ABSTRACT

Foster, Stephanie L. P. : Reflection as a Means to Teaching Improvement for Novice University Science Faculty. (Under the direction of Dr. Eileen Parsons)

This study explored the use of reflection as a professional developmental strategy to facilitate improvement of tangible classroom behaviors among novice university science faculty. Specifically, the study addressed the following questions: How did the novice college instructors perceive the reflection experiences to impact their teaching practice? During the progression of reflection experiences, in which teaching practices did the instructors' performances change? How? A mixed method approach was employed in answering the aforementioned questions. The participants' responses in semi-structured interviews and informal discussions, their written responses to reflective prompts, and the researcher's observations of their teaching were qualitatively analyzed for themes. Students' responses to a survey about the participants' instruction were analyzed quantitatively. Findings revealed that the participants developed self awareness and exhibited cognition-induced behavioral change consistent with their developmental goals. Findings also suggested that participation in the study facilitated development of cognitions supportive of sustained reform in instructional practice and bridging of gaps within participants' pedagogical content knowledge.

REFLECTION AS A MEANS TO TEACHING IMPROVEMENT FOR NOVICE

UNIVERSITY SCIENCE FACULTY

by

STEPHANIE L. POLLARD FOSTER

A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

In

SCIENCE EDUCATION

Raleigh, NC

2005

Approved by:

John E. Penick	Maria T. Oliver-Hoyo

Eileen Parsons	Glenda Carter

Chair of Advisory Committee

DEDICATION

I dedicate this dissertation to all individuals, past and present, who have inspired and guided my development into a woman of purpose. For every expression of love, concern, encouragement, and mentorship, I thank you. For challenging me to transform potential to achievement, I thank you. For your steadfast belief in me and my purpose, I thank you. Each of you is a precious gift from God. In giving me my dreams, strength, purpose, and all of you, God has most richly blessed me.

May my life's work bring honor to God and inspire others to fulfillment of their destinies as men and women of purpose.

BIOGRAPHY

I am so much more than an enumeration of facts attempting to chronicle my development into a woman of purpose. I am a composite of a myriad of influences and experiences. Created by God, nurtured by loving parents and family members, upheld by a most understanding husband, supported by a group of steadfast friends, and inspired by a host of exceptional mentors, my story is a celebration of persistence over opposition. Purposefully molded by life's battles, I am who I am because I've chosen to believe that my dreams are relevant and attainable.

To know me is to know the reconciliation of triumphs and tempests.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

CHAPTER FOUR: PERCEPTIONS AND IMPACTS OF THE REFLECTIVE PROCESS

CHAPTER FIVE: MANUSCRIPT – REFLECTION AS A MEANS TO REFORM OF

NOVICE COLLEGE SCIENCE FACULTY'S INSTRUCTIONAL PRACTICE……….. 101

LIST OF TABLES

CHAPTER 1

REFLECTION AS A MEANS TO TEACHING IMPROVEMENT

"Great teachers are neither born nor made, but may be developed."
                                        - Lois Thies-Sprinthall and Norman A. Sprinthall

Recent calls for reform in science education magnify the need for enhanced teaching effectiveness, which is a common goal of professional development programs. Unfortunately, professional development programs have tarnished reputations regarding their design, implementation, and relevance. Nevertheless, professional development is still regarded to be essential to the development of mature teaching professionals (Schoenfeld, 2002). Recognizing novice teachers to be particularly needful of professional development and support to facilitate their improvement in teaching, they are common subjects of professional development studies. Within the population of novice teachers, novice college science faculty is targeted in this study. In this study, I have operationalized novice faculty as those with less than three years of formal teaching experience at the college level.

The Problem

Novice science college instructors are entrusted with teaching the introductory science courses from which students often base decisions of future study. Some charge that these introductory courses are responsible for students' self-selection out of future science course enrollment and science majors (Sunal et al., 2001; Osborne, Simon, & Collins, 2003; van Driel, Beijaard, & Verloop, 2001). In fact, Kardash and Wallace revealed considerable student dissatisfaction with non-learner-centered instructional practices, such as ambiguous course goals and minimal student engagement (as cited in Walczyk & Ramsey, 2003).

Expressing disappointment with the affective aspects of undergraduate science courses, one student in Tobias' study described his sense of alienation as… "the isolation of the learner and the struggle to attend in a sea of inattentiveness", further indicating the existence of significant problems with science instruction at the college level (as cited in Osborne, Simon, & Collins, 2003, p. 1068).

In response to student dissatisfaction with undergraduate science courses and the concomitant decline in students choosing science majors, reform initiatives funded by the National Science Foundation (NSF) advocate the use of constructivist teaching practices, particularly learner-centered instruction (Walczyk & Ramsey, 2003). Because of the scarcity of data on learner-centered instruction in undergraduate science courses and on instructional practices, Walczyk and Ramsey developed a Survey of Instructional and Assessment Strategies and administered it to all full-time math and science faculty of Louisiana's four-year colleges and universities. This effort was a part of the Louisiana Collaborative for Excellence in the Preparation of Teachers, a program with a primary aim of promoting learner-centered instruction in Louisiana's undergraduate math and science courses. Despite several years of NSF funding that began in 1993, Walczyk and Ramsey found infrequent use of learner-centered instruction and funding's marginal impacts upon fostering the use of learner-centered instruction. Even though funding is necessary in effecting reform in instructional practices, alone it is insufficient. Gess-Newsom, Southerland, Johnston, and Woodbury (2003) proposed pedagogical dissatisfaction as an imperative to implementing and sustaining changes in instruction, including learner-centered instructional practices. Pedagogical dissatisfaction is the incongruence among declared teaching beliefs, goals, teaching practices, and learning outcomes (Gess-Newsome et al., 2003); as such, it is

important for professional development to raise teachers' awareness of incongruence and to facilitate the teachers' efforts to resolve it.

Typical professional development programs at the college level are conducted in workshops and courses (Weimer & Lenze, 1994). The impact of these activities depends upon factors such as duration and relevance. Notably in their study of the relationship between professional development and teaching practice, Supovitz and Turner (2000) found professional development of at least 80 hours to be necessary for the emergence of significant changes in teaching practice. Other characteristics of effective professional development include intensity, collaboration among the participants and planners in its execution, and active involvement of participants in meaningful developmental opportunities (Northwest Regional Educational Laboratory, 1998). Given the competing demands of preparation, teaching, additional duties, and often research upon novice science college instructors, the very characteristics of successful professional development programs present daunting challenges to improving novice science college instructors' teaching effectiveness.

This Study's Foci

What professional development focus could meet the novice college instructors' need for improvement in teaching effectiveness? How can professional development be implemented in a deliberate and sustained manner that accommodates the realities of the novice college instructors' professional lives? Discovering that reflection is promoted as a vehicle for developing effective teachers (Allen & Casbergue, 1997), I decided to explore its utility in improving the teaching effectiveness of novice college instructors via a group of behaviors characterized as effective teaching practices. Realizing the need to devise a study that addressed various aspects of teaching practice, I developed a reflection instrument. The

purpose of the instrument was to provide the study participants with guidance and support in confronting their own thoughts and behaviors. Since my primary research aim was to investigate the relevance of reflection in improving teaching practice, the study addressed the following questions:

1. How did the novice college instructors perceive the reflection experiences to impact their teaching practice?

2. During the progression of reflection experiences, in which teaching practices did the instructors' performances change? How?

Significance

Regarding the use of reflective practice by college instructors as a means of professional development, a dearth of research exists. While reflection is touted as a viable means for improvement of teaching effectiveness, where is the evidence? This study addresses the aforementioned gap in the literature by providing practical information on the nature and forms of reflection experiences that are supportive of novice college instructors' improvement of teaching effectiveness. Additionally, this study provides insights on reconciling the actions of the reflective thinker with that of the reflective practitioner within the complex existence of novice college instructors seeking to employ effective teaching practices.

Effective Teaching Practices and Corresponding Assumptions

Introduction of the notion of effective teaching practices may lead one to assume (a) there is a single definitive list of effective teaching practices, (b) use of effective teaching practices will result in student learning, and (c) all effective teaching practices can be learned and mastered by any teacher. None of these assumptions is true.

There is not widespread agreement on a single list of effective college teaching practices. In fact, the research on effective teaching in higher education is much less extensive than that for K-12 educational levels (Murray, 1997). Nevertheless, via the use of instruments designed to indicate aspects of student learning (e.g., student ratings and achievement tests), researchers are able to explore effective college teaching. Researchers are able to accumulate comprehensive data that identify teacher actions within the classroom that are correlated with significant positive influences upon student perceptions and learning. These data give rise to identification of effective teaching dimensions and the articulation of effective teaching principles. These effective teaching dimensions and principles are discussed in Chapter 2.

The second assumption of effective teaching practices is that they will affect student learning. Mere use of effective teaching practices does not guarantee student learning, but it does create a context more conducive for learning (McMahon, 1992). The influence of effective teaching practices is also dependent upon other factors like the instructor's content knowledge, coverage of the curriculum, and adherence to academic standards (Murray, 1997). Implicit within consideration of the impacts of effective teaching practice upon student learning is the third assumption that all effective teaching practices can be learned and mastered by any teacher.

Not all effective teaching practices are tangible actions that can be taught to others. Rosenshine and Furst grouped effective teaching practices into two classes: low- and high-inference (as cited in Murray, 1997). Low-inference refers to practices that are discrete, tangible and observable. "The teacher does not interrupt students while they're asking questions" is an example of a low-inference teaching practice. A high-inference teaching

behavior is more subjective. That is, the assessment of effective teaching practices that are classified as high inference is based upon an observer's inferences and judgments (Murray, 1997). "The teacher is well prepared" is representative of a high-inference teaching behavior. Additionally, regardless of whether a teaching practice is low- or high-inference, varying levels of difficulty are associated with developing competence (Murray, 1997). Because of the participants' status as novice instructors and my desire to maximize objectivity in assessment of teaching behaviors, this study targeted low-inference teaching behaviors. The low-inference teaching behaviors highlighted in this study were usage of lesson summaries and real life examples. I discuss these specific teaching behaviors in Chapter 2. So, how could reflection as a process facilitate the acquisition and implementation of these effective teaching practices?

Challenges Presented by Reflection

I introduce the term 'reflection' with trepidation. As asserted by Grunau, Pedretti, Wolfe, and Galbraith (2000), the term has been used in many ways to convey many different meanings. Furthermore, associated terms of reflective thinking, reflective practice, reflective teaching, and reflective inquiry confound the conceptualizations of reflection with their various philosophical foundations. For example, two notable scholars within the field of reflection, Dewey and Schon, present differing conceptions of reflection. Dewey's reflective thinker is forward-leaning and anchored in the scientific method while Schon's reflective practitioner is intuitively engaged with the uncertainty present in the artistry of practice (Fendler, 2003). Both Dewey's and Schon's notions confound what is meant when pursuing professional reflection (Fendler, 2003). These differences are translated into

assessment challenges because reflection is difficult to operationalize (Hatton & Smith, 1994).

Accordingly, multiple definitions exist for reflection. At its most basic extreme, reflection is just thinking, whereas at its most comprehensive extreme, it is a systematic protocol of cyclical actions taken to gain awareness of past actions to enable informed future action (Loughran, 2002). I appreciate the specificity inherent in the more comprehensive definitions because their structured conceptualizations facilitate coherent communications of the actions involved in making meaning of professional experiences. As a result, the operative definition for reflection in the study stems from Dewey's interpretation of reflection being an iterative process of problem solving with inclusive steps of identifying a problem, generating courses of action to solve the problem, experimenting with and analyzing the courses of action, and resolving the problem (Rodgers, 2002). The construct of reflection is further discussed in Chapter 2.

Operationalization of reflection is commonly communicated through the use of typologies that categorize reflections by their foci or time of performance. Hierarchies result from attempts to order reflections by their foci. Unsurprisingly, the number of levels of reflection vary depending upon the scholar (for example, Valli identified five levels as opposed to Van Manen's three), yet there appears to be consensus that the lowest level is technical reflection (focused on direct application of pedagogical research) and the highest level is critical reflection (focused on the social and political impacts of teaching) (Spalding & Wilson, 2002). Loughran's (2002) labeling of reflections as anticipatory, contemporaneous or retrospective represent an alternative orientation in which the time of reflection is of primary importance due to its differential impacts upon the framing of

experiences.   Aware that Spalding and Wilson (2002) recounted discouraging results of studies of reflection among preservice students with a typical finding being the lack of higher level reflections (Galvez-Martin, Bowman, & Morrison, 1998), I expected the participants to attain similar results and primarily demonstrate technical reflection. Accordingly, I decided to use Loughran's model of reflection because it would provide a richer and more comprehensive focus upon the participants' continuum of experiences as they addressed a specific low-inference teaching behavior.

Research Methodology

Cognizant, yet undeterred by the challenges presented by reflection, my selection of research methods flowed from the orientation dictated by my research questions. My concurrent interests in the participants' interpretations and perceptions of the reflection experiences and objective assessment of the study's product, improved teaching effectiveness, compelled the simultaneous conduct of qualitative and quantitative research. Within this mixed method research approach, qualitative research contextualized and complemented the assessment afforded by quantitative research of the study's product. Interviews, classroom observations, student surveys, and participant reflective responses afforded triangulation of the results. Also, to minimize the complexity of conducting mixed method research while maximizing understanding of the study's dynamics, I framed the study as two case studies.

Limitations

Several limitations should be acknowledged. First, this study will use a purposive sampling strategy of extreme case sampling to afford analysis of participants possessing extreme attitudinal dispositions (discussed in Chapter 4) towards involvement in a study on

teaching improvement (Patton, 1990). Accordingly, the participants' teaching orientations and study expectations uniquely shaped their study involvement. Consequently, care should be exercised in interpretation of the study's results and generalizability is limited. Second, self-reflection will be the primary mode of reflection so confrontation of personal beliefs and attitudes will be a function of individual vigilance and not a primary research interest. Third, Loughran's three phases of reflection - anticipatory, contemporaneous, and retrospective – will be the reflective framework used due to its compatibility with self-reflective processes, the expectation of participants' exhibition of only technical reflection, and the study's duration of one academic semester. Fourth, both participants were in their first semester of teaching either introductory undergraduate chemistry or physics courses, so they represented a unique subset of novice college instructors. Fifth, email and telephone were the only electronic communication platforms used, so caution should be employed in extending the study's results beyond these platforms. Despite these limitations, this study should expand the contexts for conduct of relevant professional development.

CHAPTER 2

REFLECTION AS A WAY OF LEARNING AND KNOWING

Recent calls for reform in science education magnify the need for enhanced teaching effectiveness which implies a deliberate process of analysis to assess where the profession is, where it should be, and how it should get there. Of the three aforementioned states, the "how to get there" is rife with challenges. Such challenges include *where should reform begin? With whom? With what foci? What should it look like? How can support and momentum be gained and maintained? and How will progress be measured?* Just as debates over the answers to these questions ensue so does the search for applicable methods to enhance teaching.

Reform advocates have espoused various paths to enhanced teaching effectiveness with the emergence of reflection as a most provocative path. Superficially, consideration of the term reflection typically evokes thoughts of thinking which seem to be strongly consistent with the deliberate analysis needed for reform. Concurrently, identification of reflection as a path implies a significant degree of definition and directionality. Unfortunately, the complexity of reflection as a strategy for teaching enhancement has a perplexing, compelling history.

The Struggle to Define Reflection

Within the many stages of teacher professional development, Groce, Henson, and Woods (as cited in Good & Whang, 2002) identified reflection as a primary pillar. Such a statement leads one to believe that reflection is a well-defined concept. However, a brief survey of definitions for reflection suggests otherwise. Dewey (1933) defined reflection as "the active, persistent and careful consideration of any belief or supposed form of knowledge

in the light of the grounds that support it and the further conclusions to which it tends" (p. 9).

Decades later, Van Manen (1977) purported that some described reflection as just thinking, but stressed that in education reflection is characterized by intentionality in decision making. More recently, Jay and Johnson (2002) defined reflection to be a cyclical process in teaching practice that involved contemplation of questions via dialogues with self and others as a way to gain insight for subsequent cognitions and behaviors. These cognitions and behaviors prompt additional questions that continue the cyclical process.

Reflection covers such a broad spectrum of activities that Fendler (2003) hypothesized its acceptance to stem from the 'loose' way in which it is defined and used. The sheer number of terms associated with and often interchangeably used with reflection is considerable; reflective thinking, reflective teaching, reflective learning, reflective practice, reflective inquiry, reflection in action, reflection on action, reflectivity, technical reflection, critical reflection, anticipatory reflection, contemporaneous reflection, retrospective reflection, reflective action, and reflective understanding are just a few. Though by no means complete, the previous list of terms highlights the various conceptions of reflection.

Hearkening back to two of reflection's most well-known advocates, foreshadows of today's differing viewpoints of reflection are evident. In *How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process,* John Dewey (1933) presented his views on reflective thought. Characterizing education as the examination of experience that enables future intelligent action and positioning reflection as the process of making meaning (Rodgers, 2002), Dewey ushered in rationality as a catalyst for deliberate action. In a manner similar to the scientific method that gained prominence around the same time period, reflection was deliberate, systematic thought in action. Conversely, in *The Reflective*

Practitioner: How Professionals Think in Action (1983) and *Educating the Reflective*

Practitioner: Toward a New Design for Teaching and Learning in the Profession (1987),

Donald Schon highlighted within the professional context the intuitive, artistic dimension of

reflection. Recognizing a need for a more comprehensive approach to dealing with the

complexities of professional life, Schon coined the phrases 'reflection in action' and

'reflection on action' to represent the reflections professionals conduct in the midst of and

away from professional activity. Is Schon's artistic professional a contradiction of Dewey's

rational, systematic thinker? Fendler (2003) believed so and acknowledged the tenuous

balance of Schon's intuitive practitioner with Dewey's rational thinker within current

conceptualizations of reflection. Aware of these primary conceptual rifts in reflection, one

should not be surprised by the existence of various models to portray reflective processes. In

the proceeding paragraphs, I introduce two common models of reflection representative of

Dewey's and Schon's conceptualizations of reflection.

Models of Reflective Processes

Rodgers's (2002) summarization of Dewey's reflective processes revealed a model

reminiscent of the scientific method, incorporating steps such as identification of a problem

emerging from an experience and development and testing of hypotheses. Within Dewey's

model, thought is framed by examination of evidence, enabling deliberate and responsible

action to follow intelligent thought. Framed within a historical context of the Progressive Era

in which social order and improvement were primary concerns, Dewey's reflective thinking

represented a form of discipline in which scientific rationality replaced impulsive action

(Fendler, 2003). The emphasis upon scientific rationality and responsible action is still

particularly germane to the professional development of teachers. Maturation is a most active

process involving the ability to act appropriately in response to meanings made of one's experiences.

Interestingly, Schon's model also has similarities with the scientific method. Grounded in problem solving, Schon's model as explained by Borduas, Gagnon, Lacoursiere, and Laprise (2001) considers a surprise or incident beyond a professional's zone of mastery to propel him or her into a zone of indeterminancy in which the professional has to develop a plan of action to overcome the surprise. Once the surprise or problem is resolved, the professional adds the newly acquired knowledge to his or her zone of mastery, decreasing the probability of being overwhelmed in the future by the same or similar surprise. Despite its problem solving orientation, it is important to realize that Schon's conceptualization of reflection esteems knowledge intuitively gained from practice over knowledge imparted by theory (Fendler, 2003).

The struggle to define reflection is not limited to explanatory models but also includes taxonomies to characterize the nature of reflection. Concomitant with the existence of differing models of reflective processes are diverse taxonomies characterizing varied levels of reflection illustrative of different philosophical orientations.

Taxonomies of Reflection

Van Manen (1977) espoused three levels of reflection. Technical rationality, the lowest level of reflection, is characterized by teacher concentration upon personal performance; practical action is characterized by a teacher's awareness of the need to assess personal and student behaviors for alignment with educational goals; and critical reflection, the highest level of reflection, is characterized by teacher awareness of the social and ethical consequences of educational practice (Pultorak, 1993). In a similar vein, Valli (1997) crafted

a reflection taxonomy consisting of five levels. The lowest and highest levels of Valli's taxonomy resemble the lowest and highest levels of Van Manen's characterization.

In Valli's taxonomy, technical reflection, the lowest level of reflection, involves direct application of research-based teaching strategies (Valli, 1997). Reflection in/on action involves pedagogically-grounded analysis of instructional practice (Spalding & Wilson, 2002), whereas deliberative reflection incorporates contemplation of opposing views within instructional practice (Valli, 1997). Personalistic reflection focuses upon the developmental aspects of a teacher's professional growth and critical reflection, the highest level of reflection, incorporates consideration of the social and ethical consequences of educational practice (Valli, 1997). In a striking departure from the aforementioned taxonomies, Loughran (2002) concentrated upon the timing rather than the nature of reflection.

Loughran (2002) proposed that reflection occurred in three phases. Anticipatory reflection is conducted before a lesson, contemporaneous reflection is conducted while actually teaching, and retrospective reflection is conducted after a lesson is taught (Freese, 1999).

The preceding taxonomies are often used in the development of rubrics to undergird the teaching of reflection to students. Such use of rubrics seems to imply an assumption of objectivity that is a major criticism of reflection.

Criticisms of Reflection

Self-awareness, though a major pillar within reflection, is also a lightening rod for criticisms of reflection. Can conversations with one's self spur behavioral changes more supportive of educational ideals? Critics would respond with an emphatic "No!" Acknowledging the link between teachers' beliefs and instructional practice, Webb (2001)

asserted that self reflection could undermine reform since teachers' reflections would be constrained by the limits of their pedagogical content knowledge, which may entrench use of inequitable instructional practices. Loughran (2002) softened the bluntness of Webb's criticisms by cautioning against mistaking rationalization for reflection and Fendler (2003) appeared to concur with Webb in deliberating whether reflection is more apt to solidify than confront personal beliefs. Though these criticisms pertain to self-reflection, collaborative reflection may still be susceptible to the same criticisms.

Hatton and Smith (1994) asserted that reflection activities in teacher education programs generally focus upon technical reflection and exclude significant exposure to critical reflection that would enable evaluation of the instructional practice juxtaposed with issues such as power, gender, culture and ethics. Jay and Johnson (2002) weighed in with the observation that even our efforts of communication with others are bound by personal and cultural values embedded in our use of language. Serving as a 'more knowledgeable other', based upon my broader pedagogical content knowledge and familiarity with reflection, I sought to provide insight supporting evaluation of instructional practice beyond personal contexts as the novice instructors engaged in reflective practice.

The Nature of Novices' Engagement in Reflective Practice

Research results suggest that novices demonstrate some forms of reflection (Van Manen, 1977), namely technical and practical (Hatton & Smith, 1994). However, there are concerns that novices are not cognitively ready for reflection due to underdeveloped organizational structures for instructional practice (Allen & Casbergue, 1997). Considering the plausible differences in novice and expert teachers' abilities to reflect Allen and Casbergue (1997) studied novice through expert elementary school teachers' abilities to

recall personal and student classroom behaviors. Recognizing recall to be integral to the first step of reflection, problem identification, Allen and Casbergue explored whether differences in novice and expert teachers' recalls could be contributing factors in differences in novice and expert teachers' abilities to reflect. Finding a developmental trend of increasing recall ability as teaching experienced increased, Allen and Casbergue cautioned teacher educators to pursue improvement of novices' recall ability at paces reasonable for their developmental levels.

Focusing upon the link between teacher cognitions and instructional practice, Artzt (1999) used the Artzt and Armour-Thomas framework to guide preservice mathematics teachers' engagement in reflective activities designed to illuminate thoughts governing their instructional practice. Though she did not anchor the teachers' reflections to any particular taxonomy, she did find the teachers' reflections to be effective catalysts of change within their instructional practices. Teachers substantiated these changes in teaching practices by articulating an enhanced awareness of their teaching competencies and the value of reflection as a habit.

Consistent with the research of Wedman, Martin, and Mahlios (as cited in Pultorak, 1993) indicating that teacher educators can shape learning experiences to facilitate development of reflective thought in students, Pultorak's study of the facilitation of reflection among novice K-12 teachers via the use of written (bi-daily, bi-weekly, and visitation journals) and oral (reflective interviews) reflections was a natural extension. He found the novices to exhibit all three of Van Manen's levels of reflection, yet the content and nature of reflections varied with the context and mode of reflection (e.g. bi-daily vs. bi-weekly and written vs. oral). Inconsistent with typical reports of novices' low levels of critical reflection,

Pultorak's sample incorporated moral and ethical perspectives within their reflective interviews. Such reflection was consistent with Pape and Kelly's observation (as cited in Pultorak, 1993) that oral interviews elicited higher levels of reflection than written reflection modes. Typical platforms and practices supportive of reflection include journaling, use of questions, collaboration, modeling, coaching and electronic communications (Hatton & Smith, 1994; Levin, 1999; Loughran, 2002; Pultorak, 1993; Spalding & Wilson, 2002). Substantiating claims of the viability of online platforms in fostering reflection, Salmon's (2002) study of computer mediated conferencing (CMC) of the online training of associate lecturers highlighted the participants' appreciation of individual and corporate opportunities to reflect upon ideas within an established community of learners. Concurrently, Spalding and Wilson's (2002) exploration of pedagogical strategies to enhance preservice teachers' use of reflective journaling provided an important reminder of the superiority of relationship to online platforms in the development of reflection. The researchers found no optimal pedagogical strategy or mode of dialoguing (electronic vs. hardcopy), and participants revealed that instructional feedback and relationship were most helpful to their development of reflectivity (Spalding & Wilson, 2002). Nonetheless, capitalization upon the ability of electronic media (such as computers, telephones, etc.) to foster collaborative learning environments provides unparalleled opportunities for reflective practice at personal convenience.

Also aware that research has shown the development of reflective skills to be complex and time consuming (Hatton & Smith, 1994), I expected demonstration of technical reflection by the study participants. Nonetheless, I designed the reflective processes to be most inclusive of the modes and platforms reported to be supportive of novices' engagement

in multiple levels of reflection. Accordingly, the study used reflective dialoguing via email and face to face and telephonic oral interviewing to provide participants with multiple means of communicating their experiences within their developmental journeys. Though reflection was the means by which the participants conducted their developmental activities, the intended destination was improvement of a specific effective teaching behavior, whose derivation bears discussion.

Use of Reflection to Develop Effective Teaching

So what operationalization of effective teaching behaviors is supportive of the study's focus? In Chapter 1, I countered the assumption of agreement upon a single list of effective college teaching practices. Though there may be several philosophical reasons precluding consensus, a practical barrier is the diverse manners researchers use to couch their findings. The variations give rise to effective teaching dimensions and principles of effective teaching. Within the vast body of research on effective teaching, I formed two particular approaches to identification of effective teaching behaviors most conducive to the study's focus upon improvement of tangible classroom behaviors.

Murray's (1997) analysis of observational and experimental studies of low-inference teaching behaviors within college lecture and lecture-discussion classes identified teacher enthusiasm, teacher clarity and teacher-student interaction as the most reliable antecedents of instructional outcomes. Low-inference teaching behaviors associated with each antecedent included (a) vocal and physical expressiveness for teacher enthusiasm, (b) overt written and verbal structuring of lectures for teacher clarity, and (c) solicitation and praise of student input for teacher-student interaction (Murray, 1997). Incorporation of low-inference teaching behaviors continued with the work of Hativa, Barak and Simhi (2001).

Building upon the characterizations of the classroom behaviors of exemplary college teachers resulting from previous studies, Hativa, Barak and Simhi (2001) conducted a study that included frequency analyses of exemplary teachers' use of effective teaching behaviors. Acknowledging preparation, enthusiasm and clarity in communications, and genuine respect for students as some of the characterizations of exemplary university teachers, they used an effective teaching questionnaire to consolidate these characteristics into effective teaching dimensions. The resultant effective teaching dimensions were lesson organization, lesson clarity, interest/student engagement, and positive classroom climate (Hativa, Barak & Simhi, 2001). Interestingly, they found that none of their participants mastered all four main dimensions – each had unique competencies and shortcomings and each achieved effectiveness differently (2001).

Recognizing the conciliatory nature of the Hativa, Barak, and Simhi model with other researchers' conceptualizations of effective teaching, their four main dimensions of effective teaching became the foci for this study's assessment of the novice college instructors' teaching effectiveness. An additional benefit of this orientation was that the model supported observation of the novice college instructors' performance of discrete, tangible behaviors by associating low-inference teaching behaviors with each teaching dimension. I welcomed such use of low-inference teaching behaviors because it anchored the novice college instructors' teaching behaviors in specific and observable forms supportive of execution and assessment of their developmental plans. The model linking the participants' use of reflection to attain professional growth is rooted in the relationship between teachers' cognitions and instructional practice.

A Model Explaining How Reflection Facilitates Professional Growth

Various research studies have established the importance of teachers' beliefs upon their instructional practice. Provoked by the temporary nature of reform efforts in K-12 and colleges, Woodbury and Gess-Newsome sought to identify the causes of reform failure. They found lack of change within institutional structures to support reform, lack of pedagogical preparation for conduct of desired reform and marginalization of the impact of teachers' beliefs upon instructional practice to be possible reasons for reform failures (as cited in Gess-Newsome, Southerland, Johnston & Woodbury, 2003). Further expounding upon the relationship of teachers' beliefs to reform failure, Gess-Newsome, Southerland, Johnston, and Woodbury linked reform failure to the absence of teachers' cognitive unease in the form of pedagogical dissatisfaction which is a discrepancy between teachers' cognitions, instructional practice, and desired educational aims.

Artzt and Armour-Thomas (as cited in Artzt, 1999) developed a framework supportive of previous research findings that teacher cognition seems to shape instructional practice. The framework has three levels: (a) overarching cognitions delineating knowledge, beliefs and goals; (b) cognitive processes that are comprised of the teaching stages of preactive, interactive, and postactive; and (c) instructional practice typified by classroom actions and environments (Artzt, 1999). I equate the preactive, interactive, and postactive teaching stages of Artzt and Armour-Thomas' framework to Loughran's (2002) anticipatory, contemporaneous, and retrospective reflections, respectively. The flow between the first two levels, overarching cognitions and cognitive processes, is bi-directional, reflecting the reciprocity of teachers' thoughts within the broader context of teaching as a whole and the narrower context of evaluation of a particular lesson. At the lowest level of technical

reflections, instructional practice exhibits bi-directionality only with the interactive stage of teaching, which is analogous to reflection in action. Nonetheless, thoughts from the preactive stage are inputs to instructional practice and the classroom actions and environments of instructional practice are inputs to the postactive stage of lesson evaluation. To summarize, completion of an iteration of reflection according to the Artzt and Armour-Thomas framework could be as follows: (a) teachers identify their overarching cognitions by specifying their goals and expectations for their students; (b) these overarching cognitions influence the teachers' lesson planning and preparations; (c) the teachers' planning thoughts are translated to specific teaching behaviors within the classroom; (d) while teaching, the teachers assess and modify alignment of their specific teaching behaviors with their identified overarching cognitions; and (e) after teaching, teachers evaluate the effectiveness of their specific teaching behaviors in achieving their identified overarching cognitions and devise plans to either adapt their overarching cognitions to their teaching situation or modify their teaching behaviors to better align with their overarching cognitions.

Though each step of the iteration provides opportunities for reflection, assessments within the interactive and postactive teaching stages are especially enlightening because they force comparison of the teachers' overarching cognitions, their awareness of the cognitive processes governing their instructional practice and the alignment of their instructional practice with their overarching cognitions. Teachers' perceptions of discrepancies between their cognitions and instructional practice prompt pedagogical dissatisfaction that can catalyze professional growth. The Artzt and Armour-Thomas framework suggests a mechanism by which such professional growth can occur. Modification of overarching cognitions can be attained by enhancement of teachers' knowledge of their subject matter,

pedagogy and students via exposure to professional reading and collaboration with peers and mentors. This newly acquired knowledge may also have a cascading effect upon the teachers' beliefs and goals. Additionally, this enhancement of teachers' knowledge may refine their conduct of cognitive processes within the teaching stages enabling transformation of their instructional practices. I believe the teachers' efforts to resolve their pedagogical dissatisfaction may exhibit synergy, driving them to systematically question, explore and expand their understandings of themselves, their profession, their subject, and their students. Thus, reflection undergirded by the Artzt and Armour-Thomas framework is quite conducive to the study's aim of improved teaching practice.

A Summary: The Linkage of Research Claims and Study Design

This study explored the viability of reflection in improving the teaching practice of novice college science instructors via concentration upon low-inference teaching behaviors associated with the Hativa, Barak, and Simhi (2001) model of effective teaching dimensions. The study involved two participants who identified different foci for pursuing teaching improvement. One decided to focus upon conduct of lesson summaries to enhance his lesson organization skills since his typical lesson preparation did not involve overt structuring of his classroom actions. The other participant chose to incorporate real life examples as a strategy to increase student interest, being well aware of students' typical feelings of alienation in chemistry classes. Chapter 4 provides more detailed information regarding the participants' processes for self-selection of teaching foci.

Based upon the Artzt and Armour-Thomas framework for teacher reflection linking cognition and instructional practice, I developed a reflection instrument which is discussed in Chapter 3 that employed Loughran's (2002) three phases of reflection. Broadening my

interpretation of cognitive processes to encompass weekly actions conducted in accordance with the participants' developmental plans, I substituted anticipatory reflection (conducted at the beginning of the week prior to execution of the developmental plan) for the preactive teaching stage, contemporaneous reflection (conducted midweek during execution of the developmental plan) for the interactive teaching stage and retrospective reflection (conducted at the end of the week following execution of the developmental plan) for the postactive teaching stage. The purpose of the instrument was to provide the study participants with structured, recurrent guidance through the use of prompts to support identification and confrontation of their own thoughts and behaviors.

Cognizant of the participants' experiences of pedagogical dissatisfaction resulting from their identification of a teaching dimension as needing improvement (their problem), I acted as a 'more knowledgeable other'. As such, I helped guide their completion of specific pedagogically-related tasks within their developmental plans, such as creating reading lists addressing their specific low-inference teaching behaviors. In so doing, the study's structure supported and challenged their attempts to resolve their pedagogical dissatisfaction. Evidence of their cognitive and behavioral explorations was acquired through collection of weekly and monthly reflections, conduct of semi-structured interviews, observations of their instructional practice, and a survey of their students. As the study progressed, the semi-structured interviews provided invaluable insight on the participants' articulations of the study's impacts upon their cognitions and instructional practice.

Due in part to the participants' status as novice instructors, I expected the participants to exhibit levels of reflection consistent with preservice teacher research results. Using Van Manen's (1977) taxonomy for reflection, I expected the participants to operate within

technical rationality, the lowest level of reflection and 'path of least resistance'. In fact, I

operationalized goal attainment as assessment of the participants' performance of specific

teaching behaviors rather than analysis of their attempts to align their thoughts and actions

with educational goals and desired social and ethical impacts of instructional practice.

Nonetheless, the reflection instrument incorporated prompts, such as *"how will*

accomplishment of this goal further develop me as an educator?", that were supportive of

practical action, the second level of Van Manen's taxonomy. Unaware of the developmental

and attitudinal dispositions of my participants before initiation of the reflection experiences, I

prepared a reflection instrument and developmental plan template versatile enough to guide

participants in the performance of the most basic level of reflection or spur them to practical

action, a more developmentally advanced level of reflection. Regardless of the levels of

reflection attained by the participants, I expected both to experience improved teaching

effectiveness.

Conclusion

Inspired by the knowledge claims linking professional growth and reflection,

reflection appears to be a logical path to travel in pursuit of improved teaching practice.

With my focus upon the development of novice college instructors instead of preservice or

K-12 teachers, the path forged by previous research in reflection appears to be one relatively

untraveled. This is hardly surprising since the general reality of faculty development is one

of individual rather than collective or institutional effort. Despite the proliferation of

teaching centers and various expressions of commitment to faculty development, the need for

relevant and effective professional development of novice college science instructors is still

urgent.

Novice college faculty typically teach introductory undergraduate science courses. Generally novice science college faculty have (a) the least amount of experience in managing the competing demands of professional duties on their time, (b) little to no formal teaching experience (Sunal et al., 2001; Flood & Moll, 1990), and (c) minimal pedagogical content knowledge (van Driel, Beijaard & Verloop, 2001). Hounded by charges that introductory science courses are liable for decreased student interest in majoring in science or taking higher level science courses (Sunal et al., 2001), novice college science instructors need relevant and practical methods to expand their pedagogical content knowledge and close the aforementioned knowledge gaps concerning teaching and how their students learn. Targeting expansion of the participants' overarching cognitions via conduct of the study's reflective activities, I expected subsequent demonstrations of instructional practices illustrative of cognitive and professional development.

CHAPTER 3

A METHODOLOGY FOR EXPLORING REFLECTION AS A WAY OF LEARNING

AND KNOWING

"…the significant issue is not whether one method is overall superior to another but, rather, whether the method a researcher employs can yield convincing answers to the questions that the investigation is intended to settle."
                                                                    - R. Murray Thomas

Qualitative, quantitative, or mixed method? Which research methodology should I follow? Having no predetermined philosophical preference, I decided to follow the dictates of my research questions – in other words, my primary concern became whatever would work best to answer the research questions. Such a mindset characterized a pragmatic orientation, which "allows one to eschew methodological orthodoxy in favor of *methodological appropriateness* as the primary criterion for judging methodological quality, recognizing that different methods are appropriate for different situations" (Patton, 2002, p. 72).

Given the research questions' two domains, the participants' perceptions of the reflection experiences and the impacts of the reflection experiences upon their teaching practices, it became evident that I was pursuing two kinds of information. Combining the participants' perceptions and experiences into a broader category of *process*, I determined that analysis of the process would require access to the participants' feelings and interpretations. As we worked together to reveal their conceptualizations of the process, their voices provided the answers that no one else could. Concurrently, examination of the impacts of the reflection experiences upon teaching practice implied a more objective assessment of the study's *product* – enhancement of teaching. As such, evidence of observable changes in the participants' teaching practices was needed. How did I

accommodate the needs for participant subjectivity in analyzing the study's process and

objective measurement to assess the study's product?

Analysis of the study's process and product demanded different research orientations.

Since a hallmark of qualitative research is to accurately and adequately capture the

participants' perspectives (Fraenkel & Wallen, 2003), a qualitative design better supported

analysis of the study's process. Conversely, the need to measure the study's product, impact

of the participants' reflection experiences upon teaching, led to the use of quantitative

methods. Since qualitative and quantitative research methods were necessary for me to

collect the data needed to address my research questions, this study is characterized as mixed

method (also referred to as multi-method) research.

<center>**Research Design**</center>

Mixed method research requires the researcher to shift from the use of qualitative

methods for one stage of research to the use of quantitative methods for the other stage of

research (Johnson & Christensen, 2004). Within my study, one of the two research questions

focused upon the participants' perceptions; these perceptions were readily obtained via

qualitative data collection strategies such as interviews. The second question with its

emphasis upon the impact of the reflection experiences upon the participants' instructional

practices dictated the use of quantitative methods like the surveying of students enrolled in

the participants' classes. In the collection and analysis of the data obtained for each

participant as a separate case, I employed both qualitative and quantitative methods.

This mixed method approach seemed ambitious, particularly since it required more

time, resources, and expertise in execution. It also heightened the probability of conflicting

findings (Johnson & Christensen, 2004). However, with the scope of my quantitative

research being confined to the use of simple descriptive statistics in analyzing the measurements of the participants' teaching behaviors, the concurrent conduct of the qualitative and quantitative research was manageable. In fact, I concur with Johnson and Christensen (2004): the combination of the different methods with varying strengths and weaknesses lessened the likelihood of committing a substantial error in generating the findings.

Research Setting

Site

I conducted the study at Innovative University, a pseudonym for a large research I institution located in the southeastern United States. Innovative University is the state's largest university and within its undergraduate program, General Education Requirements (GER) for natural science include two courses from the basic sciences, which are inclusive of chemistry and physics.

Sample

This study used instructors derived from a purposeful sample of Innovative University's faculty teaching GER basic natural science courses. The inclusion criteria were novice instructor status and teaching responsibilities for a GER basic natural science course during the Fall 2004 semester. Concurrently, the exclusion criteria were faculty (a) unable to fulfill participant requirements, such as the weekly reflections, (b) unwilling to allow student surveys as a means of gathering evidence of teaching performance, and (c) unable to commit to the study's completion. These criteria were significant because they shaped the pool from which I drew the study participants. Since my goal was to select cases from which I could learn the most (Patton, 2002), I ensured the selection of a sample of novice faculty

actively engaged in teaching an introductory undergraduate science course; desirous of a deeper understanding of a selected teaching practice; and willing to commit and to complete all the requirements for participation.

The steps in sample selection were fairly straightforward. I compiled a list of possible participants from available sources. The facilitator of the 2003 university's classes for new faculty supplied 109 names. In my search of departmental web pages, I identified an additional twelve assistant professors or lecturers. I eliminated the names of faculty not assigned to departments responsible for teaching GER basic natural science courses. After this elimination, I retained 41 faculty names. By way of department web pages and faculty profiles, I examined the rank and teaching responsibilities of the remaining faculty. Faculty rank of associate professor or higher and teaching responsibilities other than GER basic natural science courses resulted in the deletion of 21 names from the list of possible participants. I attempted to contact the remaining 20 faculty by phone (see Appendix A for telephone recruiting script). I chose telephonic contact because I wanted an optimal compromise of efficiency and personal contact. Aware of my own tendency to delete emails from unknown senders, I determined the additional effort of presenting my study in a more personal manner would yield more favorable reception of my recruitment efforts. Battling apprehension, I employed my telephone recruiting strategy and attained satisfactory results. Of the 14 faculty available for conversation, all were polite, considerate and encouraging as I presented the overview of my study. When questioned about their suitability for the study, seven were disqualified from participation due to their years of teaching experience; five were unable to fully participate due to workload considerations; and two were qualified and willing to participate in the study.

I conducted brief interviews with each of the two remaining candidates to gain clarification of their teaching responsibilities, experience, goals, and reasons for participation in the study. This gave me one more opportunity to assess the candidates' suitability for study participation. During the interviews, I found no reasons to eliminate any of the candidates and each candidate signed a letter of consent at the conclusion of the individual interviews.

The sample for the study consisted of two novice faculty with teaching responsibilities for chemistry and physics introductory undergraduate courses in the fall of 2004. One was female and the other male; both were in their first semester of university teaching. Beneath this initial commonality of being at the entry point in university teaching, my sample possessed a wealth of diversity in teaching orientations and expectations that I will detail in Chapter 4. Nevertheless, I will refer to the participants by pseudonyms to preclude confusion when I later describe differentiated instruments used in data collection.

Data Collection

The study utilized five sources of data: weekly reflections, monthly semi-structured interviews, monthly meta-reflections, classroom observations, and student surveys. All data sources were used to identify changes in teaching practices. All data sources except for the student surveys were used to characterize participants' experiences with the reflection process. Only the weekly reflections, monthly semi-structured interviews, and monthly meta-reflections were used to identify participants' perceptions of the study's impacts upon their teaching practice. To reinforce understanding of the relationships between the study's research questions and data collection strategies, I provide a summary in Table 3.1.

Table 3.1

Relationship Between Research Questions and Data Collection Strategies

Research Question	Weekly Reflections	Monthly semi-structured interviews	Monthly meta-reflections	Classroom observations	Student Surveys
1. How did the novice college science instructors perceive the reflection experiences to impact their teaching practice?	X	X	X		
2. During the progression of reflection experiences, in which teaching practices did the instructors' performance change? How?	X	X	X	X	X

Reflection Experiences

This division of the data collection section describes the tools and activities used to conduct the study's reflective processes. These activities included the weekly reflections, monthly meta-reflections, and monthly semi-structured interviews, which are presented in the proceeding section discussing the reflection instrument.

 Tutorial.

  I developed this instrument as a step-by-step guide (in the form of a Microsoft PowerPoint presentation) to lead the study's participants through the first phase of the

reflection experience (see Appendix B). In the first phase, the participants self assessed their

teaching behaviors to identify a main dimension of effective teaching practice in need of

improvement, familiarized themselves with effective teaching practices, determined a low-

inference teaching behavior to target as their teaching goal focus, and then created a

developmental plan to attain improvement within their teaching goal focus. For the teaching

goal focus, the tutorial encouraged the participants to specify a desired level of

understanding. The desired level of understanding corresponded to my adaptation of

Bloom's Taxonomy.

Bloom's taxonomy is a hierarchical conceptualization of delineated cognitive

processes associated with the process of learning. Focusing upon understanding as the

desired learning outcome, the spectrum of cognitive processes ranges from most basic to

advanced. A common interpretation of Bloom's taxonomy is to associate the higher levels of

the taxonomy with increased learner involvement in making meaning of learning

experiences. Such an orientation is compatible with my design of a flexible developmental

plan supportive of a spectrum of commitment to professional development. Accordingly, my

adaptation just involved transforming the general cognitive processes of Bloom's taxonomy

into specific actions to take in gaining pedagogical content knowledge. Table 3.2 illustrates

the alignment between Bloom's taxonomy and my adaptations.

Table 3.2

Bloom's Taxonomy Adapted to a Professional Developmental Context

Level	Traditional Explanation	Adapted Explanation for Teaching Competency	General Actions Associated with Adapted Explanation
Knowledge	Memorization of information	Familiarization with selected teaching practice…aware of its general contributions to educational practice	Light to moderate reading of literature related to selected teaching practice
Comprehension	Ability to convey the meaning of information	Development of personal understanding of selected teaching practice's niche within one's repertoire of teaching practices	Substantial reading of literature related to selected teaching practice as well as the educational theories supportive of the teaching practice. Exposure to demonstration of the selected teaching practice Reflection upon teaching practice's conceptualized and observed impacts
Application	Ability to transfer conceptual understanding to practical action	Ability to transfer understanding of selected teaching practice's theoretical principles into practical teaching actions	Continued reading to determine how to tailor the use of the teaching practice for your population of students Alliance with role models of the teaching practice's use for continued observation and discussion of its use with students
Analysis	Ability to reduce information to its subordinate parts	Ability to discern the extent to which the selected teaching practice can be effectively used in teaching your particular students	Development of lesson plans integrating use of the selected teaching practice Analysis of lesson plans' suitability with role models of the teaching practice's use
Synthesis	Ability to combine information to create a new entity or level of understanding	Ability to integrate selected teaching practice with existing teaching practices to further student learning	Execution of lesson plans integrating use of the selected teaching practice
Evaluation	Ability to assess information through the use of relevant criteria	Ability to critique selected teaching practice's impacts using established standards of measurement	Self analysis of execution of lesson plans integrating use of the selected teaching practices Role models' observation of execution of lesson plans Reflection (self and with role model) to determine the next step of development (further refinement or selection of another teaching practice)

Through use of adaptations to Bloom's taxonomy, participants were supported in making informed decisions about their desired levels of understanding because they had a clearer vision of the extent of commitment and effort required in goal attainment. This reinforced ownership because the participants were compelled to weigh the impacts of their workload and developmental needs and then tailor a developmental plan that best fit their unique situations.

Adapted from Joyce and Showers (1995) action plan methodology, the developmental plan established a schedule of discrete tasks for the participants to complete in order to document their progress in goal accomplishment. Within a broader context, the developmental plan served as a contract, specifying the extent of each participant's commitment to a plan of action for professional development. The developmental plan format is provided in Appendix C. While the tutorial via the developmental plan provided opportunities for self accountability, it did not have a collaborative platform, so participants did not have ready access to peers with whom to share their experiences. However the participants had opportunities to fully discuss their experiences with me during the monthly semi-structured interviews to counter the criticisms of the agency of self awareness in confronting personal beliefs and teaching actions discussed in Chapter 2.

Reflection instrument.

As with the tutorial, the reflection instrument was developed by me, the researcher. This instrument is a questionnaire composed of open-ended questions to guide the study's three formal types of reflection experiences (see Appendix D for reflection instrument). The three formal types of reflection experiences included weekly reflections, monthly meta-

reflections, and monthly semi-structured interviews. These reflection experiences were

designed to support development of reflective habits of mind.

Weekly reflections.

On designated weeks, participants sent me via email their responses to the

open-ended questions classified according to Loughran's three phases of reflection:

anticipatory, contemporaneous, and retrospection (as cited in Freese, 1999). To better

align this reflective framework with the timing of participants' efforts, I

operationalized the reflection phases slightly differently to focus upon the week as the

unit of analysis for conduct of developmental activities and reflection. This

modification was particularly helpful in highlighting the links between cognition and

instructional practice in the participants' executions of their developmental plans.

Table 3.3 presents a comparison of my adaptation to the traditional operationalization

of Loughran's reflective framework.

Table 3.3

Comparison of Operationalizations of Loughran's Reflective Framework

Reflection Phase	[1]Traditional Operationalization	Adapted Operationalization
Anticipatory	Before teaching lesson	At the beginning of the week: before any action has been taken with the developmental plan
Contemporaneous (also known as reflection-in-action)	While actually teaching lesson	Mid-week: while in the midst of completing action in accordance with the developmental plan
Retrospective (also known as reflection-on-action)	After teaching lesson	End of week: after completion of action in accordance with the developmental plan

[1]Explanations derived from Freese, A.R. (1999). The role of reflection on preservice teachers' development in the context of a professional development school [Electronic version]. *Teaching and Teacher Education, 15*, 895-909.

In alignment with the cyclical nature of reflection, the battery of open-ended questions for the weekly reflections addressed each reflection phase as demonstrated by a few sample questions (see Appendix D for reflection instrument). For example, in the anticipatory phase one question was "What is my plan for accomplishment of this goal?" For the contemporaneous phase, " How do I need to manage my efforts to accomplish this week's goal?" was an example prompt and in the retrospective phase "What have I gained from this week's study experiences?" was a sample question.

The purpose of the prompts in the anticipatory phase was to compel the participants to plan how they would accomplish the discrete tasks within their developmental plan. Ideally, the participants would use the projected deadlines within their developmental plan to determine the actions they needed to take within the weekly increments. Thus, the anticipatory reflective prompts were designed to get the participants to deliberately plan their

development: what did they need to do, how did they plan to do it, and what was the significance of what they were doing to their professional development?

Logically, the purpose of the prompts in the contemporaneous phase was to compel the participants to assess their progress mid-way through execution of their plan in accomplishing the week's developmental activities. Ideally, the participants would use the personal standards they set for achievement in the week's anticipatory reflections as the benchmark for measuring progress and make any adjustments in their efforts so they could complete the week's developmental activities. Thus, the contemporaneous reflective prompts were designed to get the participants to be accountable to themselves for execution of their developmental plan: how were they progressing, how did they feel about their progress, what changes did they need to make to align with their goals stated in their anticipatory reflections, and what were the impacts of their efforts upon their professional development?

Consequently, the purpose of these retrospective prompts was to compel the participants to contemplate the impacts of the week's executed developmental activities. Ideally, the participants would use their successes and failures as lessons to learn more about themselves as learners and professionals. My expectation was that these lessons would enhance their self- awareness that would enable them to approach the subsequent reflective activities with wisdom. Thus, the retrospective reflective prompts were designed to get the participants to interpret their experiences with deliberation: what have I gained from this week's study experiences and how can I use what I have gained to become a better educator or a better learner? Articulation of the previous week's experiences would support the participants using the experiences to inform their cognition and using this more informed state in developing the next week's activities.

Thus, the weekly cycle of anticipatory, contemporaneous, and retrospective reflective prompts was designed to undergird participant actions of deliberate planning, action, and assessment in an integrative and cyclical manner. Though I presumed the weekly reflection assignments could be moderately time consuming to prepare, I reasoned their benefits of the participants becoming familiar with reflective processes would far outweigh the sacrifices of time.

Monthly meta-reflections.

To further develop the participants' reflective abilities, the monthly meta-reflections required participants to send me via email their responses to three distinctly different categories of prompts, progressing from very structured to loosely structured contexts (refer to Appendix D). An example of a very structured prompt was "Thinking back over the month, explain which actions within your developmental plan and reflection instrument that you are or have developed confidence in completing on your own?" Conversely, an example of a loosely structured prompt was "Share your thoughts on any aspect of your experiences associated with this study that was meaningful to you."

Since the prompts for the very structured context mirrored some of the prompts to be used in the monthly interviews, I hoped to prevent the participants from feeling overwhelmed in their initial steps of completing a meta-reflection. Continuing within the same vein, the semi-structured context gave the participants guidance in synthesizing connections between their newly gained knowledge and its impacts upon their teaching. Lastly, the loosely structured context gave the participants the opportunity to freely make their own connections of insights gained from their experiences with the study. Ideally the monthly meta-

reflections would reinforce participants' awareness of the 'bigger picture' – how do they 'see' themselves and their teaching and what are the impacts of their improved vision?

Monthly semi-structured interviews.

To broaden my understanding of the participants' interpretations of their study experiences, I conducted two individual monthly face-to-face semi-structured interviews with each participant as a pillar of the study's design. I began each interview with the same set of general questions (refer to Appendix D), yet differentiated the follow up questions to gain insight and clarity of their individual interpretations of their reflection experiences (refer to Excerpts of Differentiated Semi-structured Interview Guides in Appendix D). Though this interview approach is less flexible in addressing the unique experiences of each participant, this disadvantage is greatly outweighed by the approach's strength in facilitating data comparability, organization, and analysis (Johnson & Christensen, 2004).

During the face-to-face individual meetings several transactions occurred. First, I had the opportunity to check my interpretations of the participants' perspectives that I derived from their emailed reflections. Second, the participants had the opportunity to recommend and discuss changes to enhance their reflection experiences and execution of their developmental plans, gain clarification of any confusing items within the reflection instrument, and elaborate upon their emailed responses (Thomas, 2003).

Classroom Observations

To gain familiarity with the participants' environment and their progress in executing their developmental plans, monthly classroom observations were a major part of the study's design.   Through audio taping and use of field notes, I compiled evidence to discuss with the participants observable changes in teaching behavior. Conducted during weeks 1, 8, and 13

of the study, I obtained data representative of the participants' initial, interim, and final demonstrations of teaching behaviors. Though I have some concerns about the authenticity of the participants' teaching behavior due to my presence and use of a tape recorder, this observational approach best supports my competing needs to become acquainted with the participants' environment, gather evidence of teaching behavior, and obtain credible records of my classroom visits (Thomas, 2003). Nonetheless, this concern with the observer effect was mitigated by eliciting feedback from the students.

Student Surveys

As with the tutorial and reflection instrument, the student surveys were developed by me, the researcher. Specifically, these instruments are questionnaires composed of Likert scale statements paired with free response opportunities to enable further explanation of student ratings (see Appendix E). I chose this design to mitigate the criticism that surveys fail to show the uniqueness of the individual members of the entity of interest (Thomas, 2003). Dual-purposed, the questionnaires afforded quantitative and qualitative analyses. Quantitatively, the questionnaires enabled objective analysis of the students' assessments of the participants' demonstration of teaching behaviors. Qualitatively, the student comments in the free response sections contextualized the ratings and provided insight on the students' perceptions of the best and worst aspects of the participants' use of selected teaching practices. Executed at week 14 of the study, this survey data presented the students' assessments of the participants' demonstrations of the selected classroom behaviors at the end of the semester.

Though the surveys were different for each participant's class to align with the different foci represented by the participants (use of real-life examples was the focus for Dr.

Willing's class, whereas use of lesson outlines was the focus for Dr. Skeptical's class), the administration of the surveys was similar for each class. During the last week of class in December 2004, the participants provided time for in class administration of the student surveys. For each class, I gave a brief explanation of the importance of the survey to me as a researcher and their instructors as professionals intent on gaining honest feedback of their teaching practice. I also assured the students of anonymity while requesting they lend their voices to the process. Of the 75 students enrolled in Dr. Skeptical's class, 42 completed the student surveys. Concurrently, 116 of the 216 students enrolled in Dr. Willing's class completed the student surveys. Thus, I obtained response rates of 56% and 53.7% , respectively. I judged the response rates to be reasonable given the nature of student attendance, particularly by semester's end.

In summary, the study utilized five sources of data: weekly reflections, monthly semi-structured interviews, monthly meta-reflections, classroom observations, and student surveys. Of the five data sources, only the student surveys were representative of quantitative data. In keeping with the mixed methods approach, all data sources were used to identify changes in teaching practices (the second division of the second research question). All four sources of qualitative data were used to characterize participants' experiences with the reflection process (the first research question). Only the weekly reflections, monthly semi-structured interviews, and monthly meta-reflections were used to identify participants' perceptions of the study's impacts upon their teaching practice (the first division of the second research question). Consequently, I analyzed the data qualitatively and quantitatively in order to respond to the questions guiding the research.

Data Analysis

I used content analysis to analyze the data pertaining to the participants' perceptions of the reflection process, the focus of the first division of the second research question. This was done to enable consolidation of participant responses such that I would derive the emergence of thematic relationships within the responses (Hatch, 2002) individually and collectively that would enable me to answer the study's qualitative research questions. I chose phrases to be the units of analysis for coding manifest content. I had no predetermined codes and chose to develop codes primarily from the participants' words and levels of understanding derived from my adaptation of Bloom's Taxonomy. I identified 43 codes by this process. Consolidation of related codes afforded the emergence of nine themes across the reflective processes: feedback, steps in gaining understanding, self assessment, reflection on practice, self direction, study's impacts, support request, teaching goal focus, and time management. An example of the coding and categorization of participant reflections is shown in Table 3.4. For ease of recognition, these emergent themes were sometimes bracketed within participant dialogues presented in Chapter 4.

Table 3.4

Coding Example of Participant Reflections

Codes	Selected Excerpts From Weekly Reflections	Theme
Awareness of student needs	*Wk 9: so I anticipate a lot of student interruptions.*	
Balancing of responsibilities	*Wk 3: because Tuesday is very busy*	
	Wk 9: but this is another busy week since I'm giving a test,	
Level of commitment	*Wk 2: 2-3 hours this week,*	
	Wk 3: 3-4 hours	
	Wk 4: 2 hours	Time management
Scheduling of efforts	*Wk 2: most of which will be done on Friday or possibly over the weekend*	
	Wk 3: Fit in reading on Thursday this week	
	Wk 9: Otherwise, I can do the readings this weekend.	
Time management concern	*Wk 9: I hope to find time between now and Friday*	

From the emergent themes, I gained insight on the participants' individual and collective perceptions of their reflection experiences. Within the parameters of these themes, I searched for similarities and differences expressed in the participants' perceptions to respond to the study's guiding research questions. Additionally, relevant excerpts from my secondary data sources (transcripts of semi-structured interviews and field notes) were linked with appropriate emergent themes to further clarify and contextualize the participants' articulation of their reflection experiences.

Concurrently, comparison of participants' self reporting of teaching behavior via the emailed reflections and semi-structured interviews, my classroom observations, and the students' reporting of teaching behavior via the student surveys enabled triangulation of evidence to answer the study's sole quantitative research question: "During the progression of reflection experiences, in which teaching practices did the instructors' performance change?"

Summary

Within a mixed method research design, I used case studies to explore the impacts of guided reflection experiences upon teaching practice. In confronting the "classic depth versus breadth tradeoff" associated with case study research (Johnson & Christensen, 2004, pp. 378-379), I chose to pursue depth. At this initial stage of investigation of reflection as a means for novice faculty's attainment of teaching practice enhancement, understanding is a more pressing concern than generalizability – particularly since this portends to be an innovative solution to a long-standing dilemma of how to fashion learning experiences to meet novice faculty's orientations and professional development needs. Accordingly, Chapter 4 presents the findings related to the participants' study experiences.

CHAPTER 4

PERCEPTIONS AND IMPACTS OF THE REFLECTIVE PROCESS

"One of the really nice things too about this process for me has been that you aren't, you know, coming in grading me, telling me whether or not I'm gonna get my job next year… which is how it's always been before so it does feel, I mean having someone like you it's easier to be much more honest and open. I don't have to sort of hide my faults …"
                                        - Dr. Willing (Study Participant, Interview, September 2004)

In expressing the aforementioned sentiments, Dr. Willing affirmed the non-evaluative orientation I strove to maintain in conducting the study. With growth as the aim of the professional development program, everyone involved had to be comfortable with facing reality: I had to be open to examination of possible flaws in the conceptualization and execution of the professional development program while the participants had to be transparent in sharing who they were as novice instructors and how they were making meaning of their reflection experiences. To honor the meanings derived from their experiences, I commit to presenting their voices as fully as possible, using all of the study's data collection tools to present the harmonic and discordant aspects of their experiences as they emerged from their discourses. Accordingly, I will now take the time to introduce Drs. Skeptical and Willing – their backgrounds, beliefs, and experiences-- to afford greater appreciation and understanding of their interpretations of the study experiences.

Dr. Skeptical

   Teaching orientation.

Dr. Skeptical had about five years of Teaching Assistant (TA) experience with lab and lecture sections of introductory and graduate level physics courses, which involved diverse populations of students including premed and physics majors. He expressed the goal

of his teaching as getting "*students to learn for themselves*" (interview, August 2004). He also thought students should be jointly responsible for their learning. When I asked him to give a metaphor to describe his role as a teacher, he did not come up with one. However when I gave choices of coach, role model and trainer, he said that coach was closest to his idea since it is consistent with the concept of joint responsibility for learning.

When asked to identify his biggest concern about his first year of university teaching, Dr. Skeptical replied, "*having enough time to perform all his professional responsibilities*" (interview, August 2004). These responsibilities included running a lab, supervision of five students, research and teaching. Aside from the issue of time management, Dr. Skeptical expressed no concerns about being a novice instructor. He taught one section of Physics 205 (PH 205), which is standardized in terms of content coverage and schedule. Accordingly, he had daily and weekly interactions with the other PH 205 instructors. Notably, he considered two of the other instructors to be "*highly experienced professors*" (interview, August 2004). Drawing upon his TA experience in which he focused upon problem solving, Dr. Skeptical saw his new role to be centered in teaching students how to solve problems. When asked to describe his expectations of his students, he shared that he had been told to expect a wide spectrum of students and "*everything you can imagine*" (interview, August 2004).

Study involvement.

When I asked Dr. Skeptical for his rationale in participating in this research study, he stated that he was "*just willing to help a grad student*" (interview, August 2004). When queried about his expectations for study involvement, he asserted that he did not expect the experience to have an impact upon him.

Upon evaluation of his teaching according to the four main teaching dimensions of lesson organization, lesson clarity, interest/student engagement, and positive classroom climate, he identified lesson organization and lesson clarity as the teaching dimensions needing improvement. Acknowledging time constraints to restrict the extent of his lesson preparation, he chose lesson organization as the focus for his improvement (See Appendix F, Self Assessment Results for Dr. Skeptical). Identifying knowledge as his desired level of understanding, Dr. Skeptical wanted to learn how to decrease time spent on administrative duties from approximately three hours a week to less than one hour a week to allow more time for lesson organization (See Appendix H, Developmental Plan for Dr. Skeptical). Cognizant of Dr. Skeptical's heavy workload and low expectations of study involvement, I was most curious to see what would become of his developmental journey.

Dr. Willing

Teaching orientation.

Dr. Willing recently earned her doctorate and had 3 years of experience of teaching in a private high school in which she taught a variety of course levels in chemistry while also teaching some math courses. Her students were mostly highly motivated honor students who "*were going places*" (interview, August 2004). These students did not need her to motivate them for higher education; they were already college bound. In this setting she felt isolated as the only chemistry teacher and began thinking about the transition to chemistry in higher education. During the years it took her to earn her doctorate, she was a TA for chemistry lecture and lab sections. Embarking upon her first semester of university teaching this year, she did not know what to expect of her Fall 2004 teaching experience. Nonetheless, she was excited because, as compared to her high school teaching experience, she saw teaching

introductory general chemistry (Chemistry 101) as a chance to make a bigger impact upon the students she will teach.

She was not particularly concerned about being a novice college instructor due to her high school and TA experiences. She considered *"the opportunity to change kids' minds about chemistry and themselves"* to be the best aspect of teaching (interview, August 2004). She wanted students to see how what they're doing (chemistry) is applicable to their lives. She also saw herself as a role model to women, which was particularly significant when she taught at high school. Her biggest concern about her Fall 2004 teaching experience was the class sizes of Chemistry 101 (CH 101). She believed the larger class sizes would challenge the rapport she would like to develop with her students. She had heard that typical CH 101 sections had enrollments of 200 students, yet 100 typically came to lecture sessions. She had the perception that the A students could use the class notes and text to get good grades without having to come to class; she wanted her students to want to come to class and feel that coming to class was important. With her smaller high school classes, she had an ability to *"read the class"*, but with the CH 101 sections, she was not sure she could accurately assess the students' reactions to her teaching (interview, August 2004).

She taught two sections of CH 101, both with enrollments exceeding 200 students. She felt comfortable with her preparation for teaching CH 101 and her expectation of engagement with the students was *"somewhat individual"* (interview, August 2004). Since she believed CH 101 not to be a difficult course for students with high school chemistry experience, her goal for them was to broaden their idea of chemistry. For those with less background in chemistry, she planned to *"comfort them that they can get through science courses"* (interview, August 2004). Concurrently, she expected 15 of the 100 students

attending lectures to be inattentive or sleepy, so another concern became how to engage the remaining 85 students.

Study Involvement.

When I asked Dr. Willing for her rationale in participating in this research study, she stated that she believed in what I was doing and thought study participation would help her see teaching in a broader light. When queried about her expectations for study involvement, she said, *"participation will help me to be a better teacher overall"* (interview, August 2004).

Upon evaluation of her teaching according to the four main teaching dimensions of lesson organization, lesson clarity, interest/student engagement, and positive classroom climate, she identified interest/student engagement as the only teaching dimension needing improvement and as the focus for her improvement (See Appendix G, Self Assessment Results for Dr. Willing). Identifying comprehension as her desired level of understanding, Dr. Willing committed to dedicate two hours a week to attain her expressed teaching goal: *"I plan to integrate more "everyday-life" references so that students can understand chemistry in a broader context."* (See Appendix I, Developmental Plan for Dr. Willing) At this point, Dr. Willing was ready to embark upon her developmental journey; she had a focus, goal, and plan for improving interest/student engagement within her CH 101 classes.

Time Points Within the Developmental Journey

The developmental journey spanned 14 weeks and to support analysis of the participants' experiences at common points along their journey, I established three time points: beginning, middle, and end. The beginning time point extended from initial contact with the participants in early August to the initial classroom observations held four weeks

later. Each classroom observation was followed by a separate discussion of observations with each participant. The middle time point included the first three weekly reflections submitted electronically, one monthly meta-reflection submitted electronically, one classroom observation, and one semi-structured interview. The end time point included the second round of three weekly reflections, one monthly meta-reflection, one classroom observation, and one semi-structured interview. The previously described points in time-beginning, middle, and end-organize the findings. Within these time points, the nine reflective themes mentioned in Chapter 3 will be the conduits for reporting the participants' perceptions of their study experiences and my interpretations of what the participants shared.

Findings

Intrigued by the presentation of markedly different study expectations by Drs. Skeptical and Willing, I searched for conceptual models to use in defining their individual developmental journeys. Narrowing my focus to the participants' thoughts and actions, I found each participant to express development of self awareness and subsequent modification of their teaching behaviors as a result of their enhanced awareness. To anchor the presentation of my findings, I found a conceptual model to delineate the evolution of self awareness and another model to characterize the process of cognition induced behavioral change.

To highlight the development of self awareness, I use John Dewey's characterization of reflection as my basis. Specifically, Rodgers (2002) condensed John Dewey's conceptualization of reflection to four criteria: (a) reflection is an interpretative process garnering enhanced insight as one progresses from one experience to another; (b) reflection is a prescribed manner of thinking with ties to the scientific method; (c) reflection is a

communal activity; and (d) reflection needs attitudinal dispositions supportive of individual and collective development. Focusing upon the fourth criterion, the four attitudinal prerequisites for reflection are wholeheartedness, a passion for one's discipline; directness, an awareness of the impacts of one's actions upon the dynamics of the learning process; open-mindedness, a disposition to consider alternative viewpoints; and responsibility, the unction to act in response to meaning made of previous experiences (Rodgers, 2002). Directness is evolutionary and Rodgers explained that its process may begin with self-absorption, pass through forgetting oneself, and, as one matures in reflective practice, bloom into self awareness, enabling systematic analysis of one's thoughts and behaviors.

I have always been intrigued by the adage, "when we know better, we do better". Implicit within this statement is the connection between cognition and instructional practice, which the participants expressed as awareness and modifications of their teaching behaviors. I found the Artzt and Armour-Thomas framework for the interdependency of teacher cognition and instructional practice to be most useful in characterizing cognition-induced behavioral change (as cited in Artzt, 1999). Their framework depicts knowledge, beliefs and goals as the overarching cognitions that influence and are influenced by the cognitive processes conducted within the preactive, interactive and postactive stages of teaching, which I liken to my study's use of anticipatory, contemporaneous, and retrospective phases of reflection. Consequently, instructional practice exhibits what was planned in the preactive stage (or the goals set in the anticipatory phase) and is analyzed and modified during the interactive stage (or concurrent monitoring of actions measured against the goals set in the anticipatory phase). During the postactive stage, the teacher analyzes the instructional practice and the teacher's interpretations of the experience become input for examination of

the teacher's overarching cognitions of knowledge, beliefs and goals. Execution of all these actions completes a cycle of reflection of teaching.

Using the data collection time points and the emergent themes from data collection (mentioned in Chapter 3) to chronicle their development of self awareness and cognition-induced behavioral change, the findings will be presented separately for each participant. The discussion follows, consolidating the participants' experiences to address the study's research questions.

Dr. Skeptical

Development of self awareness.

Beginning: Self-absorption

I found Dr. Skeptical's repeated expressions of concerns with his workload and uneasiness with evaluation of teaching practice, which aligned with the study's emergent themes of time management, self assessment and the study's impacts, to be most illustrative of his self-absorbed orientation at the study's onset. Despite his empathetic agreement to participate in the study as a means to help me out as a graduate student, he was very clear in establishing the priority of teaching within his myriad of responsibilities. In fact, he shared during our initial discussions in August that when he was hired, it was made clear to him that his primary job was to maintain his research program and funding. Accordingly, he interpreted teaching to be of secondary emphasis.

Coupled with his admission of a lower priority for teaching was his belief that he would not be impacted by study participation. Though unsettling to me, such a belief was reasonable in consideration of the limited amount of time he could allocate to study participation. Furthermore, I realized the importance of time management to him when he

chose a strategy of decreasing time spent on administrative duties to enable more time for

lesson organization. When I questioned his selection of teaching focus, he countered with, *"I*

have very little ability to reflect on classroom behaviors…" (interview, September 2004).

Desirous of avoiding a stalemate, I opted to share my observations of his teaching style to

prompt consideration of a teaching goal focus more amenable to objective measurement

within the classroom. Fortunately, our discussion took a more collaborative turn:

> I: ….Your understanding of the material is such a strength that you're able to make it work for the students.

> Dr. Skeptical: *If I were teaching a graduate class I'd be a lot more worried about the lectures…but this I can do without any notes basically*

> I: Yes and you can see that in your give and take with the students

> Dr. Skeptical: *So what do you suggest*

> I: …what I'm wondering about is the organizational aspect of it because you allow your ability

> Dr. Skeptical: *Yeah, I don't organize*

> I: Yes, and that's what I wanted to get at. The organization of that lecture time so that you can adequately cover what you need to cover and so that structure is there…

Consistent with the pressing demands upon his time, Dr. Skeptical relied upon his

subject matter knowledge to compensate for minimal organization of his lesson preparation.

Leveraging his subject matter knowledge, we decided to shift his teaching goal focus to

conduct of a brief review of lesson material at the end of each lecture. Aware of his priority

of work (research, teaching, etc.), the revised teaching goal focus provided a reasonable

compromise of time, effort, and potential for professional growth.

Middle: Mixture of self-absorption and forgetting oneself

As the study progressed, time management was a constant concern, yet Dr. Skeptical began to demonstrate signs of forgetting oneself in his articulations of his struggles to understand the causality of the study's impacts. When asked to share his feelings about the reflective process during our October 2004 interview, his initial comments seemed to continue within a self absorptive vein:

> Dr. Skeptical: *Um, the reflections are short, but I still find that I don't have real high quality time to do them. You know what I mean? They sort of, they're sort of, ah, one of the last things I think about doing when I'm tired and things like that.*
>
> I: Uh huh. So is there anything that I could have done about that?
>
> Dr. Skeptical: *No, I mean... in the world of priorities they slipped down and they became last, but, ah, oh yeah, I don't think that's terrible, but it is unfortunately …lower quality mental time…*

Explaining the placement of teaching improvement among his priorities as a novice instructor, Dr. Skeptical shared:

> Dr. Skeptical: *…it-it's* [teaching is] *among the lowest priorities I have right now…maybe in a few years after things are more established and I have a little more experience it might seem more important to me but …I don't know what my teaching is right now [laughter] improving or not improving. ...teaching is, ah, I don't know, less than a third of what's on my mind these days…*

Nonetheless, Dr. Skeptical diligently pursued improvement of his lesson organization via the conduct of lesson reviews at the end of each class. Despite asserting that students would learn better because *"the review will emphasize the vital aspects for students"* (week 2 anticipatory reflections), he struggled with his inability to be convinced of the direct impact of his actions. Would it really make a difference whether or not he gave reviews? Firstly, it was difficult for him to change his free-flowing teaching style to reserve time to conduct reviews, evidenced by his acknowledgement, *"the main effort I need is awareness during class that I need to*

finish new material sooner to allow more time for the review" (week 3 contemporaneous

reflections). Concurrently, he identified his engagement of student questions as a challenge to

his conduct of lesson reviews in sharing, *"Monday I was swamped with questions and did not get*

through the lecture material nor the review" (week 4 contemporaneous reflections). Secondly, he

was troubled by his perceived inability to assess his actions in saying, *"…it's the first time I*

ever taught so I don't really know how I can tell how this is making a difference in how I

teach" (interview, October 2004).

Interestingly, Dr. Skeptical's concerns with being a novice now focused upon

discomfort with understanding the *why* of teaching improvement more than his initial focus

upon *how*. In pursuit of *why*, he began to move beyond the confinements of his personal

concerns of time management to entertain broader professional concerns. Why is the conduct

of lesson reviews important?

End: Emergence of self awareness

By the study's end, Dr. Skeptical's willingness to self assess and share insights of the

study's impacts were indicative of his maturation as a reflective thinker. Accordingly, I

found the transparency of his following thoughts to be most profound:

> *I am noticing that I fail to give a written summary at the end of class. It is usually*
> *because I run out of time and students start packing up to leave before I get to it. This*
> *week I will try to come up with a creative solution of a new way to accomplish the*
> *goal.* (week 8 anticipatory reflections)

Previously, he had attributed his failure to give reviews to too many student questions during

lectures (in weeks 2 and 4 contemporaneous reflections). Now, he had identified his own

behavior as problematic and was challenging himself to change. This was particularly

noteworthy because his assessments preceded my observation of the same phenomenon –

was he the same instructor who had been so reluctant four weeks earlier to analyze his classroom behaviors because of his novice status? Once we refined his teaching strategy in our October 2004 interview, again he exhibited competence in self assessment in concluding, *"I thought about how this review strategy will complement my natural style nicely"* (week 8 contemporaneous reflections).

After experiencing success with the new review strategy, Dr. Skeptical began his own exploration of the review's impacts. What did his students think about his use of reviews? He first shared in his week 8 retrospective reflections that his greatest satisfaction with the week's study experiences was "*in a mid semester review a student asked to have a summary outline at the start of class so I think this is something they want*". Dr. Skeptical acted upon the validation offered by the student and decided to continue the practice of using the summary outline at the start of class:

> *I did the review at the beginning of class. I think the students like it because I asked them if they like it and they said yes.… I am glad that the students said they like the outline listed at the start of class* (week 9 contemporaneous reflections).

> *I will keep going with the outline at the start since students like it* (week 9 retrospective reflections).

Concurrently, he began to express awareness of the impacts of his use of reviews upon his students and himself. Delving beyond acknowledgement of the students' appreciation of the practice, Dr. Skeptical began to reflect upon the personal impacts of his use of reviews:

The outline review is very natural for me. I plan it before lecture without thinking too hard to remember it. I think that going through my lecture notes to extract an outline review is helpful for me to digest the global issues in the lecture before I deliver it (week 10 contemporaneous reflections).

I did like how the review at the start of class worked out. I think it was easy to do and helped me organize my thoughts. The students also like it (week 11 meta-reflection).

For someone who previously had not been overly concerned with lesson preparation, these were phenomenal admissions, particularly considering the additional time Dr. Skeptical would have to use in reviewing his lecture notes to create an outline. Not to mention that he now recognized how creation of the outline was helpful to him (in terms of lecture delivery) as well as the students.

Furthermore, Dr. Skeptical began to express engagement in reflections upon teaching practice beyond his teaching goal focus: *I am thinking about a wider perspective of teaching methods* (week 10 retrospective reflections). Could this be the same person who a month earlier had claimed teaching to be "…*less than a third of what's on my mind these days…*" (interview, October 2004)? In his reflections upon teaching practice, Dr. Skeptical realized he had gained awareness and empowerment as a result of study participation:

The study has made me more aware of how I am in the class room. By adding the start of class outline which is an action that I would not have done without the study, I have become more aware of what actions I take naturally. I am also more aware of the potential to change things I do in class.…without the study, and without much

experience, I think I would have just performed in the classroom in a way that is just

natural for me. Having participated in the study has made me more aware that I can

pick and choose my actions in the classroom. (week 11 meta-reflection)

In addition to embracing the potential to change his own classroom behaviors, Dr. Skeptical

surprised me with his contemplation of becoming a change agent within his sphere of

influence in predicting, "*I will be able to spread the innovations that I am working out*"

(week 10 retrospective reflections). For someone who had entered the study dubious of its

impacts and import, Dr. Skeptical's readiness to spread the knowledge gained through his

study participation is heartening and most illustrative of Rodgers' (2002) conceptualization

of the development of self awareness.

Throughout Dr. Skeptical's development of self awareness, I noticed an increase in

responsibility as his directness matured as surmised in Dewey's four attitudinal prerequisites

for reflection. His newfound thoughts found expression in his transformed teaching

behaviors. Specifically, his cognitions began to induce behavioral change in a manner

consistent with the Artzt and Armour-Thomas (1996) framework for the interdependency of

teacher cognition and instructional practice.

Cognition-induced behavioral change

Beginning: Struggle to identify a teaching goal focus

Dr. Skeptical entered the study with time management concerns and the low

prioritization of teaching practice, which I considered to be significant challenges to his study

participation. Additionally, his lack of teaching experience fueled a discomfort with self

analysis of teaching behaviors addressed in the preceding discussion of his development of

self awareness. Accordingly, his overarching cognitions regarding teaching improvement

were fairly defensive: (a) his primary job was to maintain his research program and funding, (b) teaching was of secondary emphasis, and (c) he was unfamiliar with reflection and evaluation of classroom behaviors. I believe these reasons fueled his expectation that he would not be impacted by study participation.

Nonetheless, he agreed to participate in the study. In the self assessment period preceding my initial observation of his classroom behavior, he decided to focus upon decreasing the amount of time spent on administrative duties from approximately three hours a week to less than one hour a week to allow more time for lesson organization. Aside from his self reporting of his time expenditures between administrative and lesson preparation activities, which are basically contained within the preactive (or anticipatory) stage, I could not objectively observe progress made towards goal attainment. Nevertheless, I proceeded with the initial classroom observation and noted the following about his instructional practice:

> He began class promptly at 1435 hours, enabling quiz administration from 1437-1446 hours. His initial comments following quiz administration included, *"Was that tough?" … "It was challenging…"*. He began the lesson by stating, *"Last class we did the colliding students…today we have two things to do…How do we start this problem?"* In response to student input, he replied, *". ..Great idea…"*. [Side note: As the class progressed, I noted that he had a very interactive style , striving to maintain contact with students by only working at the board when necessary.] At 1524 hours, he gave Question 1 with the Personal Response System (PRS), [Side note: with only a minute left in the class period, students entered responses, but he didn't have time to give the class the answer or discuss it.] Students began to pack up and leave at 1525 hours. [Side note: Accordingly, two questions immediately came to mind: Was the question with PRS basically done to get attendance? Is the teaching goal focus reasonable for this study?]

In our subsequent September 2004 interview, I expressed my discomfort with his teaching goal focus in stating, "That's why I really wanted, you know, to talk to you face to face

because it seems like it's [his teaching goal focus] sort of hard to put your fingers on and I wanted to do something that we can, you know, really be clear about". Dr. Skeptical readily concurred with my assessment of the ambiguity of his teaching goal focus and after a brief discussion we articulated the revised teaching goal focus to be to "develop innovative methods to summarize lesson material while maintaining student interest" (interview, September 2004).

Middle: Pedagogical dissatisfaction evident in first cycle of reflective activities

Armed with a refined teaching goal focus more consistent with low-inference teaching behaviors previously discussed in Chapter 2, Dr. Skeptical's initial round of experiences with conducting the lesson reviews seemed to alternate between failure and moderate success.

Utilizing Artzt and Armour-Thomas's conceptualizations, Dr. Skeptical's overarching cognition was synonymous with his new teaching focus. As previously stated, he desired to develop innovative methods to summarize lesson material while maintaining student interest. In realizing his overarching cognition, Dr. Skeptical enacted the cognitive processes at preactive, interactive, and postactive stages.

His preactive actions were best characterized by his week four anticipatory reflections in which he stated, "*list in my notes is all I have time to do this week*". Consequently, his interactive actions focused upon monitoring of his anticipatory actions and modification of his instructional practice to enable compliance with his overarching cognition. His week four contemporaneous reflections provided validation of such orientations in sharing, "*I list review in my class notes.… I think I need to figure out a way to trick the students into listening. I need to get the review out without letting on it is the end of class.*" His postactive

actions revealed a growing comfort with authentic evaluation of his instructional practice. His week four retrospective reflections acknowledged progress in stating, *"my efforts improved a little because I thought about the goal more toward the end of the week."* However, the following week he experienced a setback in the quality of time dedicated to thinking about goal attainment in admitting, *"I did not have too much time this week to think about it beyond just including a section in the notes to remind me to do it"* (week 4 retrospective reflections). In alignment with Artzt and Armour-Thomas' conceptualization, Dr. Skeptical continued the postactive stage by reflecting upon his instructional practice.

Consistent with his reflections of experiences within the phase of cognitive processing, Dr. Skeptical's recall of classroom behaviors and experiences revealed a growing commitment to the change process. During weeks 2 through 4, once a week he did not conduct reviews because of the significant number of student questions. In two of these instances his coverage of lesson material was affected as he described, *"Monday I was swamped with questions and did not get through the lecture material nor the review"* (week 4 contemporaneous reflections). When he did conduct the reviews, the outcomes were mixed. His strategy to solely conduct the review at the end of class on Friday of week three seemed to yield encouraging results. Dr. Skeptical asserted, *"This worked ok. It got the class into new material faster and they seemed interested"* (week 3 retrospective reflections). He found this success to be short-lived for the following week; he accounted, *"Wednesday the review was done, but students did not seem to pay attention. They just got ready to leave."* (week 4 contemporaneous reflections). Undeterred, he used the same review strategy the following lesson and concluded, *"Friday review went ok. We have a test and so students are getting nervous and paying lots of attention"* (week 4 retrospective reflections).

My experience with Dr. Skeptical's conduct of the lesson review closely mirrored his account of student inattention provided in his week 4 contemporaneous reflections. During my October 2004 classroom observation I noted the following about his instructional practice:

> At 1434 hours he posted quiz results and began class promptly at 1435 hours, addressing the quiz in sharing the news that some students did well on the quiz and asserting, *"if you didn't ace the quiz, need to figure out how. It's kind of basic stuff"*. He then jumped right into a problem to figure out how to define a system, followed by initiation of Chapter 6 lesson material at 1442 hours. Ten minutes later, he gave a mid lesson summary of sorts reinforcing definitions and stating, *"…part of what we're going through today is a lot of names and definitions, i.e. ground state…this is one of the key points we'll try to get to today..."*. At 1512 hours, using the PRS, he gave students two minutes to solve a problem grounded in determination of an electron's kinetic energy. As he showed a simulation of capacitor plates at 1517 hours, students started to chatter. [Side note: He didn't comment on this and I wondered if he was aware of the chatter.] At 1521 hours, he began to give his review. Within a minute, students began to exit the room as he continued to talk. [Side note: Accordingly, one question immediately came to mind: How to do a review without students leaving?]

Despite our collective unease with episodic student inattention to his conduct of reviews, I found his responses to be fairly provocative. His week 5 meta-reflections revealed significant expansion of his overarching cognitions and cognitive processes in sharing, *"trying to make a review at the end of class is making me realize that class time management is tough because trying to include an activity at a set time is difficult. My style is to usually not plan and schedule the lecture too much, and so a scheduled event is tough although I appreciate the idea that this review will benefit students."* Consequently, he seemed to subconsciously understand the interdependency of cognitions and instructional practice in acknowledging, *"it has changed my practice in that I am doing reviews about half the time. I did not do this before thinking about it."*(week 5 meta-reflections). Cognizant of his growing commitment to actualization of his overarching cognitions, Dr. Skeptical revealed,

"*I am starting to do class reviews without thinking*" (week 5 meta-reflections). Bolstered by

his gains in experiential knowledge, Dr. Skeptical's thinking began to shift from preactive

actions to remind him to perform the reviews to interactive and postactive assessments of

how to best integrate the reviews within his lectures.

End: Behavioral change consistent with his classroom experiences

By week eight, Dr. Skeptical was in strong pursuit of knowledge to correct

shortcomings in his review strategy, evidenced in his conclusions that "*I am noticing that I

fail to give a written summary at the end of class. It is usually because I run out of time and

students start packing up to leave before I get to it. This week I will try to come up with a

creative solution of a new way to accomplish the goal*" (week 8 anticipatory reflections).

Consistent with the Artzt and Armour-Thomas framework for the interdependency of teacher

cognition and instructional practice, he attempted refinement of his overarching cognitions

via expansion of his pedagogical content knowledge in two manners. First of all, he decided

to discuss his concerns during our upcoming interview and shared the following plan of

action via email: "*I will try to come up with ideas after the meeting with …[the investigator]

tomorrow*" (week 8 anticipatory reflections). Since I shared his concerns as indicated in the

researcher's side notes in the classroom observation excerpt, I was prepared to address his

review strategy and teaching style:

> I: …And I saw what happened on …Monday because you got to the last few minutes
> and then you had the same thing – you know, the students starting to move, close
> their books and you were trying to say something and they were exiting the
> classroom. So that made me think about, you know, what's another way where we
> can be innovative about getting that same review done but not holding it to the last
> two to three minutes
>
> Dr. Skeptical: *Uh huh*

I: keeping them off balance. And what I saw you doing and I'm not sure if this was deliberate or not, was that as you would go from the different topics, you would give like a, ah, review of sorts as you were transitioning from point to point. Was that something you had planned or are you even aware of that

Dr. Skeptical: *No, not at all.*

I: Yeah,…you'd talk about whatever you were going to say and before you'd say, "Alright, are there any questions before we move on to blah, blah, blah?" , you'd typically give a sentence or two where you would encapsulate what was important to remember about that particular concept.

Dr. Skeptical: *Okay*

I: ….So what I'm thinking- just, ah, looking at your natural flow and how you interact with your students and everything else, is that for those three or four topics that you're telling them that are most important to you, already have them on the board at the side and so as you're going from section to section, when you stop to, you know, transition between the two- you give your main points about blah, blah, blah, and I mean I don't know how overt you want to be about that because you could do it and you could check it or whatever else. (interview, October 2004)

Informed by my assessment of his behaviors and knowledge of alternative strategies for conduct of reviews, Dr. Skeptical provided the following summary of our interview: *"This week on Tuesday I met with… [the investigator]. We revised the plan. I am now going to list a review outline at the start of class and refer to it during class"* (week 8 contemporaneous reflections). During the same period, he attempted to enhance his pedagogical content knowledge through reading of articles he had selected pertaining to lesson organization of large lecture classes (refer to Appendix L, Dr. Skeptical's Reading List). Unfortunately, he was displeased with his reading of "Big, but not bad" because *"….reading the article did not teach me anything. It just had stories about unusual experiences"* (week 8 retrospective reflections). Convinced to *"…look for articles to read with much more care"* (week 8 retrospective reflections), he professed a desire to perform the preactive activity of reading

more articles, yet in his week 11 meta-reflection he admitted, *" I found some papers that I am interested to read, but have not had time to read yet"*.

Nonetheless, he forged ahead with his refined review strategy and self assessed his instructional practice positively. I found the following week 8 contemporaneous reflection to be most illustrative of the interdependency of his cognition and instructional practice: *"I did this* [the review] *today and it went pretty well. The new plan has been very natural for me to integrate into lecture. I will do the same thing Friday."* Equipped with knowledge to enable integration of the review with his teaching style, he had modified his overarching cognitions. Consequently, he had to execute different preactive activities for his new plan of listing an outline prior to the start of his lecture. Via the success experienced in the execution of his modified instructional practice, his postactive evaluations were most supportive of reinforcing cognitions consistent with continued use of his refined review strategy. Dr. Skeptical also experienced positive reinforcement of his modified instructional practice via student expressions of appreciation of his efforts. In fact, he pledged, *"I will keep going with the outline at the start since students like it"* (week 9 retrospective reflections).

I also found his refined review strategy to be successful and made the following notes during my November 2004 classroom observation:

Upon entering the room, I saw the following outline on the board:

-Heat capacity program
-Melt ice/boil water
-Non Einstein solid
-Room temp heat capacity of metal

He began his lecture by stating, *"This is what we're doing today* [referring to outline above*]…Friday we were talking about…remind ourselves what we did…this is what*

we're going to do in lab next week..." He signaled his transition between topics in saying, "*Let's talk about ice...*". As he talked, he pointed to the outline. At 1503 hours, he signaled another transition in stating, "*Let's do problems with the Non Einstein model...*" Concurrently, I noticed that Dr. Skeptical had updated the outline in the following manner:

Melt ice/boil water
1.23 J/K   1.01 J/K

At 1507 hours, he gave the first PRS problem involving calculations with a non Einstein solid, followed by additional problems involving calculations of metals' heat capacities. At 1523 hours, he shared, "One comment just about what we've been doing…". At 1524 hours, the students began to pack up to exit the classroom.

I was impressed by Dr. Skeptical's seamless integration of visual and auditory markers to highlight his review strategy. Aware of his discovery that the preactive activity of preparing the outline enabled him to "…*digest the global issues in the lecture before I deliver it*" (week 10 contemporaneous reflections) *and "…organize my thoughts"* (week 11 meta-reflection), I felt our November 2004 interview revealed that he had conquered some of his earlier suspicions of the review strategy's impacts:

Dr. Skeptical: *but the outline I think came in handy at the end to keep things on pace.*

I: What was on pace-are you talking about time wise?

Dr. Skeptical: *Yeah, yeah time wise and get all the topics covered and, you know, it was nice for me to have it up there too. I could just look at it and know where I was supposed to be [laughter].*

Interestingly, his students seemed to share similar views concerning the usefulness of his lecture outlines. Of the 42 student responses to the question of "How does your instructor's use of lecture outlines affect your understanding of lesson material?", 6 gave no comment and emergent classifications from the remaining 36 responses were 'neutral/no effect' (7 counts); 'helpful' (18 counts); and 'very helpful' (11 counts). Notable descriptors found in the 'helpful' classifications were "helpful", "direction", "organized", "prepared",

and "helps understanding" as evidenced by the consolidation of student responses in Table

4.1.

Table 4.1

Student Perceptions of Impact of Instructor's Use of Lecture Reviews

Q: "How does your instructor's use of lecture outlines affect your understanding of lesson material?":

Theme	Frequency	Selected Specific Student Comments
Very helpful	**11**	Helps greatly, well thought out plans and covers most material well
Helpful	**18**	Gives direction of lecture
		If I don't understand something it helps to see what we are covering
		My notes are more organized when the lectures are organized
		It helps me be more prepared – yes it is a help
		It helps understanding because everything sort of links together
		That's the only way I got the lesson
Neutral/No effect	**7**	Doesn't affect understanding, but it is very nice to see what we have done and what we will do for each class
		I don't think it benefits or hurts but if I didn't take notes I would be struggling
		No, but does help to know what's going on that day
Detrimental	**0**	
No comment	**6**	

       Concentrating upon the 36 students who took the time to address the usefulness of Dr.

Skeptical's use of lecture outlines, it was encouraging to find that 29 or 80.6% of them

considered the practice to be helpful in enhancing their understanding of lesson material.

Mindful of Dr. Skeptical's concerns with the direct impact of his use of lecture outlines upon student understanding, these survey results seemed to suggest that his transformed instructional practice aligned with student needs. Framed within the challenges to reform instructional practice, Dr. Skeptical's accomplishments suggested reform was achievable, even by novice science college instructors with considerable research responsibilities. In fact, Dr. Skeptical, who began the study as an unlikely advocate for reform, by the study's end was embracing the relevance of teaching improvement. Who would have thought his final reflections of his study participation would include:

> *By adding the start of class outline which is an action that I would not have done without the study, I have become more aware of what actions I take naturally...I am also more aware of the potential to change things I do in class.... Without the study, and without much experience, I think I would have just performed in the classroom in a way that is just natural for me. Having participated in the study has made me more aware that I can pick and choose my actions in the classroom. It will probably keep me thinking about classroom management for some time.* (week 11 meta-reflection)

I believe that knowledge affords empowerment through individuals' awareness of their ability to exercise a wider repertoire of behaviors. As a result of his study participation, Dr. Skeptical learned to align his cognitions and instructional practice such that he could experience development that was personally and professionally relevant.

Dr. Willing

       Development of self awareness.

Beginning: Self-absorption

       Analysis of Dr. Willing's articulation of her teaching goal and subsequent self assessment of her teaching behavior, both of which are emergent themes from the study, presented considerable evidence of her self-absorbed orientation at the study's onset. Specifically, she embarked upon her developmental journey with the following goal: *"I plan to integrate more 'everyday-life' references so that students can understand chemistry in a broader context"* (interview, August 2004). In stark contrast to Dr. Skeptical's initial suspicions regarding the direct impact of changes in instructional practice, Dr. Willing seemed to believe that as a result of her action of including more real life examples in her lectures, students would gain a broader understanding of chemistry. Accordingly, her action was the primary focus and student understanding was presumed to be a natural product of her action. Also, Dr. Willing did not express a level of specificity with her use of real life examples because *"I'd always thought of it in terms, you know, of more real life is good"*. She presumed more to be better. In keeping with this presumption, her focus was upon technique-how could she acquire a large repertoire of real life examples to use at will within her lectures? Accordingly, her discourse mirrored her preoccupation with technique (refer to Appendix J, Excerpts of Interview Transcripts with Dr. Willing).

       In our first classroom observation discussion, she appeared concerned with the absence of real life examples in the lecture and was hopeful that through execution of her developmental plan she would obtain new ideas for real life examples to include in her lectures. Interestingly enough, she did not keep a record of the real life examples she had

solicited from her students on the first day of class when she asked them what came to mind when they thought of chemistry. Though she had expressed an earlier concern to know what interested her students, she missed an opportunity to build upon their images of chemistry – possibly because she was conditioned to be the transmitter of information and not the receiver.

In her first self assessment of her classroom behavior that related to her teaching goal, she said:

> *I, not great, I mean I think that,…part of the material is, ah, sort difficult to take the big step to go from the atomic level and electron configurations and all that and show how that shows up in your every day life. So I think what I tried to do was more of an intermediate step, which was to …relate the information to stuff they have done before in class with the stuff they were gonna do in the future and maybe give them the idea in their head that maybe it will be important to learn because it's going to show up when they talk about chemical bonding….I think it doesn't make sense to take out 20 minutes to say, "well, this leads to B which leads to C which leads to D which leads to E which leads to your real life."* (interview, September 2004)

Understanding the difficulty the lesson material posed for Dr. Willing's incorporation of real life examples, I concurred with her assessment in stating, "Yeah, because as I was sitting there I was trying to think of…what you could try to pull out and it is difficult – how far do you want to go with what they understand…" (interview, September 2004). As we continued to discuss possible strategies for incorporation of real life examples and her student population, she seemed to realize the collaborative nature of our interaction and expressed a significant degree of relief:

One of the really nice things too about this process for me has been that you aren't,

you know, coming in grading me, telling me whether or not I'm gonna get my job next

year… which is how it's always been before so it does feel, I mean having someone

like you it's easier to be much more honest and open. I don't have to sort of hide my

faults … (interview, September 2004)

Conditioned to masking faults in previous interactions with external observers, Dr. Willing

seemed to realize that this experience would be different. To mature in reflective practice,

she would have to embrace transparency of her thoughts and actions. In fact, camouflage of

her thoughts and actions on any level would serve to sabotage the extent of development

possible through her involvement in the study's reflective processes.

Middle: Forgetting Oneself

During this period, Dr. Willing completed her knowledge level requirement of

reading all the articles comprising her personal reading list. Though she performed limited

experiments with inclusion of real life examples in her lectures, she seemed to center more of

her efforts upon acquisition of pedagogical content knowledge through reading. In fact, the

tenacity she exhibited in making meaning of her readings was most demonstrative of the

study's emergent themes of steps in gaining understanding, reflection on practice and

teaching goal focus. As a result of her efforts, she concluded:

The readings have also ….helped me to refine my goals, particularly… "Real world"

doesn't have to mean only the world outside of chemistry. In addition to applying the

material to their everyday lives, it is also important to synthesize the concepts within

chemistry. I think my goal could be better stated by including a phrase from the Rupp

article: "going for understanding" rather than just teaching facts. (week 5 meta-

reflections)

By week 5, Dr. Willing had read seven articles that all addressed different means including

the use of models and analogies to enhance student understanding of science. Though the

articles varied in the extent of direct application of the knowledge to low-inference teaching

behaviors, they fostered contemplation of issues related to the main teaching dimension of

interest/student engagement (See Appendix N, Dr. Willing's Reading List Reflections). As

she contemplated the meanings of these articles, she voiced several sentiments that illustrated

a process of forgetting self.

Sentiment 1. "*The paper discusses a "social constructivist" theory. I'm not sure

what this is*" (reading list reflections, October 2004). This was significant for two reasons.

Firstly, in expressing her uncertainty about social constructivist theory, Dr. Willing

demonstrated a commitment to transparency. Previously, she probably would have been

resistant to acknowledging such a knowledge gap. Secondly, the article introduced her to an

educational theory that is drastically different from her stated teaching orientation of teacher-

centered instruction. In the article's presentation of constructivism as a driving force shaping

how analogies and models are used in instruction, she was challenged by a deeper level of

cognitive processing. Confronted with a pedagogical 'fork in the road', she had a choice to

make. Would she solely concentrate on modification of an outward behavior that would not

require confrontation of her beliefs or would she critically examine what was driving her

outward behaviors? Regardless of her choice, her act of self disclosure in highlighting her

unfamiliarity with social constructivist theory was an important step towards forgetting

oneself.

Sentiment 2. "*I think we should all consider a) what would we like our students to know about our subject, and b) are we providing an atmosphere in the classroom that facilitates these goals?*" (reading list reflections, October 2004) Here, Dr. Willing expressed the need for teachers to examine their own intentions and the impacts of their actions upon the classroom climate. In so doing, she expressed a shift away from the self-centered nature of teacher-centered instruction towards contemplation of the student perspective. What should students know and how were teachers providing a supportive environment to facilitate student growth? Consistent with the shift, she must subordinate her needs to those of her students, which is another manifestation of progress in forgetting oneself.

Sentiment 3. "*This was very different from the other articles, because it brought up the dangers of trying too hard to make material relate to students' real world. I really liked the statement on p. 468 that we need to have a clear understanding of the limitations our models possess and make sure we are not endangering students' abilities to gain a deeper understanding by our oversimplifications*" (reading list reflections, October 2004). In this statement, Dr. Willing expressed the need for deliberation in how models are used – more is not and should not be the goal. Furthermore, she identified clarity and facilitation of enhanced student understanding as parameters for the use of examples in making real world connections. Concurrently, her thoughts revealed a shift from technical to conceptual emphasis in real life example usage. In so doing, she positioned herself to act more as a channel than reservoir of knowledge, which is counterintuitive to self-absorptive or teacher-centered instruction.

Sentiment 4. "*The article also helped remind me how scary freshman year can be. I try to remember how nervous many students are when they approach me*" (reading list

reflections, October 2004). In these emphatic statements, Dr. Willing saw the need to forget herself. To better relate to her students, she thought it important to remember how it felt to be a freshman student.

Sentiment 5. "*That students were rewarded for coming up with their own real-world connections to chemistry. I liked this because then the instructor doesn't have to guess what the students consider to be real-world*" (reading list reflections, October 2004). With this statement, Dr. Willing demonstrated a willingness to accept a different strategy for gaining real life examples. In this strategy, the students would be empowered to select the examples. Instead of maintaining strict control, she would share power with her students to gain insight of their thoughts and build upon their knowledge structures. In so doing, she would facilitate rather than dictate discourse. Analogous to the shift discussed in sentiment 2, once again she would have to subordinate her needs to those of her students, manifesting progress in forgetting oneself.

As a result of her readings, Dr. Willing experienced advancements in her conceptual understanding that provoked her transition from a self-absorptive orientation to forgetting oneself. No longer was the mere inclusion of more real life examples sufficient as a goal. The manner, intention, and specificity of real life example selection required a considerable degree of deliberation. She became concerned with how models, analogies, and examples were used; their limitations; and the alignment of the students' developmental readiness with the instructor's use of models and analogies. Though the aforementioned sentiments attested to shifts in Dr. Willing's cognitions, her efforts did not end with thinking. She took practical action.

As Dr. Willing's communications revealed evolution of her teaching goal, they also indicated her engagement in systematic self analysis of her teaching actions. An excerpt from her week two contemporaneous reflections showed her conduct of self analysis:

Q: What experiences (in and out of the classroom) indicate that my efforts in goal accomplishment are impacting my orientation to teaching and/or teaching practice?

I've had very interesting unexpected experiences this week [self assessment] *that are directly related to my overall goal* [teaching goal focus].... *Another professor sent an email to all faculty about chemicals in household products. Normally, I probably would have ignored this email,* [self assessment] *but since I realized it related directly to my goal,* [teaching goal focus] *I decided to incorporate it in class today* [steps in gaining understanding] *to see how the students respond* [feedback]. *I saw several students seem to get excited when they saw the connection between pool cleaners, toothpaste, and ionic compounds,* [feedback] *so I feel as though I'm at least taking a step in the right direction toward my goal* [self assessment].

Eschewing her former behavior, Dr. Willing read the colleague's email; considered its relevance for her class; realized its relevance and alignment with her teaching goal; and decided to include its contents in her lecture. All the previously described actions represented a significant departure from her earlier disposition of 'more is better' in which quantity was her sole concern. Furthermore her assessment of her use of real life examples was grounded in the student response and not her demonstration of a tangible teaching behavior. Bolstered by her students' positive reactions ("*I saw several students seem to get excited...*"), she concluded her classroom behavior to be "*...a step in the right direction toward my goal*".

Examination of the preceding contemporaneous reflection and Dr. Willing's reflections of the articles in her reading list revealed Dr. Willing's movement beyond her

initial strategy of adopting a general teaching behavior to attain a desired end. As a result of her readings and contemplation of their relevance to her teaching situation, she experienced the challenges associated with the science and art of effective employment of real life examples in her lectures. As she considered her students and the merits and limitations of the use of models and real life examples, she began to focus upon the impacts of her actions upon her students. With enhanced student understanding as an overarching aim, she realized her teaching actions had to be synergistic: *"Real world" doesn't have to mean only the world outside of chemistry. In addition to applying the material to their everyday lives, it is also important to synthesize the concepts within chemistry"* (week 5 meta-reflections). No longer was her focus upon accumulating an indiscriminate repertoire of 'one size fits all' examples, a self-contained mechanistic activity. Dr. Willing's journey in self awareness had progressed from self absorption to forgetting oneself.

End: Self Awareness

By the end of the study, Dr. Willing's articulation of the transformative nature of her evolving cognitions was most representative of the study's emergent themes of steps in gaining understanding, self assessment, reflection on practice, and teaching goal focus:

> *…Readings of constructivism: These have changed how I think of the role of student and teacher. Since most of my students aren't chemistry majors, it is not necessarily effective to teach to them the way that I would want to be taught. This aligns well with my initial goal of including more real-world applications, but I think it broadens this goal as well to include teaching using a broader style. For example, I like to learn deductively, as I feel this is the way that chemistry flows most logically. However, I'm aware that some students may learn better inductively, and so I think it*

makes since [sic] for me to vary my teaching style to try reach these students as well.

(week 11 monthly meta-reflection)

At this point, Dr. Willing's awareness of her personal learning style juxtaposed against those of her students was remarkable, especially her concession to adapt her teaching to reach more students. In five sentences she shared the synergistic impacts of reading about constructivism (representative of the emergent theme of steps in gaining understanding), identification of her preference for learning deductively (evoking the emergent theme of self assessment), acknowledgement of her predominately non-chemistry major student population and their preference for learning inductively (illustrative of the emergent theme of reflection on practice), and concentration upon her teaching goal (representative of the emergent theme of teaching goal focus). However, in refining her goal to focus upon student understanding as a consequence of her accommodation of constructivist principles, she realized that she would have to change some of her teaching beliefs. To reach more students, she needed to use approaches more consistent with their learning styles. Thus, she could not solely teach the way she preferred to learn- she needed to develop a repertoire of teaching approaches to reach more students. This admission was most counterintuitive to her original characterization of her teaching orientation "*... as a stylistic thing…*" that one accepted (interview, December 2004). She now realized the larger consequences of her observable teaching behaviors and was challenged to confront her own behaviors as a result of her observation of a fellow CH 101 instructor.

Dr. Willing's self-awareness was heightened by her observation of a peer's instruction. She found the observation enlightening. Excerpts from Dr. Willing's reflections

of her peer observation provided evidence of her receptivity to transformation of her teaching behaviors.

Q: How do their teaching styles align with your understanding of constructivism?
I heard a student say, "I like this class - he's funny!", which to me implied that Dr. Catalyst uses teaching methods that resonate well with the student interest.... It feels more like he tells a story than gives a lecture, and I think this fits well with the theory of constructivism.... the southern culture embraces storytelling.... The students are very diverse, but almost all are from the south, and so this is one commonality that would be logical to take advantage of (peer observation, November 2004).

Q: How have you benefited from your observations of other instructors?
Specifically, I can use Dr. Catalyst's examples in my class. I also realized that a lot of his examples were historical, so I would like to read more books on the history of chemistry so that I can present that perspective in my classes. Although it would be a difficult transition for me, I think I would be more effective if I were a bit more low-key like Dr. Catalyst since I think this appeals to more students and makes them more comfortable in the classroom (peer observation, November 2004).

In addition to stretching herself to read more to learn more about the history of chemistry, Dr. Willing was now contemplating changing her demeanor in an effort to make the students more comfortable. Seeing herself more clearly ("*... I think before I had more of an attitude of, ah, you know, this is the way that I teach... and that's just the way that I teach..."* – interview, December 2004) against the backdrop of a fellow CH 101 instructor, Dr. Willing realized that she could and should do more to support her teaching goal focus.

During our December 2004 interview as she reflected upon the responses of Dr. Catalyst's

students and contrasted them to her previous teaching experiences, she exemplified

achievement of self awareness within her teaching goal focus while simultaneously

discovering motivation for change.

> I: and you want to become more low key because because again you want to reach
> more students?
>
> Dr. Willing: *Ah, yeah, no-I think it has a lot to do with what I was just saying, you
> know, along the same lines as far as*
>
> I: culture-that kind of thing?
>
> Dr. Willing: *Yes-exactly. I think, I think it's still a culture thing. I just noticed that,
> you know, I don't know if I would say I go overboard, but for me, I like to stand up in
> front of a class, sort of stare at them in their eyes and say, "You will pay attention to
> me at this point", you know, I don't know if I necessarily need to be doing it at that
> level in this type of environment.*
>
> I: Uh huh.
>
> Dr. Willing: *I did in New York-I mean you have to do that-that's the way you get their
> attention [laughter]. Ah, but when I saw Dr. Catalyst was sort of effective at just
> getting up there and saying, you know, "We're gonna go ahead and get started" and,
> you know, students said, "Oh, I'll go ahead and listen" – a lot more mellow way of
> doing it, so I thought that's one way that I can, I control it. I mean I can try to stand
> up there without being as-don't know if abrasive is the right word-but, you know,
> without being as confrontational, um, you know.*

Furthermore with the insight gained from her current teaching situation, Dr. Willing revisited

her high school teaching experience and reflected upon student responses to her teaching

demeanor:

> Dr. Willing: *…. when I TA'd in New York and I needed to stand up there. I
> established that I was the authority figure….But since I haven't had any issues in a
> long time as far as somebody thinking-actually I don't think I ever had an issue with
> someone thinking I wasn't the authority figure,….maybe I can tone it back a little bit
> and still be just as effective without, ah, scaring away as many students. 'Cause that
> was the one thing I had in my last semester of high school. I was surprised 'cause I*

had, ah, you know, the department gave evaluations and everything was fine except for 2 kids who put negative on 'teacher is approachable'.

I: Ah

Dr. Willing*: You know, what's 2 kids out of however many but I thought about it and I tried to figure out where are they coming from and I think it has to do with, you know, me standing up there….and establishing that I, I was in charge-maybe I can still establish that without being quite as scary [laughter]*

I: Yeah, okay, okay, I think I understand what you are saying and again your motivation for this is being able to reach more students

Dr. Willing*: Uh huh.*

Dr. Willing was now demonstrating self awareness that mirrored Loughran's reflective model described in Chapter 2. In an anticipatory fashion she was thoughtfully considering the impacts of her teaching beliefs and classroom behaviors on her students and the classroom environment before teaching; contemporaneously she was evaluating her teaching from a student-centered perspective with a sensitivity to student response as she was teaching; and retrospectively she was considering how to build upon what she had experienced in her earlier teaching situations – even going back several years. She was operating at a level of self awareness most consistent with Dewey's conceptualization of reflective practice.

Cognition-induced behavioral change.

So how did Dr. Willing move from a teacher-centered to a student-centered focus in the course of 14 weeks? Examination of the link between her cognitions and instructional practice is quite enlightening.

Beginning: Cognitive dissonance

During her initial self assessment exercises, Dr. Willing revealed a complex integration of beliefs and goals regarding her teaching. Though she first acknowledged, "*to*

reach maximum # of students, a variety of teaching techniques should be incorporated", she also realized she *"…had more of an attitude of…this is the way that I teach…and that's just the way I teach..."* (interview, August 2004). Secondly, stating *"it's important not to use analogies so much that you stray from the topic..."* she also conceded , *"I'd always thought of it in terms, you know, of more real life is good*" (interview, August 2004). Against the backdrop of these competing beliefs, her teaching goal was *"…to integrate more 'everyday-life' references so that students can understand chemistry in a broader context*" (interview, August 2004). Synthesis of her aforementioned beliefs and goals appeared to result in a dichotomous mix of teaching foci. Her desire to pursue student understanding and reach a maximum number of students suggested a student-centered focus, yet her resistance to changing her teaching style implied a teacher-centered focus.

How would such a dichotomous mix of her professed beliefs and goals be demonstrated in her instructional practice? During the first class observation, she did not incorporate any real life examples in her lecture and I wondered why. During our discussion of the classroom observation, she justified her action by explaining the difficulty of the lesson material and its incompatibility with her goal. She further rationalized that it was better for her students that she perform the intermediate step of relating previous and future class activities rather than forcing the inclusion of examples just for the sake of inclusion. Cognitively drifting between two teaching orientations, her instructional practice followed suit. Lacking anchor in either teaching orientation, she pursued a 'middle of the road' stance that compromised clarity for action. I could not charge her with inaction, yet I could not say that her actions were evident to me as an observer. If her actions were unclear to me, how were they to her students- the professed focus of her efforts? Fortunately, I had the

opportunity to discuss her teaching actions at length to gain appreciation of her teaching actions.

Middle: Emergent clarity of teaching focus

Dr. Willing's monthly meta-reflection at week 5 attested to a refinement of her teaching goal. She asserted that, " *'real world' doesn't have to mean only the world outside of chemistry…it is also important to synthesize the concepts within chemistry*". Furthermore, she realized her focus should be "*going for understanding rather than just teaching facts*". With these admissions, a clear link between her cognition and instructional practice was evident. For example, after reading the articles comprising her knowledge level reading list, her sentiments illustrated the interdependency between her cognitive understanding and processing of the readings and her instructional practice. She identified the relevant component in the cognitive activity of reading in sharing, *"…but I think the best part of the readings has been that I now feel like I have gained a more big-picture understanding of potentially effective educational techniques (some which may work for me, others may not)* (week 4 retrospective reflections). In an earlier reflection, she described the cognitive processing she needed to do in order to realize her teaching goal in stating her desire to "*try to adapt some ideas and/or use them as an inspiration to expand my teaching 'toolbox'*" (week 3 retrospective reflections). Lastly, she indicated the result of her cognitive activity: change in instructional practice. She vowed, "*I can continue to apply specific ideas I come across in the readings*" (week 4 retrospective reflections).

Midway through the study, Dr. Willing's accumulation of newly acquired knowledge was being manifest in her instructional practice. Applying what she was learning, she identified her efforts to contextualize ("*just throwing those…couple extra words in there…*"-

interview, October 2004) her classroom demonstrations and use of actual situations as small

observable differences in her instructional practice. I also recognized her emphasis upon

contextualization and made the following notes during my October 2004 classroom

observation:

> I noticed several instances of inclusion of real life examples: she passed around the products of a thermite reaction for students to observe as a reminder of previous lesson material; she correlated the lesson material to biology, referring to enzymes as biological catalysts and linking them to DNA; she addressed the decomposition of hydrogen peroxide, linking it to an earlier class activity and her discussion of catalysts; and she used the analogy of a hill to explain energy diagrams.

Within these actions I saw a more conservative interpretation of real life examples.

Consistent with her discovery that real world does not have to be exclusive of chemistry, I

interpreted her strategy for real life examples to primarily rest upon creation of common class

experiences to connect topics within the lessons. During our October 2004 interview, her

operationalization of real life examples validated my characterization of her use of real life

examples. She also articulated an increasing influence of constructivism upon her

instructional practice.

> I: Okay. So how would you now define real life examples…?

> Dr. Willing: *Well, another thing that's helped me a lot is just doing the reading on constructivism over the last couple weeks…it sort of changed to-ah, my initial goals were to having the real world seemed like I was taking and would somehow have to force it….to the topic, whereas when I'm thinking of it sort of from a different angle, from the idea of…constructivist point, you know, you know, um, taking into account students' previous experiences….where they're coming from and also the idea of, you know, just trying to always to set a context for the information… um, and try to bridge things that way rather than, you know, forcing real world…*

Possessing a clearer understanding of her desired end of enhancing student understanding,

the means for accomplishment of her goal became more defined. Within such definition, Dr.

Willing began to actively explore and gain experience in contextualizing her presentation of real life examples. Also with enhanced student understanding as her focal point, she crafted her use of examples to expand student experiences and comfort with chemical activities. In short, her instructional practice was beginning to emulate the emergent clarity of her cognitions.

End: Commitment to student-centered focus

By the study's end, Dr. Willing's ease with conversational usage of terms such as constructivism, misconceptions, teacher-centered, and student-centered was compelling, especially since I had not introduced any of these terms and she had not used any of these terms in our initial conversations at the study's onset. As I probed the depth of her understanding of these terms in analysis of her discourse and classroom behavior, I found the murkiness of her initial teaching orientation to be replaced with a clear commitment to constructivist principles. Her successful incorporation discussed during our December 2004 interview of an anecdote on Prohibition provided insight of her cognition-instructional practice link.

Returning to the Artzt and Armour-Thomas conceptualizations, Dr. Willing's peer observation spurred her to express a new overarching cognition: "…*the southern culture embraces storytelling…*" and "…*I think it's important, you know, either I make all of them* [her students] *change or I adjust my style to try to, ah, you know, work in with the culture*" (interview, December 2004). To realize this overarching cognition, she devised a different strategy to complement her preactive stage of cognitive processes: " *I also realized that a lot of his* [colleague she observed] *examples were historical, so I would like to read more books on the history of chemistry so that I can present that perspective in my classes*" (interview,

December 2004). Accordingly, her preactive preparations enabled her incorporation of

storytelling as a modification of her instructional practice:*"…but I think pulling a little bit in

here and there of stopping and telling a story, I've tried to do that, especially over the past

couple weeks…I think one example when you were there was Prohibition and methanol and

ethanol. And it seemed to, what seems to happen when I look at the kids is they kind of perk

up. They look up from their notes for a moment, it's almost a break, in a good way…*"

(interview, December 2004). Throughout the sequence of events surrounding her

presentation of the Prohibition anecdote, Dr. Willing exhibited a student-centered focus. She

recognized the importance of culture and decided to use her understanding of the students'

southern culture to shape her teaching. She opted to present chemistry within historical

contexts even though she was not naturally inclined towards a historical perspective. Despite

self assessment of her learning preferences as "*linear and straightforward and …perfectly

happy with no stories*" (interview, December 2004), she stretched beyond her comfort zone

to present her students with an original story about Prohibition.

I was also impressed by the changes exhibited in Dr. Willing's usage of real life

examples and made the following notes during my November 2004 classroom observation:

> [Side note: Expanding upon her previously demonstrated comfort in contextualizing examples, I witnessed substantial diversity in the examples she employed.] I classified her examples into five general types: historical, personal, general application, storytelling, and discipline-specific application. I categorized her discussion of carbon tetrachloride's molecular structure and properties as historical due to the grounding of the discussion within carbon tetrachloride's historical use. In addressing vinegar and baking soda as an example of an acid-base reaction typically encountered in childhood, she attempted to forge a personal connection between the material and daily life. Within the same vein, her description of the common uses of acetylene in welding torches accounted for its characterization as general application. Taking on the role of storyteller, she told an anecdote about the making of liquor during the Prohibition and explained the occurrence of blindness due to methanol impurities in the liquor. Lastly, she explained the importance of water solubility to

organic chemistry by contrasting the solubilities of methane and methanol, garnering its categorization as a discipline-specific application.

These attempts to provide a variety of connections seem to flow from her interpretations of her observation of a colleague.

Q: How have you benefited from your observations of other instructors?

Specifically, I can use Dr. Catalyst's examples in my class. I also realized that a lot of his examples were historical, so I would like to read more books on the history of chemistry so that I can present that perspective in my classes.

I: Okay, for your classroom visit you said, " *seeing someone successfully integrate real world applications has made me more confident that I can do this as well."*...How so? Because they were the one doing it-not you. How did you feel more confident by watching them?

Dr. Willing: *I'm sure because I can mimic…And then once I do that, you know…and then I can, you know, tweak it into my own words and things like that….that's what I thought I could do-sort of copy directly and then insert my own into it slowly, you know….when I felt more comfortable.*

I: So is Prohibition yours?

Dr. Willing: *Yes.*

Though impressed with her cognitive processes of reading an additional book to gain more insight of relevant organic chemistry applications, modification of her lesson notes to include a section on applications, and sharing of some historical aspects of chemistry within her lecture, her self talk regarding her Prohibition anecdote was most enlightening.

I: So how did you feel, you know, that first time when you were thinking about sharing-did you think about, "Well, how am I going to share?" or did it just come out, you know?

Dr. Willing: *Ah, I-I didn't think about how I was going to say it, but I did feel nervous stopping-going along, you know….because it was so different for me….You know, so it was "Alright, okay, now it's time to talk about it, take a deep breath [laughter], go for it!"*

I: Uh huh.

Dr. Willing: *Ah, anyway I think what I was, you know, saying specifically that sometimes it's hard for me because the words don't come as easily either....when I sort of story tell-it's very easy for me to say, " Okay [laughter] we double this variable, this variable quadruples"-that flows very well, but trying to tell a story and come up with the right words and.... that's sometimes a little more work, especially in front of 200 people.*

Gaining confidence through observation of a colleague's use of storytelling, Dr. Willing stretched beyond her stated comfort zone of tailoring examples used by others to creating an original story to present to her students. Despite her admission of nervousness with presenting the Prohibition anecdote, she appeared relaxed as she attempted to build bridges of understanding through her use of real life examples. Accordingly, she assessed her performance as "*…probably my best class as far as using numbers of examples....pertinent to the material, a part of it being due to the subject matter being very, you know, amenable to doing examples... I had a lot of real world applications with organic chemistry.... I felt good about how it fit with the lecture*"(interview, December 2004). I agreed that it was her best class but for a different reason. The examples fit with the lecture because of the intentionality coursing from her cognitions to her instructional practice. Maintaining a student-centered focus, she selected real life examples that she could present with clarity and enthusiasm in a manner consistent with her interpretation of active student involvement: "*…it's sort of like having a dinner conversation or something, you know. You can't do direct back and forth but back and forth as hitting things that they already know so you're on the same level as them, then expanding that and going back to things they already know and then expanding on that*" (interview, December 2004).

As Dr. Willing developed a clearer student-centered focus, she became more concerned with the issue of student recognition of her use of real life examples in her

lectures. How transparent were her efforts with integration of real life examples? The student survey results suggested the majority of students did recognize her use of real life examples (refer to Table 4.2 below). Of the 116 student responses to the question of "In class, how often does your instructor relate daily life examples (like applications or current issues) to the lesson material?" , 96 or 82.76% of her surveyed students assessed Dr. Willing to relate daily life examples with lesson material with a frequency of at least 'sometimes'.

Table 4.2

Student Perceptions of Instructor's Frequency of Example Usage

Question: In class, how often does your instructor relate daily life examples (like applications or current issues) to the lesson material?

Perception of use	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Always	12	10.34	12	10.34
Usually	31	26.72	43	37.07
Sometimes	53	45.69	96	82.76
Infrequently	4	3.45	100	86.21
Rarely	10	8.62	110	94.83
Never	6	5.17	116	100.00

Acknowledging Dr. Willing's concern that the real life examples facilitate student understanding, I used the survey to gauge students' interpretations of the usefulness of the real life examples by having the students respond to the question of "How does your instructor's use of daily life examples affect your understanding of chemistry?" Results of the student responses to this open-ended question were not as straightforward as experienced

in the previous question regarding frequency of real life example usage. Of the 116 students

surveyed, 38 gave no comment and 10 gave ambiguous comments that appeared unrelated to

the question. Emergent classifications from the remaining 68 responses were 'neutral/no

effect' (19 counts); 'helpful' (41 counts); and 'very helpful' (8 counts). Common descriptors

found in the 'helpful' classifications were "relate", "importance", "relevance", "applied", and

"understand better" as evidenced by the consolidation of student responses in Table 4.3.

Table 4.3

Consolidation of Student Responses Regarding Helpfulness of Daily Life Examples

Q: How does your instructor's use of daily life examples affect your understanding of chemistry?

Theme	Frequency	Selected Specific Student Comments
Very helpful	8	Very helpful, puts it in perspective
Helpful	41	She connects the chem. examples w/ real life examples in my head
		Helped me understand better
		Relate something we are learning to something we see everyday
		It's nice to see real world application
		Helps make it relevant
		The examples are interesting and occasionally deepen understanding
		It helps to make me visualize the concept
		It helps the course be more applied, I can recognize chemicals now
		This helps me see the importance of studying chemistry
Neutral/No effect	19	Didn't hurt
		They have no effect
		I don't understand chemistry, but it isn't her fault
Detrimental	0	
No comment	38	
Ambiguous comments	10	cais etc - yes

Choosing to focus upon the 78 students who took the time to address the helpfulness of Dr. Willing's use of daily life examples, it was encouraging to find that 49 or 62.8% of them considered the practice to be helpful in enhancing their understanding of chemistry. Mindful of Dr. Willing's desire "to reach [a] maximum number of students", these survey results provided another indication of the transformational impacts of her cognitions upon her instructional practice.

By study's end, Dr. Willing had personified her pseudonym; embracing a student-centered focus, she was willing to acknowledge, confront, and change personal cognitions and behaviors deemed detrimental to establishment of positive classroom experiences for her students.

Discussion

Due to the scarcity of research involving reflection as a means for attaining teaching improvement of novice college science instructors, my study is particularly unique. Despite the knowledge claims associated with the reflection research studies involving K-12 and preservice teacher populations, I am leery of generalizing those results to novice college science instructors due to the unique demands these instructors shoulder within the higher education environment. Accordingly, my initial questions concerning their participation in a professional development program grounded in reflection were fairly basic. How would novice college science instructors respond to a fairly rigorous reflection protocol and could they achieve observable improvements in their teaching practice as a result of their study participation? To highlight the similarities and dissimilarities emergent from the findings associated with the experiences of Drs. Skeptical and Willing within the study, I discuss both participants within the confines of the individual research questions.

Experiences with the Reflection Process

Though Drs. Skeptical and Willing approached study participation with markedly different expectations and teaching orientations, I am intrigued by their common experiences of the development of self awareness and exhibition of cognition-induced behavior. This is not to imply that their developmental journeys were similar, for each journey was unique.

Time constraints significantly shaped Dr. Skeptical's involvement. Acknowledging teaching to hold a lower priority than his research responsibilities and questioning the lack of strong causality between teachers' classroom behaviors and student achievement, he entered the study expecting it to have no impact upon his teaching practice. In fact, his selection of the knowledge level of understanding as his goal seemed to underscore the limited nature of his engagement in the developmental process. Nonetheless, as he attempted to incorporate reviews within his lecture, his failures catalyzed acknowledgment of his need to be more aware of his time management within his lecture presentations. With this acknowledgement he began to take study involvement more seriously. Gaining experience through experiments with different review strategies, analysis of student responses to his actions, and consultation with me, he acquired the knowledge and self awareness supportive in transforming his instructional practice.

Dr. Willing entered the study expecting to attain teaching improvement. Despite exhibiting a teacher-centered focus initially, she genuinely desired to be skilled in the use of a wide repertoire of teaching practices in order to reach a maximum number of students. Teaching was her primary priority and she selected comprehension as her desired level of understanding of the main teaching dimension of interest/student engagement. Accordingly, she approached her reading requirements with great enthusiasm and open-mindedness. In her

readings, she began to entertain new ideas, such as constructivism that challenged her teaching orientation and behaviors. These confrontations of self spawned more questions and self analysis. Concurrently, her evolving cognitions began to shape her instructional practice, evidenced in the refinement of her teaching goal, deliberation of parameters for her use of real life examples within her lectures and commitment to transformation of classroom behaviors that jeopardized creation of a positive learning environment for her students.

Both participants' demonstrations of self awareness suggest that self reflection can catalyze behavioral changes despite critics' concerns with reinforcement of existing beliefs. Interestingly enough, both participants had to expand their cognitions through enhancement of their pedagogical content knowledge as a precursor to successful attainment of their desired teaching goals. Additionally, my interaction with both participants and Dr. Willing's experience of peer observation also enabled opportunities for collaborative reflection.

Impacts of the Reflection Experiences upon Teaching Practice

Mindful of the study's purpose of attainment of teaching improvement via reflection, I am concerned with what the participants perceived to be the study's impacts upon their teaching practice and what I can ascertain to be observable changes in their teaching practice. Is there agreement between the participants' perceptions and my observations?

Despite designing the developmental plans to measure progress in relation to performance of low-inference behaviors, both participants seemed to focus upon high-inference behaviors in articulation of the study's impacts upon their teaching practice. Dr. Skeptical shared, "t*he study has made me more aware of how I am in the class room. By adding the start of class outline which is an action that I would not have done without the study, I have become more aware of what actions I take naturally. I am also more aware of*

the potential to change things I do in class" (week 11 meta-reflection). In a similar manner,

Dr. Willing's summarization of the study's impacts exhibited a strong emphasis upon high-

inference behaviors:

> *…this study was pretty helpful in that it helped-it, it gave me a fuller picture of where*
> *everything fits in.…ah, you know, especially when I got to the readings on the*
> *constructivism educational theory.…I still do want to, you know, look things up and*
> *draw them in the lecture.…but I think that I do so in more of a-rather than just kind of*
> *pick and throw-you know, a more far reaching goal-and, and I expanded my goals*
> *rather than just sort picking and throwing in- I also wanna try and explain these*
> *things in different ways, different angles.* (interview, December 2004)

I interpreted her statement to reflect acknowledgment of an accumulation of new

ideas and strategies, development of a broader understanding of teaching, and

implementation of thoughtful consideration of her classroom behavior as the reflection

experiences' impacts upon her teaching practice. Though both participants mentioned

performance of their selected low-inference behaviors, they seemed to be more appreciative

of the transformative nature of their expanded cognitions. Cognizant of Dr. Skeptical's

contemplation of action as a change agent and Dr. Willing's desire to adapt her teaching style

as necessary to reach the maximum number of students, I am encouraged to suggest that

novice college science instructors are capable of developing reflective skills in a relatively

short period of time, which contradicts Hatton and Smith's (1994) assertion of the complex

and time intensive nature of such development. However, one must remember that my

suggestion is based upon the results attained with a sample size of two participants.

Nonetheless, both participants' foci upon using the study experiences to propel their

development as educators suggest their readiness to engage in practical action. Primarily

because of the study's short duration, I did not expect the participants to exhibit progression

beyond technical reflection. Nonetheless, the participants demonstrated ability to reflect at

higher levels consistent with Pultorak's study (1993), which revealed novice K-12 teachers to

exhibit all three of Van Manen's levels of reflection.

As I reflect upon my assessments of how the study impacted the participants'

teaching practices, I realize that I also acknowledged high- and low-inference behaviors. For

Dr. Skeptical, I identified his conduct of lesson reviews and sensitivity to preparation and

time management in lectures to be areas of impacted teaching practice. His transformation

from an instructor who typically did not structure his lecture to one that habitually engaged in

lecture outlining was most illustrative of the interdependence of cognition and teaching

practice. For Dr. Willing, I noted her engagement in systematic deliberation of instructional

practice, concurrent adoption of student-centered instructional practice, and development of

proficiency in presenting examples in a variety of relevant contexts to be aspects of impacted

teaching practice. In fact, the following comment taken from our December 2004 interview

encapsulates my assessment of the study's impacts upon her teaching practice:

> So for you as a teacher, what I have seen is that there is a level of deliberation in what
> you're doing and what you *aren't* doing that I think you are more aware of than
> before….such as with the analogies, you won't just throw in any kind of analogy
> based upon what you've said and what you've experienced. You think about how am
> I going to do it, why do I want to do it, what impact will it have on the students?

Though Dr. Skeptical's use of lecture outlines and Dr. Willing's incorporation of real

life examples within her lectures were characterized as low-inference teaching behaviors, I

would characterize the outcomes as potentially high impact due to the evidence of reform in

instructional practice. Empowered by their attainment of teaching improvement, both

instructors expressed sentiments of continued engagement in professional development after study participation. Invoking Artzt and Armour-Thomas's conceptualizations, I believe study participation facilitated development of cognitions supportive of instructional practice reform to enhance undergraduate students' experiences in science classes. Consequently, this study's findings have significant implications for the professional development of novice college science instructors.

Implications

Professional development programs can be incorporated in the daily activities of novice instructors in an integrated and relevant manner. However, instructors' ownership of the program's focus, intensity, and outcomes is critical to their sustained participation. Empowered to determine the what, when, and where for this study's professional development program, the instructors were able to fashion the program to meet their developmental needs and dynamic work environments. However, the self accountability inherent in this kind of program requires participants comfortable with and committed to self disclosure in sharing their successes, struggles, failures, concerns, and support needs. To honor such transparency, the program and its facilitators must not be evaluative. Growth, not judgment, must be the overarching goal.

Development of reflective habits of thinking requires considerable support. As the sole facilitator for this program, I found myself increasingly engaged in providing support absent from the program's design. Since the program did not involve collaboration among the participants, I became both participants' sounding board for discussion of their interpretations of reflection experiences. In terms of pedagogical content knowledge, I served as a 'more knowledgeable other' in addressing Dr. Skeptical's concerns with student

inattention to his review strategies and Dr.Willing's questions about constructivism since the program did not provide ready access to an external mentor. These interactions support Dewey's third criterion of reflection in which reflection is described to have a social construct demanding collaborative interactions (Rodgers, 2002). Though I initially thought self reflection would be sufficient to drive the action necessary to attain the desired teaching behavioral changes, Dr. Willing's experiences suggested otherwise. At the beginning of the program she expressed satisfaction with completing the readings on her own. However, once she began to consider acting upon the knowledge gained from her readings, she wanted to talk with peers and mentors to discuss their self talk before, during, and after their teaching. Such a desire is supportive of Freese's (1999) finding that Loughran's reflective model, used as an organizing framework, can support preservice teachers in developing "habits of mind or dispositions which influence them to consciously and deliberately think about their teaching" (pp. 907-908). Specifically, Dr. Willing wanted to compare her thoughts with others as she contemplated how to facilitate enhanced student understanding. In so doing, she would counter Loughran's (2002) concern that "rationalization may masquerade as reflection" (p. 35) and engage in discourse supportive of evaluation of her thoughts and actions. Learning has a strong social component and any sustained professional development program should provide opportunities for collaboration among its participants. Within the population of novice instructors, collaboration among participants should be expanded to include mentors. Interestingly enough, the support I have discussed for development of reflective habits of thinking is largely interpersonal. This study's program involved a minimal expenditure of dollars, but considerable expenditures of time. Personnel availability and time were the most vital resources to this program's success.

A novice college science instructor can effectively participate in a prolonged, systematic professional development program while maintaining teaching and departmental responsibilities. Active participation in a rigorous 14 week professional development program by novice instructors in their first semester of college science teaching is particularly noteworthy. Crucial to the instructor's involvement is a professional development program that is focused, flexible, and responsive. The focus should be singular or upon a specific behavior. Time management is a significant gate keeper, so the program should afford the participants flexibility in its completion. Too often, novice instructors are not the sole determinants of how their time is allocated and any program that does not accommodate the unpredictability of novice instructors' responsibilities is particularly vulnerable to failure.

Concurrently, the program should grow with the instructors. At each stage of growth, the program must support and challenge the instructors (Reiman, 1999). This was particularly evident in Dr. Skeptical's inability to gain the desired enhancement of his pedagogical content knowledge via reading of the articles on his personal reading list. Again serving as a 'more knowledgeable other' in sharing alternative strategies for conduct of his lesson reviews, I was able to readily impart experience that furthered his development without the considerable expenditure of time and effort associated with typical experiential learning. Thus, another benefit of this professional development program is its ability to facilitate bridging of pedagogical knowledge gaps in an efficient and focused manner.

Reflection can be a viable vehicle for enhancement of teaching practice. Cognition does impact instructional practice. Though Dr. Willing's initial goal was *"to integrate more "everyday-life" references so that students can understand chemistry in a broader context"*,

by the program's end she had refined her operationalization of "everyday-life" examples such that her instructional practice aligned with constructivist principles counter to her earlier teacher-centered orientation. Such a transformation was phenomenal considering the program's focus upon a single discrete teaching behavior, the lack of a collaborative platform within the program, and the lack of external pressure to change her teaching orientation. As Dr. Willing executed her developmental plan framed by my adaptation of Loughran's model of anticipatory, contemporaneous, and retrospective reflections (2002), the exploration of a tangible teaching behavior gave way to examination of intangibles-personal beliefs and attitudes. I believe this was prompted by the design of the developmental plan that incorporated increasing requirements for introspection of participant activities. In the confrontations of self catalyzed by her readings, reflections, observation of a colleague, and interviews, Dr. Willing gained self awareness and a broader perspective that enabled her to align her instructional practice with her evolving cognitions of teaching. Embracing her newfound beliefs, she voiced and demonstrated a responsibility and commitment to reformation.

The results attained with this study may not be typical. This study's professional development program is based upon self report, self accountability, and self motivation. Such an emphasis on self highlights the primacy of participants' individual characteristics on results attained. Dewey identified whole-heartedness, directness, open-mindedness, and responsibility (Rodgers, 2002) as prerequisite attitudinal dispositions for conduct of reflection. Though Drs. Skeptical and Willing exhibited varying manifestations of the desired attitudinal dispositions, both were extremely conscientious and goal oriented, which fueled their ability to complete the program's rigorous schedule of reflective activities

complementing their developmental plans. Both participants' experiences bolster my belief

in the viability of the program's process, yet I also acknowledge that the extent of growth is

largely shaped by the attitudinal dispositions of each participant. Thus, the results of this

study cannot be generalized beyond its context. This professional development program is by

no means a "one size fits all" approach. Attitudinal dispositions predisposed to reflection

should self select participants most appropriate for this professional development program.

CHAPTER 5

REFLECTION AS A MEANS TO REFORM OF NOVICE COLLEGE SCIENCE FACULTY'S INSTRUCTIONAL PRACTICES

Abstract

This study explored the use of reflection as a professional development strategy to facilitate change in the teaching practices of novice college instructors. Specifically, the study addressed the following questions: During the progression of the reflection experiences, in which teaching practices did the novice college instructors' performances change? How? A mixed method approach was employed in answering the aforementioned questions. The participants' responses in semi-structured interviews and informal discussions, their written responses to reflective prompts, and the researcher's observations of their teaching were qualitatively analyzed for themes. Students' responses to a survey about the participants' instruction were analyzed quantitatively. The findings revealed the participants to exhibit cognition-induced behavioral change with regard to self-identified teaching behaviors.

Introduction

Recent calls for reform in science education magnify the need for enhanced teaching effectiveness, which is a common goal of professional development programs. Unfortunately, professional development programs have tarnished reputations regarding their design, implementation, and relevance. Nevertheless, professional development is still regarded to be essential to the development of mature teaching professionals (Schoenfeld, 2002). Recognizing novice teachers to be particularly needful of professional development and support to facilitate their improvement in teaching, they are common subjects of professional development studies. Within the population of novice teachers, novice college science faculty is targeted in this study.

Novice science college instructors are entrusted with teaching the introductory science courses from which students often base decisions of future study. Some charge that these introductory courses are responsible for students' self-selection out of future science course enrollment and science majors (Sunal et al., 2001; Osborne, Simon, & Collins, 2003; van Driel, Beijaard, & Verloop, 2001). In fact, Kardash and Wallace revealed considerable student dissatisfaction with non-learner-centered instructional practices, such as ambiguous course goals and minimal student engagement (as cited in Walczyk & Ramsey, 2003). Generally novice science college faculty have (a) the least amount of experience in managing the competing demands of professional duties on their time, (b) little to no formal teaching experience (Sunal et al., 2001; Flood & Moll, 1990), and (c) minimal pedagogical content knowledge (van Driel, Beijaard & Verloop, 2001). Accordingly, novice college science instructors need relevant and practical methods to expand their pedagogical content

knowledge and close the aforementioned knowledge gaps concerning teaching and how their students learn.

Typical professional development programs at the college level are conducted in workshops and courses (Weimer & Lenze, 1994). The impact of these activities depends upon factors such as duration and relevance. Other characteristics of effective professional development include intensity, collaboration among the participants and planners in its execution, and active involvement of participants in meaningful developmental opportunities (Northwest Regional Educational Laboratory, 1998). Given the competing demands of preparation, teaching, additional duties, and often research upon novice science college instructors, the very characteristics of effective professional development programs present daunting challenges to reforming novice science college instructors' instructional practices. One plausible approach to developing novice science college instructors is by way of reflection. Very little research regarding the use of reflective practice by college instructors as a means of professional development exist. This study addressed the aforementioned gap in the literature by exploring the viability of reflection in reforming the instructional practice of novice college science instructors via concentration upon low-inference teaching behaviors. Consistent with this focus, the study addressed the following questions: During the progression of reflection experiences, in which teaching practices did the instructors' performance change? How?

Background

What professional development focus could meet the novice college instructors' need for reform of instructional practice? Discovering that reflection is promoted as a vehicle for developing effective teachers (Allen & Casbergue, 1997), I decided to explore its utility in

reforming the instructional practice of novice college instructors via a group of behaviors characterized as effective teaching practices.

I introduce the term 'reflection' with trepidation. As asserted by Grunau, Pedretti, Wolfe, and Galbraith (2000), the term has been used in many ways to convey many different meanings. Hearkening back to two of reflection's most well-known advocates, foreshadows of today's differing conceptualizations of reflection are evident. Dewey's reflective thinker is forward-leaning and anchored in the scientific method while Schon's reflective practitioner is intuitively engaged with the uncertainty present in the artistry of practice (Fendler, 2003). Characterizing education as the examination of experience that enables future intelligent action and positioning reflection as the process of making meaning (Rodgers, 2002), Dewey ushered in rationality as a catalyst for deliberate action. Conversely, Schon highlighted within the professional context the intuitive, artistic dimension of reflection. Is Schon's artistic professional a contradiction of Dewey's rational, systematic thinker? Fendler (2003) believed so and acknowledged the tenuous balance of Schon's intuitive practitioner with Dewey's rational thinker to confound what is meant when pursuing professional reflection. Accordingly, multiple definitions exist for reflection. At its most basic extreme, reflection is just thinking, whereas at its most comprehensive extreme, it is a systematic protocol of cyclical actions taken to gain awareness of past actions to enable informed future action (Loughran, 2002).

Operationalization of reflection is commonly communicated through the use of typologies that categorize reflections by their foci or time of performance. Hierarchies result from attempts to order reflections by their foci. Unsurprisingly, the number of levels of reflection varies depending upon the scholar. For example, Valli identified five levels as

opposed to Van Manen's three, yet there appears to be consensus on the lowest and highest levels of reflection. Technical reflection, the lowest level of the hierarchy, focuses on direct application of pedagogical knowledge and the highest level, critical reflection, emphasizes the social and political impacts of teaching (Spalding & Wilson, 2002). Loughran's (2002) labeling of reflections as anticipatory, contemporaneous or retrospective represent an alternative orientation in which the time of reflection is of primary importance. In Loughran's model, anticipatory reflection occurs before instruction, contemporaneous reflection occurs during instruction, and retrospective reflection occurs after instruction. Regardless of the conceptualization of reflection, similar means are used to enable reflection.

Typical platforms and practices supportive of reflection include journaling, questioning, collaborating, modeling, coaching and communicating electronically (Hatton & Smith, 1994; Levin, 1999; Loughran, 2002; Pultorak, 1993; Spalding & Wilson, 2002). Interestingly, Spalding and Wilson's (2002) exploration of pedagogical strategies to enhance preservice teachers' use of reflective journaling provided an important reminder of the superiority of relationship to online platforms in the development of reflection. The researchers found no optimal pedagogical strategy or mode of dialoguing (electronic vs. hardcopy), and participants revealed that instructional feedback and relationship were most helpful to their development of reflectivity (Spalding & Wilson, 2002).

The Nature of Novices' Engagement in Reflective Practice

Research results suggest that novices demonstrate some forms of reflection (Van Manen, 1977), namely technical and practical aspects of Van Manen's conceptualizations of reflection (Hatton & Smith, 1994); the third dimension of Van Manen's hierarchy is critical reflection. Pultorak's (1993) study of the facilitation of reflection among novice K-12

teachers via the use of written (bi-daily, bi-weekly, and visitation journals) and oral (reflective interviews) reflections demonstrated novices to exhibit all three of Van Manen's levels of reflection, yet the content and nature of reflections varied with the context and mode of reflection (e.g. bi-daily vs. bi-weekly and written vs. oral). The teachers' actions or behaviors were integral to both the aforementioned content and context.

Identification of Effective Teaching Behaviors Consistent with the Study's Focus

Building upon the characterizations of the classroom behaviors of exemplary college teachers resulting from previous studies, Hativa, Barak and Simhi (2001) conducted a study that included analysis of the frequency of exemplary teachers' use of effective teaching behaviors. They consolidated characterizations of exemplary university teachers into four main effective teaching dimensions of lesson organization, lesson clarity, interest/student engagement, and positive classroom climate (Hativa, Barak & Simhi, 2001). A significant benefit of this orientation was the model's association of low-inference teaching behaviors which are tangible, observable actions for each teaching dimension. The use of low-inference teaching behaviors anchored the novice college science instructors' teaching behaviors in specific and observable forms supportive of instructional change.

A Model Explaining How Reflection Facilitates Professional Growth

Various research studies have established the importance of teachers' beliefs upon their instructional practice. Provoked by the temporary nature of reform efforts in K-12 and colleges, and cognizant of the relationship of teachers' beliefs to reform failure, Gess-Newsome, Southerland, Johnston, and Woodbury (2003) linked reform failure to the absence of teachers' cognitive unease. This cognitive unease exists in the form of pedagogical

dissatisfaction. Pedagogical dissatisfaction occurs when a discrepancy exists among

teachers' cognitions, instructional practice, and desired educational aims.

Artzt and Armour-Thomas (as cited in Artzt, 1999) developed a framework

supportive of previous research findings that teacher cognition seems to shape instructional

practice. The framework has three levels: (a) overarching cognitions, which delineate

knowledge, beliefs and goals, (b) cognitive processes, and (c) instructional practices, which

encompass classroom actions and environments. The second level, cognitive processes, is

comprised of the teaching stages of (a) preactive which I equate to Loughran's (2002)

anticipatory reflections, (b) interactive which I equate to Loughran's (2002)

contemporaneous reflections, and (c) postactive which I equate to Loughran's (2002)

retrospective reflections. According to the Artzt and Armour-Thomas framework,

completion of an iteration of reflection could be as follows: (a) teachers identify their

overarching cognitions by specifying their goals and expectations for their students; (b) these

overarching cognitions influence the teachers' lesson planning and preparations; (c) the

teachers' planning thoughts are translated to specific teaching behaviors within the

classroom; (d) while teaching, the teachers assess and modify alignment of their specific

teaching behaviors with their identified overarching cognitions; and (e) after teaching,

teachers evaluate the effectiveness of their specific teaching behaviors in achieving their

identified overarching cognitions and devise plans to either adapt their overarching

cognitions to their teaching situation or modify their teaching behaviors to better align with

their overarching cognitions.

Though each step of the iteration provides opportunities for reflection, assessments

within the interactive and postactive teaching stages are especially enlightening because they

force comparisons among the teachers' overarching cognitions, their awareness of the cognitive processes governing their instructional practice, and the alignment of their instructional practice with their overarching cognitions. Teachers' perceptions of discrepancies between their cognitions and instructional practice prompt pedagogical dissatisfaction that can catalyze professional growth. Thus, the study's aim of reformed instructional practice is founded upon reflection undergirded by the Artzt and Armour-Thomas framework.

Methodology

I conducted the study at Innovative University, a pseudonym for a large research I institution located in the southeastern United States. Within its undergraduate program, General Education Requirements (GER) for natural science include two courses from the basic sciences, which are inclusive of chemistry and physics. The sample consisted of two novice faculty with teaching responsibilities for chemistry and physics introductory undergraduate courses in the Fall of 2004; both were in their first semester of university teaching. Beneath this initial commonality of being at the entry point in university teaching, the sample possessed a wealth of diversity in teaching orientations and expectations. To signify their expectations about the outcomes of the study expressed during the first interview, I call the participants Dr. Skeptical and Dr. Willing.

Dr. Skeptical had about five years of Teaching Assistant (TA) experience with lab and lecture sections of introductory and graduate level physics courses. His current responsibilities included running a lab, supervision of five students, research, and teaching. He taught one section of Physics 205 (PH 205), which is standardized in terms of content

coverage and schedule. Accordingly, he had daily and weekly interactions with the other PH 205 instructors.

Dr. Willing recently earned her doctorate and had three years of experience of teaching in a private high school in which she taught a variety of course levels in chemistry while also teaching some math courses. During the years it took her to earn her doctorate, she was a TA for chemistry lecture and lab sections. In her current position, she taught two sections of Chemistry 101 (CH 101), both with enrollments exceeding 200 students. The work completed by Dr. Skeptical and Dr. Willing as they proceeded through the reflection experience served as data for the study. The reflection experience lasted for fourteen weeks.

Data Collection

The study utilized five sources of data: weekly reflections, monthly semi-structured interviews, monthly meta-reflections, classroom observations, and student surveys. Of the five data sources, only the student surveys were representative of quantitative data. In keeping with the mixed methods approach, all data sources were used to identify changes in teaching practices.

Reflection Experiences

Tutorial

I developed this instrument as a step-by-step guide (in the form of a Microsoft PowerPoint presentation) to lead the study's participants through the first phase of the reflection experience. In the first phase, the participants self assessed their teaching behaviors to identify a main dimension of effective teaching practice in need of improvement, familiarized themselves with effective teaching practices, determined a low-

inference teaching behavior to target as their teaching goal focus, and then created a developmental plan to attain improvement within their teaching goal focus.

Adapted from Joyce and Showers' (1995) action plan methodology, the developmental plan established a schedule of discrete tasks for the participants to complete in order to document their progress in goal accomplishment. Within a broader context, the developmental plan served as a contract, specifying the extent of each participant's commitment to a plan of action for professional development. The developmental plan format is provided in Appendix A.

Reflection instrument

As with the tutorial, the reflection instrument was developed by me, the researcher. This instrument is a questionnaire composed of open-ended questions (see Appendix B) to guide the study's three formal types of reflection experiences. The three formal types of reflection experiences included weekly reflections, monthly meta-reflections, and monthly semi-structured interviews. These reflection experiences were designed to support development of reflective habits of mind.

Weekly reflections.

On designated weeks, participants sent me via email their responses to the open-ended questions classified according to Loughran's (2002) three phases of reflection: anticipatory, contemporaneous, and retrospection. To better align this reflective framework with the timing of participants' efforts, I operationalized the reflection phases slightly differently from the Loughran model. In order to efficiently and regularly focus upon the participants' conduct of developmental activities and reflection, I used the week demarcated by the three reflection phases as the unit of analysis This modification was particularly

helpful in highlighting the links between cognition and instructional practice in the

participants' executions of their developmental plans. Table 5.1 presents a comparison of my

adaptation to the traditional operationalization of Loughran's reflective framework.

Table 5.1

Comparison of Operationalizations of Loughran's Reflective Framework

Reflection Phase	[1]Traditional Operationalization	Adapted Operationalization
Anticipatory	Before teaching lesson	At the beginning of the week: before any action has been taken with the developmental plan
Contemporaneous (also known as reflection-in-action)	While actually teaching lesson	Mid-week: while in the midst of completing action in accordance with the developmental plan
Retrospective (also known as reflection-on-action)	After teaching lesson	End of week: after completion of action in accordance with the developmental plan

[1]Explanations derived from Freese, A.R. (1999). The role of reflection on preservice teachers' development in the context of a professional development school [Electronic version]. *Teaching and Teacher Education, 15*, 895-909.

In alignment with the cyclical nature of reflection, the battery of open-ended questions for

the weekly reflections addressed each reflection phase as demonstrated by a few sample

questions. For example, in the anticipatory phase one question was "What is my plan for

accomplishment of this goal?" For the contemporaneous phase, " How do I need to manage

my efforts to accomplish this week's goal?" was an example prompt and in the retrospective

phase "What have I gained from this week's study experiences?" was a sample question.

Thus, the weekly cycle of anticipatory, contemporaneous, and retrospective reflective

prompts was designed to undergird participant actions of deliberate planning, action, and

assessment in an integrative and cyclical manner.

Monthly meta-reflections.

To further develop the participants' reflective abilities, the monthly meta-reflections required participants to send me via email their responses to three distinctly different categories of prompts, progressing from very structured to loosely structured contexts (refer to Appendix B). An example of a very structured prompt was "Thinking back over the month, explain which actions within your developmental plan and reflection instrument that you are or have developed confidence in completing on your own?" Conversely, an example of a loosely structured prompt was "Share your thoughts on any aspect of your experiences associated with this study that was meaningful to you." Ideally, the monthly meta-reflections would reinforce participants' awareness of the 'bigger picture' – how do they 'see' themselves and their teaching and what are the impacts of their improved vision?

Monthly semi-structured interviews.

To reinforce my understanding of the participants' interpretations of their study experiences, I conducted two individual monthly face-to-face semi-structured interviews with each participant as a pillar of the study's design. I began each interview with the same set of general questions (refer to Appendix B), yet differentiated the follow up questions to gain insight and clarity of their individual interpretations of their reflection experiences.

Classroom Observations

To gain familiarity with the participants' environments and their progress in executing their developmental plans, monthly classroom observations were a major part of the study's design. Through audio taping and use of field notes, I compiled evidence to discuss with the participants any observable changes in teaching behavior. Conducted during

weeks 1, 8, and 13 of the study, I obtained data representative of the participants' initial, interim, and final demonstrations of teaching behaviors.

Student Surveys

As with the tutorial and reflection instrument, the student surveys were developed by me, the researcher. Specifically, these instruments were questionnaires composed of Likert scale statements paired with free response opportunities to enable further explanation of student ratings. Administered by me at week 14 of the study, this survey elicited the students' assessments of the participants' demonstrations of the selected classroom behaviors at the end of the semester. The survey items were different for each participant's class so that the questions aligned with the different foci represented by the participants.

Data Analysis

I used content analysis to organize the data pertaining to the participants' experiences within the reflective processes. Most importantly, examination of the participants' discourse from my adaptation of Loughran's (2002) model of anticipatory, contemporaneous and retrospective reflections enabled consolidation of related experiences into narrative expositions of the reflective processes. Concurrently, comparison of participants' self reporting of teaching behavior via the emailed reflections and semi-structured interviews, my classroom observations, and the students' reporting of teaching behavior via the student surveys enabled triangulation of evidence to address the study's impact upon the participants' instructional practice.

Time Points Within the Developmental Journey

The developmental journey spanned 14 weeks and to support analysis of the participants' experiences at common points along their journey, I established three time points: beginning, middle, and end. The beginning time point extended from initial contact with the participants in early August to the initial classroom observations held four weeks later. Each classroom observation was followed by a separate discussion of my observations with each participant. The middle time point included the first three weekly reflections submitted electronically, one monthly meta-reflection submitted electronically, one classroom observation, and one semi-structured interview. The end time point included the second round of three weekly reflections, one monthly meta-reflection, one classroom observation, and one semi-structured interview. These time points -beginning, middle, and end-organize the findings.

Findings

Narrowing the focus to the participants' actions, the foci of the guiding research questions, each participant exhibited modification of their teaching behaviors as a result of their enhanced cognitions. To anchor the presentation of my findings, the Artzt and Armour-Thomas framework for the interdependency of teacher cognition and instructional practice was employed in characterizing the participants' cognition-induced behavioral changes (as cited in Artzt, 1999). The findings are presented separately for each participant, using the data collection time points and the emergent themes from data collection to chronicle their demonstration of cognition-induced behavioral change. The findings conclude with a brief discussion of the participants' views of the impact of the study upon their instructional practices.

<center>*Dr. Skeptical*</center>

Beginning: Struggle to identify a teaching goal focus

When asked to identify his biggest concern about his first year of university teaching, Dr. Skeptical replied, "having enough time to perform all his professional responsibilities" (interview, August 2004). Aside from the issue of time management, Dr. Skeptical expressed no concerns about being a novice instructor. When I asked Dr. Skeptical for his rationale in participating in this research study, he stated that he was "just willing to help a grad student" (interview, August 2004). When queried about his expectations for study involvement, he asserted that he did not expect the experience to have an impact upon him. Furthermore, he indicated that teaching was not a pressing priority; his understanding was that his primary responsibility was to "maintain his research program and funding" (interview, August 2004).

Even though teaching was not a priority for Dr. Skeptical, he did evaluate his teaching according to the four main effective teaching dimensions. In doing so, he expressed some discomfort in analyzing his own teaching: "I have very little ability to reflect on classroom behaviors….I don't know how do you evaluate classroom behaviors here" (interview, September 2004). His overarching cognitions regarding the improvement of teaching were also fairly defensive: (a) his primary focus was upon his research program and funding, (b) teaching was of secondary emphasis, and (c) he was unfamiliar with reflection and evaluation of classroom behaviors. Eventually, he identified lesson organization and lesson clarity as the teaching dimensions needing improvement. Acknowledging time constraints to restrict the extent of his lesson preparation, he chose lesson organization as the focus for his improvement. Specifically, he decided to focus upon conduct of lesson

summaries to enhance his lesson organization skills since his typical lesson preparation did not involve overt structuring of his classroom actions.

In the self assessment period preceding my initial observation of his classroom behavior, he decided to focus upon decreasing the amount of time spent on administrative duties from approximately three hours a week to less than one hour a week to allow more time for lesson organization. Aside from his self reporting of his time expenditures between administrative and lesson preparation activities, which are basically contained within the preactive (or anticipatory) stage, I could not objectively observe progress made towards goal attainment. In our subsequent September 2004 interview, I expressed my discomfort with his teaching goal focus in stating, "That's why I really wanted, you know, to talk to you face to face because it seems like it's [his teaching goal focus] sort of hard to put your fingers on and I wanted to do something that we can, you know, really be clear about". Dr. Skeptical readily concurred with my assessment of the ambiguity of his teaching goal focus and after a brief discussion we articulated the revised teaching goal focus to be to "develop innovative methods to summarize lesson material while maintaining student interest" (interview, September 2004).

Middle: Pedagogical dissatisfaction evident in first cycle of reflective activities

Utilizing Artzt and Armour-Thomas's conceptualizations, Dr. Skeptical's overarching cognition was synonymous with his new teaching focus. As previously stated, he desired to develop innovative methods to summarize lesson material while maintaining student interest. In realizing his overarching cognition, Dr. Skeptical enacted the cognitive processes at preactive, interactive, and postactive stages.

His preactive actions were best characterized by an anticipatory reflection in which he stated, "list in my notes is all I have time to do this week" (September 2004). Consequently, his interactive actions focused upon monitoring his anticipatory actions and modifying his instructional practice to enable compliance with his overarching cognition. A contemporaneous reflection provided validation of such orientations in sharing, "I list review in my class notes…. I think I need to figure out a way to trick the students into listening. I need to get the review out without letting on it is the end of class" (September 2004). His postactive actions revealed a growing comfort with authentic evaluation of his instructional practice. A retrospective reflection acknowledged progress in stating, "my efforts improved a little because I thought about the goal more toward the end of the week" (September 2004). However, the following week he experienced a setback in the quality of time dedicated to thinking about goal attainment in admitting, "I did not have too much time this week to think about it beyond just including a section in the notes to remind me to do it" (week 4 retrospective reflections, September 2004). In alignment with Artzt and Armour-Thomas' conceptualization, Dr. Skeptical continued the postactive stage by reflecting upon his instructional practice.

Consistent with his reflections of experiences within the phase of cognitive processing, Dr. Skeptical's recall of classroom behaviors and experiences revealed a growing commitment to the change process. During weeks 2 through 4, once a week he did not conduct reviews because of the significant amounts of student questions. He described, "Monday I was swamped with questions and did not get through the lecture material nor the review" (week 4 contemporaneous reflections, September 2004). When he did conduct the reviews, the outcomes were mixed. His strategy to solely conduct the review at the end of

class on Friday of week 3 seemed to yield encouraging results. Dr. Skeptical asserted, "This worked ok. It got the class into new material faster and they seemed interested" (week 3 retrospective reflections, September 2004). He found this success to be short-lived for the following week he accounted, "Wednesday the review was done, but students did not seem to pay attention. They just got ready to leave" (week 4 contemporaneous reflections, September 2004).

My experience with Dr. Skeptical's conduct of the lesson review closely mirrored his account of student inattention provided in his week 4 contemporaneous reflections. During my October 2004 classroom observation I noted:

> …. At 1521 hours, he began to give his review. Within a minute, students began to exit the room as he continued to talk. [Side note: Accordingly, one question immediately came to mind: How to do a review without students leaving?]

Despite our collective unease with episodic student inattention to his conduct of reviews, I found his responses to be fairly provocative. His week 5 meta-reflections revealed significant expansion of his overarching cognitions and cognitive processes in sharing:

> trying to make a review at the end of class is making me realize that class time management is tough because trying to include an activity at a set time is difficult. My style is to usually not plan and schedule the lecture too much, and so a scheduled event is tough although I appreciate the idea that this review will benefit students. (October, 2004)

Consequently, he seemed to subconsciously understand the interdependency of cognitions and instructional practice in acknowledging, "it has changed my practice in that I am doing reviews about half the time. I did not do this before thinking about it" (week 5 meta-reflections, October 2004). Cognizant of his growing commitment to actualization of his

overarching cognitions, Dr. Skeptical revealed, "I am starting to do class reviews without thinking" (week 5 meta-reflections, October 2004). Bolstered by his gains in experiential knowledge, Dr. Skeptical's thinking began to shift from preactive actions to remind him to perform the reviews to interactive and postactive assessments of how to best integrate the reviews within his lectures.

End: Behavioral change consistent with his classroom experiences

By week 8, Dr. Skeptical was in strong pursuit of knowledge to correct shortcomings in his review strategy. He attempted refinement of his overarching cognitions via expansion of his pedagogical content knowledge in two manners. First of all, he decided to discuss his concerns during one of the interviews. Informed by my assessment of his behaviors and knowledge of alternative strategies for conduct of reviews, Dr. Skeptical provided the following summary of our interview: "This week on Tuesday I met with… [the investigator]. We revised the plan. I am now going to list a review outline at the start of class and refer to it during class" (week 8 contemporaneous reflections, October 2004). During the same period, he attempted to enhance his pedagogical content knowledge through reading of articles he had selected pertaining to lesson organization of large lecture classes. Unfortunately, he was displeased with his reading because "….reading the article did not teach me anything. It just had stories about unusual experiences" (week 8 retrospective reflections, October 2004).

Nonetheless, he forged ahead with his refined review strategy and self assessed his instructional practice positively. I found the following week 8 contemporaneous reflection to be most illustrative of the interdependency of his cognition and instructional practice: "I did this [the review] today and it went pretty well. The new plan has been very natural for me to

integrate into lecture. I will do the same thing Friday" (October 2004). I also found his

refined review strategy to be successful and made the following notes during my November

2004 classroom observation:

> Upon entering the room, I saw the following outline on the board:
>
> -Heat capacity program
> -Melt ice/boil water
> -Non Einstein solid
> -Room temp heat capacity of metal
>
> He began his lecture by stating, "This is what we're doing today [referring to outline above]…Friday we were talking about…remind ourselves what we did…this is what we're going to do in lab next week…" He signaled his transition between topics in saying, "Let's talk about ice…". As he talked, he pointed to the outline. At 1503 hours, he signaled another transition in stating, "Let's do problems with the Non Einstein model…" Concurrently, I noticed that Dr. Skeptical had updated the outline in the following manner:
>
> Melt ice/boil water
> 1.23 J/K   1.01 J/K
>
> …. At 1523 hours, he shared, "One comment just about what we've been doing…"
> At 1524 hours, the students began to pack up to exit the classroom.

I was impressed by Dr. Skeptical's seamless integration of visual and auditory markers to

highlight his review strategy. Aware of his discovery that the preactive activity of preparing

the outline enabled him to "…digest the global issues in the lecture before I deliver it" (week

10 contemporaneous reflections, November 2004) and "…organize my thoughts" (week 11

meta-reflections, November 2004), Dr. Skeptical acknowledged the instructional change and

its impact upon his practice during our final semi-structured interview: "but the outline I

think came in handy at the end to keep things on pace…. time wise and get all the topics

covered and, you know, it was nice for me to have it up there too. I could just look at it and

know where I was supposed to be…" (November 2004).

Interestingly, his students seemed to share similar views concerning the usefulness of

his lecture outlines. Of the 42 student responses to the question of "How does your

instructor's use of lecture outlines affect your understanding of lesson material?", 6 gave no

comment and emergent classifications from the remaining 36 responses were 'neutral/no

effect' (7 counts); 'helpful' (18 counts); and 'very helpful' (11 counts) as evidenced by the

consolidation of student responses in Appendix C.

Concentrating upon the 36 students who took the time to address the usefulness of Dr.

Skeptical's use of lecture outlines, 29 or 80.6% of them considered the practice to be helpful

in enhancing their understanding of lesson material. Mindful of Dr. Skeptical's concerns with

the direct impact of his use of lecture outlines upon student understanding, these survey

results suggested that his transformed instructional practice aligned with student needs.

Framed within the challenges to reform instructional practice, Dr. Skeptical's

accomplishments suggested reform was achievable, even by novice science college

instructors with considerable research responsibilities. In fact, Dr. Skeptical, who began the

study as an unlikely advocate for reform, by the study's end was embracing the relevance of

teaching improvement:

> By adding the start of class outline which is an action that I would not have done
>
> without the study, I have become more aware of what actions I take naturally…I am
>
> also more aware of the potential to change things I do in class…. Without the study,
>
> and without much experience, I think I would have just performed in the classroom in
>
> a way that is just natural for me. Having participated in the study has made me more
>
> aware that I can pick and choose my actions in the classroom. It will probably keep

me thinking about classroom management for some time. (week 11 meta-reflections, November 2004)

As a result of his study participation, Dr. Skeptical learned to align his cognitions and instructional practice such that he could experience development that was personally and professionally relevant.

Dr. Willing

She was not particularly concerned about being a novice college instructor due to her high school and TA experiences. Her biggest concern about her Fall 2004 teaching experience was the class sizes of Chemistry 101 (CH 101). She believed the larger class sizes would challenge the rapport she would like to develop with her students. With her smaller high school classes, she had an ability to "read the class", but with the CH 101 sections, she was not sure she could accurately assess the students' reactions to her teaching (interview, August 2004).

When I asked Dr. Willing for her rationale in participating in this research study, she stated that she believed in what I was doing and thought study participation would help her see teaching in a broader light. When queried about her expectations for study involvement, she said, "participation will help me to be a better teacher overall" (interview, August 2004).

Upon evaluation of her teaching according to the four main effective teaching dimensions, she identified interest/student engagement as the only teaching dimension needing improvement and as the focus for her improvement. She articulated her teaching goal as "I plan to integrate more "everyday-life" references so that students can understand chemistry in a broader context" (interview, August 2004). She chose to incorporate real life examples as a strategy to increase student interest, being well aware of students' feelings of

alienation in chemistry classes. So how did Dr. Willing move from a teacher-centered to a student-centered focus in the course of 14 weeks? Examination of the link between her cognitions and instructional practice is quite enlightening.

Beginning: Cognitive dissonance

During her initial self-assessment exercises, Dr. Willing revealed a complex integration of beliefs and goals regarding her teaching. Though she first acknowledged, "to reach maximum # of students, a variety of teaching techniques should be incorporated", she also realized she "…had more of an attitude of…this is the way that I teach…and that's just the way I teach…" (interview, August 2004). Secondly, stating "it's important not to use analogies so much that you stray from the topic…" she also conceded , "I'd always thought of it in terms, you know, of more real life is good" (interview, August 2004). Against the backdrop of these competing beliefs, her teaching goal was "…to integrate more 'everyday-life' references so that students can understand chemistry in a broader context" (interview, August 2004). Synthesis of her aforementioned beliefs and goals appeared to result in a dichotomous mix of teaching foci. Her desire to pursue student understanding and reach a maximum number of students suggested a student-centered focus, yet her resistance to changing her teaching style implied a teacher-centered focus.

How would such a dichotomous mix of her professed beliefs and goals be demonstrated in her instructional practice? During the first class observation, she did not incorporate any real life examples in her lecture and I wondered why. During our discussion of the classroom observation, she justified her action by explaining the difficulty of the lesson material and its incompatibility with her goal. She further rationalized that it was better for her students that she perform the intermediate step of relating previous and future

class activities rather than forcing the inclusion of examples just for the sake of inclusion. Cognitively drifting between two teaching orientations, her instructional practice followed suit. Lacking anchor in either teaching orientation, she pursued a 'middle of the road' stance that compromised clarity for action.

Middle: Emergent clarity of teaching focus

Dr. Willing's monthly meta-reflection at week 5 attested to a refinement of her teaching goal. She asserted that, " 'real world' doesn't have to mean only the world outside of chemistry…it is also important to synthesize the concepts within chemistry" (October 2004). Furthermore, she realized her focus should be "going for understanding rather than just teaching facts" (week 5 meta-reflections, October 2004). With these admissions, a clear link between her cognition and instructional practice became evident.   Midway through the study, Dr. Willing's accumulation of newly acquired knowledge from selected readings on constructivism and student-centered instruction as well as the observation of a peer was being manifest in her instructional practice. Applying what she was learning, she identified her efforts to contextualize ("just throwing those…couple extra words in there…"-interview, October 2004) her classroom demonstrations and use of actual situations as small observable differences in her instructional practice. I also recognized her emphasis upon contextualization and made the following notes during my October 2004 classroom observation:

> I noticed several instances of inclusion of real life examples: she passed around the products of a thermite reaction for students to observe as a reminder of previous lesson material; she correlated the lesson material to biology, referring to enzymes as biological catalysts and linking them to DNA; she addressed the decomposition of hydrogen peroxide, linking it to an earlier class activity and her discussion of catalysts; and she used the analogy of a hill to explain energy diagrams.

Consistent with her discovery that real world does not have to be exclusive of chemistry, I interpreted her strategy for real life examples to primarily rest upon creation of common class experiences to connect topics within the lessons. During our October 2004 interview, her operationalization of real life examples validated my characterization of her use of real life examples. She also articulated an increasing influence of constructivism upon her instructional practice.

Researcher: Okay. So how would you now define real life examples…?

Dr. Willing: Well, another thing that's helped me a lot is just doing the reading on constructivism over the last couple weeks… I'm thinking of it sort of from a different angle, from the idea of…constructivist point, you know, you know, um, taking into account students' previous experiences….where they're coming from and also the idea of, you know, just trying to always to set a context for the information… um, and try to bridge things that way rather than, you know, forcing real world…

Possessing a clearer understanding of her desired end of enhancing student understanding, the means for accomplishment of her goal became more defined. Within such definition, Dr. Willing began to actively explore and gain experience in contextualizing her presentation of real life examples. Also with enhanced student understanding as her focal point, she crafted her use of examples to expand student experiences and comfort with chemical activities. In short, her instructional practice was beginning to emulate the emergent clarity of her cognitions.

End: Commitment to student-centered focus

By the study's end, Dr. Willing's ease with conversational usage of terms such as constructivism, misconceptions, teacher-centered, and student-centered was compelling, especially since I had not introduced any of these terms and she had not used any of these terms in our initial conversations at the study's onset. As I probed the depth of her

understanding of these terms in analysis of her discourse and classroom behavior, I found the murkiness of her initial teaching orientation to be replaced with a clear commitment to constructivist principles. Her successful incorporation discussed during our December 2004 interview of an anecdote on Prohibition provided insight of her cognition-instructional practice link.

Returning to the Artzt and Armour-Thomas conceptualizations, Dr. Willing's peer observation spurred her to express a new overarching cognition: "…the southern culture embraces storytelling…" and "…I think it's important, you know, either I make all of them [her students] change or I adjust my style to try to, ah, you know, work in with the culture" (interview, December 2004). To realize this overarching cognition, she devised a different strategy to complement her preactive stage of cognitive processes: "I also realized that a lot of his [colleague she observed] examples were historical, so I would like to read more books on the history of chemistry so that I can present that perspective in my classes" (interview, December 2004). Accordingly, her preactive preparations enabled her incorporation of storytelling as a modification of her instructional practice:

> …but I think pulling a little bit in here and there of stopping and telling a story, I've tried to do that, especially over the past couple weeks…I think one example when you were there was Prohibition and methanol and ethanol. And it seemed to, what seems to happen when I look at the kids is they kind of perk up. They look up from their notes for a moment, it's almost a break, in a good way… (interview, December 2004).

Throughout the sequence of events surrounding her presentation of the Prohibition anecdote, Dr. Willing exhibited a student-centered focus. She recognized the importance of culture and

126

decided to use her understanding of the students' southern culture to shape her teaching. She opted to present chemistry within historical contexts even though she was not naturally inclined towards a historical perspective. Despite self assessment of her learning preferences as "linear and straightforward and …perfectly happy with no stories" (interview, December 2004), she stretched beyond her comfort zone to present her students with an original story about Prohibition.

I was also impressed by the changes exhibited in Dr. Willing's usage of real life examples during my November 2004 classroom observation. Despite her admission of nervousness with presenting the Prohibition anecdote, she appeared relaxed as she attempted to build bridges of understanding through her use of real life examples. Accordingly, she assessed her performance as "…probably my best class as far as using numbers of examples….pertinent to the material, a part of it being due to the subject matter being very, you know, amenable to doing examples… I had a lot of real world applications with organic chemistry…. I felt good about how it fit with the lecture" (interview, December 2004). I agreed that it was her best class but for a different reason. The examples fit with the lecture because of the intentionality coursing from her cognitions to her instructional practice. Maintaining a student-centered focus, she selected real life examples that she could present with clarity and enthusiasm in a manner consistent with her interpretation of active student involvement:

> …it's sort of like having a dinner conversation or something, you know. You can't do direct back and forth but back and forth as hitting things that they already know so you're on the same level as them, then expanding that and going back to things they already know and then expanding on that. (interview, December 2004).

As Dr. Willing developed a clearer student-centered focus, she became more concerned with the issue of student recognition of her use of real life examples in her lectures. How transparent were her efforts with integration of real life examples? The student survey results suggested the majority of students did recognize her use of real life examples (refer to Appendix D). Of the 116 student responses to the question of "In class, how often does your instructor relate daily life examples (like applications or current issues) to the lesson material?" , 96 or 82.76% of her surveyed students assessed Dr. Willing to relate daily life examples with lesson material with a frequency of at least 'sometimes'.

Acknowledging Dr. Willing's concern that the real life examples facilitate student understanding, I used the survey to gauge students' interpretations of the usefulness of the real life examples by having the students respond to the question of "How does your instructor's use of daily life examples affect your understanding of chemistry?" Results of the student responses to this open-ended question were not as straightforward as experienced in the previous question regarding frequency of real life example usage. Of the 116 students surveyed, 68 responded to the helpfulness of Dr. Willing's use of real-life examples. Forty-nine or 62.8% of the students considered the practice to be helpful in enhancing their understanding of chemistry (refer to Appendix E). Mindful of Dr. Willing's desire "to reach [a] maximum number of students", these survey results provided another indication of the transformational impacts of her cognitions upon her instructional practice.

By study's end, Dr. Willing had personified her pseudonym; she embraced a student-centered focus. She was willing to acknowledge, confront, and change personal cognitions and behaviors deemed detrimental to establishment of positive classroom experiences for her students.

Participants' perspectives.

Mindful of the study's purpose of teaching improvement via reflection, I was concerned with what the participants perceived to be the study's impacts upon their teaching practice and what I could ascertain to be observable changes in their teaching practice. Is there agreement between the participants' perceptions and my observations?

When asked to discuss the impacts of study participation upon his teaching practice, Dr. Skeptical shared, "the study has made me more aware of how I am in the class room. By adding the start of class outline which is an action that I would not have done without the study, I have become more aware of what actions I take naturally. I am also more aware of the potential to change things I do in class" (week 11 meta-reflections, November 2004). Dr. Willing expressed similar sentiments:

> …this study was pretty helpful in that it helped-it, it gave me a fuller picture of where everything fits in….ah, you know, especially when I got to the readings on the constructivism educational theory….I still do want to, you know, look things up and draw them in the lecture….but I think that I do so in more of a-rather than just kind of pick and throw-you know, a more far reaching goal-and, and I expanded my goals rather than just sort picking and throwing in- I also wanna try and explain these things in different ways, different angles. (interview, December 2004)

I interpreted the participants' statements to reflect acknowledgment of an accumulation of new ideas and strategies, development of a broader understanding of teaching, and implementation of thoughtful consideration of their classroom behavior as the reflection experiences' impacts upon their teaching practices. Though both participants mentioned performance of their selected low-inference behaviors, they seemed to be more

appreciative of the transformative nature of their expanded cognitions. Cognizant of Dr. Skeptical's contemplation of action as a change agent and Dr. Willing's desire to adapt her teaching style as necessary to reach the maximum number of students, I suggest that novice college science instructors are capable of developing reflective skills in a relatively short period of time, which contradicts Hatton and Smith's (1994) assertion of the complex and time intensive nature of such development. Concurrently, both participants' foci upon using the study experiences to propel their development as educators suggest their readiness to engage in practical action. Primarily because of the study's short duration, I did not expect the participants to exhibit progression beyond technical reflection. Nonetheless, the participants demonstrated ability to reflect at higher levels consistent with Pultorak's study (1993), which revealed novice K-12 teachers to exhibit all three of Van Manen's levels of reflection.

In sum, the reflection experiences impacted the participants' teaching practices. For Dr. Skeptical, I identified his conduct of lesson reviews and sensitivity to preparation and time management in lectures to be areas of impacted teaching practice. His transformation from an instructor who typically did not structure his lecture to one that habitually engaged in lecture outlining was most illustrative of the interdependence of cognition and teaching practice. For Dr. Willing, I noted her engagement in systematic deliberation of instructional practice, concurrent adoption of student-centered instructional practice, and development of proficiency in presenting examples in a variety of relevant contexts to be aspects of impacted teaching practice. Empowered by their attainment of teaching improvement, both instructors expressed sentiments of continued engagement in professional development after study participation. Invoking Artzt and Armour-Thomas's conceptualizations, I believe study

participation facilitated development of cognitions supportive of instructional practice reform to enhance undergraduate students' experiences in science classes. Consequently, this study's findings have significant implications for the professional development of novice college science instructors.

Implications

Professional development programs can be incorporated in the daily activities of novice instructors in an integrated and relevant manner. A novice college science instructor can effectively participate in a prolonged, systematic professional development program while maintaining teaching and departmental responsibilities. Active participation in a rigorous 14 week professional development program by novice instructors in their first semester of college science teaching is particularly noteworthy. Crucial to the instructor's involvement is a professional development program that is focused, flexible, and responsive. The focus should be singular or upon a specific behavior. Time management is a significant gate keeper, so the program should afford the participants flexibility in its completion. Also, the self accountability inherent in this kind of program requires participants comfortable with and committed to self disclosure in sharing their successes, struggles, failures, concerns, and support needs. To honor such transparency, the program and its facilitators must not be evaluative. Growth, not judgment, must be the overarching goal.

At each stage of growth, the program must support and challenge the instructors (Reiman, 1999). This was particularly evident in Dr. Skeptical's inability to gain the desired enhancement of his pedagogical content knowledge via reading of the articles on his personal reading list. Serving as a 'more knowledgeable other' in sharing alternative strategies for conduct of his lesson reviews, I was able to readily impart experience that furthered his

development without the considerable expenditure of time and effort associated with typical experiential learning. Thus, another benefit of this professional development program is its ability to facilitate bridging of pedagogical knowledge gaps in an efficient and focused manner.

Development of reflective habits of thinking requires considerable support. As the sole facilitator for this program, I found myself increasingly engaged in providing support absent from the program's design. Since the program did not involve collaboration among the participants, I became both participants' sounding boards for discussion of their interpretations of reflection experiences. In terms of pedagogical content knowledge, I served as a 'more knowledgeable other' in addressing Dr. Skeptical's concerns with student inattention to his review strategies and Dr.Willing's questions about constructivism since the program did not provide ready access to an external mentor. These interactions support Dewey's third criterion of reflection in which reflection is described to have a social construct demanding collaborative interactions (Rodgers, 2002). Learning has a strong social component and any sustained professional development program should provide opportunities for collaboration among its participants. Within the population of novice instructors, collaboration among participants should be expanded to include mentors.

Reflection can be a viable vehicle for enhancement of teaching practice. Cognition does impact instructional practice. Though Dr. Willing's initial goal was "to integrate more "everyday-life" references so that students can understand chemistry in a broader context", by the program's end she had refined her operationalization of "everyday-life" examples such that her instructional practice aligned with constructivist principles counter to her earlier teacher-centered orientation. Such a transformation was phenomenal considering the

program's focus upon a single discrete teaching behavior, the lack of a collaborative platform within the program, and the lack of external pressure to change her teaching orientation. As Dr. Willing executed her developmental plan framed by my adaptation of Loughran's (2002) model of anticipatory, contemporaneous, and retrospective reflections, the exploration of a tangible teaching behavior gave way to examination of intangibles-personal beliefs and attitudes. I believe this was prompted by the design of the developmental plan that incorporated increasing requirements for introspection of participant activities. In the confrontations of self catalyzed by her readings, reflections, observation of a colleague, and interviews, Dr. Willing gained a broader perspective that enabled her to align her instructional practice with her evolving cognitions of teaching. Embracing her newfound beliefs, she voiced and demonstrated a responsibility and commitment to reformation.

The results attained with this study may not be typical. This study's professional development program was based upon self report, self accountability, and self motivation. Such an emphasis on self highlighted the primacy of participants' individual characteristics on results attained. Dewey identified whole-heartedness, directness, open-mindedness, and responsibility (Rodgers, 2002) as prerequisite attitudinal dispositions for conduct of reflection. Though Drs. Skeptical and Willing exhibited varying manifestations of the desired attitudinal dispositions, both were extremely conscientious and goal oriented, which fueled their ability to complete the program's rigorous schedule of reflective activities complementing their developmental plans. Both participants' experiences bolster my belief in the viability of the program's process, yet I also acknowledge that the extent of growth was largely shaped by the attitudinal dispositions of each participant. Thus, the results of this study cannot be generalized beyond its context. This professional development program was

133

by no means a "one size fits all" approach. Attitudinal dispositions predisposed to reflection

should self select participants most appropriate for this professional development program.

References

Allen, R. & Casbergue, R. (1997). Evolution of novice through expert teachers' recall: Implications for effective reflection on practice. *Teaching and Teacher Education, 13*(7), 741-755.

Artzt, A. (1999). A structure to enable preservice teachers of mathematics to reflect on their teaching. *Journal of Mathematics Teacher Education, 2*, 143-166.

Fendler, L. (2003). Teacher reflection in a hall of mirrors: Historical influences and political reverberations. *Educational Researcher, 32*(3), 16-25.

Flood, B. J., & Moll, J. K. (1990). *The professor business: A teaching primer for faculty*. Medford, NJ: Learned Information, Inc.

Freese, A.R. (1999). The role of reflection on preservice teachers' development in the context of a professional development school [Electronic version]. *Teaching and Teacher Education, 15*, 895-909.

Gess-Newsome, J., Southerland, S.A., Johnston, A., & Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal, 40*(3), 731-767.

Grunau, H., Pedretti, E., Wolfe, E., & Galbraith, D. (2000). Collaborative professional development for science educators: Locating reflection in practice through a science methods course [Electronic version]. *Journal of Science Teacher Education, 11*(1), 47-61.

Hativa, N., Barak, R., & Simhi, E. (2001). Exemplary university teachers: knowledge and beliefs regarding effective teaching dimensions and strategies. *The Journal of Higher Education, 72*(6), 700-729.

Hatton, N. & Smith, D. (1994). *Facilitating reflection:Issues and research.* Paper presented at the Conference of the Australian Teacher Education Association, Brisbane, Queensland, Australia. (ERIC Document Reproduction Service No. ED 375110)

Levin, B. (1999). Analysis of the content and purpose of four different kinds of electronic communication among preservice teachers. *Journal of Research on Computing in Education, 32*(1), 139-156.

Loughran, J.J. (2002). Effective reflective practice: In search of meaning in learning about teaching. *Journal of Teacher Education, 53*(1), 33-43.

Northwest Regional Educational Laboratory. (1998, June). High-quality professional
        development. Retrieved April 25, 2003, from
        http://www.nwrel.org/request/june98/article11.html

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the
        literature and its implications. *International Journal of Science Education, 25*(9),
        1049-1079.

Pultorak, E. G. (1993). Facilitating reflective thought in novice teachers. *Journal of Teacher
        Education, 44*, 288-295.

Reiman, A.J. (1999). The evolution of the social roletaking and guided reflection framework
        in teacher education: Recent theory and quantitative synthesis of research. *Teaching
        and Teacher Education, 15*, 597-612.

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking.
        Teachers College Record, 104(4), 842-866.

Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards,
        testing, and equity. *Educational Researcher, 31*(1), 13-25.

Spalding, E. & Wilson, A. (2002). Demystifying reflection: A study of pedagogical
        strategies that encourage reflective journal writing. *Teachers College Record, 104*(7),
        1393-1421.

Sunal, D., Hodges, J., Sunal, C., Whitaker, K., Freeman, L., Edwards, L., Johnston, R., &
        Odell, M. (2001). Teaching science in higher education: Faculty professional
        development and barriers to change. *School Science & Mathematics, 101*(5), 246-
        258.

van Driel, J.H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in
        science education: The role of teachers' practical knowledge. *Journal of Research in
        Science Teaching, 38*(2), 137-158.

Van Manen, M. (1977). Linking ways of knowing with ways of being practical. *Curriculum
        Inquiry, 6*, 205-228.

Walczyk, J.J. & Ramsey, L.L. (2003). Use of learner-centered instruction in college science
        and mathematics classrooms. *Journal of Research in Science Teaching, 40*(6), 566-
        584.

Weimer, M. & Lenze, L. (1994). Instructional interventions: A review of literature on efforts
        to improve instruction. In K. Feldman &M.B. Paulson (eds.), *Teaching and learning
        in the college classroom*. Needham Heights, MA: Ginn Press.

Appendix A

Developmental Plan Format

Date: _____

1. List your learning needs:

2. Write a statement describing your level of commitment to completion of this developmental plan:

3. Write a statement acknowledging the source(s) of your motivation for completion of this developmental plan:

4. Write a goal statement for the selected teaching strategy to develop (as a teaching outcome in specific and measurable terms):

<center>PLAN OF ACTION FOR DR. SKEPTICAL</center>

Desired level of understanding: **<u>Knowledge</u>**

Level	Actions	Projected Date of Completion	Actual Date of Completion
Knowledge	Develop personal reading list	Mid Oct	Late Oct
	Complete readings	Mid Nov	Mid Nov

<center>PLAN OF ACTION FOR DR. WILLING</center>

Desired level of understanding: **<u>Comprehension</u>**

Level	Actions	Projected Date of Completion	Actual Date of Completion
Knowledge	Develop personal reading list	Late Aug	Early Sep
	Complete readings	Mid Sep	Early Oct
	Complete knowledge level requirements	Mid Sep	Early Oct
Comprehension	Develop personal reading list for educational theories encountered in knowledge level readings	Late Sep	Mid Oct
	Complete readings of related educational theories	Mid Oct	Late Oct
	Identify accessible sources for demonstration of the selected teaching practice	Late Oct	Early Sep
	Schedule and witness demonstration(s)	Early Nov	Early Nov
	Reflect upon reactions to demonstration(s)	Mid Nov	Early Nov
	Reflect upon your reasons for using the selected teaching practice with your students	Late Nov	Mid Nov

*Modification of table format (juxtaposition of actions and dates of completion) from Joyce, B. & Showers, B. (1995). *Staff development for student achievement*. New York: Longman.

Appendix B

Reflection Instrument

I. General Instructions.

Please refer to the emailed Data Collection Information files to guide your completion of the various reflection activities. There are no "right answers" and the aim of these activities is your personal development, so share your real thoughts and feelings as you respond to the open-ended questions and prompts.

A. Weekly Reflections (to be emailed as a composite at the end of each week)

1. Anticipatory (to be completed at the beginning of the week before taking action IAW your developmental plan):

 a. What is my major goal to accomplish this week IAW my developmental plan?

 b. What is my plan for accomplishment of this goal?

 c. What are my standards for accomplishment of this goal?

 d. How will accomplishment of this goal further develop me as an educator?

2. Contemporaneous (to be completed mid-week while in the midst of taking action):

 a. How am I adhering to my plan for accomplishment of this week's goal?

 b. What adjective best describes my progress towards goal accomplishment?

 c. How do I need to manage my efforts to accomplish this week's goal?

 d. What experiences (in and out of the classroom) indicate that my efforts in goal accomplishment are impacting my teaching?

3. Retrospective (to be completed at the end of the week after taking action):

 a. How would I describe my efforts based upon my standards for goal accomplishment?

 b. How do I feel about my efforts towards goal accomplishment this week?

 c. My greatest satisfaction with this week's study experiences (such as use of the reflection instrument, tutorial, etc.) was _____, whereas my greatest disappointment was _____.

 d. What have I gained from this week's study experiences?

 e. How can I use what I have gained to become a better educator? A better learner?

B. Monthly Semi-structured Interview Guide (audio taped face-to-face meetings with the researcher):

   1. Describe the actions you are most and least proud of in following your developmental plan for the past 2-3 weeks.

   2. Recalling your experiences with the reflection instrument and tutorial:

   a. which actions did you feel comfortable completing on your own?

   b. for which actions did you desire feedback from a coach or mentor?

   c. what available feedback and/or support has helped your progress? How?

   d. for which actions did you desire face-to-face interactions with a coach or mentor?

   e. for which actions did you desire discourse with peers for a sense of community and/or collaboration?

   3. What is the most significant discovery you've made about teaching as a result of the past weeks' experiences?

   4. What is the most significant discovery you've made about yourself as an educator and learner as a result of the past weeks' experiences?

   5. How would you characterize this study's tools (such as reflection instrument and tutorial) and processes in impacting your teaching practice?

   6. What changes would you recommend to enhance your reflection experiences within this study?

C. Monthly Meta- reflections (to be emailed as a composite at the end of every 4th week

following 3 weekly reflections)

    1. Thinking back over the month, explain which actions within your developmental plan and reflection instrument that you

        a. are or have developed confidence in completing on your own?

        b. are desirous of feedback (of any form, such as electronic communication, physical meetings, etc.) with a coach or mentor?

        c. are desirous of experiencing modeling via physical (face-to-face) interactions with a coach or mentor?

        d. are desirous of discourse with peers to foster a sense of community or collaboration?

    2. Looking back over your retrospective reflections of the past 2-3 weekly reflections, share how your integration of newly gained knowledge has impacted your teaching practice.

    3. Share your thoughts on any aspect of your experiences associated with this study that was meaningful to you.

Appendix C

Student Perceptions of Impact of Instructor's Use of Lecture Reviews

Question: "How does your instructor's use of lecture outlines affect your understanding of

lesson material?"

Theme	Frequency	Selected Specific Student Comments
Very helpful	**11**	Helps greatly, well thought out plans and covers most material well
Helpful	**18**	Gives direction of lecture
		If I don't understand something it helps to see what we are covering
		My notes are more organized when the lectures are organized
		It helps me be more prepared – yes it is a help
		It helps understanding because everything sort of links together
		That's the only way I got the lesson
Neutral/No effect	**7**	Doesn't affect understanding, but it is very nice to see what we have done and what we will do for each class
		I don't think it benefits or hurts but if I didn't take notes I would be struggling
		No, but does help to know what's going on that day
Detrimental	**0**	
No comment	**6**	

Appendix D

Student Perceptions of Instructor's Frequency of Example Usage

Question: In class, how often does your instructor relate daily life examples (like applications or current issues) to the lesson material?

Perception of use	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Always	12	10.34	12	10.34
Usually	31	26.72	43	37.07
Sometimes	53	45.69	96	82.76
Infrequently	4	3.45	100	86.21
Rarely	10	8.62	110	94.83
Never	6	5.17	116	100.00

Appendix E

Consolidation of Student Responses Regarding Helpfulness of Daily Life Examples

Q: How does your instructor's use of daily life examples affect your understanding of

chemistry?

Theme	Frequency	Selected Specific Student Comments
Very helpful	8	Very helpful, puts it in perspective
Helpful	41	She connects the chem. examples w/ real life examples in my head
		Helped me understand better
		Relate something we are learning to something we see everyday
		It's nice to see real world application
		Helps make it relevant
		The examples are interesting and occasionally deepen understanding
		It helps to make me visualize the concept
		It helps the course be more applied, I can recognize chemicals now
		This helps me see the importance of studying chemistry
Neutral/No effect	19	Didn't hurt
		They have no effect
		I don't understand chemistry, but it isn't her fault
Detrimental	0	
No comment	38	
Ambiguous comments	10	*cais etc - yes*

APPENDICES

Appendix A

Telephone Recruiting Script

Good morning/afternoon,

My name is ____ and I'm a doctoral candidate recruiting Innovative University faculty who teach basic science courses for involvement in my research study designed to evaluate reflection as a means to attaining enhanced teaching effectiveness. Are you interested in learning more? Do you have a few minutes for me to discuss my research project? *[If another time is more convenient for you, when would you like me to contact you for further discussion?]*

It will be a semester long case study of Innovative University faculty meeting projected inclusion criteria of three or less years of university teaching experience and teaching responsibilities for an introductory science course at Innovative University during the Fall 04 semester. Do you meet these criteria?

I will provide participants with a PowerPoint tutorial on effective teaching practices and self study to guide them in selection of a classroom teaching behavior to improve (from the effective teaching dimensions of lesson organization, lesson clarity, interest/student engagement, and positive classroom climate) and creation of a developmental plan for enhancement of the selected behavior. Throughout the semester as participants follow their individualized developmental plans, they will participate in emailed weekly and monthly reflections; three face-to-face semi-structured interviews with me; and four classroom observations – one of which I will ask their students to anonymously complete surveys of the selected classroom teaching behavior. Importantly, all activities are designed to provide experiences and opportunities to analyze participants' demonstration of selected classroom behaviors from a spectrum of perspectives: self, student, and external observer. Thus, participants should gain significant professional development from participation in this study.

Despite the acknowledgment of reflection as a viable vehicle for the development of effective teachers, there's a lack of research on the use of reflective practice by university instructors for professional development. My goal is to lessen this knowledge gap by providing practical insight on the forms of reflection experiences that are supportive of novice university instructor's improvement of science teaching effectiveness.

Are you interested in participating in this study?

If yes: when could we meet to further discuss the research study?

> To help me prepare for our meeting could you answer the following questions: How much formal teaching experience do you have? What are your teaching responsibilities for Fall 04?

If no: are there particular aspects of the study that are responsible for your decision?

Do you have any questions of me at this time?

Thank you for time. *[If a subsequent meeting is scheduled – I look forward to our meeting on ____].*

Appendix B

Selected Information from Tutorial
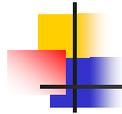
Introduction

If teaching is important to you, but you feel that you just
don't seem to have the time, support, or focus to further
develop your teaching practice, this guide may be just for
you!

Why?

Because your expenditures of time and effort, *though
significant*, will be self-paced and directed towards
accomplishment of specific goals designed within the
context of your particular needs and interests.

Introduction

***What should I expect from use of this guide (i.e., what are the
learning outcomes)?***

■ Users will experience the applicability of Bloom's taxonomy
to development of personalized self-study of teaching practices.

■ Users will identify their teaching competencies and create plans
for development.

■ Users will execute and reflect upon their developmental plans.

Self assessment for determining teacher behavior focus: main teaching dimensions based on research*

How do you evaluate your teaching in the following areas? Just fill in the blanks with S or N to denote areas of strengths and those needing improvement. Also, in the space for comments, please explain what you based your ratings upon.

	Initial	Comments	Final	Comments
**1. Lesson organization	_____		_____	
**2. Lesson clarity	_____		_____	
**3. Interest/Student engagement	_____		_____	
**4. Positive classroom climate	_____		_____	

*Format from Walberg, H. (1984). Improving the productivity of American schools. *Educational Leadership 41*, 19-27.

**Main teaching dimensions from Hativa, N., Barak, R., & Simhi, E. (2001). Exemplary university teachers: Knowledge of beliefs regarding effective teaching dimensions and strategies. *The Journal of Higher Education*, 72(6), 700-729.
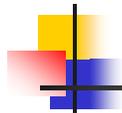
Getting to Work

The Focus

There are four overarching questions that will guide the creation of your developmental plan. They are:

Q1: What are your learning needs?

Q2: What is your level of commitment to completion of your developmental plan?

Q3: What are your motivations for completion of your developmental plan?

Q4: What is your goal for the teaching dimension you've chosen to develop?

Tip - As you complete steps to answer these questions, please write your answers on your developmental plan.

Getting to Work

Step 4: Selection of desired level of understanding, cont.

Presentation of the developmental plan's framework

Acknowledging the usefulness of Bloom's Taxonomy in distinguishing specific behaviors associated with various levels of cognitive processing, this self-study guide has adapted Bloom's Taxonomy to enable transfer of its parameters to a professional development context.

The next slide presents a comparison of the traditional and adapted explanations of Bloom's Taxonomy.

Getting to Work

Step 4: Selection of desired level of understanding, cont.

	Level					
	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
General Actions	Light to moderate reading	Substantial reading Exposure to demonstrations Reflection on teaching practice's impacts	Continued in depth reading Alliance with role models for continued observation and discussion of teaching practice	Development of lsn plans incorporating selected teaching practice	Execution of lsn plans	Self and role models' analysis of execution of lsn plans Determination of next developmental step

3. Considering your teaching needs and the amount of effort you're willing to exert, select the appropriate level of understanding from the adapted Bloom's Taxonomy (abbreviated above) as your goal.
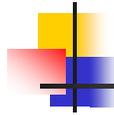
Getting to Work

Step 7: Reflections of experiences

Regardless of the level of understanding pursued in previous steps, take time to contemplate the following statements:

1. The most fulfilling aspects of my learning experiences were _____ _____ because _____.

2. The most troubling aspects of my learning experiences were _____ _____ because _____.

3. These learning experiences have inspired me to _____ _____ because _____.

What other statements can you think of to reflect upon your learning experiences?

Appendix C

Developmental Plan Format

1. List your learning needs: Date: _____

2. Write a statement describing your level of commitment to completion of this developmental plan:

3. Write a statement acknowledging the source(s) of your motivation for completion of this developmental plan:

4. Write a goal statement for the selected teaching strategy to develop (as a teaching outcome in specific and measurable terms):

PLAN OF ACTION

Desired level of understanding: _____

Level	Actions	Projected Date of Completion	Actual Date of Completion
Knowledge	Develop personal reading list	_____	_____
	Complete readings	_____	_____
Comprehension	Complete knowledge level requirements	_____	_____
	Develop personal reading list for educational theories encountered in knowledge level readings	_____	_____
	Complete readings of related educational theories	_____	_____
	Identify accessible sources for demonstration of the selected teaching practice	_____	_____
	Schedule and witness demonstration(s)	_____	_____
	Reflect on reactions to demonstration(s)	_____	_____
	Reflect upon your reasons for using the selected teaching practice with your students	_____	_____
Application	Complete comprehension level requirements	_____	_____
	Expand personal reading lists by reading the references compiled in knowledge and comprehension requirements	_____	_____
	Complete readings	_____	_____
	Identify accessible sources to role model use of selected teaching practice	_____	_____
	Select and meet with role model(s) to schedule observations and discussion of teaching practice	_____	_____
	Conduct observation and discussion of teaching practice with role model(s)	_____	_____

Level	Actions	Projected Date of Completion	Actual Date of Completion
Analysis	Complete application level requirements	_____	_____
	Develop lesson plans incorporating use of selected teaching practice	_____	_____
	Schedule and conduct meeting(s) with role model(s) to review lesson plans for suitability	_____	_____
	Revise lesson plans as necessary	_____	_____
Synthesis	Complete analysis level requirements	_____	_____
	Tape classes taught using lesson plans resulting from the analysis level requirements	_____	_____
Evaluation	Complete synthesis level requirements	_____	_____
	Self analyze teaching tapes from synthesis level requirements, focusing upon goal accomplishment (from 4) and instructional changes to make	_____	_____
	Schedule observation visit by role model to assess goal accomplishment	_____	_____
	Teach class and self reflect on performance and next step – refinement or selection of another teaching practice	_____	_____
	Meet with role model to assess goal accomplishment and determine next step	_____	_____

*Modification of table format (juxtaposition of actions and dates of completion) from Joyce, B. & Showers, B. (1995). *Staff development for student achievement.* New York: Longman.

Appendix D

Reflection Instrument

I. General Instructions.

Please refer to the emailed Data Collection Information files to guide your completion of the various reflection activities. There are no "right answers" and the aim of these activities is your personal development, so share your real thoughts and feelings as you respond to the open-ended questions and prompts.

A. Weekly Reflections (to be emailed as a composite at the end of each week)

1. Anticipatory (to be completed at the beginning of the week before taking action IAW your developmental plan):

a. What is my major goal to accomplish this week IAW my developmental plan?

b. What is my plan for accomplishment of this goal?

c. What are my standards for accomplishment of this goal?

d. How will accomplishment of this goal further develop me as an educator?

2. Contemporaneous (to be completed mid-week while in the midst of taking action):

a. How am I adhering to my plan for accomplishment of this week's goal?

b. What adjective best describes my progress towards goal accomplishment?

c. How do I need to manage my efforts to accomplish this week's goal?

d. What experiences (in and out of the classroom) indicate that my efforts in goal accomplishment are impacting my teaching?

3. Retrospective (to be completed at the end of the week after taking action):

a. How would I describe my efforts based upon my standards for goal accomplishment?

b. How do I feel about my efforts towards goal accomplishment this week?

c. My greatest satisfaction with this week's study experiences (such as use of the reflection instrument, tutorial, etc.) was _____, whereas my greatest disappointment was _____.

d. What have I gained from this week's study experiences?

e. How can I use what I have gained to become a better educator? A better learner?

B. Monthly Semi-structured Interview Guide (audio taped face-to-face meetings with the researcher):

1. Describe the actions you are most and least proud of in following your developmental plan for the past 2-3 weeks.

2. Recalling your experiences with the reflection instrument and tutorial:

   a. which actions did you feel comfortable completing on your own?

   b. for which actions did you desire feedback from a coach or mentor?

   c. what available feedback and/or support has helped your progress? How?

   d. for which actions did you desire face-to-face interactions with a coach or mentor?

   e. for which actions did you desire discourse with peers for a sense of community and/or collaboration?

3. What is the most significant discovery you've made about teaching as a result of the past weeks' experiences?

4. What is the most significant discovery you've made about yourself as an educator and learner as a result of the past weeks' experiences?

5. How would you characterize this study's tools (such as reflection instrument and tutorial) and processes in impacting your teaching practice?

6. What changes would you recommend to enhance your reflection experiences within this study?

Excerpts of Differentiated Semi-structured Interview Guides : Dr. Willing

Part Two - Specific to Dr. Willing(18 Oct 04)

1. Review of some of her earlier reflections

<u>RETROSPECTIVE</u> (Week 2):
whereas my greatest disappointment was
I thought one of the papers had very little to offer – I was very interested to read it, since it was about teaching freshmen, but it turned out not to be very insightful to me

Q: why?

<u>RETROSPECTIVE </u>(Week 4):
whereas my greatest disappointment was
not enough time to go into the articles in more depth and synthesize ideas

Q:What are her strategies for time mgmt in her efforts to participate in the study and balance her many responsibilities?

Reading List -
Rop, C. Journal of Research in Science Teaching, 36 (2), 221, 1999.

The paper discusses a "social constructivist" theory. I'm not sure what this is.
[Take time to do an EBSCO search to find out more about constructivism]

2. Joint completion of plan of action. **How well is she progressing?**

3. Miscellaneous**. Does she have any concerns or other feedback to share of the study experience?**

Part Two - Specific to Dr. Willing(1 Dec 04)

1. Review of some of her earlier reflections

Retrospective (Week 9):

f. How can I use what I have gained to become a better educator? A better learner?

The article "Defending Constructivism in Science Education" helped to validate and refine my goal. One way to teach science such that there is a "real world" component is to try not to teach topics in isolation, but to set them up historically and contextually.

Q: how did this article validate and refine your goal?

2. Discussion of her observation of a colleague:

1. How did you select instructors to observe?

Everytime I've overheard Dr. Catalyst teaching, he seems to be applying chemistry to real-life examples, so I thought he would be a good person to observe. He's also had a lot of real-world experience, as he's worked in industry for many years.

Q: When did you meet with him? How did you explain the request for observation? Do you have an idea of how much teaching experience he has? Was he teaching a class with similar level and student population to yours?

2. How would you describe their use of real-life examples in their teaching? [Please take notes of specific examples used]

I noticed 5 real-world examples:
*1) **historical presentation** of batteries: they used to last for 1 week (30 years ago), which is why they switched to alkaline (using base instead of acid)*
*2) throwing away batteries is particularly bad for NiCad batteries because of the toxicity of cadmium, and these batteries are **banned in Europe***
3) galvanization uses a sacrificial metal such as zinc that becomes oxidized to protect steel (compared to oxidized Fe, which crumbles)
*4) **told a story** of how when he was in industry, some coworkers threw sodium into a creek with oil on top, and the reaction of Na with water caught the oil on fire*
*5) **Historical story** of discovery of Bronsted-Lowry acids: Lowry published first, but Bronsted was the better PR guy*

Q: How did you feel about the amount of real-life examples used? How did his teaching strategy reinforce student understanding of the lesson content? What kind of connections was the instructor making through his use of diverse connections [historical, contemporary, disciplinary, personal, human] Thinking back to your comment about Defending constructivsm in Science Education, it seems that your colleague was modeling what you had read and interpreted-what do you think?

[Comment: Now is the perfect time to discuss my classroom observations. What real-life examples did I notice? What connections did I think she made through her examples? How did she feel about her use of real-life examples?]

3. Joint completion of plan of action. How well is she progressing?

4. Miscellaneous**. [Does she have any concerns or other feedback to share of the study experience?]**

a. What about the impacts of other responsibilities [research interests] upon study participation? The impacts of time mgmt upon study participation?

b. How does her study participation experience align with her original rationale (believes in what I'm doing – thinks it will help see things in a broader light) and expectations (participation will help her to be a better teacher overall) in participating in the study?

c. So now that the study is ending, what is she going to do with what she has gained? What would she like to do for the next step?

Excerpts of Differentiated Semi-structured Interview Guides : Dr. Skeptical

Part Two - Specific to Dr. Skeptical (19 Oct 04)

1. Review of some of his earlier reflections

ANTICIPATORY (Week 2**)**:
    b. How much time (in hours) do I plan to devote to accomplishment of this goal?

Less than one hour

 Q: is the hour to cover the writing of the review?

 ANTICIPATORY (Week 4):

    a. What is my major goal to accomplish this week IAW my developmental plan?

Just get through the reviews again

Q: what are his feelings towards conducting the reviews?

    e. How will accomplishment of this goal further develop me as an educator?

I hope the students learn the material better

Q: how does he think his actions will impact him as an instructor? Can you do something beneficial for someone else without being positively impacted yourself?

(Week 5 monthly meta-reflection)

3. Share your thoughts on any aspect of your experiences associated with this study that was meaningful to you.

Trying to make a review at the end of class is making me realize that class time management is tough because trying to include an activity at a set time is difficult. My style is to usually not plan and schedule the lecture too much, and so a scheduled event is tough although I appreciate the idea that this review will benefit students.

Q: does this also benefit him? How is the incorporation of reviews impact his teaching orientation?

2. Joint completion of plan of action. How well is he progressing?

Mentioned he needed help with the personal reading list – go through an EBSCO search with him. Possible descriptors: lecture method, teaching methods, classroom techniques, large group instruction, and instructional effectiveness.

Possible article: Jones, L.L.C. (2003). Are lectures a thing of the past? Tips and techniques for success.
        Journal of College Science Teaching, 37(7), 453-457.

3. Miscellaneous. [Does he have any concerns or other feedback to share of the study experience?]

Part Two - Specific to Dr. Skeptical (23 Nov 04)

1. Review of some of his earlier reflections

Week 8 Reflections

3. RETROSPECTIVE :

    c. How do I feel about my efforts towards goal accomplishment this week?

It feels good to do the review at the start of class and so it is easier to feel good about accomplishing the goal.

Q: How so?

Week 9 Reflections

2. <u>C</u>ONTEMPORANEOUS:

      a. How am I adhering to my plan for accomplishment of this week's goal?
I did the review at the beginning of class. I think the students like it because I asked them if they like it and they said yes.

Q: did they share anything else?

      d. What experiences (in and out of the classroom) indicate that my efforts in goal accomplishment are impacting my orientation to teaching and/or teaching practice?
I am glad that the students said they like the outline listed at the start of class.

[Note: This is a perfect time to discuss my classroom observations from Monday – he listed the outline before starting the lecture, he referred to it several times, he updated it with relevant calculations, and he appeared to use it as a time mgmt tool – how did he feel about his use of outlining? Bottomline-I found it to be extremely helpful in organizing my thoughts and following his lecture-it also let me know the major pts without being overwhelmed]

2. Joint completion of plan of action. How well is he progressing? (Q: what is his assessment?)

3. Miscellaneous. [Does he have any concerns or other feedback to share of the study experience?]

    a.   **What suggestions does he have for conducting the student survey? Will class meet during the last week of classes? Is the final exam a possibility?**
    b.   **What about the impacts of his research program/interests upon study participation? The impacts of time mgmt upon study participation?**
    c.   **How does his study participation experience align with his original expectation of participating in the study just to help out a grad student?**

C. Monthly Meta- reflections (to be emailed as a composite at the end of every 4th week following 3 weekly reflections)

   1. Thinking back over the month, explain which actions within your developmental plan and reflection instrument that you

        a. are or have developed confidence in completing on your own?

        b. are desirous of feedback (of any form, such as electronic communication, physical meetings, etc.) with a coach or mentor?

        c. are desirous of experiencing modeling via physical (face-to-face) interactions with a coach or mentor?

        d. are desirous of discourse with peers to foster a sense of community or collaboration?

   2. Looking back over your retrospective reflections of the past 2-3 weekly reflections, share how your integration of newly gained knowledge has impacted your teaching practice.

   3. Share your thoughts on any aspect of your experiences associated with this study that was meaningful to you.

Appendix E

Student Surveys

Undergraduate Student Survey (for Dr. Willing's class)

Please answer the provided questions regarding your classroom experiences. This survey is not a part of your classwork, and is entirely voluntary. Your responses will be anonymous, and will not affect your class grade. For questions with responses to choose from, circle the number of the response that describes how you feel. For open-ended questions, write your comments in the space provided. Thank you!

1a. What is your gender?
   1. Female
   2. Male

1b. Are you or do you want to be a chemistry major?
   1. No
   2. Undecided
   3. Yes

1c. What class do you belong to?
   1. Freshman
   2. Sophomore
   3. Junior
   4. Senior

2a. In class, how often does your instructor relate daily life examples (like applications or current issues) to the lesson material?
   1. Always
   2. Usually
   3. Sometimes
   4. Infrequently
   5. Rarely
   6. Never

2b. How does your instructor's use of daily life examples affect your understanding of chemistry?

3a. Overall, how satisfied are you with your instructor's teaching?
   1. Very Satisfied
   2. Satisfied
   3. Somewhat Satisfied
   4. Somewhat Dissatisfied
   5. Dissatisfied
   6. Very Dissatisfied

3b. What are your reasons for your answer to Question #3a?

3c. What do you most like about your instructor's teaching?

3d. What do you least like about your instructor's teaching?

4. How has your instructor's teaching impacted how you feel about chemistry?

Undergraduate Student Survey (for Dr. Skeptical's class)

Please answer the provided questions regarding your classroom experiences. This survey is not a part of your classwork, and is entirely voluntary. Your responses will be anonymous, and will not affect your class grade. For questions with responses to choose from, circle the number of the response that describes how you feel. For open-ended questions, write your comments in the space provided. Thank you!

1a. What is your gender?
   1. Female
   2. Male

1b. Are you or do you want to be a physics major?
   1. No
   2. Undecided
   3. Yes

1c. What class do you belong to?
   1. Freshman
   2. Sophomore
   3. Junior
   4. Senior

2a. How would you describe your typical class preparation (like reading text book and reviewing notes)?
   1. Always prepare for class
   2. Usually prepare for class
   3. Sometimes prepare for class
   4. Rarely prepare for class
   5. Never prepare for class

2b. How does your instructor's use of lecture outlines affect your understanding of lesson material?

2c. What does your instructor do that most helps you understand the lesson material?

3a. Overall, how satisfied are you with your instructor's teaching?
   1. Very Satisfied
   2. Satisfied
   3. Somewhat Satisfied
   4. Somewhat Dissatisfied
   5. Dissatisfied
   6. Very Dissatisfied

3b. What are your reasons for your answer to Question #3a?

3c. What do you most like about your instructor's teaching?

3d. What do you least like about your instructor's teaching?

4. How has your instructor's teaching impacted how you feel about physics?

Appendix F

Self Assessment Results for Dr. Skeptical

Teaching Dimensions	Ratings	Comments
Lesson organization	Needs Improvement	*Time limit restricts preparation*
Lesson clarity	Needs Improvement	*Due to incomplete organization, clarity suffers*
Interest/student engagement	Strength	
Positive classroom climate	Strength	

Appendix G

Self Assessment Results for Dr.Willing

Teaching Dimensions	Ratings	Comments
Lesson organization	Strength	*Very time-consuming, but I feel well-prepared w/ skeleton notes* *-I try to explain complex concepts in several different ways*
Lesson clarity	Strength	*-It's important not to use analogies so much that you stray from the topic, but they are often the best way for students to "get" an idea* *-Large diversity of incoming class – careful not to make course too challenging* *-Often have to wait until after class w/ large class size* [in regards to checking students' understanding of lesson material as it is presented in class]
Interest/student engagement	Needs Improvement	*-I'd like to find ways to bridge the topics in class with students' real-life experiences* *-To reach maximum # of students, a variety of teaching techniques should be incorporated* *-Could find ways to make some topics more engaging* *-I'm still trying to figure out their "daily lives" – what interests them*
Positive classroom climate	Strength	*-All questions are encouraged* *-Reward "thinking", even if wrong answer*

Appendix H

Developmental Plan for Dr. Skeptical

Date: 8/30/04

1. List your learning needs:

2. Write a statement describing your level of commitment to completion of this developmental plan:

3. Write a statement acknowledging the source(s) of your motivation for completion of this developmental plan:

4. Write a goal statement for the selected teaching strategy to develop (as a teaching outcome in specific and measurable terms):

Initial thought: Organize my notes better so that student notes reflect thematic flow of lecture better [which would require looking at students' notes and comparing them to ideal notes…with further thought he decided this was too invasive]

Subsequent thought: Decrease time spent on administrative duties from ~ 3 hrs/wk to less than 1 hr/wk to allow more time for lesson organization [he further shared that webassign is an integral part of the administrative workload and it has hundreds of features he doesn't know – it takes time to generate statistics – record keeping /keeping attendance is challenging (adding and dropping - rolls constantly changing). Teaching is his secondary job and emphasis – his primary job is to maintain his research program and funding – this was made clear to him when he was hired]

Subsequent actions: Through our post-classroom observation discussion, we came to the agreement that the study didn't readily lend itself to a focus upon decreased allocation of time spent on administrative duties. In fact, Dr. Skeptical's teaching approach revealed a use for reviewing lesson material as a means for enhancing lesson organization (before and during actual lesson conduct). Thus, Dr. Skeptical's goal statement became: *To incorporate innovative ways of conducting reviews of the lesson material while still maintaining student interest.*

PLAN OF ACTION

Desired level of understanding: **Knowledge**

Level	Actions	Projected Date of Completion	Actual Date of Completion
Knowledge	Develop personal reading list	Mid Oct	Late Oct
	Complete readings	Mid Nov	Mid Nov

*Modification of table format (juxtaposition of actions and dates of completion) from Joyce, B. & Showers, B. (1995). *Staff development for student achievement*. New York: Longman.

Appendix I

Developmental Plan for Dr. Willing

Date: 8/23/04

1. List your learning needs: *-defining students' "everyday lives" – determining how chemistry concepts relate to their everyday lives*

2. Write a statement describing your level of commitment to completion of this developmental plan: *I can commit a couple of hours 1 day/week (Tuesdays, tentatively)*

3. Write a statement acknowledging the source(s) of your motivation for completion of this developmental plan*: I feel the next step to becoming a more effective teacher is to show the students how to make the material relevant to their lives.*

4. Write a goal statement for the selected teaching strategy to develop (as a teaching outcome in specific and measurable terms): *I plan to integrate more "everyday-life" references so that students can understand chemistry in a broader context.*

PLAN OF ACTION

Desired level of understanding: **Comprehension**

Level	Actions	Projected Date of Completion	Actual Date of Completion
Knowledge	Develop personal reading list	Late Aug	Early Sep
	Complete readings	Mid Sep	Early Oct
	Complete knowledge level requirements	Mid Sep	Early Oct
Comprehension	Develop personal reading list for educational theories encountered in knowledge level readings	Late Sep	Mid Oct
	Complete readings of related educational theories	Mid Oct	Late Oct
	Identify accessible sources for demonstration of the selected teaching practice	Late Oct	Early Sep
	Schedule and witness demonstration(s)	Early Nov	Early Nov
	Reflect upon reactions to demonstration(s)	Mid Nov	Early Nov
	Reflect upon your reasons for using the selected teaching practice with your students	Late Nov	Mid Nov

*Modification of table format (juxtaposition of actions and dates of completion) from Joyce, B. & Showers, B. (1995). *Staff development for student achievement*. New York: Longman.

Appendix J

Excerpts of Interview Transcripts with Dr. Willing

7 September 2004 interview

I: I'll just get started with a few questions

Dr. Willing: Mm hmm

I: and we'll just go from there. Um, first of all, what's the goal focus? Would you mind restating the goal focus as you understand it, yes, for the study?

Dr. Willing: Okay, so the main part of the focus is to try to incorporate more real-life, um, references in the classroom so they understand the connection between chemistry and real life, you know, how it applies to them.

I: Okay, now thinking way back upon the focus how would you assess how you did on Friday's class?

Dr. Willing: I, not great, I mean I think that, uh, the material, part of the material is, ah, sort difficult to take the big step to go from the atomic level and electron configurations and all that and show how that shows up in your every day life. So I think what I tried to do was more of an intermediate step, which was to at least, you know, relate the information to stuff they have done before in class with the stuff they were gonna do in the future and maybe give them the idea in their head that maybe it will be important to learn because it's going to show up when they talk about chemical bonding and then

I: Mm hmm

Dr. Willing: when we get to chemical bonding and certain parts of chemistry that they can start to relate a little bit more to what they see in chemical reactions. So rather than going, you know, just directly this is where it applies to your life

I: Mm hmm

Dr. Willing: I think that was what I tried to do (inaudible) show them some motivation for the future.

I: Do you think that was clear to them?

Dr. Willing: I don't know, you know, that's the hardest thing about the big lecture classes.

I: Mm hmm

Dr. Willing: not really being able to sense what they're thinking.

I: Mm hmm, because that's what I was going to say because I was waiting to see how you were going to relate that because I was thinking that with the trends and everything else and the difficulty that would be posed by that so I didn't have any evidence of that being directly related to their daily lives.

Dr. Willing: Mm hmm.

I: and uh, do you think that there are times when what you did is the best step? Were you just showing them in terms of the lesson flow

Dr. Willing: Mm hmm

I: of just how you're building upon concepts instead of trying to force some kind of, ah, connection that doesn't flow as well?

Dr. Willing: Right, I mean I think it doesn't make sense to take out 20 minutes to say, "well, this leads to B which leads to C which leads to D which leads to E which leads to your real life."

I: Right.

Dr. Willing: I think that could be pushing it a little bit, ah, so yeah, that is sort of where I was trying to go which was to point out the next step and then hopefully that at some point I could find some connection to real life – yeah, that was I think that was particularly hard material to try to relate to – ah, maybe a little bit with the reactivity of gases, but again I'm not sure how much they in everyday life, you know, look at noble gases and think about them being reactive or unreactive.

I: Mm hmm

Dr. Willing: that's sort of hard to

I: Yeah, because as I was sitting there I was trying to think of, you know, what you could try to pull out and it is difficult – how far do you want to go with what they understand so far and everything else of how that would relate. So far the baseline for, um, that first class I'd

have to say that there wasn't, you know, an incident of that and the notes would support that the rationale why

Dr. Willing: Mm hmm

I: because, uh, the subject matter that was being discussed and everything else. Are you still excited about pursuing the focus though for the study?

Dr. Willing: Oh yeah, absolutely, I think it would be nice to have

I: Okay

Dr. Willing: new ideas to work with

I: Okay

Dr. Willing: Now I'm just going to do a bit of brainstorming for subsequent classes where they may be more apt or more feasible for you to pull in the examples that flow

I: Mm hmm. With the lesson material, um, do you plan on trying to involve them with it in some aspect or more of the instructor imparting this information and just getting the "Oh wow!" factor or "I didn't know that was related to chemistry-oh you know something I'm learning in the textbook I just came across and blah, blah, blah at the store and you know I was scanning, you know, the cashier was scanning such and such-oh that applies" Do you plan on being the main facilitator of that or trying to draw out some kind of examples from them in asking questions or have you really thought about it?

Dr. Willing: Ah, well on the first day of class I did try to pull from them and ask questions and it worked to an extent. I mean what I asked them in the first day was where have they seen chemistry-what different types of chemistry have they heard of

I: Uh huh

Dr. Willing: and what do they know about it. Ah, and the only real problem with that is that with such a large class

I: Uh huh

Dr. Willing: you're really not hitting that many of them-I mean even if you pick five out-get ten or fifteen responses-so my plan was to use that sort of limited throughout the semester-getting their-asking them to brainstorm and come up with ideas.
.
.
.
.

Excerpts of Interview Transcripts with Dr. Skeptical

7 September 2004 Interview

I: Alright, so first of all, I would like to, ah, discuss your feelings about the, ah, lesson based upon the focus that we had sort of come to closure on last week.

Dr. Skeptical: Um, I guess the focus we decided on was organization and the amount of time

I: Yeah

Dr. Skeptical: spent organizing it somewhat

I: [inaud]

Dr. Skeptical: related to the behavior

I: Right, and I'm wondering if it's a little bit

Dr. Skeptical: Okay

I: too ambiguous to, you know, work with. That's why I really wanted, you know, to talk to you face to face because it seems like it's sort of hard to put your fingers on and I wanted to do something that we can, you know, really be clear about.

Dr. Skeptical: Ah, yeah, I guess I, I don't

I: Uh huh

Dr. Skeptical: have much to say about that. I mean I agree it's hard to quantify better organization can always-leads to better classroom performance but the Friday's lecture

I: Uh huh

Dr. Skeptical: is sort of a preformed lecture. You can see, I don't know, ah, depends a little on how the students prompt us through things

I: Uh huh

Dr. Skeptical: to how fast we get through things

I: Absolutely

Dr. Skeptical: it was clear the last topic wasn't covered enough. That'll be started on Wednesday.

I: Uh huh

Dr. Skeptical: tomorrow

I: right, yeah 'cause the more I thought about the focus, we were talking about decreasing the amount of time that was allocated to, you know, the administrative tasks that you were speaking of, ah, to include, ah, maintaining the class roll and looking at what we've done with where the time has gone and so forth, and trying to really get to what we see in the classroom, that's quite a challenge.

Dr. Skeptical: Right, I guess all you can, you can certainly see the –at the end of class where I have this…
.
.
.
.
I: So, looking at those four areas, what do you think?

Dr. Skeptical: In terms of figuring out some project?

I: Uh huh. Because I'm trying to get a feel for your personality and what works for you because you've already made it very clear that the amount of time that you can, can dedicate to this is, you know, very, very defined and so that's why I wanted something, you know, really clear that will benefit you with the amount of time that you have.

Dr. Skeptical: Yeah, ah, can't, haven't given it a whole lot of thought
.
.
.
.
Dr. Skeptical: I have very little ability to reflect on classroom behaviors. I don't, I don't know how do you evaluate classroom behaviors here

I: Uh huh

Dr. Skeptical: could be a lot of things

I: That's why I try to give you feedback so that, ah, you would have something to go with. Because what I'm saying is that what I'm seeing with your basic instructional style is that for your interactions with students I don't see that to be an area that's needing of emphasis. Because you just inherently engage your students, meaning that you seem to have that, ah, understanding of those points that are sticky where you need to go slow

Dr. Skeptical: Uh huh

I: where you need to just be relaxed and say, "Okay, well think about it a little bit more – but let's work with whatever." So in terms of your, ah, rapport with students, I think that's very good and you seem to have that innate understanding. Your understanding of the material is such a strength that you're able to make it work for the students.

.
.
.
.

Dr. Skeptical: So what do you suggest

I: I'm working my way down here [laughter] and what I'm wondering about is the organizational aspect of it because you allow your ability

Dr. Skeptical: Yeah, I don't organize

I: Yes, and that's what I wanted to get at. The organization of that lecture time so that you can adequately cover what you need to cover and so that structure is there because within a particular subject it's awesome – 'cause of course you're gonna go wherever you need to go but the other things suffer because

Dr. Skeptical: Okay, suffer in the end

I: Yep, yep

Dr. Skeptical: So how do we do that [laughter]?

I: I know [laughter]. I know and I'm looking at how this is done. Ah, well what we can do

Dr. Skeptical: can say organize my notes better so that I can cover everything in lecture or I don't know.
.
.
.
.

Appendix L

Dr. Skeptical's Reading List

Bartlett, Thomas "Big, but not bad", chronicle of higher education Vol 49, Issue 35, pA12, 30, 1c, 1bw (5/9/2003)

Techniques for Promoting Active Learning. The Cross Papers. Cross, K. Patricia; League for Innovation in the Community Coll., Laguna Hills, CA., 2003 (ED475431)

Technology and Science Education: Starting Points, Research Programs, and Trends. Linn, Marcia C.; International Journal of Science Education, v25 n6 p727-58 Jun 2003 (EJ672142)

Do Instructor-Provided On-Line Notes Facilitate Student Learning. Barnett, Jerrold E., 2003 (ED476465)

Appendix M

Dr. Willing's Reading List

Teichert, M. Journal of Research in Science Teaching, 39 (6) 464, 2002.

DeLorenzo, R. Journal of Chemical Education, 76 (4) 503, 1999.

Reinarz, A. College Teaching, 39 (3), 1991.

Stein, A. Journal of Chemical Education, 74 (7), 788, 1997.

Coll, R. Journal of Research in Science Teaching, 40 (5), 464, 2003.

Rop, C. Journal of Research in Science Teaching, 36 (2), 221, 1999.

Ryder, J. Journal of Research in Science Teaching, 36 (2), 201, 1999.

Appendix N

Dr. Willing's Reading List Reflections

Rop, C. Journal of Research in Science Teaching, 36 (2), 221, 1999.

<u>Most significant:</u> the idea of "going for understanding", p. 222. I think it is inevitable that students will always have the priority of getting a good grade, and the challenge seems to be to tie this in to also making sure they understand not only the bits and pieces that they are tested on, but also the big picture. In fact, I think that if an instructor can effectively relate the material to the students' world, it should be easier for the students to remember the details, both for the short term and the long term, which will help them attain their goal of getting a good grade.

<u>Questions:</u> I am interested in one of the references for this paper: Barrow (1991), which may have more detail about the "real chemistry" discussed on the bottom of p. 223.

The paper discusses a "social constructivist" theory. I'm not sure what this is.

I am disturbed by the statement on the bottom of p. 223 that "few know what chemistry is all about". I would hope this isn't true in most cases, but it is certainly an important question to ask oneself as an instructor: have I spent so much time on the details that I haven't given them a picture of what it is like to be a chemist, and even broader - how does chemistry tie in to the world at large?

Another controversial topic is whether a teacher should tell students exactly what will be on the test (p. 228). In many ways, this seems fair, but it also is much more difficult to test understanding since students can simply memorize for the test.

<u>Recommend</u>: To all science teachers, particularly those teaching introductory courses to non-majors, because I think we should all consider a) what would we like our students to know about our subject, and b) are we providing an atmosphere in the classroom that facilitates these goals?

Coll, R. Journal of Research in Science Teaching, 40 (5), 464, 2003.

<u>Most significant:</u> This was very different from the other articles, because it brought up the dangers of trying too hard to make material relate to students' real world. I really liked the statement on p. 468 that we need to have a clear understanding of the limitations our models possess and make sure we are not endangering students' abilities to gain a deeper understanding by our oversimplifications.

<u>Questions</u>: It was interesting to read about the comparisons of high school, undergraduate, and graduate students' mental models. I'd be interested in learning more about how these different levels learn differently.

Recommend: To chemistry teachers of all levels, because we all teach with models, and it is important to be aware of how the students interpret the models and their limitations.

Reinarz, A. College Teaching, 39 (3), 1991.

Most significant: The author believes it is okay to sell one's discipline, which is different from the views of many scientists I've encountered who believe it's better to let the facts inspire interest on their own.

The article also helped remind me how scary freshman year can be. I try to remember how nervous many students are when they approach me.

Questions: I think some of the analogies that are made in trying to make the material interesting to students are pretty large stretches (e.g. comparing ATP to money). This reminded me of the Coll article, which talked about how oversimplified models can be dangerous. I tend to agree more with Coll on this.

Recommend: To teachers of freshmen, for the insightful descriptions of how freshmen are feeling - nervous, but motivated to learn.

Stein, A. Journal of Chemical Education, 74 (7), 788, 1997.

Most significant: That students were rewarded for coming up with their own real-world connections to chemistry. I liked this because then the instructor doesn't have to guess what the students consider to be real-world.

Questions: I think this would be difficult to implement with 220+ students per class, but I wonder if there is some variation on this idea that may work with a large class.

Recommend: Definitely to high school teachers, since that classroom environment seems more amenable to the suggestion box. Possibly for introductory college courses with smaller class sizes.

Appendix O

Dr. Willing's Reflections of Peer Observation

Observation of Dr. Catalyst:

1. How did you select instructors to observe?

Everytime I've overheard Dr. Catalyst teaching, he seems to be applying chemistry to real-life examples, so I thought he would be a good person to observe. He's also had a lot of real-world experience, as he's worked in industry for many years.

2. How would you describe their use of real-life examples in their teaching? [Please take notes of specific examples used]

I noticed 5 real-world examples:
1) historical presentation of batteries: they used to last for 1 week (30 years ago), which is why they switched to alkaline (using base instead of acid)
2) throwing away batteries is particularly bad for NiCad batteries because of the toxicity of cadmium, and these batteries are banned in Europe
3) galvanization uses a sacrificial metal such as zinc that becomes oxidized to protect steel (compared to oxidized Fe, which crumbles)
4) told a story of how when he was in industry, some coworkers threw sodium into a creek with oil on top, and the reaction of Na with water caught the oil on fire
5) Historical story of discovery of Bronsted-Lowry acids: Lowry published first, but Bronsted was the better PR guy

3. How do their teaching styles align with your understanding of constructivism?

I heard a student say, "I like this class - he's funny!", which to me implied that Dr. Catalyst uses teaching methods that resonate well with the student interest. He taught a 75 minute class, and although there were plenty of "sleepers", there were also students who were engaged the entire time. It feels more like he tells a story than gives a lecture, and I think this fits well with the theory of constructivism: to me, the southern culture embraces storytelling but has an aversion to a more didactic approach. The students are very diverse, but almost all are from the south, and so this is one commonality that would be logical to take advantage of.

4. How have you benefited from your observations of other instructors?

Specifically, I can use Dr. Catalyst's examples in my class. I also realized that a lot of his examples were historical, so I would like to read more books on the history of chemistry so that I can present that perspective in my classes. Although it would be a difficult transition for me, I think I would be more effective if I were a bit more low-key like Dr. Catalyst since I think this appeals to more students and makes them more comfortable in the classroom.

References

Allen, R. & Casbergue, R. (1997). Evolution of novice through expert teachers' recall: Implications for effective reflection on practice. *Teaching and Teacher Education, 13*(7), 741-755.

Artzt, A. (1999). A structure to enable preservice teachers of mathematics to reflect on their teaching. *Journal of Mathematics Teacher Education, 2*, 143-166.

Borduas, F., Gagnon, R., Lacoursiere, Y., and Laprise, R. (2001). The longitudinal case study: From Schon's model to self-directed learning. *The Journal of Continuing Education in Health Professions, 21*, 103-109.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educational process*. New York: D.C. Heath and Company.

Fendler, L. (2003). Teacher reflection in a hall of mirrors: Historical influences and political reverberations. *Educational Researcher, 32*(3), 16-25.

Flood, B. J., & Moll, J. K. (1990). *The professor business: A teaching primer for faculty*. Medford, NJ: Learned Information, Inc.

Fraenkel, J.R., & Wallen, N.E. (2003). *How to design and evaluate research in education* (5th ed.). New York: McGraw-Hill.

Freese, A.R. (1999). The role of reflection on preservice teachers' development in the context of a professional development school [Electronic version]. *Teaching and Teacher Education, 15*, 895-909.

Gabel, D. L. (2003). Enhancing the conceptual understanding of science. *Educational Horizons, 2*, 70-76.

Galvez-Martin, M.., Bowman, C., & Morrison, M. (1998). An exploratory study of the level of reflection attained by preservice teachers. *Mid-Western Education Researcher, 11*(2), 9-18.

Gess-Newsome, J., Southerland, S.A., Johnston, A., & Woodbury, S. (2003). Educational reform, personal practical theories, and dissatisfaction: The anatomy of change in college science teaching. *American Educational Research Journal, 40*(3), 731-767.

Good, J.M. & Whang, P.A. (2002). Encouraging reflection in preservice teachers through response journals [Electronic version]. *The Teacher Educator, 37*(4), 254-267.

Grunau, H., Pedretti, E., Wolfe, E., & Galbraith, D. (2000). Collaborative professional
development for science educators: Locating reflection in practice through a science
methods course [Electronic version]. *Journal of Science Teacher Education, 11*(1),
47-61.

Hatch, J.A. (2002). *Doing qualitative research in educational settings*. Albany, NY: State
University of New York Press.

Hativa, N., Barak, R., & Simhi, E. (2001). Exemplary university teachers: knowledge and
beliefs regarding effective teaching dimensions and strategies. *The Journal of Higher
Education, 72*(6), 700-729.

Hatton, N. & Smith, D. (1994). *Facilitating reflection: issues and research*. Paper presented
at the Conference of the Australian Teacher Education Association, Brisbane,
Queensland, Australia. (ERIC Document Reproduction Service No. ED 375110)

Jay, J. & Johnson, K. (2002). Capturing complexity: a typology of reflective practice for
teacher education. Teaching and Teacher Education, 18, 73-85.

Johnson, B., & Christensen, L. (2004). *Educational research: Quantitative, qualitative, and
mixed approaches* (2nd ed.). Boston: Pearson Education, Inc.

Levin, B. (1999). Analysis of the content and purpose of four different kinds of electronic
communication among preservice teachers. *Journal of Research on Computing in
Education, 32*(1), 139-156.

Loughran, J.J. (2002). Effective reflective practice: In search of meaning in learning about
teaching. *Journal of Teacher Education, 53*(1), 33-43.

McMahon, S. (1992). Exploring my teaching of TE-101. In S. Feiman-Nemser & H.
Featherstone (Eds.), *Exploring teaching: Reinventing an introductory course* (pp.
146-158). New York: Teachers College Press.

Murray, H. G. (1997). Effective teaching behaviors in the college classroom. In R. P. Perry &
J. C. Smart (Eds.), *Effective teaching in higher education: Research and practice* (pp.
171-204). Bronx, NY: Agathon Press.

Northwest Regional Educational Laboratory. (1998, June). High-quality professional
development. Retrieved April 25, 2003, from
http://www.nwrel.org/request/june98/article11.html

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25*(9), 1049-1079.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (Rev. ed.). Newbury Park, CA: Sage.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Pultorak, E. G. (1993). Facilitating reflective thought in novice teachers. *Journal of Teacher Education, 44*, 288-295.

Reiman, A.J. (1999). The evolution of the social roletaking and guided reflection framework in teacher education: Recent theory and quantitative synthesis of research. *Teaching and Teacher Education, 15*, 597-612.

Rodgers, C. (2002). Defining reflection: Another look at John Dewey and reflective thinking. *Teachers College Record, 104*(4), 842-866.

Salmon, G. (2002). Mirror, mirror on my screen…exploring online reflections. *British Journal of Educational Technology, 33*(4), 379-391.

Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher, 31*(1), 13-25.

Schon, D. (1983). *The reflective practitioner: How professionals think in action.* New York: Basic Books.

Schon, D. A. (1987). *Educating the reflective practitioner.* San Francisco: Jossey-Bass.

Spalding, E. & Wilson, A. (2002). Demystifying reflection: A study of pedagogical strategies that encourage reflective journal writing. *Teachers College Record, 104*(7), 1393-1421.

Sunal, D., Hodges, J., Sunal, C., Whitaker, K., Freeman, L., Edwards, L., Johnston, R., & Odell, M. (2001). Teaching science in higher education: Faculty professional development and barriers to change. *School Science & Mathematics, 101*(5), 246-258.

Supovitz, J.A., & Turner, H.M. (2000). The effects of professional development on science teaching practices and classroom culture. *Journal of Research in Science Teaching, 37*(9), 963-980.

Thomas, R. M. (2003). *Blending qualitative and quantitative research methods in theses and dissertations*. Thousand Oaks, CA: Corwin Press, Inc.

Tobin, K., Tippins, D.J., & Gallard, A.J. (1994). Research on instructional strategies for teaching science. In D.L. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 45-93). New York: Macmillan.

Valli, L. (1997). Listening to other voices: A description of teacher reflection in the United States. *Peabody Journal of Education, 72*(1), 67-88.

van Driel, J.H., Beijaard, D., & Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching, 38*(2), 137-158.

Van Manen, M. (1977). Linking ways of knowing with ways of being practical. *Curriculum Inquiry, 6*, 205-228.

Walczyk, J.J. & Ramsey, L.L. (2003). Use of learner-centered instruction in college science and mathematics classrooms. *Journal of Research in Science Teaching, 40*(6), 566-584.

Webb, P.T. (2001). Reflection and reflective teaching: Ways to improve pedagogy or ways to remain racist? [Electronic version] *Race Ethnicity and Education, 4*(3), 149-156.

Weimer, M. & Lenze, L. (1994). Instructional interventions: A review of literature on efforts to improve instruction. In K. Feldman &M.B. Paulson (eds.), *Teaching and learning in the college classroom*. Needham Heights, MA: Ginn Press.