

## **Cognitive Frameworks and Teaching Practices: A Case Study of Teacher Learning and Change**

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In this interpretive case study constructs that may enable teachers to reflect on how their knowledge facilitates and constrains their ability to make changes in teaching practice were explored in collaboration with one teacher. Transcripts and field notes from participant observations in the teacher's high school chemistry classes were primary data sources. Data were analyzed using theoretical perspectives derived from philosophy, social-psychology, and anthropology. Socially negotiated constructs, including images, metaphors, and cultural myths that the teacher employed in making sense of teaching and learning were identified. Through exploring the process of change with this teacher, I found both cognitive and cultural dissonance make even individually desired change a difficult process which requires a context of social support if it is to be maintained

En collaboration avec un enseignant, une étude interprétative qui permet aux enseignants de réfléchir sur la manière dont leurs connaissances facilitent et empêchent leurs capacités de faire des changements dans leur enseignement fut entreprise. Les données furent recueillies à partir des observations des participants dans une classe de chimie au secondaire. L'analyse des données fut effectuée en utilisant des perspectives théoriques découlant de la philosophie, de la psychologie sociale et de l'anthropologie. Des constructions sociologiques, des images, des métaphores, et des mythes culturels, utilisés par l'enseignant pour rendre l'enseignement et l'apprentissage significatifs, furent identifiés. Tout en explorant le processus de changement chez cet enseignant, j'ai trouvé une dissonance cognitive et culturelle. Cela a rendu les changements souhaités plus difficiles. C'est la raison pour laquelle un contexte de support social est de grande importance pour que le changement puisse prendre place.

Researchers and change agents have expressed frustration that teachers are unable or unwilling to implement suggestions for change. Large investments have been made in planning and implementing staff development programs, yet few have produced desired changes in the teaching practices of participants (Guskey, 1986; Guskey, 1988; Rich, 1990).

However, as Richardson (1990) argues, a critical feature in this literature is that change is defined, not by teachers themselves, but by someone outside the classroom. In this respect, for teachers to change is for them to do "something that others are suggesting they do" (Richardson, 1990, p. 11).

On the other hand, several recent studies indicate that teachers constantly adjust their practices to take into account the nature of their students as learners (Johnston, 1990; Strahan, 1990), the contexts of the school and classroom in which learning is to take place (Eisner, 1992), and the social and political factors which influence learning (Hollingsworth, 1992; Miller, 1990). From these studies, which have investigated personally initiated changes from a teacher's perspective, researchers have begun to develop theoretical perspectives that explain why change is difficult to accomplish and sustain.

### *Purpose*

Building on the research on individual change, this interpretive case study explored the personal change process of one science teacher. Two initial questions provided a focus for the study: (a) What conceptual tools are useful in assisting the teacher to describe and change his practices? and (b) how does the change experience fit into the context of the teacher's life at school? The nature of the teacher's knowledge and the change process were interpreted using multiple theoretical perspectives. As the study progressed, constructs which teachers and researchers may find useful in reporting and reflecting on teachers' knowledge bases, their interpretations of classroom roles and relationships, and curriculum implementation were identified.

### *Theoretical Frameworks*

A basic assumption of this research is that change implies learning. Schön, (1983, 1987) described reflection-in- and reflection-on-action as means by which teachers may become empowered to construct knowledge, take charge of their actions, and initiate change. Schön's conception of

reflection has been applied to research in teacher education that is concerned with ascertaining how educators make sense of their culture and work (Connelly & Clandinin, 1988; Grimmet & Erickson, 1988). Although the concept of reflection that has driven research in teacher cognition varies (Grimmett, Reiken, MacKinnon & Erickson, 1987), the primary goal of reflection research is answering questions regarding how teachers construct meaning for what they do and how the socio-cultural setting in which teachers are enmeshed constrains the conceptual frameworks that they use to make sense of their work and their world (Erickson, 1988).

Unfortunately, research on teacher cognition rarely provides clear evidence for developing an understanding of the nature of teachers' personal knowledge or its influence on classroom practices (Kagan, 1990; Pajares, 1992). This area of research is complicated by several factors: (a) The term teacher cognition, as currently represented in the literature, is ambiguous having been applied to multiple aspects of a teacher's thinking; (b) cognition can only be assessed indirectly, inferred from what a teacher says or does; (c) reported findings are based on small numbers of subjects and therefore, not generalizable in the traditional sense; and (d) the nature of reflection and its relationship to change that can promote growth is not well understood (Kagan, 1990).

Yet, the study of teacher cognition remains an important area of research because a teacher's personal knowledge tends to reflect the decisions made regarding the content and processes implemented in classroom instruction (Bandura, 1986; Connelly & Clandinin, 1988; Elbaz, 1983; Nespor, 1987). For example, science teachers' beliefs about how students learn (Gallagher, 1989; Munby, 1985; Rich, 1990) as well as their beliefs about the nature of science and their personal epistemologies (Benson, 1989; Duschl & Wright, 1989; Lamaster, Lorsbach, Briscoe & McFadden, 1990) have been found to strongly influence teachers' curricular decisions. However, even as these studies have begun to characterize the manner in which teacher's personal knowledge influences decision making, it must be recognized that within and without the classroom a teacher interacts in cultural, political, and social contexts that give rise to the personal aspects of their knowledge constructions. Accordingly, the

interpretations generated from this study are framed in theoretical perspectives from philosophy, social-psychology, and anthropology.

*Epistemological framework.* One line of research involving reflective practice draws explicitly on a constructivist view of knowledge. Within this paradigm, reflection is viewed as:

reorganization or reconstruction of experience that leads to (1) new understandings of action situations, (2) new understandings of self as teacher, or the cultural milieu of teaching, or following a critical theoretical tradition, (3) new understandings of taken for granted assumptions about teaching (Grimmett, 1988, p. 12).

From a constructivist perspective, learning is viewed as an interpretive process through which individuals construct unique frameworks of knowledge as they make sense of their experiences (Eisner, 1988; Piaget, 1964). The nature and extent of prior knowledge as well as contextual factors determine the nature and viability of what is learned (von Glasersfeld, 1989).

Viability means that as teachers attempt to change their practices, what is learned is tested for fit in the social and cultural milieu of the educational community. The meaning and extent of change is negotiated as the teacher interacts with administrators, peers, parents, students, and others from the school culture (Eisner, 1982). Additionally, as curriculum is implemented, the meanings of practices are also negotiated among the participants in teaching and learning contexts. The resulting implemented curriculum fits the teacher's personal understanding of what makes sense in a given context.

From the researcher's point of view, understanding of teacher learning and change depends upon construction of an understanding of the subjective meanings that teachers have for cultural, social, and personal experiences which influence how they make sense of their classroom practices. Explication of the knowledge constructs that teachers employ as they make sense of those experiences and reorganize their knowledge to

make it viable, is a first step in generating knowledge about the nature of the change process.

*Psycho-social framework.* Berger and Luckmann (1967) argue that social reality is constructed by groups of individuals whose interpretations of daily events constitute and sustain it. The nature of interactions among members of the social group is a strong contributor to the development of roles for members of the group. Consequently, the group may facilitate or constrain changes in practices that involve changes in the roles of the teacher or students.

Although teachers may envision ideal teaching roles that they believe would facilitate students' learning, they tend to adopt roles that they believe satisfy the expectations that others have for them. It may be the case that teachers who are viewed as successful in the eyes of students, parents, and administrators do not view themselves as successful because they are unable to enact their ideal roles. Teachers' conceptions of their roles within the school organization may conflict with personally constructed knowledge about teaching and learning resulting in tensions between the organizational and personal aspects of teaching that may constrain change (Little, 1987; Rosenholtz, Bassler, & Hoover-Dempsey, 1986; Tikunoff & Ward, 1983; Weinshank, Trumbull, & Daly, 1983). Understanding of the change process entails understanding how teachers construct conceptions of their roles in relation to the social processes and functioning of schools.

*Anthropological framework.* Theorists generally agree that individuals construct the knowledge or beliefs which guide their actions through a process of enculturation as well as social construction (Britzman, 1986; Eisner, 1992; Lortie, 1975; Zeichner, Tabachnick, & Densmore, 1987). Thus, although much of the knowledge constructed is practical in nature and context specific, there are aspects of teachers' knowledge which seem to be normative in nature, constructed and shared by many teachers (Feiman-Nemser & Floden, 1986). Common instructional patterns prevail across subjects and grade levels that are indicative of the construction of a culture among teachers that promulgates shared beliefs.

Acting in accordance with culturally generated beliefs or norms is a learned behavior. In initiating change in their classroom practices teachers may have to act against culturally generated beliefs. By focusing on understanding the social processes through which teachers construct and come to take for granted the reality of the culture in which they work, this type of research may assist teachers to identify those constructs which are perceived as frustrating their goals and assist them to eliminate or overcome them.

### *Methods*

Learning how a teacher made sense of teaching and learning and how that sense making process influenced change, involved designing a long term study with a teacher participant who felt comfortable as a part of the research team. The teacher, Brad, volunteered to participate, viewing the study as an opportunity to examine what was happening in his classroom, the relationship between the way he was teaching and what his students were learning.

Brad teaches at Southern High, an urban school with a minority population of nearly 65%. Having begun his career at Southern High as a student teacher in 1974, he is currently teaching chemistry, chairs the science department, and acts as a senior class sponsor. Recognized as an exemplary teacher by his peers, he was designated as Teacher of the Year at his school in 1985.

The study began in June and continued over a 12 month period. Brad and I met weekly. Following exemplars in the work of Connelly and Clandinin (1990) during these meetings, I encouraged Brad to share his understanding of teaching and learning through narratives of his life as a teacher. Early in the study, Brad focused on describing his perceptions of teaching and learning as they were in the previous school year and as he would like them to be if he could achieve his ideal. The discussions were open ended and Brad expressed his thoughts and concerns in a number of areas relating to his experiences in the classroom. As the study progressed into the school year the foci of the discussions were on what was

happening in the classroom, why Brad chose certain lessons, what worked, and what didn't work.

Throughout the study the inquiry process evolved as a kind of collaborative conversation (Hollingsworth, 1992) through which Brad and I began to make sense of why he taught as he did and the nature of the process of his personal change. Since Brad and I had been allied professionally in non-research settings for ten years, our previously established rapport facilitated the formation of a close communicative relationship between us. All the discussions were taped and later transcribed for analysis. Copies of all transcriptions were given to Brad for amendments or additions.

Other sources of data included field notes from faculty meetings, informal interviews with teachers and students, and classroom observations that were conducted on a biweekly basis throughout the study once the school year began. At least two classes were observed on each visit and the visits were arranged so that each of Brad's classes was observed at least once a month throughout the year. Teacher and student generated documents such as tests, worksheets, and student work were also obtained and used as sources of data.

Data were analyzed on a continuous basis throughout the study. Initially, data were categorized to represent four concerns Brad identified as problematic in his teaching: assessment, classroom control, implementing cooperative learning, and designing a problem centered curriculum. As constant comparisons (Glaser & Strauss, 1967) among the various data sources were made, patterns which represented Brad's thoughts and actions in these areas emerged. Assertions based on the data corpus were generated (Erickson, 1986). During analysis, field notes and site documents were classified according to whether they supported or refuted an assertion.

Central to the process of interpreting the data and generating assertions was communication between Brad and myself. All of the assertions and the supporting and refuting evidence were discussed with him. Through

this iterative process, assertions were reworked and reworded so as to encompass the data. Although I asked Brad to share authorship of documents generated from the study, he chose not to be a coauthor. Thus, Brad's voice in this written document is heard only in the quotations that have been selected as representative of his views. However, the selection of interview data and quotes from field notes was shaped through interaction with Brad. Viewing research from a constructivist perspective (Guba & Lincoln, 1989), it is suggested that the knowledge claims presented in the assertions cannot be viewed as representing a necessarily true or correct portrait of the factors that influenced Brad as he attempted change. Rather, they represent viable explanations which, Brad and I have agreed, emerged from the data.

### *Interpretations*

In the initial phases of the study, Brad expressed dissatisfaction with the learning outcomes in his classes. Historically a large number of students had failed the tests he administered. In Brad's assessment, their ability to apply chemistry concepts to everyday life was minimal. He had decided to shift the focus of his teaching away from traditional teacher centered practices, lessen the emphasis on rote memorization of science facts and algorithms, and expand students' opportunities to engage in hands-on cooperative group problem solving activities relevant to the use of chemistry in daily life. Having previously experimented with cooperative learning, Brad believed that his involvement in the research activity might assist him to learn how to make cooperative learning a more viable option as a method of instruction in his classes. He explained his concern:

June 11: I'm not real satisfied with the whole teaching/learning situation as it occurs at school in general. I really don't know where to turn in terms of solutions. I don't like what's going on, and I don't really like too much what I do, but I don't know what the hell to do. I see this kind of as an opportunity to come up with some alternatives and to look hard at some of the things I have been doing and do some research ... I don't know, its real hard, but I want to be a good teacher and I don't feel like its really happening yet for me ... I've found it very difficult, trying to change the teacher/learner roles.

Brad's construction of a personal commitment to change was the initial requisite for implementing changes in his practices. However, as he implemented new practices and reflected on his thoughts and actions throughout the course of the study, Brad began to examine the meanings he had for his practices and to characterize his teaching in terms of personal theories about teaching and learning. As Brad described and reflected on learning and change, he seemed to frame his thoughts and actions using cognitive referents of four types which have been identified in studies of teacher cognition: images, including metaphors; cultural myths; metonymic models; personal epistemologies. Each of these is defined and expanded in the assertions that follow.

*Visual images served as referents for Brads' immediate actions. Metaphors provided a way for him to talk about and construct meanings for the images.* Dialogue between teachers and researchers is a key to finding out how teachers view their practices and to assisting them in unlocking and reflecting on their beliefs. However, much of the knowledge which a teacher holds and acts on is tacit, perhaps held in images of experience (Clandinin, 1986; Connelly & Clandinin, 1988; Elbaz, 1983). Because teachers do not always possess language with which to describe their personal knowledge, a necessary component of reflection research may be the assignment of language to otherwise nonlinguistic constructs.

Metaphor has been shown to be a powerful linguistic tool through which a teacher can express the meaning of what it is to be a teacher (Provenzo, McCloskey, Kottkamp & Cohn, 1989), the ways in which practical knowledge is constructed (Russell, Munby, Spafford, & Johnston, 1988), and the ways in which classroom roles are understood (Briscoe, 1991; Tobin & Ulerick, 1989). Lakoff and Johnson (1980) argue that metaphor not only plays a role in the way we speak but in the way we conceptualize our experience and the way we function as well thus, becoming guides for our actions in various contexts.

Brad's use of metaphor in making sense of and describing his interactive roles was evidenced throughout the study. Early in the study Brad described an image he held of an ideal chemistry class in which

students were engaged in cooperative problem-solving activities. Two metaphors that he identified with his teaching role were teacher-as-facilitator and teacher-as-sounding board. As he described his image:

June 11: I'd like to have the kids working in groups, small groups together. Kids could really be supportive of each other. The ones who understood could help the others. In terms of my role, it would be more as a materials support person and as a sounding board for the kids' ideas ... I would be just circulating around and looking at what the kids were doing and asking them about what they were thinking ... trying to avoid being the person who tells them if they are right or wrong — more being the person who's trying to help them clarify their thoughts and maybe suggest to them some avenues that they might explore.

For Brad, to be a sounding board meant that he did not answer students' questions other than to give them feedback on their responses. He described the actions attached to the metaphor.

June 11: I wanted them to propose something to me first and then I would kind of either throw out some other questions or try and help them to process it and understand it.

July 7: They could come to me and just kind of discuss it, we could bounce it back and forth as opposed to me being the information giver, and answer giver kind of person.

Although Brad had constructed an image that represented what he wanted chemistry teaching and learning to be like, he also understood teaching in terms of images and metaphors constructed from years of experience that were dissonant with this ideal. The metaphor that had historically served as a referent for Brad's practical actions was teacher-as-knowledge source. The teacher-as-knowledge source was at the center of learning activities, giving students information, telling students what it was important to know, and directing them in structured laboratory activities. The images derived from this metaphor represented what teaching had always been like for Brad and as indicated in the following excerpt, his experiences provided justification for continuing in the knowledge source role.

July 7: It's just tied into the history of my education ... I have always had this ideal, learning being exciting and teaching being exciting, but I've never been able to pull that off. I guess I've always fallen back on the work, information giving and receiving model as what I do in place of this ideal.

Implementing curriculum in a manner consistent with his constructed ideal image, began with Brad organizing instructional settings to naturally limit his teacher-as-knowledge source role. He introduced activities that increased the amount of time allocated for small group and individual activities and decreased the time spent in whole group interaction. In this way he was able to reject as models for action traditional metaphors that were teacher centered. For Brad, implementing cooperative learning made sense because it was a means to reduce the time he was required to be an information giver; yet, enacting an alternative metaphor remained difficult for him.

September 11: I'm still having a lot of mixed feelings about things. There's still a part of me that wants to draw me back to the old fashioned way. Not that I consciously want to do that. Its just that its there .... There's a part of me that says I should be up there showering them with all the information.

October 17: For now I can catch myself and not give the answer, but the other things like trying to do questioning or whatever to try to get them to think through it on their own, that's going to take some time to develop ... so I keep in the back of my mind that I don't want to be the answer giver and when a kid comes and asks me a question I can stop my automatic response which is give them the answer and say, I don't want to do that.

Brad's understanding, as expressed in these examples is consistent with Clandinin's (1986) assertion that images are a part of an individual's conceptual model of teaching and learning. Images (including metaphors) represent a teacher's understanding of classroom life and serve as the basis for generating personal theories that are enacted in practice. Because they also serve as objects of reflection in the change process, they may help teachers define their goals and the direction of their change.

Reconstruction of images or construction of new images may be part of the learning process that leads to change.

However, the data from this study suggest that individual commitment to change and construction of an ideal image or role metaphor on the part of a teacher are not sufficient to induce the desired changes. Like other cognitive frameworks, images are constructed in social contexts; hence, the meanings that individuals derive from them are dependent upon the dialogic relationship between these constructed images and associated socially situated practice. A number of factors operating in the school social environment contribute to how a teacher makes sense of actions associated with images and role metaphors as described in the following section.

*Taboos and customs associated with cultural myths constrained Brad from personalizing alternative roles or practices.* Myths, as belief systems, are phenomena of cultures. Cultural myths provide a set of images, definitions and justifications by which members of the culture evaluate their thoughts and actions (Britzman, 1991). They serve as referents for members of the culture in making sense of their practices and at the same time, impose upon members of the culture customs and taboos that guide actions. Accordingly, individuals within the culture think and act in a manner consistent with the myths. Furthermore, as individuals adopt the taken for granted roles and approaches to teaching that myths suggest, they may not question why they do what they do or whether change is possible.

Three myths, which are pervasive in school cultures were explored as they emerged in this study. Framed in the literature as metaphors describing the nature of schools, the roles of teachers, what knowledge is, and how it may best be taught and assessed, these myths conceptualize: (a) the school-as-workplace (Marshall, 1988), (b) the teacher-as-social controller (Britzman, 1991; Denscombe, 1985), and (c) knowledge-as-objective truths (Lakoff, 1987).

Viewing the school-as-workplace characterizes teachers-as-managers who oversee the activities of students-as-workers. The emphasis of the

teaching and learning activities is on doing assignments properly and well. Students/workers, are paid (rewarded or praised) for their academic products or performance. Teachers/managers are centrally concerned with maintaining students' task orientation.

Conceptualizing the teacher-as-social controller results in the view that everything depends on the teacher. What is learned and how it is to be learned are determined by the teacher. Consistent with viewing the school-as-workplace, learning and order are viewed as intertwined. Thus, the role of the teacher-as-social controller is to establish and then maintain control of the learning environment so that learning can take place.

Objectivism characterizes knowledge as truths derived from direct observation of nature. According to the myth of objectivism, knowledge is not open to human interpretation. Objectivism focuses teaching on transmission of observed truths, intact, from teachers to learners. Assessment is designed to determine how well students' mental constructs match those truths; therefore, learning tends to be focused on memorizing facts and algorithms.

Brad's learning and change were influenced by his ability to fit his understanding of new practices into a conceptual framework that was interwoven with beliefs associated with these myths. For example, an important concept Brad associated with his teaching roles was being fair. Consistent with viewing the school-as-workplace, Brad was concerned that in cooperative activities some students would not do their fair share of the work.

June 26: I don't feel real good about everybody in the group getting an 'A' for the product ... if only two people in the group really did the thing ... I don't think its fair ... somebody's getting credit for something they didn't do and somebody else is carrying the burden.

Viewing himself as centrally responsible for the success of learning events in the classroom, Brad adopted management role metaphors which fit the teacher-as-social controller myth. He described one role as "teacher-as-policeman." As policeman his role involved checking on each group

periodically to "assess who was working and who wasn't and trying to dock points" (June 22). He viewed his institutionally legitimated authority to assign grades as a primary means by which he could manage students' academic task orientation and reduce inappropriate behavior. He used grades in a system of rewards and punishments to support his management role.

However, Brad also justified using grades to reward students for task completion in an alternative way. Rewarding students for doing the work made sense to Brad because he believed himself to be preparing students for future life roles in which they might only be rewarded for hard work as represented in the following excerpt:

May 15: I think, in high school it is reasonable to reward students for both effort and performance, effort being measured by doing their assignments ... because I'm not talking about professional training for people who have to be 100% competent to go and do this. We're talking about developing a basic knowledge base to operate from the rest of your life.

Brad's interpretation of what it meant to be fair was also salient in assessment contexts. Viewing his traditional assessment practices (i.e., multiple choice tests) as inappropriate for assessing what students learned in problem-solving contexts, Brad developed alternative assessment procedures including concept mapping, performance based assessment, and essay tests. He implemented alternative assessment techniques for formal evaluation of students' learning during the first semester of the school year. However, he reintroduced multiple choice evaluation procedures in the second semester providing the following rationale:

January 25: I guess there's my concern that it [grading subjectively] might not be totally fair in some cases. At the beginning I may have graded one of them a certain way and then by 50 papers later I may have gotten harder or easier.

Brad's use of the fairness concept here is derived from the objectivism myth. He conceptualized objective tests as required so that fair (objective) comparisons of students' knowledge could be made, and fair grades

assigned. Concerned that any interpretation he might make regarding a student's understanding of science concepts, being subjective, would not meet the objectivity test valued by parents and other members of the school culture, Brad was unable to maintain the changes he initiated in assessment practices.

Brad felt compelled to conform to traditional practices suggested by the myths, fearing poor evaluations by administrators and peers if he did not. As he noted:

March 20: It's really hard for me to overcome that problem of knowing that there are going to be people who look at what I'm doing, and disagree with it and say, "Hey you're supposed to be up in front of that classroom putting on a big show here for these kids and you're not doing that" .... When you're working in an environment where the other is the more accepted way and the people who are doing the evaluating adopt that as their metaphor, it's even a step beyond somebody being in disagreement with you. It's people who you respect and you would like them to look at what you're doing in a positive light, too.

This study lends support to Britzman's (1991) assertion that cultural myths are constructs that influence teachers as they make sense of their practices. Because they represent knowledge negotiated and understood by a large number of individuals, cultural myths are not easily reconstructed. The results of this study suggest that cultural myths were a constraint to individual change in Brad's case. He believed he would be evaluated by his peers, administrators, and parents on the basis of whether he conformed to the expectations they had for teaching and learning. Brad was able to negotiate only minor changes in his and the students' roles because actions inconsistent with the myths were perceived as nonviable in the social setting of Southern High.

*Metonymic conceptual models structured Brad's learning and constrained change.* The theoretical construct of metonymic conceptual models as means individuals use to categorize knowledge (Lakoff, 1987) further contributed to development of an understanding of how learning and change may be constrained. According to Lakoff (1987), whenever an individual reasons about concepts, categories which have meaning for that

person are employed. Concepts that are related to one another in some way are categorized together; however, some members of a category may be more central examples of the category than others. In some cases, one well understood and easy to perceive aspect of a conceptual category is used to stand for the whole. Such a concept is a metonymy or metonymic model. Learning may be a matter of fitting new ideas into categories already characterized by the metonymic model.

Two metonymic models were found to be factors in constraining change in Brad's classroom practices, that is, assessment as testing, and classroom management as controlling students. As an example, Brad's metonymic model of assessment is discussed.

Evidence supporting the concept, testing, as Brad's metonymy for assessment includes his frequent reference to giving a test when assessment of learning was discussed. Brad did not monitor learning within groups during class activities nor did he consider class discussions with students a means of ascertaining what they knew. Assessing students' learning was viewed only as testing as represented in the excerpts from transcripts which follow.

September 11:

Author: You have no way at this point in time to assess what's happening, what they're learning?

Brad: Only if I were to give them a test. I am uncomfortable with assessing intermediate things.

February 8:

Author: Do you think that they [students] made the connections between the problem they solved in the laboratory and the chemistry content?

Brad: I don't know, we'll see tomorrow ... I'm going to give them a test tomorrow .

Author: What about assessing the kids without paper and pencil while you're working with them. How much of that do you do?

Brad: Very little, part of it is I've never really come up with a way to do it and keep records as to who did what ... I have to have some sort of way of making a written record of that kind of thing.

By considering tests as a primary data source to evaluate student learning, Brad's sense of effectiveness in evaluating his success in teaching was undermined. As he noted:

May 15: I don't know if they're learning any more or less or the same or whatever. I sometimes think that that's too complicated for us to even know. You just hope for the best. Give them some experiences and hope that they learn as much as they can from them.

The emphasis placed on written communication for students' evaluations confounded Brad's attempts to assess students' learning so that he could evaluate the changes he had made in the curriculum. Additionally, the focus of assessments which fit Brad's metonymy was not congruent with a science curriculum which emphasized problem-solving and group cooperation as central to the learning process. His assessment metonymy imposed upon Brad to make sense of practices within assessment contexts in a manner that conflicted with how he made sense of practices associated with desired change in other teaching/learning contexts.

Metonymic models preconceptually structured Brad's learning and actions in the classroom. As Brad generated knowledge about teaching from his classroom experiences or from enhancement activities, viability of concepts was determined by how well they fit with his metonymies. Metonymic models acted as cognitive constraints to learning and change. These results suggest that identification of metonymic models teachers use to interpret and organize their knowledge is an important step toward understanding learning and the change process.

*Brad's personal epistemological perspective influenced his beliefs about what counts as knowledge about teaching. Although images, myths, and metonymic models are constructed as outcomes of social interaction, the knowledge frameworks of a given individual are viable for that individual*

only, and may not match that of any other individual. Individuals construct knowledge using information from a variety of sources. However, what an individual counts as knowledge depends upon their personal epistemological perspective (Belenky, Clinchy, Goldberger, & Tarule, 1986). Some individuals are reliant on outside authority as sources of truth and the right answers to questions of action and belief. Others come to understand that authority is not always right, that truth is relative, and that they as individuals, can construct their own knowledge of what is true or right. Thus, a teacher's personal epistemological perspective influences her or his beliefs about the roles of language, power, and learning in the classroom.

Brad's biographical history included a predominantly parochial school experience. As Brad described them, learning activities were teacher centered, primarily lecture. The transmission view of learning, modeled by his teachers, influenced how Brad approached learning in association with the change process. He had learned to learn by listening to others.

February 8: I read and talk to people to see what they have to say and make a decision based on that, as opposed to really gathering empirical evidence about things as a basis for acting.

March 10: I'm one of those guys who, is sort of the sponge, trying to absorb as much as I can. And I tend to not be very critical at all of whatever the person is presenting. I just kind of accept what they do and sort it out for myself later.

Brad considered knowledge as received from others. He placed high value on the presentations of individuals, whom he perceived as experts, at summer workshops and at national meetings he had attended. For example, Brad's interpretation of what he had heard about cooperative learning and its benefits in science teaching at a recent meeting of the National Science Teachers Association formed the basis for construction of the images and metaphors he identified as ideal. Brad depended on the voices of authority to provide direction in his teaching life and he looked for confirmation from others in judging the worth of knowledge he had constructed.

Brad was committed to changing the context for teaching and learning in his classes, but he did not believe he had legitimate authority to take actions which were not consistent with those prescribed by perceived authorities or experts. Furthermore, change was difficult for Brad because conflicting opinions from various authorities made it impossible for him to construct a viable personal image of what teaching might be like.

February 8: Given the day's input, I can change what my vision is for that particular day .... Before, I thought I knew what to do and the problem was just how to do it correctly. I never really arrived at that. Now the problem has shifted to not being sure about what's the right thing to do.

This excerpt demonstrates that as he reflected on beliefs associated with the images he held, Brad attempted to sort them into right and wrong based on the voices of authority. Relying on outside authority as the source of truth and the right answers to questions of action and belief, Brad did not value his own potential to construct knowledge of best practice for meaningful learning in his science classes. Uncertain of his own worth as a generator of knowledge, he developed a strategy for change which involved attempting to perfect methods prescribed by others.

Investigating Brad's learning and change in relation to his personal epistemological perspective provided further understanding of the interrelationship of learning and individual change. In the case of a received knower, like Brad, practical outcomes of learning may not be consistent with desired change because one can never *know* in the same way as another. Conflicting information from authorities and experiences leads to indecision and frustration. Rather than change being the result of the decision of an empowered individual to improve teaching and learning through reflective practice, it becomes a disempowering activity in which the teacher attempts to adopt the views, values, and voices of others.

### *Summary*

Viewing one teacher's learning from multiple perspectives provides some clues as to why personal change may be a difficult process for an

individual teacher. Fullan (1982) identified the alteration of teachers' cognitive constructs as a key to educational change. He argues, "Beliefs guide and are informed by teaching strategies and activities; the effective use of materials depends upon their articulation with beliefs and teaching approaches" (p. 33). This case study suggests that research which focuses on teacher change must look beyond the realm of classroom experience as a mediator for the construction of beliefs which guide practice. Cognitive constructs such as images, cultural myths, metonymic models, and personal epistemologies as part of an individual's belief system are equally, if not more, influential in facilitating or constraining the change process than beliefs associated with classroom experiences alone.

Brad's case explored the manner in which new information regarding teaching and learning was tested for fit with these existing cognitive frameworks and how the viability of new knowledge impacted on decisions he made regarding the direction and extent of his change. This study suggests that for change to be successful and sustained, either a teacher's cognitive frameworks have to be altered or the context for teaching and learning has to be altered. Integrating new knowledge into existing cognitive frameworks does not result in desired change because these frameworks are socially and culturally dependent. Thus they are not amenable to new knowledge which contradicts existing images, myths, and metonymic models. This study provides an initial step toward developing an understanding of what Erickson (1988) has termed the "tension between the personal and social influences on knowledge construction" (p. 205). However, many questions remain unanswered regarding the process of teacher learning and its relationship to individual change. First, this study of personal change was initiated because Brad had decided that change in his practices was necessary. He had formulated ideal images of what he would like teaching and learning to be like; however, he was unable to implement his ideal. The image was not viable in the context of his own teaching experience. More research is needed to identify the kinds of experiences that create perturbations that challenge existing constructs, to the extent that alternative constructs may become viable knowledge teachers use to guide their actions.

Second, studies of teacher cognition, like this one, involve long term commitments and labor intensive interaction on the part of both teacher and researcher in identifying and reconstructing cognitive frameworks. Is it possible for individual teachers to identify the images, metaphors, metonymic models, and cultural myths making up their personal cognitive frameworks and overcome their potential to constrain change without intensive commitment by others to assist in the process?

Third, much research which promotes reflective practice is currently being done in the area of preservice teacher education, yet little has been done to assist inservice teachers to develop skills of reflective practice. How can teacher educators assist practicing teachers to develop the skills of reflective practice that may promote learning and change?

Finally, our understanding of how teachers make sense of their practices and changes in them continues to be focused on individuals and their unique knowledge frameworks. Are the constructs that we have used to describe Brad's case applicable to other cases? Are metaphors, images, and myths adequate constructs for reporting and reflecting on learning and change? Are there other potential constructs that might be helpful in characterizing teachers' knowledge?

Clearly, additional research that emphasizes communication through reflective dialogue among teachers and researchers is needed. Unlike traditional positivist research approaches, methodologies that involve mutual discussion, argument, and elaboration among teachers and researchers may provide a more appropriate means for explicating the language and exemplars teachers use to describe and make sense of their classroom practices and changes in them. Furthermore, research that assists teachers to reflect on the social, cultural, and personal dimensions that influence their knowledge constructions may assist teachers, like Brad, to begin thinking of themselves, not as efficient practitioners implementing practices decided on by more qualified individuals; but rather as professionals capable of acting in self-directed, empowered ways.

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