Entering the Community of Teachers: The Difficulties and Prospects in Raising the Bar of Expectations in an Elementary Science Methods Course

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In preparing pre-service teachers for careers in teaching, many of the necessary characteristics of competent teachers are not typically addressed within the framework and nature of methods courses in institutions of higher education. Such characteristics include: (a) taking on independence and responsibility; (b) being passionate about learning and teaching; (c) developing and following one's own and children's curiosity; (d) striving for excellence (not just grades); (e) becoming an active participant in a professional community; (f) striving for and engendering integrity; and (g) thinking deeply and critically about subject matter, one's own identity as a teacher and community member, one's practice, and children's needs and learning. All too often the socialization of schooling undermines the development of such characteristics and promotes a jumping-through-the-hoops or going-through-the-motions approach.

This paper will explore the dynamics of a science methods course designed to promote the development of the professional characteristics delineated above, as well as specific skills and knowledge in teaching science through inquiry. Within this exploration, conflicting assumptions, patterns within group dynamics, and changes within individuals will be examined in detail.

Background

The impetus to reformulate my approach to teaching an elementary science teaching methods course arose from dissatisfaction with student participation, the quality of their work, and what appeared to be a general sense of malaise (i.e., lack of motivation, curiosity, passion, etc.) among most students. At the same time, my work with in-service teachers and my reading and thinking about professional communities of practice and related ideas resulted in a re-evaluation of the assumptions underlying teacher preparation and of the goals and actions of the methods course. The following paragraphs summarize some of the literature that has had an impact on the reformulated course and the evaluation of the data collected.

In the National Science Education Standards (National Research Council, 1996)), the notion of community appears as a goal both for the profession and for the classroom. However, as will be argued in this paper, aspiring teachers have few, if any, experiences of communities that promote independence, initiative, inquiry, critical thinking, and so forth. Such experiences need to be provided in order for future teachers to reformulate their understandings of community and to work towards developing their abilities to establish and maintain communities among colleagues and in their classrooms. As suggested by Wenger (1998), establishing functional and effective communities addresses how people participate in and define their roles and identity in communities. Although other efforts in teacher preparation have been implemented, Wang and Odell (2002) have found that the underlying assumptions of such efforts have not addressed reform efforts, but rather have focused on emotional and technical aspects of teaching and learning to teach. Although such efforts may be important, they fail to address the larger and more cohesive and coherent issues of entering a professional community currently engaged in reforming its goals and approaches to practice.

Community

The notion of community, as discussed by Lave and Wenger (1991), Rogoff, Goodman Turkanis, and Bartlett (2001), Wells (1993), and Wenger (1998), suggests that entering a community of practice is one of acquiring or developing senses of identity as a practitioner and of the meanings associated with community membership, as well as developing the understandings of and abilities to perform the activities of the community. In other words, much

of what is involved in entering a community of practice focuses on implicit learning, as opposed to explicit content or skills (see figure 1 for a model of entering a community of teachers). Although the content and skills are important, they may have little impact on the quality of teachers without the concomitant implicit aspects of "being a teacher." In fact, as suggested by Feldman (2002), teaching is a way of being that is individually unique and situated within a specific setting and context.

In Wenger's (1998) model, identity, meaning, participation, and community are all closely intertwined in well functioning communities of practice. As suggested by Feldman (2002), identity as a teaching professional involves aspects that extend into the other three categories of meaning, participation, and community. This same notion of interconnectedness also is apparent in Howes (2002) discussion of the areas of strength (or lack of strength) that pre-service teachers bring into science teaching methods courses. These areas include a propensity for inquiry or basic curiosity about the natural world, attention to children, and an awareness of the relationships of school and society. From this perspective, Howe includes many of the dimensions depicted in figure 1, as well as Wenger's emphasis on knowing the history of one's community of practice. Such historical knowledge is of critical importance in understanding communities of practice, as Rosebery and Puttick (1998) described science: "scientists are seen as members of a community sharing a set of socially and historically constituted ideas and practices for investigating and constructing knowledge about the natural world" (p. 671). In the same way, such knowledge of one's community of teaching practice leads to the development of an extensively situated identity, meaning, and participation.

As will be discussed later, the notion of community as discussed by Lave, Wenger, and others, tends to be holarchic in nature, rather than hierarchic. As opposed to hierarchies, where power and control move down through the layers, holarchies are embedded layers with no particular stratification of power or control. Within this holarchic sense of community, the layers are more ambiguous and context specific. Within the specific context of a professional community of teachers, the layers involve degrees of knowledge, meaning, identity as a community member, and understandings of the nature of the specific community. As people enter such a community of professionals, they move through these layers towards full participation.

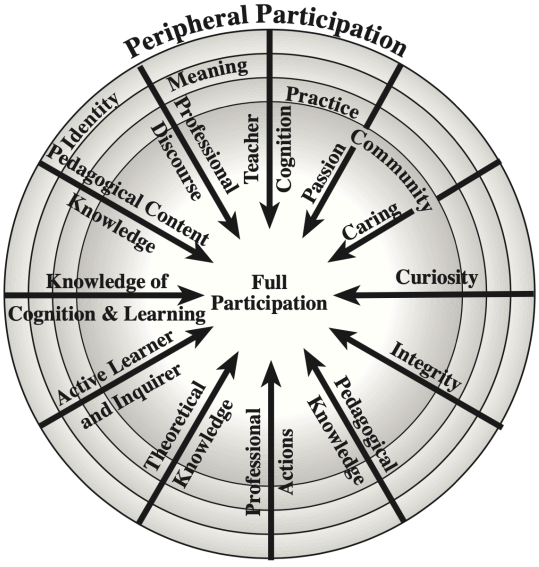

Figure 1. Holarchic model of entering the community of teachers based on Wenger (1998).

Along similar lines, McClure (1998), suggests that in order for groups to develop to their full potential they must move through various stages. His model of group develop, as depicted in figure 2, shows a progression through alternating phases of conflict and unifying tendencies. Although the figure depicts a linear process, in actuality participants cycle back and forth through bordering stages as they progress from left to right through the arc. Each of these stages and associated issues concern the negotiation of meaning, identity, participation, and the nature of the particular group or community as discussed by Wenger (1998). In other words, community development occurs in a nonlinear fashion as participants negotiate their roles in and purposes of the group. Within this nonlinear development, the group alternatively engages in binaries of conflict and agreement, of divergence and unification, of dependence and independence, and so forth.

As discussed in the results section of the present paper, the issues of moving from the commonly experienced hierarchies of groups (as in classroom, schools, and employment situations) to holarchic and democratically focused groups, a number of conflicts arise, such as those of distrust and trust, safety and risk-taking, power and powerlessness, and so forth. Moving towards full participation in basically unfamiliar territory presents many challenges to aspiring teachers (i.e., students in teacher preparation programs) and to instructors of such courses who work towards moving from authoritarian roles to roles associated with being a full participant, such as that of mentor, model, coach, and orchestrator (Gallas, 1991).

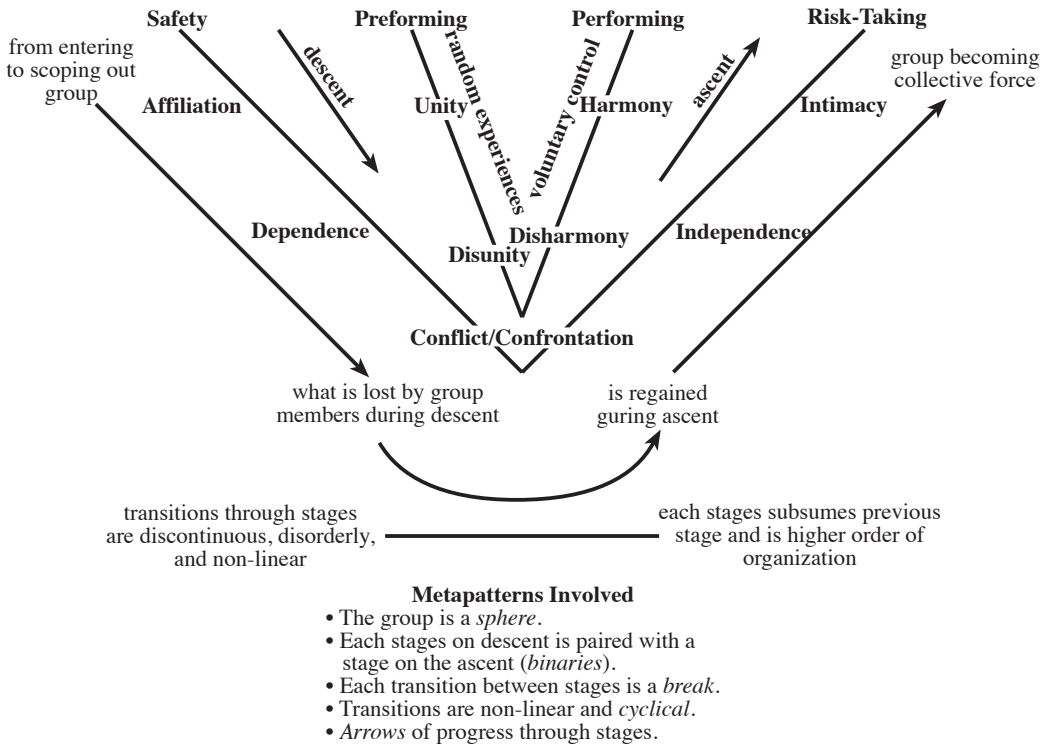

Figure 2. Adaptation of McClure's (1998, p. 50) model (arc) of stages of group development and related issues, with associated metapatterns.

Both Wenger (1998) and McClure (1998) point to the inherent difficulties of establishing communities or groups. A wide range of obstacles to the developmental progress can arise for individuals within groups, for subsets of individuals, and for the group as a whole. Many of these obstacles may be specific to the group, but others, as suggested by McClure, will fall into several general categories. In terms of science teacher development, Volkman and Anderson (1998) point to three common obstacles described as dilemmas: (a) student vs. teacher identities, (b) caring vs. disciplining, and (c) science as easy vs. science as difficult. Each of these three obstacles is indicative of the types of conflicts pre-service teachers may encounter as they develop and/or negotiate their identities, meaning, and participation in the professional community. As will be discussed in more detail throughout the results section of this paper, similar conflicts (including those described by Ellis [2001]), as well as others, seem to have their source of conflict between the assumptions and expectations created by past and present experiences of hierarchies and those underlying holarchic structures of community.

At the basis of this notion of a professional community is the sense of a teacher as a scholar and inquirer. As discussed by Bertrand Russell (1950/1969), "A feeling of intellectual independence is essential to the proper fulfillment of the teacher's functions, since it is his business to instill what he can of knowledge and reasonableness into the process of forming public opinion" (pp. 112-113). Such a notion of the function of a teacher situates the teacher as one who is not only intellectually independent, but also involved in social and political contexts of the greater community. Russell compares this perspective of the teacher to the differences between those functioning at the lower layers of a hierarchy versus those who function in democratic holarchies:

> So long as he is teaching only the alphabet and the multiplication table, as to which no controversies arise, official dogmas do not necessarily warp his instruction; but even while he is teaching these elements he is expected, in totalitarian countries, not to employ the methods which he thinks most likely to achieve the scholastic result, but to instill fear, subservience, and blind obedience by demanding unquestioned submission to his authority. And as soon as he passes beyond the bare elements, he is obliged to take the official view on all controversial questions. (p. 114)

> The function of the teacher, however, is not merely to mitigate the heat of current controversies. He has more positive tasks to perform, and he cannot be a great teacher unless he is inspired by a wish to perform these tasks. Teachers are more than any other class the guardians of civilization. They should be intimately aware of what civilization is, and desirous of imparting a civilized attitude to their pupils. We are thus brought to the question: what constitutes a civilized community? (p. 118)

From such a perspective, we see that teachers need to be concerned with the nature of communities, not only as teachers performing within their classrooms, but also as "guardians of civilization." As such, teachers must consider the larger issues beyond those handed down by the hierarchy of schooling, but as critical consumers, producers, and facilitators of knowledge and understanding.

It was from the basis of creating a professional community that the new methods course was conceived and developed. Such an effort hoped to "up the ante" on intellectual engagement and on engagement in the reforming of identity and meaning from "student" to "teacher." The following section will provide a brief overview of this course.

Course Design

As the development of the course proceeded, one of the over-arching principles included the contrast between hierarchical notions of schooling and teacher preparation vs. a holarchic sense of community (holarchic refers to a sense of embedded layers in which control is distributed among the layers of participation [see Volk, 1995 for further information on holarchies]). In the hierarchical approach, control moves downward through the layers and propagates conflicts based on power and powerlessness (Russell, 1938/1969). Such conflicts in higher education can lead to students taking on a "going-through-the-motions" attitude to survival and success in academia. However, such an attitude is counter-productive to acquiring the identities and meanings associated with entering a community of practice and becoming a teacher, who takes initiative, is passionate about teaching and learning, and strives for excellence.

Many of the characteristics and skills associated with being a teacher, including many of the dilemmas associated with the implicit and affect characteristics of teachers, appear in the extant literature, but a holistic and integrated view is frequently lacking. Figure 1 delineates the context and extent of the knowledge, skills, and affective characteristics of teachers. The knowledge and skills required of teachers include (a) knowledge of children's cognition and learning; (b) pedagogical content knowledge; (c) teacher cognition, including critical reflection; (d) pedagogical knowledge; and (e) theoretical and philosophical knowledge. Each of these areas of knowledge and skill receive significant emphasis in the literature of teacher development (e.g., Bell & Gilbert, 1996; Fensham, Gunstone, & White, 1994; Lampert, 1999; Schön, 1991; Trumbull, 1999). The notions of passion, caring; curiosity; integrity; involvement in professional actions and activities; teacher as active learner and inquirer; and engagement in professional discourse receive sporadic emphasis in the literature (e.g., Berry & Loughran, 2002; Hodson, 1998; Palmer, 1998; Vinz, 1996).

Attempting to create the context for beginning the development in each of these aspects of becoming a teacher presents a variety of challenges, especially when students meet in class for two and a half hours a week for 15 weeks and the course is only one of several and the only course making such an effort. In addition, several other more substantive challenges are of critical importance. Since hierarchies are the typical context of students prior experiences in schooling and the work place, their views, expectations and tacit knowledge are deeply embedded in such a framework or paradigm. As mentioned previously, hierarchies set up a dichotomous continuum of power (at the top) and powerlessness (at the bottom). According to Bertrand Russell (1938/1969), the psychology at both extremes involves one of fear. The powerful are fearful of losing power and the powerless are fearful of those in power. Students entering a situation that is not hierarchical are faced with challenges to the assumptions upon which they have based all of their prior actions. Not only do they have to contend with such a groundless and frightening situation, but also have to confront their fears of science and science teaching, which is common among those pursuing certification in elementary education. As a result, expectations of students to grow professionally along the dimensions of passion, caring, curiosity, integrity, active learning and inquiry, and involvement in professional actions and discourse present extensive challenges. The research contained within this paper will explore these challenges and the dynamics of creating such a community of practice in a methods course (see table 1 for summary of major course characteristics).

Table 1. Major characteristics of the reformulated elementary science teaching methods course and their relationships to Wenger's (1998) notions of communities of practice.

Characteristics of Course	Identity	Meaning	Participation	Community
• Instructor as model of full participant, not as figure of power—control.		X	X	X
• Participants were expected to demonstrate responsibility for learning, participation, and context of the class group.	X	X	X	X
• Control of grades and course distributed among all participants.	X	X	X	X
• Participants were expected to critically reflect on their growth along each aspect described in figure 1.	X	X	X	X
• Weekly self and peer assessment on participation (off-track, going through motion, putting in effort, and striving for excellence).	X	X	X	X
• Students were expected to complete all readings and incorporate them into their work.	X	X	X	X
• Assignments were described, but students could determine when to complete and how to organize and communicate their results.		X	X	X
• Students were expected to complete an investigation of the nature of science (e.g., comparing media portrayals vs. that studied, etc.).		X	X	X
• Engagement in inquiry was a major emphasis throughout the course.	X	X	X	X
• Inquiry activities included extended investigations (in and/or out of class) and short-term investigations.	X	X	X	
• Groups of students conduct investigations with small groups of children over a period of a month during weekly meetings.	X	X	X	X
• Final project of an inquiry unit was expected to demonstrate understandings, skills, and applicable affective aspects.	X	X	X	X

Method

The data were collected from (a) questionnaires given at the beginning, middle, and end of the course; (b) a course evaluation; (c) video tapes of most class meetings; (d) extensive and detailed ethnographic observations, including informal interviews, by two graduate students (one of whom was trained in anthropological research); and (e) notes recorded by the instructor. The ethnographic observations and interviews occurred during class sessions, as well as outside of class during impromptu meetings with students.

The analysis of the data was based in a grounded theory approach using a framework of metapatterns (Bloom, 2002; Volk, 1995) as a way of representing and identifying specific

patterns of interactions among the course participants, course activities and emphases, and the contexts affecting students. Metapatterns (originally discuss by Gregory Bateson [1979]) are fundamental concepts or patterns of patterns that are found in all disciplines and aspects of life experience and culture. Examples of metapatterns as used here include: (a) spheres as context; (b) tubes as bidirectional relational links; (c) sheets as two-dimensional distributional patterns; (d) borders and pores as barriers with regulatory "openings;" (e) binaries as disparate or unifying relational pairings; (f) arrows as uni-directional relational links; (g) centers as attractors and loci of control; (h) layers as hierarchical or holarchic (embedded or nested layers) contexts of group relational contexts; (i) breaks as transformations, change, dilemmas, decisions, and insights; (j) cycles; and (k) time as progression (see table 2).

Table 2. Metapatterns as used within the analytical framework (Volk, 1995).

Metapatterns	Description
Spheres	Denote contexts and containment. The fundamental concepts involve notions of equanimity, omni-directional strength, simplification, and durability.
Tubes	Denote relationships and connections. The fundamental concepts involve notions of linearity and bi-directional relationships and connections, bridging distances, flow, and bi-directional
Sheets	Denote planar distribution. The fundamental concepts involve capture, contact, and two-dimensional directionality.
Borders and Pores	Denote barriers or obstacles. The fundamental concepts involve protection, separation, regulation of flow and information exchange, and regulated containment.
Layers	Denote the building up of order, stabilization, and the providing of structure.
-- Hierarchies	Hierarchies cannot be identified without seeing the relationships between the parts. They provide stratified stability, where information and/or materials move up through the layers and control moves down through the layers.
-- Holarchies	Holarchies consist of nested parts (layers) of a whole, where the whole may be evident even if the parts are not. Relationships between layers may not be distinct or based on the importance of one layer over another. Flow of information or materials may be cyclic and distributed.
Centers	Denote importance and attraction. Centers provide for centralized stability and longevity and resistance to change. They may set up organizing principles and radiate relations outward.
Binaries	Binaries are the simplest form of complexity as pairings. Such complexity may extend to trinaries, quaternaries, and so on. The fundamental concepts involve notions of unifying or separating relationships, duality, difference, and tension.
Arrows	Arrows denote directionality of flow, connections, and sequences.
Breaks	Breaks denote change, transformation, leaps, shifts, and the changes involved in sequences of stages. They may indicate insight, dilemmas, and decisions.
Time and Calendars	Time and calendars involve the concepts of movement and memory as a binary, progression, and counting. They may be evident as arrows or cycles.
Cycles	Cycles involve repetition in time and space. Arrows may interact with cycles to create spirals and helices.

In addition to the information provided in list of metapatterns in table 2, the significance of binaries as descriptive of relationships needs to be elaborated upon further. Gregory Bateson (1979; personal communication, July, 1975) identified three fundamental types of relationships: (a) complementary, (b) symmetrical, and (c) reciprocal. Complementary relationships are characterized as a binary of dominant and submissive. Such a relationship tends to lead to divergence or separation between human beings, but may be more stable within certain animal societies. Symmetrical relationships are comprised of individuals vying for control or sinking into more slothful situations, where neither individual seeks control nor negotiates any aspect of the relationship. Such relationships also tend to diverge or separate. The third type of relationship is referred to as reciprocal, where individuals engage in negotiating terms of the relationship. A summary of these relationships and their comparison to types of binaries and other descriptors appears in table 3.

Table 3. Types of binary relationships

Bateson:	Complementary	Symmetrical	Reciprocal
Metapattern specific:	Disparate Binary	Competitive Binary	Collaborative Binary
Metapattern general:	Divergent Binary	Divergent Binary	Convergent Binary
Other Descriptors:	Separating Dominant-Submissive Controlling-Subservient Directive-Passive	Separating Dominant-Dominant Submissive-Submissive Vying for control Oppositional	Unifying Cooperative Mutuality Supportive

Results

In this section, the discussion of the results will begin with a brief review of the course context, followed by a discussion of student characteristics from questionnaire data and from observations throughout the course. The next subsection will examine issues of the change from hierarchically structured courses to a holarchically-structured course. From this point, more specific analyses of participation, identity, and meaning will be examined.

Background to the Formulation and Intent of the Course

The intent to create this course as a cohesive approach to induction into a community of professional teachers arose from my increasing interest in the notion of holarchic communities of practice as described by Lave and Wenger (1991), Wenger (1998), and Rogoff, et al. (2001) and from a seeded "revolution" in the course during the previous semester. The "seeded revolution" occurred mid-way through the semester several weeks after I had mentioned that the students could take control and make decisions about the direction and content of the course and about assessment. When the revolution occurred, the students and I restructured the course, which then focused on collaboratively constructing a thematic inquiry unit. In addition, we negotiated the terms and conditions of self- and peer-assessment as demonstrating the acquisition of the course goals and objectives. At the end of this course, we met for dinner at a local restaurant and discussed how what we had done could be applied to reconceiving and restructuring the course in the future.

Based on this experience and my previous theorizing about holarchic communities, the course, which is the focus of the present study, was redesigned. A major component of this redesign was based on trying to create a course based on a consistent set of assumptions and presuppositions about community and on inducting student participants into a professional community that addressed the dimensions of knowledge, skill, and attitude development as depicted in figure 1.

The Student Participants

Twenty-six students (5 males, 21 females: 1 deaf male, 1 Navajo male, 1 Navajo female, 1 Hispanic female, and 2 females of mixed ethnic origins) were enrolled in this elementary science teaching methods course. All of the students were enrolled in the traditional program in teacher education, as opposed to the block program (where students take methods classes in a partner school and work in classrooms for half of the day) or the cohort program (where students take most courses as a group and spend some time in classrooms each week). Two students (1 male and 1 female) were enrolled through the post-degree certification program and the rest were regular undergraduate students.

In order to get a sense of the students' reasons for pursuing a university degree and a teaching career, as well as some sense of how they relate to learning, engagement, and participation in university courses, two sets of questions were asked of them in the pre- and post-course questionnaires. These questions concerned motivations for attending university and areas of passion they have experienced.

A summary of the results from the motivation questions appears in table 4. In their written responses, all but four students indicated two or more motivations for attending university. The two most common reasons for attending university concerned a desire (a) to learn or grow in some way (22 students) and/or (b) to gain a credential or to prepare for a job (20 students). Five students indicated a desire to help others through teaching or in some general sense. Two students wanted to attend university in order to meet new people, while one mentioned her family expected her to attend university and another indicated a passion (for learning and thinking) as reasons.

From a somewhat subjective perspective, there is an interesting pattern revealed from the data in table 4. Those students who appeared to be the most actively engaged in and willing to participate in a holarchic community (i.e., the students with names beginning with "A") had motivations concerned with learning, helping others, and passion (i.e., six students mentioning motivations from categories B, C, and F, at the bottom of the table, nine times for a percentage of 150 versus mentioning motivations from categories A, D, and E four times or 67%). The remaining 17 students mentioned motivations from B, C, and F 19 times or 112% and from A, D, and E 19 times or 112%. Although 13 or 56% of students had more practical motivations (i.e., from categories A, D, and E), only 2 or 33% of the most engaged students had such motivations. On the other hand, 11 of the remaining 17 students (65%) had such practical motivations. The more altruistic and academic motivations were mentioned by 17 or 74% of the students, with 6 or 100% of the most engaged students mentioning these motivations versus 11 or 48% of the remaining students mentioning such motivations.

Table 4. Student motivations for attending university.

Student	Learn	Employment Opportunities	Credentials	Become Better Teacher	New Ideas	Educate Others	Self-Improvement	Better Pay	Meet new People	Passion	Make a Difference	Career Advancement	Family Expectations	Help Others	Number of Reasons
Abbey	1					1									2
Alan	1	1	1												3
Alice	1			1											2
Amanda		1	1		1					1					4
Ann	1														1
Aron	1														1
Barbara	1	1													2
Bart	1														1
Beth				1			1								2
Betsy		1							1						2
Betty	1				1										2
Bill	1			1											2
Blaise		1	1												2
Blythe		1											1		2
Bonnie			1	1											2
Brenda	1	1						1							3
Carl	1		1		1									1	4
Carla		1							1						2
Carmen		1				1									2
Cathy		1	1					1				1			4
Cecilia						1	1				1				3
Danielle				1	1										2
Donna			1												1
Total	**11**	**10**	**7**	**5**	**4**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	
N=23	**C**	**A**	**A**	**C**	**C**	**B**	**C**	**A**	**D**	**F**	**B**	**A**	**E**	**B**	

A. Practical—Job and Credentials	20
B. Help and Teach Others	5
C. Self-Improvement – Learning and Growth	22
D. Social	2
E. External Expectations	1
F. Other (passion)	1

As will be discussed later, three students were particularly resistant to engaging and participating in this particular course, in terms of taking on greater degrees of independence, responsibility, and control. Six students appeared to be more willing to take on these characteristics of engagement and participation. Of the three most resistant, one did not indicate any particular motivation. Another one of these students indicated the goal of getting a credential as the sole reason for attending university. The third resistant student indicated that she was motivated to become a teacher and learn new ideas. Although the learning of new ideas appears to be more characteristic of a general openness to engaging in new approaches, this student, Danielle, seemed to view learning as a transmission of knowledge rather than as a process of engagement in constructing understandings. In a general sense, she indicated in class 16 that she has not connected to the way the class is being presented. As is evident from the observational notes, she is caught in a divergent binary, where she has dug in her heals and resists: "Danielle looks unhappy so I ask her if everything is ok. She says she, 'hates this class' and doesn't want to be here. She just doesn't 'like the way it's taught'." Rather than shifting responsibility for learning onto herself, she blames the instructor. This shift in responsibility also is evident in the relations between students. Later in the same class, Danielle's question about working on the self- and peer-evaluated portfolios has a negative effect on another group member who has been working to take on much more responsibility: "Danielle: 'What are we doing on Friday?' Ann: 'We haven't gotten together on that (somewhat irritated with the question). My portfolio is gonna be a lot of writing because I just like to write—that's just who I am. Not a lot of people will probably want to read mine.' Danielle: 'Ok, but I don't like to take notes so I don't have anything.'" At the end of this interchange, Danielle's comment indicates even further evidence of resistance. She has nothing for her portfolio at the mid-semester point, even though the students have been working on pond investigations, have completed an earthworm investigation and a moon investigation, and have been doing inquiry projects with children, from which they were to be completing a critical reflection component for their portfolios. Such a pattern also is noted in my own notes recorded following the class session, "Danielle also is becoming more resistant. But, she is poisoning her group. Ann and Abbey have been showing signs of making the connections to what we're trying to accomplish, but Danielle's negative talk and behaviors are having a negative affect on Ann and Abbey." Again, from the observations during class 20, Danielle shows another resistant strategy while the class is engaged in examining models of moon-Earth relationships: "Danielle's reading a children's book to Bonnie's group—they aren't taking anything too seriously. The book is about the universe. (Danielle will find any way to get the work done but get out of what she isn't interested in.)"

There also is evidence of some sense of self-deception. On several occasions, during the class' self-assessment of engagement activity, Danielle placed herself in "striving for

excellence." However, the observational notes indicated that she was almost always "off-track" or "going through the motions" (e.g., class 5 notes: "I really don't think I have seen ANYTHING that warrants… Danielle being in striving for excellence" and later at 12:15: "At Abbey and Danielle's table they are COMPLETELY off track. Only 2 of them even have the assessment out.").

In a sense, motivation for attending university translates into motivation in specific courses. Such motivation is embedded in a complex set of assumptions and expectations based on prior experiences, which tend to be hierarchical in nature. Although all students have such experiences, delineating why some students resist change more than others is much more difficult. However, in considering the make-up of individuals, we can see them as consisting of embedded holarchic layers of meaning, identity, interactional styles, motivations, and so forth (see figure 3). From a Buddhist psychological perspective (Guenther, 1974; Trungpa, 1987), such layers are created as a means of attempting to maintain a sense of solidity to one's identity. Depending upon the individual such layers may vary in their solidity or porosity. The psychological mechanisms we use to maintain the solidity of these layers are deeply embedded and automatic, much like the sense of Andy diSessa's (1993) p-prims (i.e., phenomenological primitives), where they operate below our conscious awareness and appear to be self-evident. Such mechanisms tend to be rooted in binaries, which can be related to hierarchic or holarchic tendencies, nonlinear or linear preferences, and so forth. So, the sense of resistance we may encounter among students is situated within a complex context of interactions between central binaries and the various layers of meaning, identity, and so forth, as well as the degree of selective porosity or solidity of these layers. When students encounter situations that may trigger resistance, they are at some level responding to perceived threats to their most comfortable styles of interacting and acting in courses. In other words, such threats may be situations that run counter to deeply embedded expectations and assumptions about learning and schooling. As we proceed in this paper, we will see numerous examples of the dynamics of how such expectations and assumptions affect student engagement.

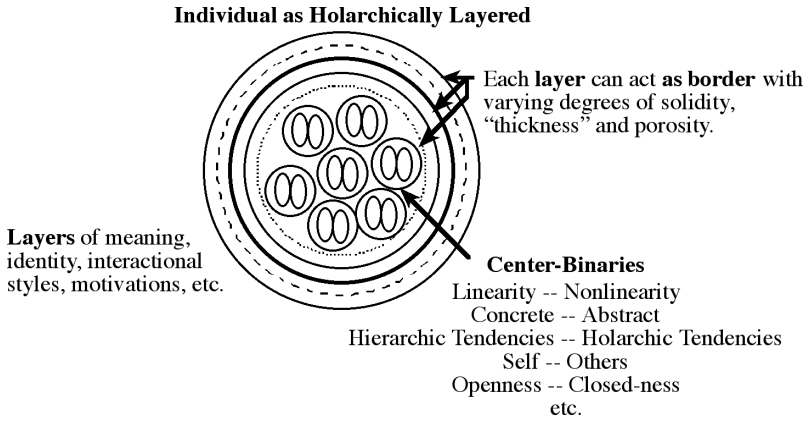

Figure 3. Notion of individual as holarchy.

The other area that can impact on our understandings of the students is that of passion. In the questionnaires, students were asked to describe any experiences they have had with passion for a particular activity or academic area. As shown in appendix B, student responses pointed to five basic characteristics of passion: as an interest, as an area or aspect of employment, as an area or topic of study, as a future professional field, and as a leisure activity. The areas of passion included teaching, reading, writing, seven academic areas, social justice issues, working with

children, and a larger vision of service to humanity (which was indicated by the same person who expressed an interest in social justice issues).

The notion of passion is an intriguing, albeit slippery, concept. In a metaphorical sense, passion is like a flame or a fuel that generates the energy to engage in various activities. From the perspective of chaos and complexity theories, passion is a major source of "energy" for self-generating, self-maintaining, and self-amplifying systems in human personal and social contexts (Bloom, 2001). In completing the questions concerning passion in the questionnaire, students may have drawn on their own idiosyncratic definitions of passion, which may be quite different from the sense intended in this study. However, those who described passion as an interest and as something that took place during or extended into leisure time may have a definition that more closely approaches that of "fuel" or "flame." As in previous tables, those students who were more engaged and open to the approach of this course consistently indicated passion as an interest and as a leisure activity more frequently than the other students (see top of table 5).

Table 5. Combined data of student passions according to most engaged students (A names) and other students.

	As Interest		**As Leisure Time Activity**		**As Employment, Area of Study, and Profession**	
Students	**# of Responses**	**# of Individuals Responding**	**# of Responses**	**# of Individuals Responding**	**# of Responses**	**# of Individuals Responding**
A Names (6)	4 (0.67)	4 (0.67)	3 (0.50)	3 (0.50)	8 (1.33)	6 (1.00)
B, C, & D Names (20)	11 (0.55)	11 (0.55)	3 (0.15)	3 (0.15)	30 (1.50)	18 (0.90)

	Characteristic		**Areas of Passion (Numbers of Individual Responses)** [1st percentage is out of total group, 2nd is out of those who had characteristic as interest or leisure activity)				
	As Interest & As Leisure Time Activity	→	**Teaching**	**Reading & Writing**	**Issues (Social Justice)**	**Working With Others**	**Academic Area**
A Names (6) Most Engaged	5 (0.83)			3 (.50--.60)	1 (.17--.20)	1 (.17--.20)	4 (.67--.80)
B, C, & D Names (20)	12 (0.60)		8 (.40--.67)	2 (.10--.17)		4 (.20--.33)	6 (.30--.50)

In terms of examining the connections between motivation and passion, table 6 compares two general clusters of motivation (i.e., motivation with a practical, social, or external focus and motivation with a focus on helping others, self-improvement, or passion) with the two clusters of passion (i.e., passion as an area of employment, of study, or of a professional field and passion as

a leisure activity or area of interest). This comparison between motivation and passion is further compared between the two groups of students (i.e., those who most engaged vs. the remaining students). In the table, the numbers (of students) and percentages (number of students responding out of total group) are based on the students who have responses in both the specific motivation category and the passion category (e.g., if a student indicated a practical motivation and a passion in an employment area, then that student is included at the intersection of these two categories). For the most engaged students, both areas of passion correlate highly with motivation focused on helping others, self-improvement, and passion. On the other hand, the remaining students have a higher correlation between passion focused on employment, area of study, and professional field and both areas of motivation.

Table 6. Relationships between engagement levels of students, motivation characteristics, and types of passion.

	Most Engaged Students ("A" Names) N = 6			**Remaining Students ("B", "C", "D" Names) N = 17**	
	Motivation			**Motivation**	
	Practical Social External	**Help Others Self-Improve. Passion**		**Practical Social External**	**Help Others Self-Improve. Passion**
Passion	2 33%	6 100%	**Employment Area of Study Professional Field**	11 65%	10 59%
	2 33%	5 83%	**Leisure Activity Interest**	8 47%	7 41%

From a different perspective, table 7 compares the two groups of students (shown as engagement rank, where 1 equals most engaged) in terms of a number that is based on a balance between practical and non-practical foci of motivation and passion. As suggested in the previous table, table 7 indicates a strong correlation between the level of engagement and practical—non-practical dimensions of motivation and passion. The more engaged students had non-practical orientations to motivation and passion both separately and when motivation and passion were combined. (See appendix A for further information and individual scores.)

Table 7. Comparison of the number of items listed by students (most engaged vs. less engaged) in practical and non-practical characteristics of motivation and passion.

Engagement Rank	**Motivations Mean Balance**	**Passion Mean Balance**	**Motivation and Passion Combined Value**
1	0.83	-0.17	0.67
2	0.00	-0.88	-0.88

*** NOTE:** Mean balance refers to placing a negative value for each practical category item of motivation and passion and a positive value for each non-practical motivation and passion item (i.e., if a student had two practical motivation items and 1 non-practical item, the calculation would be [-2 + 1] = -1 for a motivation balance). The mean of these balances for each engagement rank of students was then determined. The combined value adds the mean motivation and passion balances.

In general, the descriptions of the complexity of the student characteristics have just scratched the surface. However, the evidence provided does suggest that there is a continuum between engagement and resistance, which appears to correlate to continua between practically oriented versus non-practically oriented notions of passion and motivation. With this background in mind, additional dimensions of the attempt to create a holarchic community of professionals will be examined in the following subsections.

Changing from Hierarchies to Holarchies

The move from hierarchically structured to holarchically structured situations is based on very different sets of characteristics, assumptions, and expectations. Many of these assumptions and expectations of hierarchies are deeply embedded in the psychology of students as they enter university courses (see table 8). And, when presented with a course based on holarchic expectations (see table 9), students may confront numerous conflicts.

Table 8. Characteristics, assumptions, and expectations in hierarchies.

Layered Organization	Characteristics and Assumptions	Expectations
		LEVEL
Hierarchy		**Top**
	• Static top down organization • Control centered at top and moves down • Ownership centered at top • Control acquired competitively • Competition valued • Deferring of power to higher layers • Identity based on layer (controlling or controlled) • Meaning situated in complex relations between positions in layer, rewards, control, power, etc. • Induction is imposed upon inductees from higher levels • Degree of participation is imposed	• Those at lower levels not to be trusted • Obedience to authority • Use of strategies for control and power • Formulate rules • Set expectations of behavior, etc.
		Bottom
		• Those at higher levels not to be trusted (or blindly trusted) • Obedience to authorities • Defer control and power to those at higher levels • Follow rules • Conform to expectations of behavior, etc.

In university courses, the hierarchical structure manifests as the power and control that is exerted explicitly or implicitly by the instructor. Such explicit strategies include commonly include imposing absolute deadlines for assignments; grading by the instructor; establishing rules for attendance, behavior, and participation; and delineating a variety of other requirements. Implicit strategies may include arrangement of the classroom; position of the instructor in classroom; amount of instructor talk; instructor acting as content authority, which may include how the instructor reacts to student responses; questioning strategies that follow an IRE (initiate-response-evaluation) pattern; expectations for the way to be addressed (i.e., by title); expectations that students raise hands to talk; and so forth. All of these strategies work to

establish a hierarchically organized context. From the earliest years of schooling, these strategies have worked to deeply imbed student expectations of schooling experiences. Unless students have thought deeply about the nature and effects of such hierarchical actions and expectations, they enter situations with a plan of action. Such a plan of action may include scoping out the specific expectations of an individual instructor (but such expectations all fit within a hierarchical framework), determining the specific strategies needed to obtain a certain grade, and determining what is needed to please the instructor (especially in smaller classes where the instructor has the potential to know the student). All of these strategies are used to establish a game plan. Such "playing the game" approaches tend not to promote (a) taking responsibility for and ownership of learning; (b) learning as producing knowledge as opposed to consuming knowledge (Marshall, 1992); (c) developing an identity as a self-sufficient participant in a collaborative community of learners; (d) higher levels of critical thinking about content and processes of learning; (e) meaningful connections to course content; and (f) social interactions that distribute control, enable the exertion of power, and promote cooperation and collaboration in relevant and productive ways. On the other hand, as described by Lemke (1990), students may use strategies that attempt to exert power and control. However, such strategies are not relevant and productive in terms of the particular course foci. In other words, both control and power can be divided into binaries, such as productive—non-productive, functional—dysfunctional, socially-mediated—self-centered, and so forth.

Table 9. Characteristics, assumptions, and expectations in holarchies.

Layered Organization	Characteristics and Assumptions	Expectations
		LEVEL
Holarchy		**Full**
	• Fluid, distributed organization among participants • Control distributed among participants • Ownership distributed among participants • Control acquired with increased participation • Cooperation and collaboration valued • Shared power • Identity based on participation • Meaning situated in complex relations among participation, identity as participant, etc. • Induction is socially-mediated • Degree of participation is self-determined within social sphere	• New, peripheral participants move toward full participation • Question authority of self and others • Collaborate on and negotiate the formulation of rules, expectations, etc. • Assume responsibility and expect others to assume responsibility
		Peripheral
		• New participants determine degrees and approaches to participation • Question authority of self and others • Collaborate on and negotiate the formulation of rules, expectations, etc. • Work towards assuming responsibility and expect others to assume responsibility

The overall binary of holarchy vs. hierarchy involves a number of more specific binaries, which are delineated in figure 4. Such binaries further establish the difficulties in making the transition from hierarchy to holarchy. When students are introduced to holarchies, they tend to enter with established patterns of distrust, competition (with other students), being controlled, dependence on the instructor, conformity to the expectations of authority, powerlessness, fear and risk, and resistance (to authority, to taking on responsibility, to active participation, etc.).

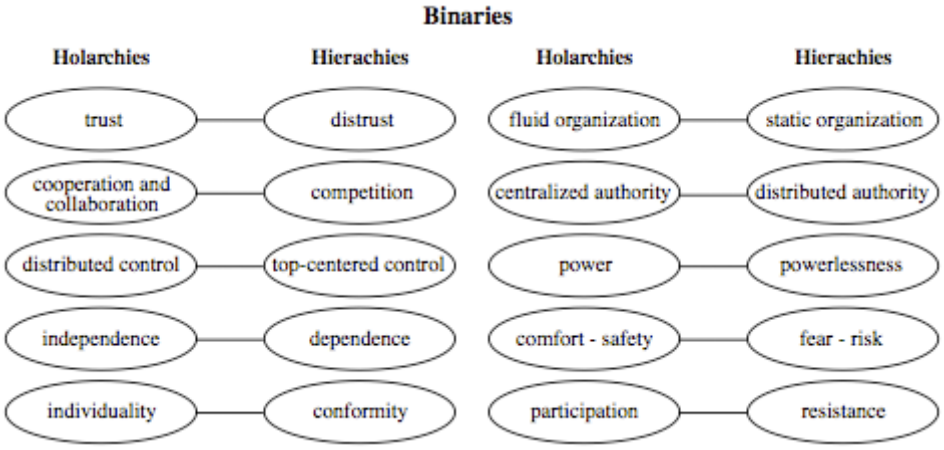

Figure 4. Common binaries evident when comparing holarchic and hierarchic situations.

These patterns establish the barrier or border to the transition to the patterns associated with full participation in holarchic communities (see figure 5). The rather static organization and imposed structure of hierarchies create a relatively easy approach to entering into classrooms. Such an approach relates to the notion "scripts" (Norman, 1982; Schank & Ableson, 1977). Scripts are automatic patterns of action with clearly defined expectations. Once these scripts are learned and established, we can enter new situations, behave in expected ways, and successfully function. If we enter a bank to deposit and check and withdraw cash, we do not need to think about what we do in each stage. However, if we were to do the same thing in a bank in a vastly different culture (e.g., from doing the action in a bank in the United States or Canada to a bank in India), our script may no longer function as successfully. A torn rupee bill, how to handle getting to the right person, and so forth may create huge problems in performing these transactions.

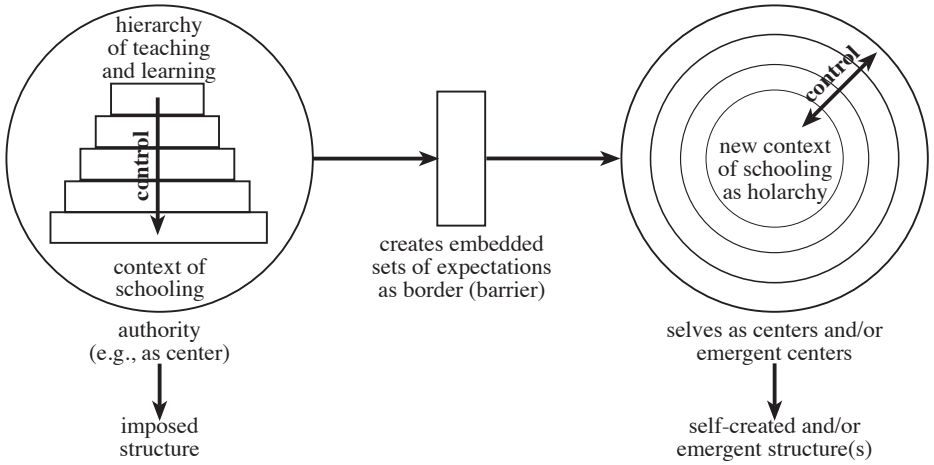

Figure 5. The creation of a barrier in moving from a hierarchic to holarchic approach to induction to a community of professionals.

In addition to the binaries and barriers discussed thus far, hierarchies and holarchies tend to create generalized social binaries. As depicted in figure 6, the individual as center is subject to control from above and is active laterally within the layer. Such a situation is the manifestation of a complementary or dominant—submissive relationship or separating binary. At the same time, this hierarchical context tends to create competitive, symmetrical relationships among individuals within the specific layer. In some instances, the relationships may be commiserate (a version of a reciprocal relationship, but which is one side of separating, symmetrical binary with the group) and based on a sharing of one's particular frustrations, resistance, and so forth. Both of these types of relationships tend to be separating binaries. On the other hand, in holarchies the self as center can act, move, and share control between layers. At the same time, the relationships tend to be reciprocal or collaborative and can be described as unifying binaries.

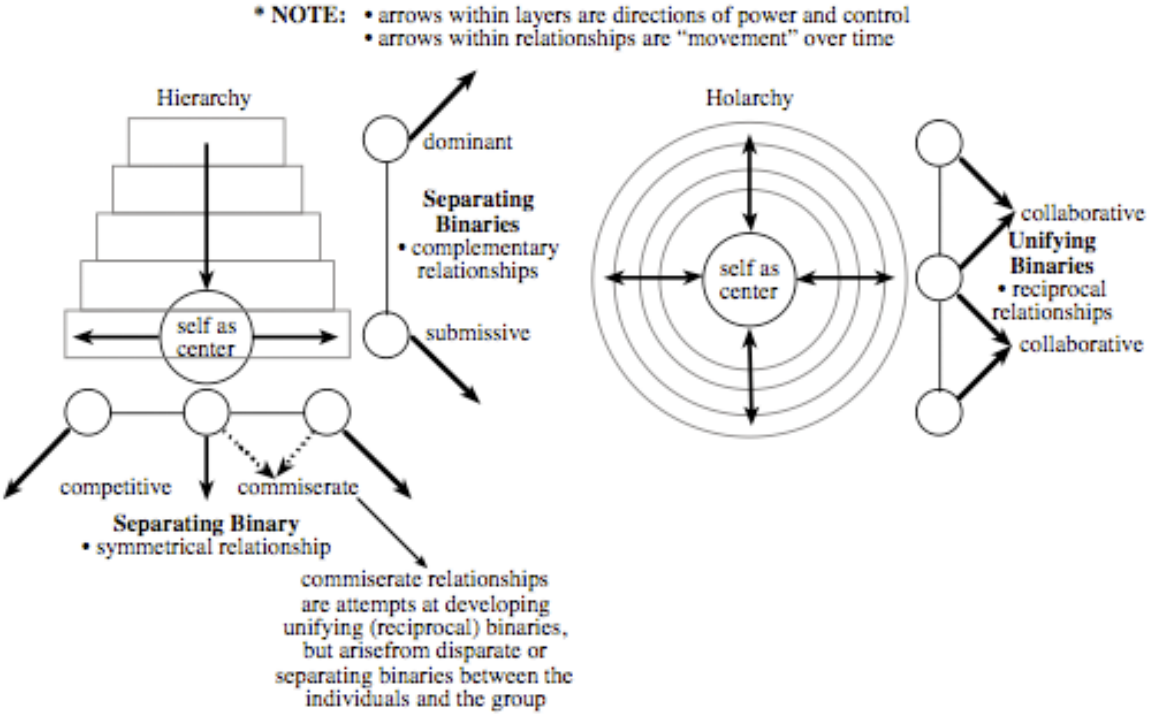

Figure 6. Binaries established by hierarchies and holarchies in terms of the individual and his or her social interactions and relationships.

As mentioned previously, at least six students were initially intrigued with the idea of a community approach that distributed control and responsibility among participants. However, even with these students the process of induction was not necessarily smooth or easy. During the second week of class, I talked informally with Amanda, who was one of the most engaged students:

> Talked with Amanda this afternoon. Started outside the front door…. I asked her how the course was going. She said she was "really into it" and thought it was exactly the kind of teaching she was interested in, but like most other students felt "confused about how the whole thing was going to work without exact guidelines." She also talked about how she was trying to figure out what "striving for excellence" meant to her. She seems like a very upbeat, energetic, and thoughtful person. As we talked about certain issues, (a) like getting

> more people to talk about their confusion and concerns, (b) how we need to decide the workload (e.g., do we need to eliminate some tasks? etc.), (c) how the whole situation is very new and no one has really had any experience with this sort of situation, (d) etc., I encouraged her to take more of an active role in helping people along.

In this excerpt, part of Amanda's confusion concerned the lack of "exact guidelines." Although the syllabus for this course delineated a number of activities, the perception of students was that there were no exact guidelines.

In hierarchically structured course situations, syllabi provide details of specific activities, how reports on such activities need to be structured, when such activities need to be handed in to the instructor, and how they are to be graded. In the course being examined here, the syllabus provided details on the specific activities and on preferred, but tentative, dates of completion. Suggestions for structuring the final written aspects of the activities were provided within the context of a portfolio. However, the specific structure was left up to the student. The basic point made in the syllabus was that the students needed to present evidence of task completion and of the learning and thinking involved. Elaborate materials and information on grading, including a grading rubric, were provided to students near the beginning of the course. The intent of providing these materials was to provide a structure for students to engage in self and peer assessment and evaluation, as well as to provide guidelines for the kinds of issues that needed to be addressed in putting together the portfolios. In addition, to the above information, the syllabus, as well as class discussions, made the point that all aspects of the course were negotiable, including activities, completion dates, portfolio structure, and grading.

However, such an approach is a departure from the normal expectations in hierarchically structured courses. The underlying feelings of students may have included some sense of distrust (a major component in the binary involved in hierarchies and group development), as well as a major affront to their imbedded game plans for successful course completion. Such an affront places responsibility and control over course activities, assignments, and assessment on the shoulders of the participants, rather than having the instructor provide a clear structure for course completion. In other words, decision-making was distributed among participants, where the traditional approach of "spoon-feeding" was eliminated.

In table 10, additional examples of the conflicts between hierarchic and holarchic assumptions of ownership, control, and authority over the course are provided. These examples are taken from the ethnographic observations made by the two graduate assistants. In general, the table provides examples of how hierarchical assumptions (on the left side of table) continued to manifest throughout the semester, even though the notion of holarchy was discussed on regular basis. The right side of the table provides evidence of how the notions of ownership, control, and authority manifested in ways that were consistent with holarchies. The examples move sequentially from the beginning to the end of the semester.

On the left side of the table, we several examples of questions that typify hierarchies; of how students, when taking on roles of teachers, maintain hierarchical control and authoritarian behaviors; and fail to take on responsibility for and control over self-assessment and for doing thorough work (example of presentation on the nature of science). The examples on the right side of the table, the students manifest control and ownership as collaboration, as initiative, as making connections from a child's question to implications for practice, and as assessing the work of peers.

Table 10. Ownership, control, and authority over course: Manifestation of assumptions and expectations within the contexts of hierarchies and holarchies.

Hierarchical Manifestation	Holarchic Manifestation
• Figure out and do what instructor expects with minimal, if any, extension beyond requirements. Instructor has sole ownership and control over course.	• Determine what is needed and useful, then work towards goal. Collaborate and negotiate personal and community goals and activities. Ownership is shared among all participants
- Student asks whether they are raising hands or not. Jeff tells them whatever works.	- Groups are helping each other figure out the [water chemistry] testing kits.
- Betsy: "Are we going to have the same kids in our group each week?" (Jeff had already mentioned this at beginning of class, and several times before).	- Before class (#15): Alan was in using the probes to test respiration and heart rate. He just got them out, read the directions and went for it. Jeff brought in Damian's probe sheet, but Alan had pretty much figured it all out by then.
- (Class #16) Danielle looks unhappy, so I ask her if everything is ok. She says she, "hates this class" and doesn't want to be here.	- Aron, "One of our students [a child] asked a great question and I didn't know how to answer so I was thinking about it this weekend." He explains that answers to a couple of their questions would lead to good investigation for the next week after you find out the answers. He then tells the group that a good way to expand and have enough to work on is to take their questions from that week and use them for the next week.
- A little girl gives an explanation of how hot air balloons float… Danielle: "Uh, we're gonna do it different though."	
- (Group presents on nature of science.) Cassie starts, speaking softly and stays seated. Jeff says it might be a good idea to stand and use "teacher talk." She sighs and reluctantly stands. She talks about 2 cartoons she watched and some "science-like" things that happened. She [has no] conclusions. Debbie stands and says she explained what science was to pre-schoolers, then asked them to draw about it. She shows pictures… and tells what they are, but doesn't give any further explanation. Beth presents "internet search" part, She says some sites might be helpful. Barbara brought in some science magazines, holds them up and says, "here are some science magazines." She doesn't read titles, doesn't tell about what is in any of them. She says she found some science children's books, but doesn't have any with her. Debbie and Camie didn't present!	- (In response to Cassie's group presentation on nature of science, which lacked content and analytical substance [see example directly on the left]): Amanda—"Did you come up with a definition of the nature of science or anything?" Carl: "Maybe more explanations. Like, why would a kid draw a shoe?" (Referring to a drawing that Blaise brought in.) Ann: "Did she say what you can do with the magazines?"
- Camie to Jeff: "Can I ask you a question about our final project? What do we have to do?" (Didn't they already say what they were going to present?) She asks, "So, we're doing mixtures (with kids), do we just do a bunch of experiments?" (Has she even been here this semester?)	- Cassie is organizing a trip to Lowell Observatory. "How many of you are interested in going?" (About 8 hands go up)

Within a group of two highly engaged students and one highly resistant student, the tension (binary) between the two types of students (i.e., those trying to participate in the holarchy and the student entrenched in hierarchical assumptions and expectations) is evident from the observational notes taken during class number 7:

> Jeff asks Danielle, Abbey, and Ann's group to go first because he knows they are prepared. They came to him before class and asked for an extra "worm packet" and if we had slinkies. Jeff asked them how the class was going. Ann said she thought it was good but she said she knew "of really anal people that are totally freaking out." She looked at Danielle as she said it and Danielle laughed (Danielle must be "totally anal" in Ann's opinion).

Here the notion of "anal" seems to refer to the expectations common in hierarchically-based courses, where the instructor controls the content and actions in class and where the expectations are all geared towards providing what the instructor wants.

The embeddedness of hierarchical patterns also manifests in the way students act as teachers. For example, during class 17, when the students were working with children on inquiry projects, Danielle dominates the interactions and dismisses one of the girl's ideas on two occasions:

> A little girl gives her an explanation of how hot air balloons float because of the heat. Danielle: "Uh, we're gonna do it different though." (didn't expect that answer!) She then explains that they are also going to make some helium balloons hover. The same little girl says: "Then we need one of those things to hold it down." Danielle, "No, then they would go all the way down and we want them to hover—using paperclips—you guys have to figure it out."

On the other hand, other students, such as Ann, in the following excerpt from the observational notes, make an effort to change to interactional patterns that do not perpetuate hierarchical assumptions. In relating to the same girl during the same activity as described previously (where Danielle dismisses the girl's ideas):

> Ann asks the kids: "Why doesn't it work?" Same little girl: "It doesn't have enough helium." Ann: "What does that have to do with anything?" (good thinking on her feet w/ questions.) Girl: "Helium makes it float." Ann: "Why?" Girl: "Don't know." (Good, push until you get to something they may want to find out more about.)

In this example, Ann tries to ask questions that not only reveal the limits of the girl's understandings, but also communicate a sense of relationship that is collaborative and negotiative (i.e., a reciprocal relationship or convergent, unifying binary).

In holarchies, as well as in the issues involved in group development (see figure 2 on McClure's group development), risk-taking is aspect connected to developing a sense of trust and developing ownership and control. Table 11 provides examples of how such risk-taking does not manifest in those who maintain hierarchical expectations and of how such actions do manifest in those who are taking on holarchic expectations.

Without the development of a safe environment, taking risks is greatly hampered. In the course being examined, every effort was made to create a safe environment. However, only a few students felt that they could take risks. Others who maintained their assumptions of hierarchies never moved through McClure's (1998) first stages of preforming in group development and safety in the issues of groups.

Table 11. Risk-taking: Manifestation of assumptions and expectations within the contexts of hierarchies and holarchies.

Hierarchical Manifestation	Holarchic Manifestation
• Fear of taking a risk in competitive, disconnected atmosphere	• Willing to take risks in collaborative and connected atmosphere
- I overheard Danielle talking with Bonnie about not getting "too deep in front of these people." - Amanda: "I probably would be over there if I wouldn't be the only one." (During self-evaluation of effort activity)	- Holly's observations included the larger group having more boldness and ideas—a student was going around to look at other tables' ideas. - [During a battery and bulbs activity:] Jeff stops everyone when they have gotten at least the first problem and asks which of three diagrams on the board will work. Alan blurts out an answer and Jeff asks him "Ok, why?" Alan starts to laugh and Jeff tells him to go up to the board and draw the circuit. He draws with a little encouragement.' Jeff, "Based on the last class, what are we doing here?" Jeff, "Based on the last class, what are we doing here?" Blythe, "Elaborating and explaining." Jeff, "In the 7 E's yes, but remember what we talked about—models? Who else would like to try?" (Alan wasn't exactly correct.) Amanda gets up to draw the light bulb and the circuit. She has it right but can't explain why.

Another aspect of the movement from hierarchies to holarchies, involves the notion of who or what is the authority over course content. In the typical hierarchical classroom, the teacher maintains control and authority over content. In holarchies, authority and control over content tends to be distributed, at least, through some participants. In addition, participants may seek sources of authority outside of the group. As mentioned earlier in this paper, the types of questions may be indicative of hierarchical or holarchical assumptions and expectations. The first two examples on the left side of table 12 arise from hierarchical expectations. In both instances, the students ask questions of the instructor, with the expectation of receiving the correct answer. The last two examples on the left side, show how the students move into the role of content authority when they move into situations where they are teachers. On the right side of the table, the example occurred within a group while investigating earthworms. Here, the student refers to an external authority, without asking for confirmation from the instructor.

In another example, a student taking on the role of teacher asks the children a question that is quite appropriate for a holarchic inquiry context:

> Bonnie: "Do you know how many times a minute you breathe?" They don't know. She then tells them, just like she is reading it from a textbook. She explains that the number is different when you are sleeping, but doesn't ask why or whether you have to remember to breathe.

However, the student (as teacher) quickly moves to content authority and provides the answer, rather than helping the students explore ways to generate the answer.

Table 12. Authority over content: Manifestation of assumptions and expectations within the contexts of hierarchies and holarchies.

Hierarchical Manifestation	Holarchic Manifestation
• Teachers are content authorities.	• Authority of content is external, distributed, and negotiated.
- While pondering which end of an earthworm is its head or tail: students ask, "Do you know which it is?" - Many groups ask me, "Can't you just tell us?" (trying to identify male and female guppies) - Beth and Cassie are telling the kids about smog in Phoenix (do kids really want to sit around and be lectured about smog?) - Carla: "Be more knowledgeable. They had a lot of questions and I couldn't answer them all. I kept saying Bonnie can answer that because she knew so much."	- Donna comments: "I read about that experiment in the book where they were poking a worm and it gave off a chemical of some sort but how many times was that experiment done?"

The final aspect of moving from a hierarchic context to a holarchic context, involves the fundamental change made in this particular course: assessment and grading. In hierarchic classrooms, students complete assignments that conform to what they think the instructor wants. The most frequent examples of this expectation were the questions: "Is this what you want?" or "What do I need to do to get an 'A'?" When this expectation was removed, most students had a great deal of difficulty, which manifested as a persistent sense of confusion and resistance. As we have seen in previous examples of the self-assessment of effort activity (i.e., students placing themselves in the categories of off-track, going through the motions, putting in effort, and striving for excellence), most students placed themselves in higher categories than were evident from class observations. At the end of the semester, all but six students made greatly inflated self- and peer-assessments. These tendencies to inflate one's self or peer assessment are more characteristics of hierarchies, where participants are competing for approval from those at higher levels of authority, as well as, on some occasions, from those occupying the same layer.

On the other hand, a few students made the connection to distributed assessment, at least on some occasions. In the following example, Ann makes a truthful (although possibly under-inflated self-assessment): "Ann comments to her teammates: 'It's almost the end of February! I've got to get myself together. I'm definitely off track!'" Such under-inflation appears to be more characteristic of holarchies where assessment expectations of performance move from higher authority to oneself. The same sort of self- and peer-assessment also extended to the students' work with children, as in the following example: "Carla: 'we only planned one activity and when we were done we were bored. We should have had a back up.'" However, as in previous examples, many students, especially in the public arena of the whole class, inflated the self-assessments of their work with children. In another instance of a student, who never made a complete transition to holarchic actions and attitudes, quite assessed her and her group's work with children: "Debbie comments: 'We didn't teach them anything at all and we don't know what their ideas of mixtures are. If we ask them questions, at least we'll know where to go.'" However, as in the previous example, Debbie did not make this assessment in the public arena.

Participation: Engagement and Resistance

In considering the self-assessment of engagement activity discussed earlier, one expects that in a professional community participants will spend most of their time somewhere between putting in effort and striving for excellence. Off-track and going through the motions are not particularly appropriate for a professional community, where the notion of being a professional is intertwined with most aspects of one's life. The word professional itself implies independence, responsibility, initiative, and passion. Although effort may vary widely depending on a wide variety of circumstances, professionals put in a great deal of effort beyond the official time boundaries. Although teachers may spend seven to eight hours in school, they spend considerable time during evenings, weekends, and vacations working or at least thinking about teaching.

Engagement in the activities, discourse, and thinking of a professional development community requires a willingness to confront many of the obstacles or borders that are confronted personally and socially. These obstacles may involve strongly held beliefs about teaching and learning, prior experiences with learning and teaching, values about teaching and learning, group dynamics, self-efficacy, emotional reactions to particular activities or to the personalities of group members (including the instructor), and so forth. Resistance to confronting such obstacles may not be indicative of resistance to learning (as suggested by Wenger, 1998), even though it may appear as such, but may be indicative of a complex set of other factors. Such factors may include issues with safety and taking risks, with participating, with imagined roles of self and others, with a willingness to take initiative (at least within the specific context), with the expectations and assumptions one holds when entering the community, and so forth. These issues correspond with and extend beyond those identified by McClure (1998) in figure 2.

In this particular elementary science teaching methods course, student participation ranged from apparent resistance to thorough engagement. On the right side of table 13, the excerpts from the observational notes demonstrate active engagement. In these examples, the participants are engaged without any prompting from the instructor. In contrast, the excerpts on the left side of the table are indicative of a lack of engagement. In the first example, the two students show a glimmer of what they should do, but sink back into non-engagement during their pond water investigation. The last two examples demonstrate lack of engagement when the students are working with children. In these examples the students are completely off-track and make no effort to engage or engage with the children.

Although McClure (1998) places the issue of dependence further down in the arc of group development, it appears that dependence may be a key factor underlying the lack of engagement of the disengaged students, while the students who engage actively have reached the point of independence. However, as mentioned in previous sub-sections, other factors involved in the binary of hierarchic and holarchic assumptions and expectations may affect whether students progress to greater independence and participation.

Table 13. Participation and engagement: Manifestation of assumptions and expectations within the contexts of hierarchies and holarchies.

Hierarchical Manifestation	Holarchic Manifestation
• Respond to instructor's questions or remain in background	• Actively engaging in professional actions, discussions, etc. from perspective of being valued member of
- Beth: "Maybe we should look at something under the microscope." Kelly: "Yeah, what?" No one in the group gets up to get the microscope. - Camie is not doing anything- just watching- looking bored (sitting down). Kids look bored (they are talking and laughing amongst themselves). This group's experiment (whatever it was) is over in 2 minutes - it is 10:44 and they have nothing else to do with the kids. - Cassie, Camie, Beth and Blaise are in the classroom- but where are their kids???… Now Barbara is standing around too- who is with the kids?… Camie is still sitting down doing nothing… The rest of Cassie's group is standing around doing nothing- unbelievable!… Cassie's group is leaving to go outside again, but Cammie is in the classroom looking lost.	- Class 11 - Amanda: "Betsy, you should see this! Look how far his head is out." (Gets out of the way of their microscope to let Amy look.) Bart is standing close by and hears them. He says, "Ooh, can I jump in after?" - Class 12 - 11:10 People are walking in and begin to check their ponds. - All members of Loren's group are interacting with the kids.

Identity and Meaning

The development of meaning and identity are closely intertwined with participation and the history and nature of the community (Wenger, 1998). Although participation, as examined above, was observable, the participants' knowledge of the history and the nature of the community are more difficult to ascertain. Understandings of the history and nature of teaching communities for most of the participants is based on their experiences of teaching as students. As such, the knowledge is strongly rooted in experiences from the bottom layer of the hierarchy of schooling. Examples of this knowledge include (a) the purposes of teaching, (b) the nature of the teaching, (c) the nature of learning, (d) the discourse of teaching within the profession, (e) the nature of the relationships with other teachers and administrators, and so forth. A brief comparison of hierarchic and holarchic understandings of the above examples of such knowledge appear in table 14. In general, this comparison reinforces the basic notions examined thus far in terms of hierarchical understandings that have a narrower vision of the teaching enterprise and one that is based on experiences within the hierarchy. On the other hand, holarchic understandings of teaching need to have a wider view of teaching and learning, as well as more critical and extensive understandings of current, recent, and historical trends in teaching, schooling, and curriculum. As explored thus far in this paper, such knowledge contradicts much of the knowledge associated with the type of holarchic community that was attempted in this particular course.

Identity within schooling hierarchies is closely related to identity within corporate hierarchies. As discussed by Wood (1990), such corporate identities involve the notions of conformity (as expected by higher levels in the hierarchy), obedience, not questioning authority, and maintaining "place" (i.e., not participating in decision-making, etc.). On the other hand, democratic communities value individuality, not blindly following rules, questioning authority, and actively participating in decision-making, etc.

Table 14. Examples of hierarchic vs. holarchic understandings of the history and nature of the community of teachers.

Nature of Knowledge	From a Hierarchic Perspective	From a Holarchic Perspective
Purposes of Teaching	• To transmit knowledge. • If constructivist-based, ultimate control is from teacher. • To prepare students for tests. • To address standards in fairly linear fashion.	• To help children develop thorough, complex, meaningful, relevant, and accurate understandings. • To address goals of teacher and children first, while making sure standards are addressed.
Nature of Teaching	• To get students to consume knowledge and remain on-task. • To act as authority and disciplinarian. • To control the action in the classroom.	• To engage students in constructing and producing knowledge. • To act as model and mentor to students. • To orchestrate the action in the classroom.
Nature of Learning	• Learning as rote process. • Learning through repetition. • Learning through sequenced and linear processes.	• Learning as active and socially constructive process. • Learning as elaborative process. • Learning as non-linear and cyclical processes.
Discourse of Teaching	• Focus on children and learning. • Focus on discipline. • Focus on divergent binary established by hierarchy (complaining, etc.).	• Focus on children and learning. • Focus on nature of classroom and school communities. • Focus on negotiating meaning, control, etc.
Nature of Relationships	• Competitive, jealous, or commiserate among teachers. • Competitive or submissive towards administrators.	• Collaborative and negotiative among teachers. • Collaborative and negotiative towards administrators.
History of Teaching and Schooling	• Based on experiences as student and as teacher in hierarchy. • Minimal, if any, understandings of the history of teaching and schooling in terms of major themes and efforts over the last century and earlier.	• Based on critical examination of experiences and assumptions encountered as student and teacher. • Based on understandings of major trends throughout history with an emphasis of situating current and recent efforts as a teacher (or future teacher).

During the previous semester, students exerted their power and negotiated new directions, assignments, and assessment approaches. The course was reformulated as students reconstructed new identities as participants in a changing community of professionals. However, during the

course being examined here, with only a few minor exceptions, the students maintained a hierarchical orientation. Their identities remained bounded by hierarchical assumptions and expectations as consumers and students. One type of question that regularly arose and characterized such an orientation was " is this what you want?" as opposed to the rarely posed statement and question: "I've been working on this. Could you let me know what you think?" This binary of questions clearly indicates a disparity of identities, where the first is hierarchically based and the latter is indicative of one that is holarchically based. Another example that shows the deeply embedded nature of hierarchic identity appears in an interaction between student and my graduate assistant, when Debbie asks the following questions: "Why don't you go over that in class then? Instead of just saying this is a requirement, go do it. Why don't you show us?" In another example, a group of students discuss their portfolios. During this interaction among students, we can see the difference in how identity affects the way in which they approach the task at hand:

> Amanda has joined Blythe's group. She asks Carl, "What more do you think you'd like to put in your portfolio?" Donna: "Have you been doing the readings?" Amanda: "That's why I'm gonna go back…because it says <u>evidence</u> of assignments."

Here Amanda takes on a more of a leadership role by initiating a discussion on how another student can focus on his own ideas of what to include in his portfolio. Donna's question to Amanda demonstrates more of a student identity, in terms of perceiving the completion of readings as a required task rather than as a task for one's own professional growth. Amanda's response is one of seeing how her reading can provide evidence of her professional growth.

In commenting on the impact of the course, Amanda demonstrates a change in how she sees the course affecting her identity and the meaning it has brought to her professional growth: "It [course] started a whole umbrella of thought of how to do things for me." Such a comment indicates how she is situating herself within a contextually relevant way of thinking. In contrast, Danielle's comment shows how she has maintained a position of resistance to change: "Yeah, it [course] just didn't suit me. I'm just a structured person. That's just the way I am." In another example of such resistance, Debbie says, "I think it just gave us a point of view and you can take it or leave it." Both of these examples show how students maintain a distance from the context of the course. Such distance is maintained through a basic disconnect between engaging with the ideas and activities and developing a professional identity.

Throughout this section of the paper, we can see how the data from previous sub-sections do or do not contribute to developing complex interconnections between participation, a sense of professional community, identity, and meaning. For some students, the progression towards such complexity took place. However, such progress was removed from the specific community of the course. Such students found it difficult to function amidst the dominance of the more negative and resistant students. For Blaise, who had a great deal of difficulty making a personal connection to the move to a more independent stance, such a separation from her particular group seemed necessary. After class for several weeks, Blaise would ask me how she needed to proceed with various tasks. She repeatedly said, "But I don't learn this way." My first response was that "I think you may think that you learn this way, but if you really examine how you learn, you may find that you learn differently." Week after week, I suggested that she come see me outside of class to work on some strategies. However, she always had an excuse for not being able to meet. Then, just after the mid-point in the semester, she came up to me before class and said, "I've been working my projects and doing the readings. Do you want to look at what I've

done so far?" At about the same point, she was observed coming an hour early to class to work on her pond studies. When her group arrived in class, they would make comments to her such as, "why are you doing this? Blaise just ignored her group and kept working. In this example, the pressures from the dominating negative influence of others was more than Blaise could handle, so she kept to herself and did what she thought was necessary. However, for many students, who did not situate their identity and meaning in a coherent and cohesive framework, the negative influences of others pulled them away from the possibilities of establishing independence, initiative, meaning, and identity situated within the broad context of a community of professionals.

Discussion

This study probably produces many more questions and directions for further research than it produces definitive answers. However, the study does delineate a rather detailed map of the territory. In attempting to create a more holistic and relevant approach to teacher education within the context of an elementary science teaching methods course, a number of key issues, including a variety of conflicting assumptions and expectations have been revealed (see figure 7 for an overview of some of these key issues).

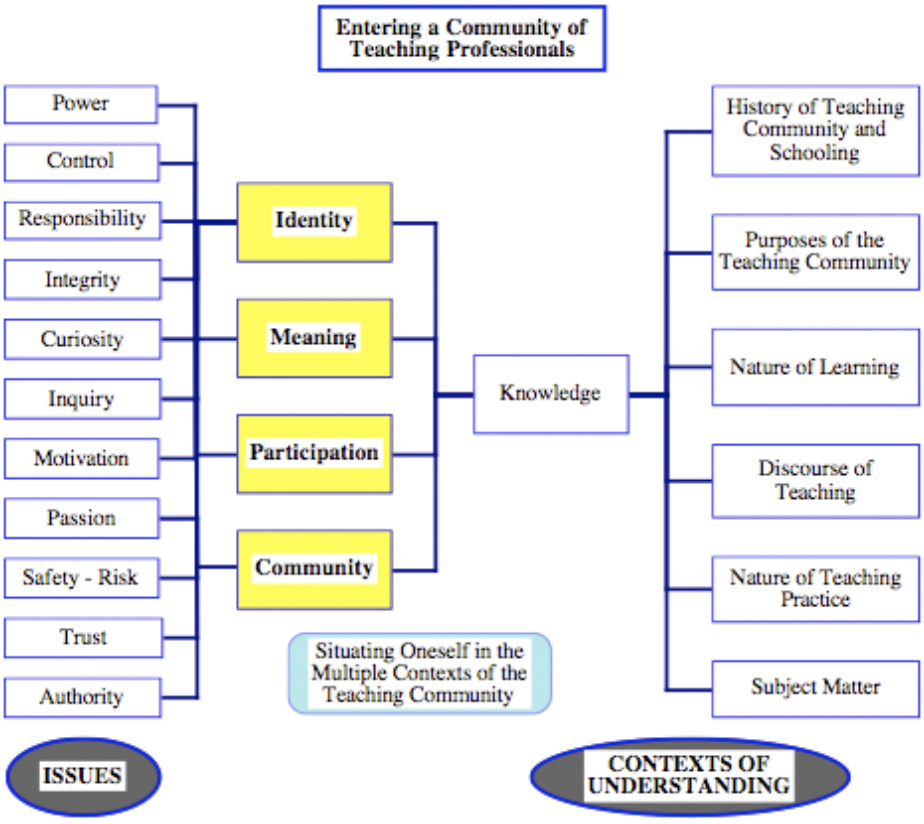

Figure 7. Summary of the issues and understandings associated with entering the community of teaching professionals.

In trying to address the notion of entering a professional community, modeling of such a community is not sufficient to stimulate personal transformations among many students. Students must reveal and confront underlying beliefs, assumptions, rules, and their own centers of foci

(e.g., interests, strengths, passions, etc.). Frameworks of beliefs, assumptions, rules, and expectations become embedded in each individual over years of experience in schools, jobs, and other situations. These underlying frameworks involve tacit notions of hierarchically structured educational institutions, which have created an atmosphere of powerlessness and fear. Fundamentally, the situation of moving from the traditional hierarchical model of schooling to one that tries to foster a holarchic community of developing professionals produces, at least initially, a divergent binary of conflicting contexts. Figure 8 provides a brief overview of such conflicting contexts.

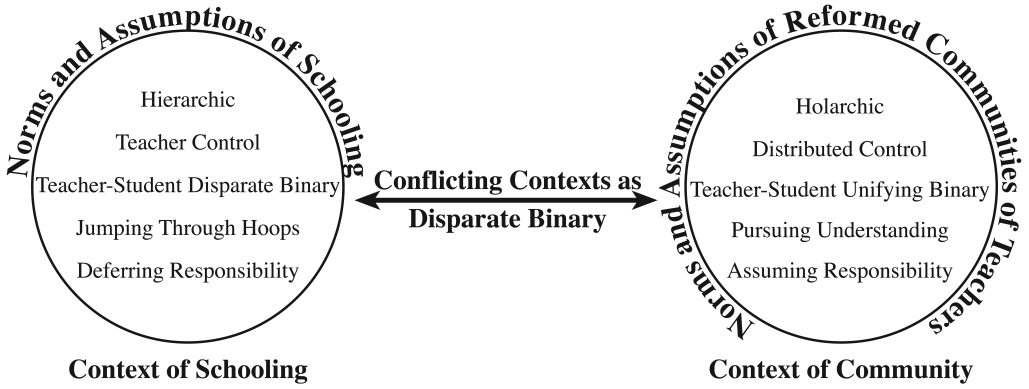

Figure 8. The contexts of schooling and professional communities as a conflicting binary.

In confronting such assumptions, students must examine how their social contexts have influenced such underlying beliefs and how their actions as teachers in the future can affect children. However, such efforts are difficult for students in that again they have had little experience in thinking more deeply and critically about anything. Even with continual work on deeper and more critical reflection along with experiences that may help bring issues to the surface (e.g., opportunities to work with children during the course and specific issue-focused discussions), some students still may be resistant to change. In the case of this particular study, at least four dominant students demonstrated such resistance. As in any complex system, the influence of specific factors can have major effects on the whole system, which did occur here. The notion of community floundered and never came together as a functional whole. On the other hand, some students did examine the issues of the conflicting contexts and managed to develop professionally. However, these students had to develop coping strategies, which involved pulling back from the others and working on their own.

In other cases, such as during the following semester, students in a graduate level curriculum course initially struggled with the conflicting contexts, but within a few weeks they came to terms with the conflicts they were experiencing. Without any overt effort on my part to create a community (although I held to certain principles of not being an authority over content, supporting student voice, encouraging critical reflection on one's own practice including my own, among others), the class changed (experienced a break) to a community of personal and professional transformation. As students, openly discussed their own practice – from shockingly personal accounts of failures to uneasiness with current practices – the entire group took on power and authority. Now, as we meet in the halls, we look at one another and express the strangeness of no longer meeting. In this particular course maybe it was the particular group of people, who were ready for such an experience. Maybe it was a combination of readings, events, and other unplanned aspects of the course that made the entire system take on an energy of its

own. Maybe it was the dominant, negative student, who dropped the course after week 2, that made a difference (had he stayed, I doubt the course would have taken the same path).

During the current semester, such an effort with the science methods course may have worked, but I have postponed pursuing the effort until I have had a chance to rework the approach. The students appear to be much more engaged and willing to take risks, although many clearly admit to being overwhelmed by their other 15 credit hours of courses to maintain a "striving-for-excellence" or even a "putting-in-effort" level of work in any course.

However, in terms of the present study, the importance of certain factors in creating such a community is evident. As described in McClure's (1998) model, group development needs to go through certain stages of conflict and unity. The major conflicts as expressed in the binaries of assumptions and expectations established by hierarchies and holarchies serve as the major foci of group development. If students are willing to engage in such a process (as in the curriculum course discussed previously), the stages of conflict proceed rather quickly. If some students are unwilling to engage in the process, then the problem becomes one of time to deal with these issues more directly versus time to engage in the specific purpose of the course (in this case, how to teach science). Obviously, one way to approach such a problem of developing a professional community while addressing the issues of the time involved is to develop such a focus for the entire teacher education program. Such an approach, of course, requires that all faculty subscribe to the same sets of beliefs and expectations and work to reinforce this sense of community in their courses. Although some of the faculty in my department are beginning such a process, reaching a consensus with all faculty is unlikely.

So, in terms of working to develop more successful communities in one's own courses, fostering inquiry into and discussions of the conflicts and dilemmas (binaries) from the beginning of the course may have a significant impact on establishing a clear framework upon which to build a community. Such discussions also can include the scientific community (or communities), which can lead to the development of understandings about the nature of science. In addition, such focused inquiry and discussion can work at several levels or layers of Wenger's (1998) community model. As such conflicts and dilemmas (as seen here and in the work of Volkman and Anderson [1998]) are encountered and examined, students begin to develop a sense of identity, which can include placing themselves in particular positions as related to the binary conflicts, achieving voice in classroom discussions, and so forth. At the same time of formulating a professional identity, they can begin making meaningful connections between their developing identities and the purposes of the profession, into which they are entering. Throughout this process, they are developing a sense of what participation in such a community concerns and, as suggested by Feldman (2002), such a process provides a contextually situated approach to developing an individual's professional identity.

If we are to successfully transform (or reform) our approaches to elementary science education, as suggested by Wang and Odell (2002) and the material in the present paper, students must confront the underlying assumptions that have driven their experiences with schooling and those of the new approaches we are trying to promote. At the same time, we need to address the what Howe (2002) points to as the holistic contexts of schooling and society, of working with children, and of science and inquiry, within which each individual's position can be situated as he or she develops notions of identity, meaning, and participation. And, finally, as discussed by Bertrand Russell (1950/1969), we need to help students develop identities as teachers that are more than that of being technicians. Rather such identities need to include the notion of being scholars (i.e., inquirer and critical consumers and producers of knowledge) who help children

understand their own positions in society and how they too can participate in multiple democratic communities.

As we proceed toward transformations in science teacher education and teacher education, in general, a number of key questions still need to be investigated. Some of the more significant questions include:

1. How do we address resistance among students to engage in critical examinations of the conflicts and dilemmas presented by moves from hierarchical notions of schooling to holarchic communities?
2. How can we address the time constraints both on faculty and course structures and on students who are involved in heavy course loads, which may be required to adequately respond to the needs of group and community development?
3. How can we continue to "up the ante" on course expectations, while contending with the complexity of helping students acquire the knowledge and skills necessary for teaching science, as well as of helping students enter the professional community, along with their development of professional identities and concomitant meaning as participants in such communities?

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Appendix A

The table below shows the number of items mentioned in the question responses to motivation and passion.

Practical Motivation refers to practical, social, and external influences.
Non-Practical Motivation refers to helping others, self-improvement, and passion.

Practical Passion refers to employment, area of study, and professional field.
Non-Practical Passion refers to interest and leisure activity.

Each item in the practical categories of both motivation and passion were assigned a value of –1.
Each item in the non-practical categories of motivation and passion were assigned a value of +1.

The decision to assign negative values to the practical dimensions is based on a notion that practically-based motivation and passion may be related to more hierarchically-based assumptions and expectations, whereas the non-practical dimensions may be related to more holarchically-based assumptions and expectations. The presupposition of such an approach concerns the idea that the non-practical dimensions may relate more directly to people who work independently, need less externally imposed structure, and thrive in environments that are less certain, etc.

	Engage. Rank	Motivation			Passion			Overall Balance
		Pract.	Non-Pract.	Balance	Pract.	Non-Pract.	Balance	
Abbey	1		2	2	-1	1	0	2
Alan	1	-2	1	-1	-2	1	-1	-2
Alice	1		2	2	-1	1	0	2
Amanda	1	-2	2	0	-1	2	1	1
Ann	1		1	1	-2	2	0	1
Aron	1		1	1	-1		-1	0
Barbara	2	-1	1	0	-1		-1	-1
Bart	2		1	1	-2		-2	-1
Beth	2		2	2	-2		-2	0
Betsy	2	-2		-2	-1	1	0	-2
Betty	2		2	2	-1	1	0	2
Bill	2		2	2	-2	1	-1	1
Blaise	2	-2		-2	-2		-2	-4
Blythe	2	-2		-2	-2	2	0	-2
Bonnie	2	-1	1	0	-3		-3	-3
Brenda	2	-2	1	-1		1	1	0
Carl	2	-1	3	2	-1	1	0	2
Carla	2	-2		-2	-3		-3	-5
Carmen	2	-1	1	0	-2	1	-1	-1
Cathy	2	-4		-4	-1	1	0	-4
Cecilia	2		3	3	-2	2	0	3
Danielle	2		2	2	-2	1	-1	1
Donna	2	-1		-1	-1	1	0	-1

Appendix B
Characteristics and Areas of Student Passion

Students N=26	Characteristics of Passion					Areas of Passion													
	As Interest	As Enjoyment	As Area of Study	As Professional Field	As Leisure Activity	Teaching	Reading	Writing - Poetry	Science-Medicine	Art and Art History	Mathematics	Anthropology - Culture	Psychology - Development	Sports and Activities	Criminal Law	World Religions	Social Justice Issues	Working with Children	Larger Service to Humanity
Abbey	1	1						1	1										
Alan		1	1		1				1										
Alice	1			1										1					
Amanda	1		1		1			1					1				1		1
Ann	1	1	1		1		1	1											
Aron				1		1													
Barbara			1						1										
Bart			1	1		1									1				
Beth		1	1																
Betsy	1		1			1										1		1	
Betty	1		1			1				1								1	
Bill	1	1		1		1								1				1	
Blaise		1	1									1							
Blythe	1		1	1	1	1	1			1									
Bonnie		1	1	1					1										
Brenda					1		1												
Camie	1		1								1								
Carl	1		1			1			1										
Carla		1	1	1		1							1						
Carmen	1		1	1		1			1										
Cassie			1										1						
Cathy	1			1		1							1						
Cecilia	1	1	1		1					1									

Danielle	1	1		1			1													1	
Debbie																					
Donna	1		1						1												
TOTAL	14	9	18	10	6		11	3	4	6	3	1	1	4	2	1	1	1	4	1	