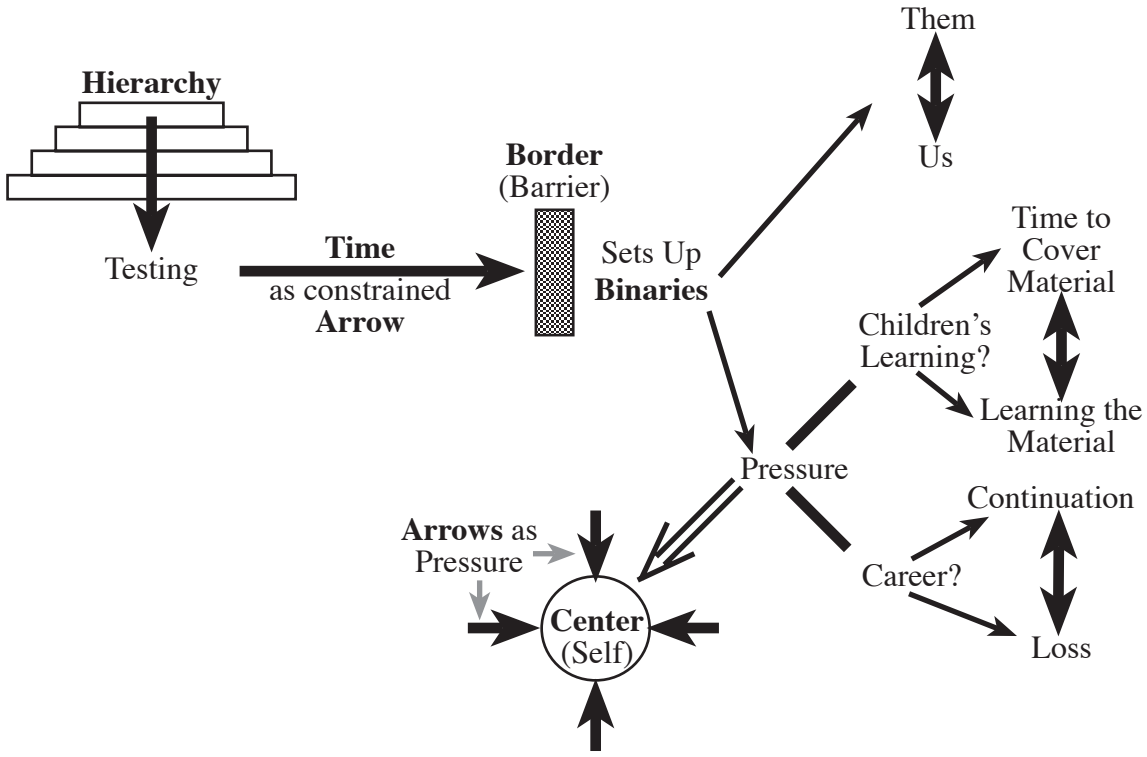


Figure 3. A representation of the hierarchical pressures of testing.

Similar occurrences of a focus on testing, standards, and imposed curricula emerged prior to and during several other meetings. Another example of the hierarchical nature of schooling is contained within a statement by Diane: ''Cause don't you get almost every week a letter inviting you to bring your kids to do something and they always say, 'Meets the Arizona standards'?" George's question, "Well, who set the standards?" in response to Diane focuses even more pointedly to the problem of hierarchies. Somehow the standards are viewed as some magical sphere atop the hierarchy. They become the gospel, from which all of schooling is centered. But, the question of who developed the standards lingers as a dark cloud above the heads of teachers. In fact, my twelve year-old son's homework has the specific standards printed across the top of the pages. He, too, reacts with frustration and, fortunately, with some sense of righteous indignation. With students even lower in the hierarchy than teachers, some sense of children seeing the ridiculousness of the standards is hopeful.

How does such a focus on standards affect students and learning? Although the best of intentions may have been behind the creation of creating standards, the intentions appear to have a high likelihood of backfiring. When a specific homework assignment is focused on one specific standard (printing the standard across the top of the assignment is school district policy),

the assignment has the potential to be decontextualized and devoid of meaning. As with my son, doing the assignment becomes a ritualized "going-through-the-motions." Intrinsic motivation, meaningful cognitive and emotional engagement, and the development of complex understandings are blocked. The control emanating from the hierarchy under the guise of standards inserts a barrier (border) between the individual student and his or her own growth potential as a learner. As in Hermine Marshall's (1992) contention that the view of education needs to change from seeing students as consumers of knowledge to students as producers of knowledge, the way in which standards are used in schools continues to emphasize students as consumers of knowledge. Such an emphasis will continue to trivialize learning, to propagate disconnected and fragmented knowledge, and to perpetuate a short half-life of knowledge retention.

In more subtle ways, the standards and the way in which science is portrayed in a variety of contexts has an insidious effect on teachers' practice. In the following excerpt (Excerpt 3), Diane, I, and others engage in a discussion about the scientific method.

Excerpt 3. A discussion on the scientific method.

Marsha: Back to this, like you were saying, let's throw, let's not have the scientific method and the standards and the Arizona state standards, and I would disagree with that. I would say, "Let's just look at science through that way. But, it certainly something I think the kids need to learn how to go through that process."

Jeff: Why?

Marsha: Because I think they can have a better understanding of how things work, and how they-

George: __ they think a little bit.

Jeff: What are we doing here? Imposing some sort of framework, versus allowing frameworks to emerge, which is actually the way in science. It just so happens that certain things happen. I think there's a better alternative than using, there's just something that grates at me when I hear the words "scientific method" because it has a tendency to really shut down kids. I think there are other frameworks that are coming out that are much more useful I think if we are looking at what types of things occur when we are doing science? One is, certainly, questions are important, and __ what kinds of questions you can test through an experiment or kinds of questions lead to observational studies. What questions lead to or require some other source for information, which are just technical questions that we need to supply some information to get it done so you can get one with it. Coming up with alternative explanations, coming up with more than one explanation, coming up with evidence to support claims. These are really the major components, scientific method is like, it's really becoming like a "Who cares" kind of, hobby. I don't know, very many science teacher educators who would talk, I can't think of any that would talk science. I don't know any of them, and some of them are positivistic too, but you see more about the major characteristics, which is science, differences between science and other things is that you come up with evidence to support your claim and that evidence can be of various sorts.

Diane: But there's a place for it, I mean you certainly don't want the drug companies not using the scientific method to decide if a drug is suitable for us and I don't want to make decisions in my classroom necessarily based on observation. I may want to have a little data. I want to take a little data-

Jeff: But see that's coming from the old, kind of positivistic view that the only valuable data is experimental data.

Frank: Could you still develop, like do your scientific method or whatever?

Jeff: There is no scientific method. That's the fallacy of operating on it. It's different for every situation, and it doesn't follow. I mean, when they go to write it up, it is written up in this form, but it's not, it really works in a kind of a linear path.

Marsha: I think scientists know, I think, maybe the "heart sciences" I think, a good scientist starts with a good question.

In this excerpt, Diane and the other teachers think that the scientific method and associated standards are necessary and important. Such a view suggests that the scientific method is a linear series of absolute steps and is in some sense infallible. As shown by Herbert Simon (1995), a great many Nobelists did not win the Nobel Prize for work arising from an experiment or for following the traditional notion of the scientific method. In addition, much of, if not nearly all of, science is done in ways that are closely intertwined with the personality and theoretical and philosophical views of the individual scientist, and proceeds along complex, nonlinear pathways. The essential notion that the methods of science share a groundwork in providing evidence for generated explanations is lost in the dogmatic view propagated by institutional hierarchies of science as a positivistic and mechanistic discipline.

In general, it is difficult to draw distinct lines of separation from teachers' professional concerns and those that focus on teaching, learning, and children. So, in the following subsection, some of the same issues discussed thus far emerge again. However, such issues will be explored in greater depth.

Teachers' Concerns with Teaching and Students

As we begin to examine in more depth teachers' concerns with students and learning, we again can see how the hierarchical binary of schooling creates some problematic dilemmas (binaries). In Excerpt 4, Diane begins with the notion of how she could use the state standards to create a lesson "that's good science." This seemingly "good" idea, however, takes the hierarchical mandate of standards and suggests the possibility of creating a hierarchically created and perpetuated assumption of a single lesson. This single lesson, in turn, needs to meet the standards "so the kids can pass their AIMS test (Arizona state mandated test)" and also demonstrate good science. However, "good science," which is based on meaningful inquiry, is difficult if not impossible to do in a single lesson. Such inquiry, as we will explore later, arises from children's curiosity and questions and extends across substantial periods of time.

As the discussion continues, Diane expresses great concern that if teachers teach to the test, the children are going to leave her class hating science. On the other hand, she wants her students to move on to the grade loving science. Figure 4 depicts this situation as a set of hierarchically created binaries with apparent causal relations from one set of binaries to the next.

Excerpt 4. Teachers' discussion of the dilemmas they face in terms of standardized tests.

Diane: I just thought of something as we were having this discussion that I would be interested in doing if you were to pay. Bringing in the standards, and picking something from it and trying to create a lesson that's good science as well as meets the standards as well as keeps kids excited science, because I guess that's my, what I want to do. I want to meet the standards so the kids do well on the tests, so the kids can pass their AIMS tests, but I don't want to just stand in front of the class and say, "This is the vocabulary you need to learn." I want them to discover that vocabulary in a meaningful way, and-

Jeff: The other way to do it would be to think up a good thing to do and then see how-

Diane: And not start with the standards.

Jeff: So we could pick something that we have done and then see how it fits the standards.

Diane: 'Cause don't you get almost every week a letter inviting you to bring your kids to do something and they always say, "Meets the Arizona standards."

George: Well, who set the standards?

George: Creative teachers, or?

Jeff: Some, I think there were a couple of good teachers, but I think there's also, there are some teachers I know that were on that, that were kind of dreadful. Just very

positivistic that we have to know this stuff, my question is always, "Why is this so important?" The national standards, I don't mind a lot of the process sorts of things they talk about, as standards, but I always have a problem with the content. In science why is that more important than this?…

Diane: Well, let's say it's in the standards. I'm not sure, but I bet it is. The kids have to know the parts of a plant. Well, I don't want to draw a diagram, I don't want to give them a worksheet with a plant, and we all label it. That's not good science, and it's not good science. So, I don't want to do it that way, but how do I do it so that I don't do what I did to this little girl and have them go to the next grade, "Oh, I hate science. Science is boring."

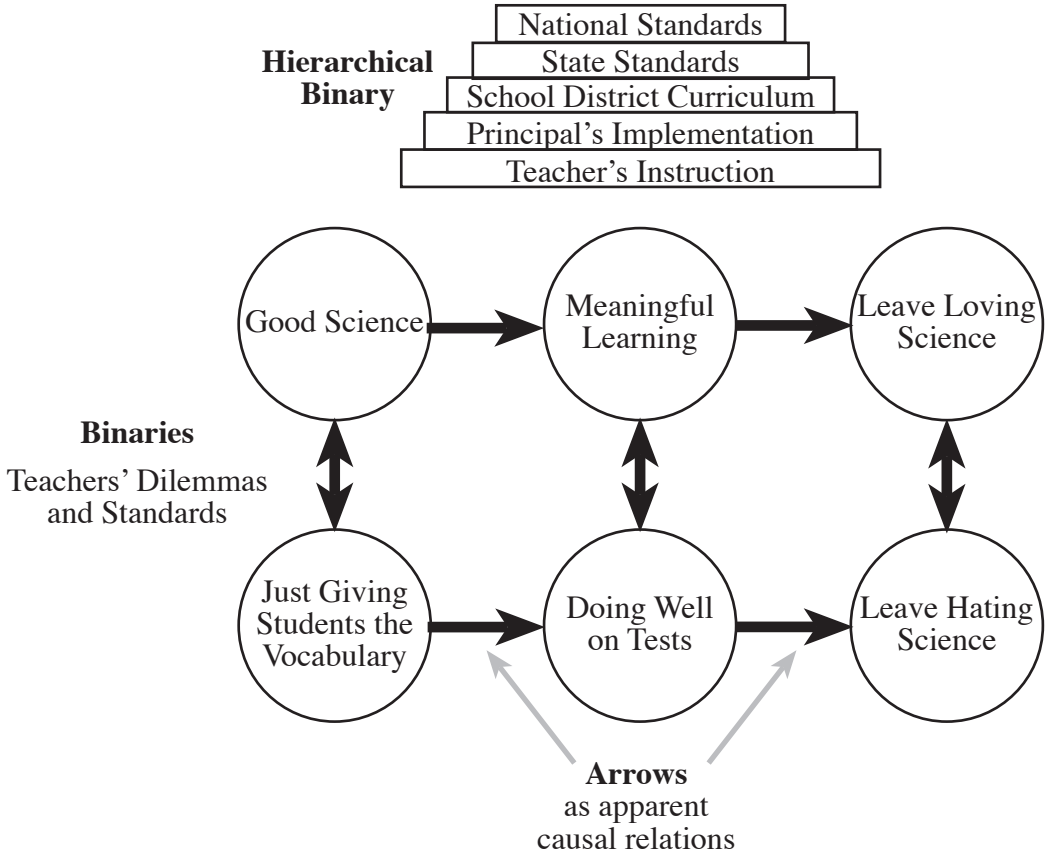


Figure 4. Standards as hierarchically created binaries with apparent causal relations.

In excerpt 5 and figure 5, a similar situation arises in mathematics instruction. The conversation begins on a positive note. Barbara describes a situation, in which she allowed a student to struggle with a problem throughout the day. The result was that the student solved the problem in a way that made sense. However, Barbara describes her struggle with the binary (dilemma) of being more instructionally efficient (i.e., takes less time to solve the problem for the student) vs. allowing time for the student to struggle with a problem. Such a dilemma not only arises from the hierarchical pressure for content coverage, but also depicts the tension between the teacher-centered vs. student-centered curricular binary.

Excerpt 5. Teachers' discussion of efficiency vs. time to struggle with problems in mathematics.

Barbara: Well, I was saying that before I was taking this, before we had this discussions, in math I would have never done what did today. A child could not figure out a story problem and I just, and we worked on it and worked on it and she finally just stood back, "Let's

take the day and think about it." I put her name on the board so I wouldn't forget to ask her, "Put your name up here and I'll keep checking in on you and let me know how it's going. Think about it throughout the day and it'll come to you how to do this." I know how things happen for me, sometimes, if you don't think about it or, and she said, "Oh, I think I know how to do this now. I need to find the area of the entire rectangle before I can start." What was throwing her, this is what was so frustrating to me. It wasn't a one step story problem. You had to solve two other things before you could solve the question. She just wasn't prepared to think about the big picture. But giving her some time to think, which I never would have done before because I would have solved it for her. "Look, here, let's draw a picture and I'll show you." I hope it gave her confidence as well, but I don't know how long I would have been able to hold off, I'm sure eventually I would have to show her how to do it, of course I would have. But, she did it and it finally made sense to her what to do.

Jeff: Even struggling through it and not being able to do it and helping them is a lot different from stepping in and helping them right away.

Barbara: It's hard not to do that though.

Jeff: Well, nothing in our socialization as teachers allows us to develop that kind of __… we are not socialized that way.

George: But what about another approach? 'Cause I teach algebra and one of the things I found so often, this happens a lot, is kids will, it's almost like they'll get locked up and when they are faced with a problem they'll go, "I don't know how to do that!" Yet, you can give them a simple problem that has the same principles and they can do it. So, they somehow freeze at the complexity of it, but the process is the same as a simple one. I was doing one with a student last week, where we were adding 1/x+1 and 1/x^2. "Ah, I can't do that! They don't have the same numbers in the bottom. They don't have the same denominator." How would you add fractions that don't have the same bottom? "How do you add 1/2 and 1/3? Oh, you find a common denominator." "I don't know how to do it!" The process is the same to do the simple one as the complex one, but somehow they freeze at the complex one. If we can give them, and I found sometimes just give them a, just say, "Okay, hold that problem there. Let's work a simple one." They go through it, using the same steps for this one, and then they can do it. I'm not giving them the answer, I'm just saying, "Use what you already know and apply it to this one."

…..

George: But in reality, I'm just reacting, who has time to sit and watch the snails? I have to go to work. You know what I mean? The reality of life is that, how much time can we devote to simply sitting there and observing and waiting for questions to come? I work knee-jerk, there's a problem and I solve it and a problem and I solve it, etc. That's how I go through the day.

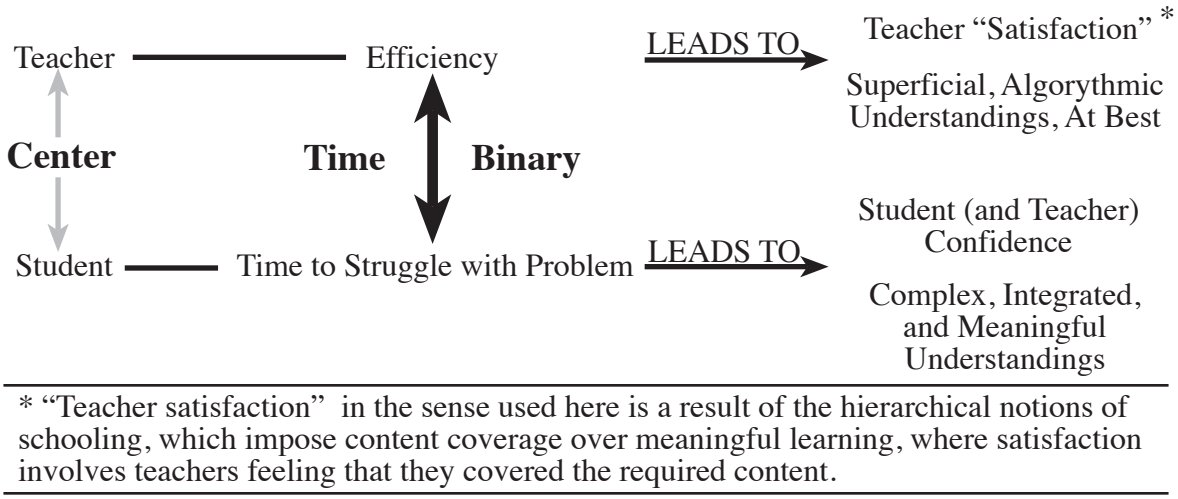


Figure 5. Teacher (Barbara's) dilemma (binary) of time as binary in mathematical problem solving.

On the other hand, George's approach is one that tries to find the middle ground between teacher and student-centered, between efficiency and time to struggle. Rather than allowing students the time to struggle, he provides a sequence of steps that involves breaking the problem into smaller parts. Such smaller parts capture the sense of clonons (Volk, 1995) in that they contain similarities to the whole. By being simpler representations of the whole, they are holarchic layers rather than building upon one another as hierarchic layers. However, the entire process described by George appears to be a hierarchic sequence of stages.

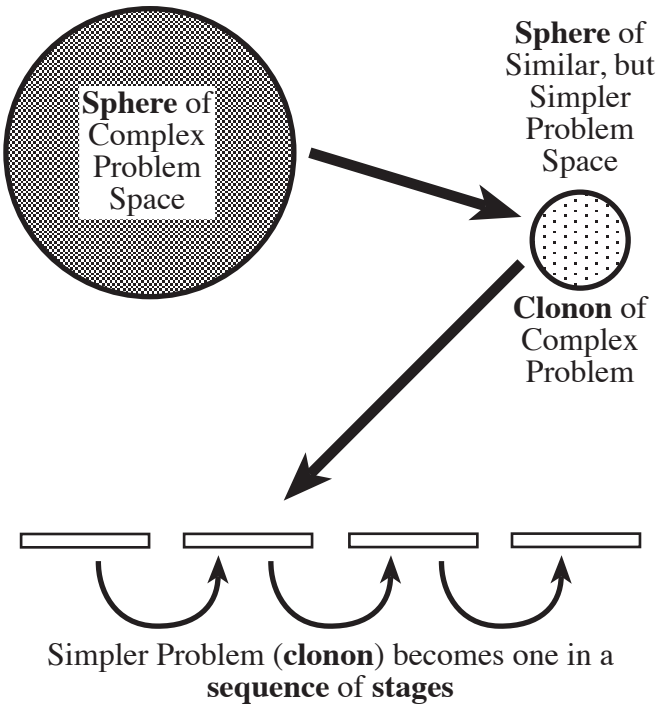


Figure 6. Teacher (George's) approach to teaching mathematics as layered (use of clonon or simpler versions of complex problem) sequence of stages.

Near the end of excerpt 5, George's allegiance appears to lie in the realm of efficiency and linearity – see a problem and solve it. Where Barbara started exploring nonlinear and more time intensive approaches to student problem-solving, George maintained his allegiance to linearity and efficiency, but found a compromise position between the binary of teacher-centered and student-centered.

Excerpt 6. Teachers' discussion of conflicting assumptions in teaching mathematics.

Frank: Yeah, I'll ask about all the subjects. You know, when I see things like learning different algorithms or learning different formulas, you know, I think of it as just being a shortcut. You know, a shortcut to find out the answer, but if you just constantly teach those shortcuts the kids don't understand why they are doing it, what does it really mean? They don't get that. Unfortunately, I often tell the kids that, you know, sorry guys, but you know, you may not understand it, but this is the way it's done. You're going to need to know this.

Barbara: There are just so many rules. You can go crazy just trying to remember all the rules. You know that rule something minus 2 times 180 or…. Will give you the kind of angles…. Or something. What if you forget that it was minus two? What if you thought it was minus 1? You know what I mean? Its hard, if you don't understand why something is happening. 'Cause then if you can figure out, well it has to be 2 because …… and there would be some reason. You would know the reason why.

Jeff: I keep thinking back to that 53 x 47 and the way we teach we teach mathematics, that concept for that algorithm, I don't have a clear understanding of what that is. You know, if you were to do a different one it would make more sense. 53, well, you could get rid of the 3 and say 50. Well, 50 is half of 100, so half of 470 is 235. Then you just take 3 50's, then remove 3 3's. That you could do in your head easily and that makes more sense, like, your actually taking

Frank: Yes, but there's more to it though, which means there's more opportunity for mistakes. You know, if the kids can learn, okay you put a placeholder here, go onto your ones again, then your tens-

Jeff: But what is the concept behind that? It's seems much more difficult.

Frank: By the time they get to doing those kind of problems you would hope that they had a pretty good understanding of place value and all that.

Jeff: But why couldn't they learn multiple algorithms too? In fact, put the challenge, see how many different ways you can figure out to solve this problem.

Frank: Come up with something easier or better than what the books told us.

Barbara: They do everything with money. Dimes and pennies, and so when we were doing regrouping with addition it was you had 13 cents plus 27 cents, and so how many pennies will you have? You will have 3 and 7 pennies which really make a dime, so oh, it's a dime! You put it over with the dimes. That's how they, that's sort of giving some sort of concrete. And most children have had opportunities with money so they sort of are familiar with it. So that's how they do that, and I thought that was pretty interesting, I even feel that one of the problems was 10 more than 31, and so, a student wrote 44, and I said, well you have 31 cents and I give you another dime, that's 10 cents. How much would you have? She said "Oh, 41." I mean, like, all you do is put the cent sign there and it became clear. I don't know, but… That's just what happened.

Jeff: A lot of that has to do, I think that's where the conceptual. She has a conception of money but she doesn't have a conception in it, even though they are the same, it just doesn't… compute somehow.

Barbara: So we introduce it with money, and so if we introduce it with money and gradually,… it begins to make sense for them. Its interesting.

In teaching mathematics, as in many other subject areas, there are often conflicting assumptions about teaching and learning. Each side of this binary of conflicting assumptions is

comprised of a binary, as depicted in figure 7. One side of the conflicting assumption views teaching and learning as convergent and unifying, On the left side of the figure, the assumption learning is situated in a framework of constructivism, where students actively engage in processes of sense-making. The assumption of teaching is one that works to provide the time and assistance for students to struggle with problems, generate explanations and solutions, and find multiple pathways to solutions. Such an approach places students and meaningful learning at the center of the convergent binary of teaching and learning.

On the other side of the conflicting assumptions, student learning is viewed as a process of consuming knowledge. Within this view, lies the notion that a teacher supplied approach, algorithm, or logical set of steps is sufficient for student understanding. Teachers view their task as that of supplying children with a single way to reach solutions to problems. In such an approach, the binary of teaching and learning is divergent. The process of transmitting knowledge has a tendency to disengage children from learning in meaningfully and complex ways. Here learning and teaching are divergent. As my 12-year-old son complains about his math class, "this is stupid. We keep going over the same stuff. I'm not learning anything."

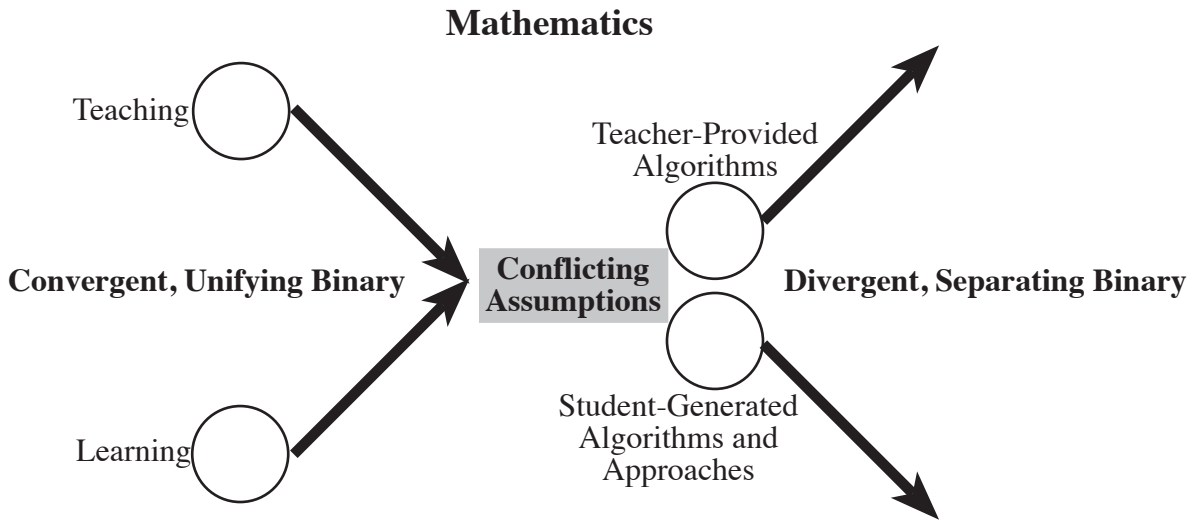


Figure 7. Teachers' conflicting assumptions in teaching mathematics.

In the previous discussions of mathematics instruction, teachers find it difficult to approach mathematics in a ways that provide more meaningful learning opportunities. In contrast, the following example (excerpt 7 and figure 8), a teacher expresses her confusion on how to provide appropriate inquiry activities in response to an unexpected classroom event.

Excerpt 7. A teacher's discussion of an unexpected science inquiry event.

Barbara: I just keep thinking at the second grade level. I don't know. Like with light like today, they had this thing that spins and they were bouncing the light off of it onto the ceiling. Doing that and all of the sudden they bounced it one way and wow! Look at all of those rainbows on the ceiling. They see rainbows all of the time, but they don't like understand this. And how can we do this? Because we know that this light is breaking, but how can you explain that? How can you explore enough to figure that out to know this?

….

Barbara: I said, "how did those rainbows get there?" "Well, I don't know."

….

Barbara: Well, what are kinds of things that we can put out for the children to explore to make this happen? So that they can make some sort of conclusion that if this shape or this

> has to be like this and if we do this then we will make a rainbow. What kind of things can we give them what kind of like a basket of things to look at?

This pedagogical concern, which arises frequently among elementary teachers attempting to teach science, creates a problem binary of the present context (sphere) of the problematic event and the context of how children can develop explanations of the event. A part of the problem faced by teachers is their lack of complex understandings of the phenomena they encounter. Although they appear to see the importance of encouraging children's inquiry, they are not sure as to how to proceed. This lack of knowledge of the content and inquiry presents a fuzzy border or barrier to continued inquiry with children. Although such a border is problematic, the notion of confronting the issue is positive in that teachers have a desire to overcome this obstacle. Where teachers have the expertise to deal with similar barriers in other subject areas, their lack of expertise in science makes such situations even more frustrating. Even if, they have been developing expertise in conducting inquiry, their minimal understandings of the science concepts and how such concepts are constructed and interconnected makes it difficult to identify the appropriate questions, concepts, and inquiry procedures.

With such a lack of thorough understandings, teachers tend to look for sequential and clearly defined sets of activities. With more expertise, teachers can develop greater confidence to work with nonlinear approaches to student inquiry. In such cases, the conceptual goals are understood. At the same time, the teacher can design or help children design experiments and activities that address their specific questions.

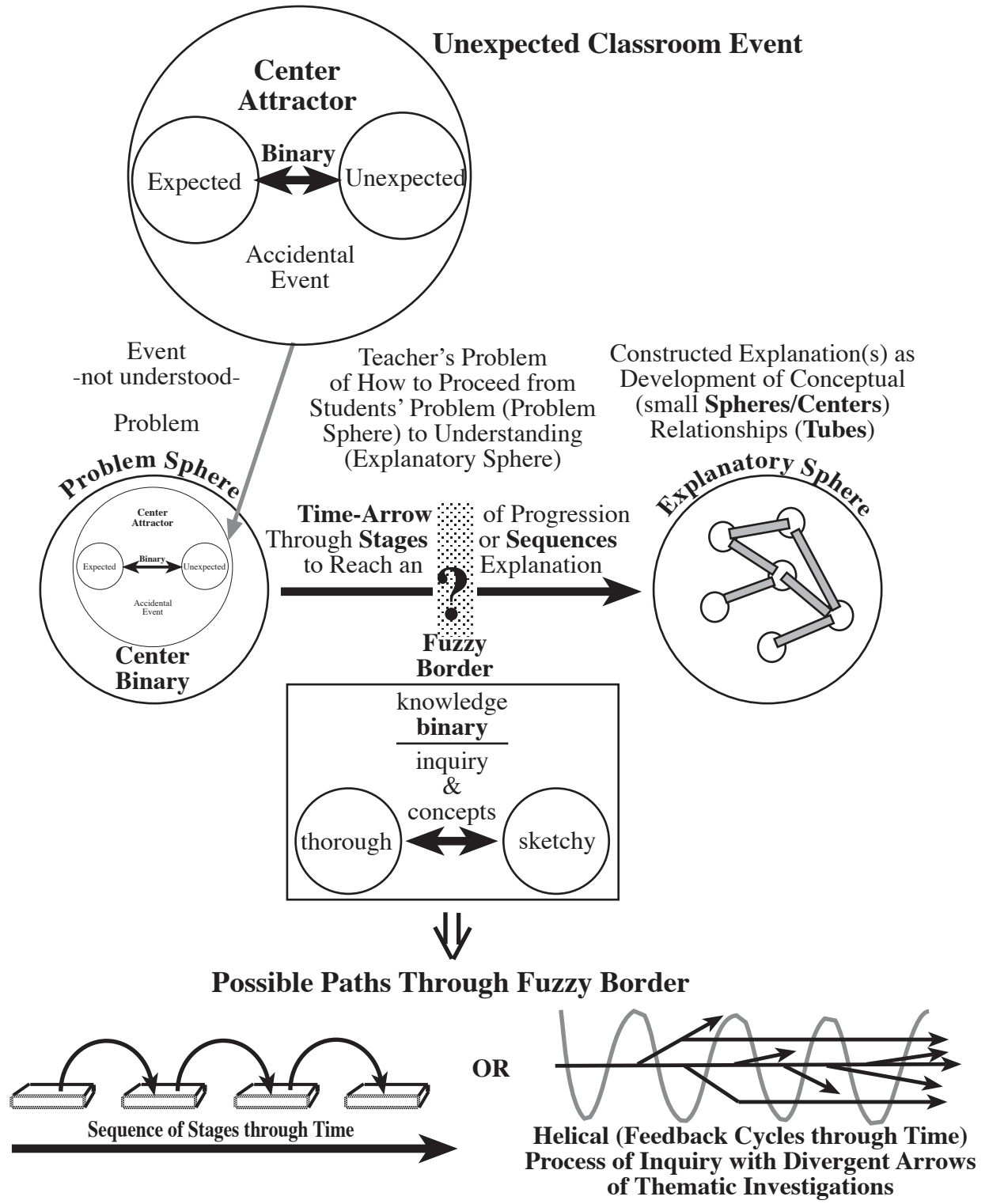


Figure 8. Unexpected events during children's inquiry and teacher's problem of how to proceed.

In the final example of teacher's concerns with children's thinking and learning (excerpt 8 and figure 9), the teachers express a concern for how to stimulate children's thinking, especially when realize how children have been socialized not to think for themselves and to accept the knowledge of authorities.

Excerpt 8. Teachers' discussion of children's thinking.

Barbara: It's being able to I don't know, it's almost like being able to refute authority almost like saying like you have to, you know being able to question and being able to not think that this person knows everything.

Allison: You can do that. But, how do you teach children how to think when they are so used to being told.

Barbara: You know and you have to give them the brains to go the other way. It's a really difficult thing. I think. At least down here.

Frank: It's got to start that first day they come to school.

Barbara: You know you make mistakes on purpose sometimes just so that they'll say ,"wait a minute." That's all I want to hear, "wait a minute that's not right," or ",huh." You know 'cause that's what I want them to do. Or um, and then the whole justify. "Why do you think this way?"

Jeff: Yea.

Frank: Well, here's a case in point. My kids were doing some practice with the *Stat. 9* and *Scholastics*. We have *Scholastic News* in our classroom. And they sent a little supplement where the kids read stuff, they answer questions and they fill in the little circles. You know…A-B-C-D. And that just kind of gets them into the whole process of what the *Stat 9* tests are like. And there was a question on there that a substitute brought it to my attention that none of the four choices were correct answers. When we looked at it, we puzzled over it and were missing something. So, I said, "let me go get the answer key," and sure enough the one that they said was right, wasn't right. It was wrong. And of the kids in my class, none of them said, "you know what I can't figure this out" or you know what I don't think the answer is here." They just all assumed, which is unfortunate, they just assumed that the answer is there and if they didn't know it, they were gonna take the best guess.

Allison: That's just what they knew to do.

Frank: Yea, well, Scholastics. I need to write them a letter.

Diane: That's right. Yea.

Diane: Like in the math book, too, every once in a while… something that the child will have right, but the book will say is wrong.

Children's acceptance of knowledge authorities stems from a hierarchical view of schooling and of knowledge and authority. The context of this hierarchy of schooling becomes a sphere of socialization, within which children are affected in ways that either produce a certain conformity that is consistent with the context of schooling or disenfranchise children. Such a hierarchy results in at least two binaries, which directly affect children's views of knowledge and schooling: (a) following authority vs. thinking for oneself and (b) power vs. powerlessness. Of course, other potential binaries include, (a) loving school vs. hating school, (b) love for learning vs. aversion to (formal) learning (i.e., children may not like to learn in school, but love to learn outside of school, which may involve learning about topics not generally considered to positive in terms of society), (c) confidence vs. lack of confidence, (d) positive self image vs. negative self image, and so forth.

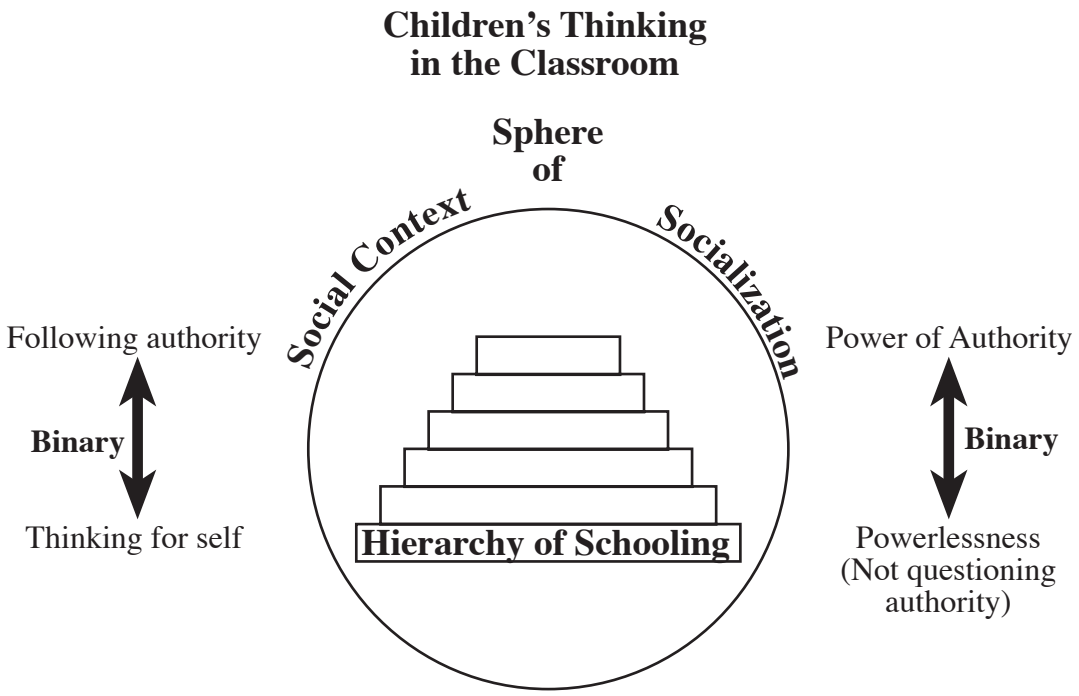


Figure 9. Teachers' perceptions of how children's thinking for themselves is prevented by their socialization in a schooling hierarchy, in which children defer to authority.

A Generalized Model of Teacher Discourse

From the data discussed thus far, several patterns appear to typify the discourse of teachers. Figure 10 uses metapatterns to develop a generic model of such discourse. At the bottom of the figure, the center, which acts as an attractor and is represented as a sphere, contains a binary. As discussed previously, several types of situations may set up such a binary, but the notion of binary appears to be the consistent characteristic. Binaries in their fundamental nature tend to create a tension, which can develop to unify and/or separate, to converge and/or diverge. As in any complex system, which self-generates and self-sustains, energy of some sort must be present or introduced in order for the process to initiate and continue. In the case of human interactions, specifically discourse, that energy is emotional. The initiator of emotional energy appears to be binaries. Binaries provide the "spark" to initiate and "fuel" to sustain conversation.

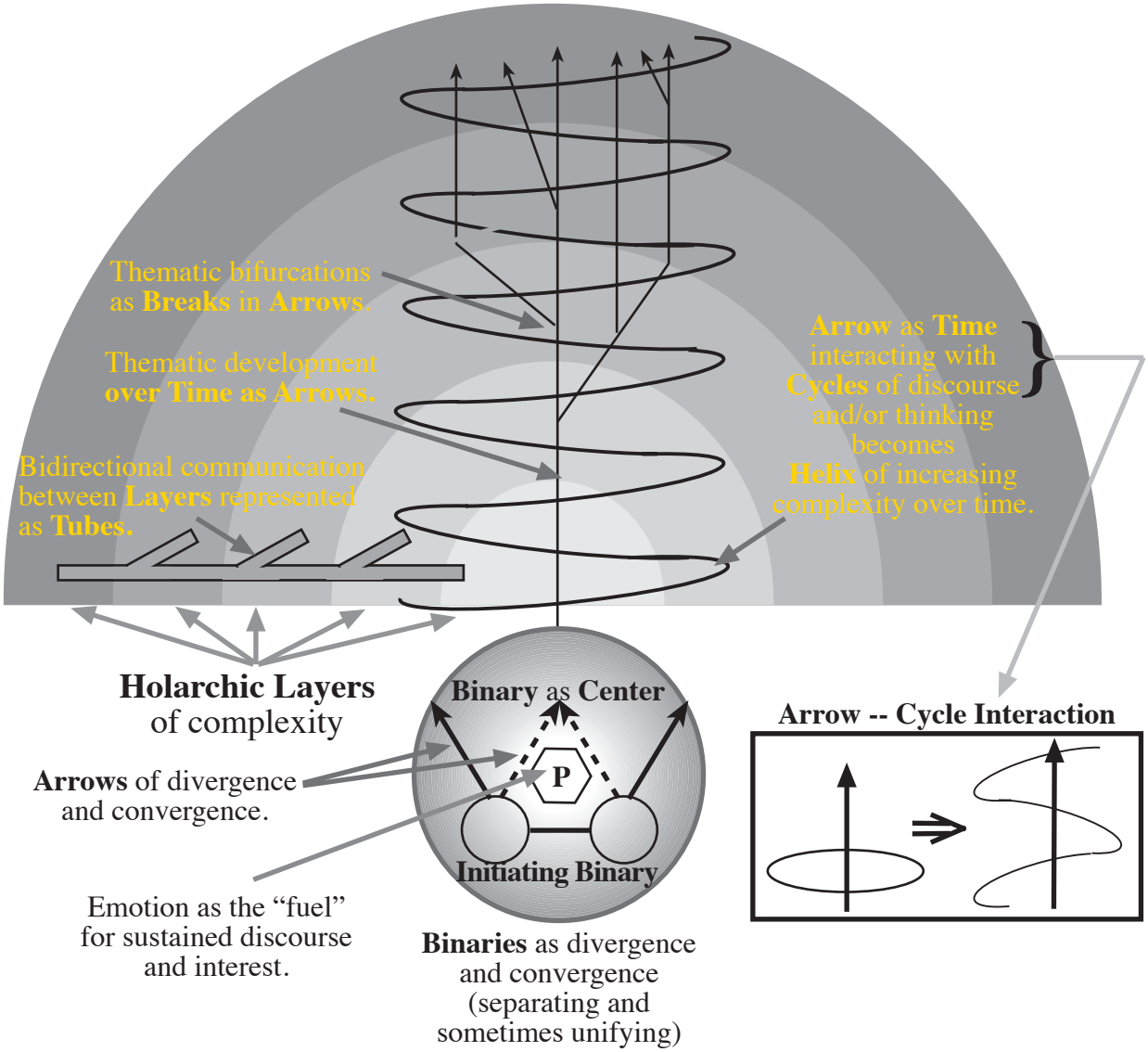


Figure 10. A generalized model of sustained teacher interactions using metapatterns.

As the conversation begins and continues over time the lines and arrows in the model represent both time and thematic strands. Such strands diverge (break) into other thematic strands. At the same, there is a sense of growing complexity as the cycles of interaction and cognition continue. In the box at the bottom right-hand corner, a cycle of interaction interacts with an arrow of time and thematic development to form one or more helices of increasing complexity. The entire process of discourse is embedded in nested or holarchic layers of complexity, which are represented by the semicircular layers of different shades of gray. Such are not hierarchic, in that they may not build upon one another in terms of one layer relying upon another for necessary information. Rather, each layer contains its own information and complexity of relations, which may have resulted from previous aspects of the conversation, but the linear dependency of hierarchies is not present.

Discussion and Implications

In this section, the process of teacher discourse, the content of their conversations, and the implications for creating professional communities of teachers will be discussed. These three

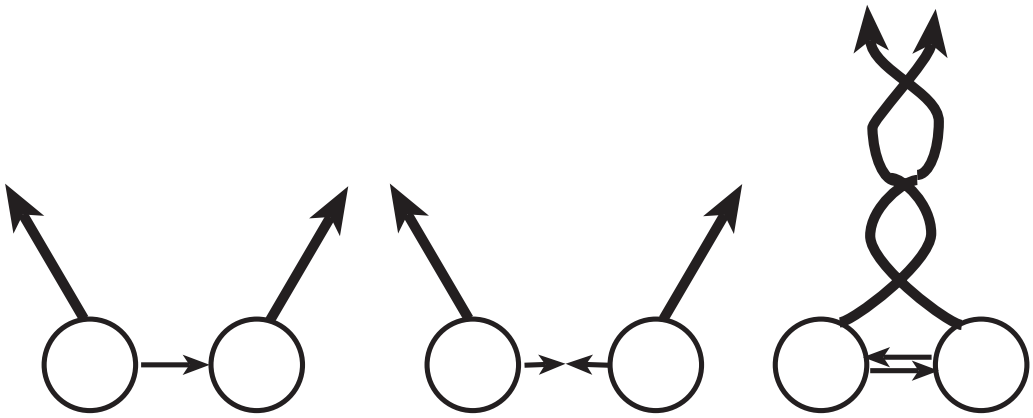
areas represent critical foci for schooling, the facilitation of discourse, teaching, and the development of teaching as a profession.

The Process of Teacher Discourse

Sustained and engaged teacher discourse arises from the tensions of binaries (e.g., dilemmas, conflicts, disparities, etc.) and is fueled by emotional connections to particular content. The emotional connection arises from the teachers' personal and professional values and identities, from caring and passion for their students and the work they do. Figure 12 represents, as overlapping spheres of activity, the complexity of contexts, from which teacher discourse arises,

Each of these contexts overlap and contributes to the emotional make-up and identity of teachers. Teachers draw from and contend with a multiplicity of contexts, all of which affect teachers in complex and uniquely personal ways. However, the basic patterns with which teachers contend, such as binaries, hierarchies, and so forth, are held in common. Some teachers may grapple with the hierarchically imposed content standards and testing proactively, while others contend with such issues along the continuum between proactive and reactive. In whatever way they react, the basic tension is held in common.

In terms of the question of how we can create contexts for teachers' discourse, the notion of binary is significant. Without binaries to initiate conversations, engagement in sustained discourse is unlikely. Several fundamental types of binaries comprise all relations. According to Bateson (1979), cognition, and I will have to include discourse within this notion, requires relationship. In particular "difference" as a type of relationship lies at the core of "binary." The "difference relationship" of binaries is further distinguished as a trinary: (a) complementary, (b) symmetric, and (c) reciprocal (Bateson, personal communication, July 1975; 1979). In figure 11, these three types of relationship are compared to metapatterns terminology. Bateson's sense of complementary refers to out-of-balance relationship, where one side may be dominant and the other submissive. Symmetrical relationships are comprised of two similar sides vying for control. Both of these types of relationship tend to diverge or separate. Reciprocal relationships, in contrast, are characterized as collaborative, where each side interacts through give-and-take negotiative processes. Such relationships tend to converge and unify.



Bateson's (1979) Terminology	Complementary	Symmetrical	Reciprocal
	Disparate Binary	Competitive Binary	Collaborative Binary
	Divergent Binary	Divergent Binary	Unifying Binary

Relationship Binaries

Figure 11. Bateson's three types of relationship as types of binaries.

In the present paper, the hierarchical binaries are complementary or disparate. In such cases, the authoritative control from the upper layers of the hierarchy creates situations where teachers (at the lower levels of the hierarchy) feel disenfranchised. Although they express their concerns as professionals, they fear for their jobs. In no case were teachers willing to have their name associated with their expressed concerns and criticisms.

In figure 7, two sets of binaries are represented. In one set, teaching and learning, the relationship is reciprocal or unifying. The other set where the teacher provides an algorithm versus students generating multiple algorithms represents a competitive binary or symmetric relationship. Both approaches are equally valid, but the potentiality of effectiveness in developing conceptual understandings is competitive.

From the data presented in the present study, binaries appear to be the primary component of the center (attractor) for sustained discourse among the teachers. Whether binaries are at the center of all sustained discourse is yet to be determined, but they certainly appear to be the dominant stimulating factor in conjunction with the emotional connection to the binary. As mentioned previously, the emotional connection is the key energizing component of sustained discourse. However, what psychological factors are considered to be emotional is questionable. It strikes me that the Vulcan characters of *Star Trek*, who repress emotion, may be incapable of sustained discourse. As logical thinkers, would they not engage in inquiry out of curiosity or inquisitiveness? Is curiosity an emotion or purely a construct of intellect? The difference between thought and emotion may not be all that distinct. In terms of curiosity, thought and emotion seem to be tightly interwoven. Curiosity seems to be a desire to know (i.e., desire as emotion, to know as intellect).

The one particular instance of sustained discourse, of which I can think and which may not involve a binary, is the situation of sharing ideas. We all have encountered such occurrences among children and adults. Someone tells a little story, then others start jumping into the conversation with their own stories. Such instances may be purely the connection between the story and one's own story along with an emotional spark. Or, such stories may spark an emotional connection in conjunction with a competitive (symmetrical) or collaborative

(reciprocal) binary. Participation may involve a sense of out-doing the other person (competitive) or a sense of sharing or extending the commonalties in the stories. So, although a binary may not arise out of the topic content, it may arise in the dynamic of the group.

In order to stimulate engaged discourse, we then need to find binaries that connect to the emotions of participants. In some cases, the binary can involve primarily the allegiance of participants, which then leads to an argument, or the competitive or collaborative make-up of the group. In other cases, the binary can be contained within the topic of discussion.

The Content of Teacher Discourse

The content of discourse arises from spheres of activity and influence as discussed in the previous subsection. Such spheres are the contexts, in which teachers professional lives are embedded, and that contain the connections to and between specific ideas or content, as well as the emotional connections that sustain discourse and cognition.

As we have seen, the context of society and politics exerts a major influence on teacher discourse. The hierarchy of schooling establishes the primary binary arising from this context. The disparity between those in power and those who feel powerless connects to and stimulates emotions of anger and frustration. At the same time, the overlapping contexts in figure 12 contribute to the complexity of the issues. Teachers experience with their schools, classrooms, students, community, and even their personal lives outside of school contribute to the thinking and conversations about the issues involved in the hierarchy of schooling.

Frankly, the content of these conversations is frightening. Teachers are working in communities of fear. They are afraid to do what they think is best for the children, to take risks, or to take the time to go into greater depth. The hierarchy of fear prevents teachers from performing as professionals. Instead they are or at least they perceive that they are forced to follow what those in positions of authority demand. They teach to the test, because it is too risky to do otherwise. They adhere to the standards, even though the standards may not address content that arises in the classroom or that they feel is important. They accept the required science kits provided by the district, even though they may generate a going-through-the-motions approach with the children, instill boredom among the children, misrepresent the nature of science, or limit the extent of inquiry.

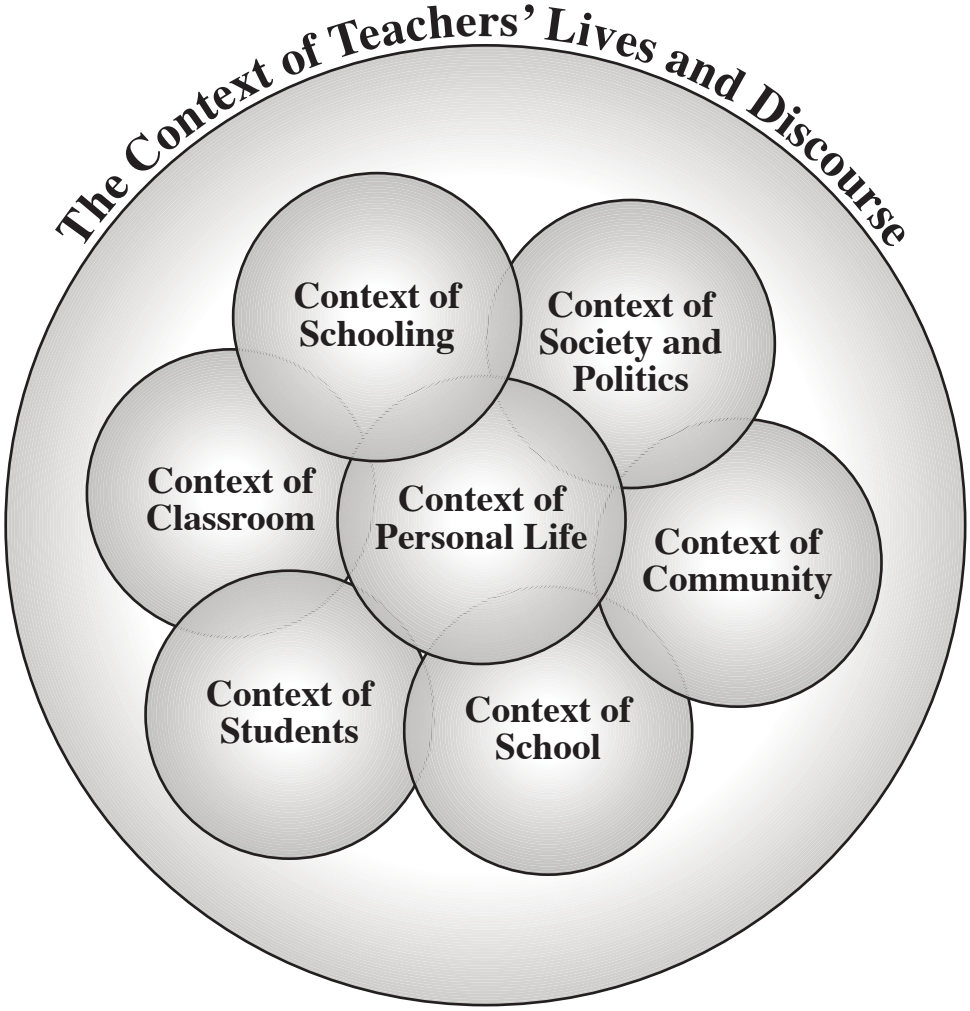


Figure 12. A representation of the contexts affecting teachers' lives and discourse.

Such conditions are undermining the education of our children. The conflicts teachers encounter – between testing and learning, between more fruitful pedagogical approaches and approaches that address testing, and so forth – are indicative of dysfunctional communities. When the professional knowledge and insight of teachers takes second position to the pressures placed upon them by the upper levels of the hierarchy, the professional community is undermined.

Teacher Professional Communities

Although a great deal of effort and research has gone into the development of professional communities (Baird, 1992; Loghran & Northfield, 1996; MacCaleb, 1994; Wells, 1994) I worry that such communities cannot develop fully as long as the institutional hierarchy of schooling places teachers in subservient positions. Teachers are not only placed in subservient positions, but become representatives of the hierarchy of schooling. Subject to the pressures of the institution, teachers drift away from being role models of active learners and inquirers to being managers and transmitters of "learning" and classrooms. As contended by Wenger (1998),

> teachers do not have much opportunity to act as themselves – as adults and thus as doorways into the adult world. Rather they constantly have to act as teachers – that is, as

> representatives of the institution and upholders of curricular demands, with an identity defined by an institutional role. (p. 276)

In a similar critique of teaching in his essay "The functions of a teacher" from over 50 years ago, Bertrand Russell (1950/1969) contended that,

> The profession has a great and honorable tradition, extending from the dawn of history until recent times, but any teacher in the modern world who allows himself to be inspired by the ideals of his predecessors is likely to be made sharply aware that it is not his function to teach what he thinks, but to instill such beliefs and prejudices as are thought useful by his employers. (p. 112)

Russell continues his critique in that teachers have been reduced to civil servants controlled by people who have no understanding of teaching and children, and that those in control view education from the perspective of propagandist.

In an even earlier work, Bertrand Russell (1938/1969) maintains that, "authoritative education…leads to the feeling that the only possible relation between two human being who co-operate is that in which one issues orders and the other obeys them" (p. 18). In general, teachers (and students) are offered few choices other than complementary and symmetrical relationships, which tend to be established by the hierarchy of schooling. As long as fear, which Russell contends is the basis for all submissiveness (complementary relationships) and aggression (symmetrical relationships), resides in the hearts of students and teachers, the ability to move into reciprocal relationships in their interactions with those at higher levels is difficult. Even their relationships with peers can be affected -- if not in their relationships with one another, at least as a basis of their discourse (i.e., the content of their discourse focuses upon divergent binaries).

Furthermore, the discourses of those in upper levels of the hierarchy, including politicians, are at odds with the discourse of teachers and teacher educators. As suggested by Lemke (1995), each social or political point of view or context constructs its own discourse. When higher levels of the hierarchy talk about testing, teacher accountability, school reform, and standards, the way in which such terminology and its meaning translates into the practice of schooling is quite different from teacher discourse on student evaluation, from discourse on their own practice, from their views of how schools need to be changed, and from their talk on what children need to learn. For instance, testing from the political point of view suggests that it is a measure of what children have learned and achieved. However, more critical and theoretically informed points of views contend that testing never provides a picture of the complexity of children's understandings and, at best, shows what children do not know (Garcia & Pearson, 1994).

Effective evaluation of children's learning from teachers' practice involves observation of individual children, analysis of the children's discourse and the work they produce, and a variety of other techniques and approaches (Garcia & Pearson, 1994). However, the political discourse on testing maintains that testing can be used to assess not only children's achievement, but also teaching effectiveness. The use of testing to assess teachers has created an atmosphere under which teachers, under duress of institutional reprimands to loss of jobs, take the safer, lower risk paths of least resistance, that is, teach to the test. Such approaches to student and teacher evaluation are becoming increasingly violent acts on the well-being students and teachers, as well as on the future of our society.

The inherent message of high stakes testing is to devalue creativity, imagination, and the joy of learning and constructing meaning. Block (1997) views such devaluation as additional acts of violence. The use of testing to devalue complex learning, for the placement of students, and as criteria for teachers maintaining their jobs or climbing career ladders has potential dire consequences for society. The potential outcomes of such a situation include the propagation of anti-intellectualism, the decrease in creativity and creative endeavors, and the creation of a subservient society with decrease abilities to think critically. In addition, the effects of the hierarchy of schooling can produce a populace whose only known options for relationships are those based in dysfunctional and fundamentally distructive binaries: complementary (disparate binary) and symmetric (competitive binary).

As a result of the hierarchical effects on teachers, schools as professional communities tend to be dysfunctional. The disparity between the upper and controlling levels of the hierarchy and

the lower and controlled levels of the hierarchy hinders or prevents the development of reciprocal relationships, in which teachers can fully manifest their professionalism.

On the other hand, from the data presented in this paper, we see the basic patterns upon which professional communities can be established. Emergent and sustained teacher discourse extends the complexity of thought and understanding. Although the teachers' relationships with those in authority are characterized by counterproductive binaries (symmetrical or complementary), their relationships with one another tend to be reciprocal or collaborative. Such reciprocal relationships are productive and sustainable.

The only hope for the creation of truly functional professional communities is to restructure the hierarchical establishment and replace it with a holarchic institution of schooling. In such an institution, power and control are distributed and negotiable. There is no one central authority, but rather fluidity in community members taking leadership roles. Reciprocal relationships, where fear does not lie at the core, dominate interactions. Without fear and within such communities, teachers can develop fully as professionals, take risks, and engage in practices that benefit children's learning and growth. In developing functional communities, Wenger (1998) describes four key components of communities of practice: (a) *identity,* (b) *meaning*, (c) *practice*, and (d) *community*. When identity develops as a competent, knowledgeable, and confident professional, rather than as one whose competence and knowledge are questioned, participation in the professional community can be fully developed. When the meaning associated with community membership and participation involves meaningful, productive, and functional knowledge and skills, teachers can feel fully connected to the professional community and act with confidence. In order truly to be a full participant in the community, teachers need to practice with autonomy and as one with knowledge and insight. As teachers develop these positive and functional characteristics of identity, meaning, and practice, they develop a sense of respect and appreciation for the abilities and knowledge of other teachers and a sense of confidence in themselves. From such development, a fully functional and productive community can develop based on reciprocal relationships.

In figure 13, Wenger's (1998) community of practice serves as the basis for a model of teacher communities. Here the overall model is holarchic, in that the layers of identity, meaning, practice, and community are not arranged in terms of superordinate or subordinate relations, but rather as embedded layers of development and manifestation. Such holarchic teacher professional communities provide for the emergence of critical and personally relevant and meaningful discourse and activity (i.e., flow of control and ownership is distributed and does depend upon a central authority or hierarchic center).

In this model, passion, caring, curiosity, and integrity are critical aspects of being a good teacher. These aspects can thrive within a holarchy, but are undermined by the current hierarchy of schooling. The pressures and conflicts established by the hierarchy can prevent teachers from fully following their passions for learning and creating innovative approaches to teaching. Although they may care deeply about and for their students, their actions prompted by caring are hindered. Their own and their students' curiosity about the topics they study cannot be addressed fully, when the pressures to follow a particular curriculum, cover the material, or prepare students for tests prevent such lines of inquiry. Integrity, which requires a cohesiveness and consistency between teachers' beliefs and their actions, is usurped by the hierarchy. In the same way, teachers' development and their abilities to manifest all of the other aspects depicted in figure 13 are hindered by the conflicting and divergent binaries established by the current hierarchy of schooling.

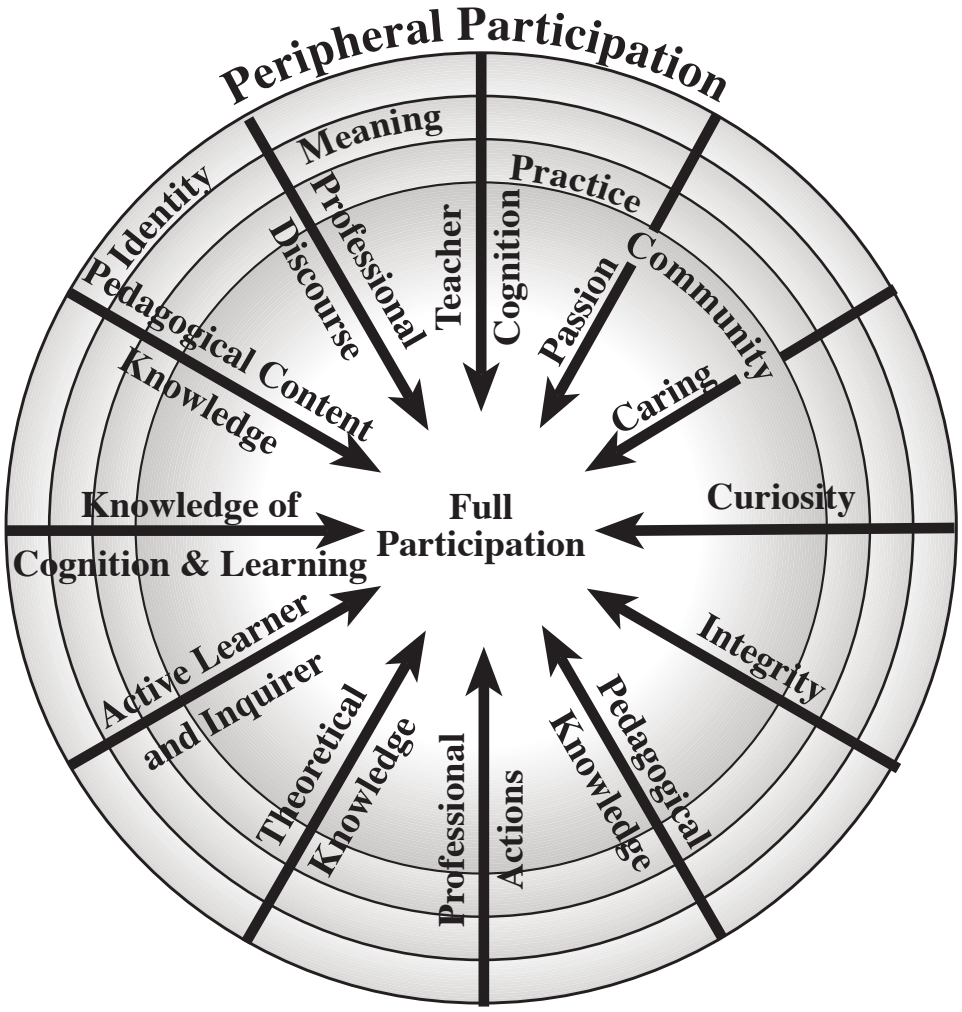


Figure 13. Elements of a professional community of teachers as holarchy (based on Wenger's [1998] notion of communities of practice).

The data provided in the present paper is limited to a small group of teachers. However, as I write, a new group of 14 teachers is meeting. Their conversations thus far are consistent with those from the previous group. In some ways, their fears, conflicts, anger, and frustration are even more extensive. The demands to implement scripted, teacher-proof curriculum add to the community of fear and repression. What is even more troublesome, is that the teachers in the present group are among the best in the district. Some have been asked to take on leadership and supervisory roles in the schools. Yet, they are subject to the same constraints, pressures, and fears of all of the teachers in the district.

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