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Metaphors in Teaching Dilemmas Conveyed by First-Year Science Teachers in Online Mentoring Dialogues

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Abstract

This study explored online mentoring dialogues of first-year science teachers (FYSTs) to construct a model that was informed by metaphors in teaching dilemmas. Nine teachers' yearlong threaded dialogues were archived and first analyzed by Windschitl's (2002) four dilemma categories, and later by Lakoff and Johnson's (2003) conceptual metaphor theory. Particularly, we charted conceptual metaphor systems and schematic elements of FYSTs' teaching practices in conceptual, pedagogical, cultural, and political dilemma categories using computer-mediated discourse analysis. Findings indicated that the FYSTs' mentoring dialogues were predominantly pedagogical dilemmas (64.34%), mostly related to mastering the art of facilitation. The conceptual metaphors and schematic elements include a) "Teaching is a trip" within a path schema, b) "Teaching is a race" within an up-down and more-less visual field schema, c) "Teaching is policing" within a sanctioned land schema, and d) "Teaching is building a house" within a construction site schema. This study contributes to the understanding of challenging factors that FYSTs encounter and also illustrates the functionality of the conceptual metaphors for teacher effectiveness.

Introduction

Internationally, there has been increased attention to teacher effectiveness and teacher retention (Avalos, 2007; Britzman, 2003; Creemers, 2007; Darling-Hammond et al., 2017; Dede, 2006; Fancy, 2007; Fleisch, 2007; Ingersoll, 2001; Moir et al., 2009; Sackney, 2007). Within this discussion, researchers have deemed first-year teaching experiences as critical in determining successful, quality, pathways for teacher and student success (Schuck et al., 2012; Thomas & Beauchamp, 2011). The experiences of teachers during their early formative years ranges broadly and can impact how well an educator successfully supports student learning (Ryan, 1986).

Britzman (2003) argued that more attention should be placed on "the private struggles and subjectivities" (p. 25) that teachers face in their practices. Earlier, Windschitl (2002) had conceptualized teacher struggles or dilemmas (p. 131) as critical parts of the negotiation process in becoming a reform-based science teacher. Windschitl's Four Dilemma Categories of Constructivism in Practice (FDCCP) (2002) guide this study: (1) conceptual dilemmas to

conceptual understanding, (2) pedagogical dilemmas to pedagogical expertise, (3) cultural dilemmas to cultural consciousness, and finally (4) political dilemmas to political acumen.

Through metaphors, this one-year study was designed to examine teaching dilemmas of first-year science teachers (FYSTs) who participated in nation-wide online mentoring program. Specifically, this study aimed at discovering metaphorical concepts and their schematic elements of teaching that resided within teaching dilemmas.

Metaphors identified in many studies appear to be predictors of teachers' intent towards teaching and learning instead of representing their teaching practices. A few studied FYST challenges and dilemmas through metaphors, but they were mostly concerned with teacher beliefs, not teacher practices. Some metaphor studies were conducted within a short time span with an explanatory intent, rather than an exploratory intent (e.g., a one-time survey inquiring about or comparing types of teaching metaphors of past, present, and future intentions).

To fill this gap in the literature, this study was designed to develop a model that represented the complexity of the teaching dilemmas of FYSTs. By mapping out salient metaphors and their matching schematic elements within the teaching dilemmas, we hope to understand complex phenomena of being and becoming secondary science teachers. The research questions of the study include:

1. What were the major patterns that emerged from year-long online mentoring dialogues of first-year science teachers?
2. What were the metaphorical concepts of the first-year science teachers that pertained to the concept of teaching within the context of conceptual, pedagogical, cultural, and political dilemmas?
3. What were the underlying organized patterns within the discovered metaphorical concepts of first-year science teachers?

Theoretical Framework

Lakoff and Johnson (2003) discuss metaphor as a transfer of meaning between a "source domain" (a concrete concept) and a "target domain." (an abstract concept). Lakoff (1991) also claims there are two functions at work in the metaphorical understanding of a situation, the pervasiveness of a "fixed set of metaphors that structure how we think" (p. 1) and their applicability to a specific situation. These functions indicate that metaphors or metaphoric concepts are not just language, but are also critical components of our thoughts, attitudes, and actions—which are further grounded in our everyday experiences situated in specific cultural presuppositions (Lakoff & Johnson, 2003). However, Petrie and Oshlag (1993) advise that metaphors need to be managed with caution regardless of their various pedagogical and cognitive functions.

Related Literature

First-Year Teaching Dilemmas and Practices

Various efforts have been made to understand the professional lives of FYSTs for decades. Some of the results indicate that first-year teachers go through a reality shock of the teaching profession; experience a "washout

effect" in their university teacher education; experience disillusionment; or isolation and loneliness along with physical fatigue (Bolam, 1987; Britzman, 2003; Ryan, 1986; Zeichner & Tabachnick, 1981). Some of the factors contributing to these experiences and teaching practices of the FYSTs can include gaps between their teacher preparation programs and the reality of school classrooms (Luft et al., 2011). Some factors that may hinder teachers are related to teacher knowledge, school culture, the nature of a teacher's educational experiences, induction programs and teacher professional development programs (Luft et al., 2011; Windschitl, 2002).

These multiple factors influence teaching attitudes and practices of FYSTs. For instance, Zeichner and Tabachnick (1981) indicate that first-year teachers' progressive or liberal attitudes towards education shift to more traditional views. As for teaching practices of beginning teachers, Reynolds (1992) reported them in three task domains: (1) pre-active task domain: designing lesson plans superficially; having difficulties in tailoring instructional materials and teaching based on students' needs, (2) interactive task domain: having difficulties establishing learning-filled classrooms; lacking in understanding the dynamics of classroom environments and establishing routines and rules; having under-developed understanding of pedagogical content knowledge, and finally (3) post-active task domain: having challenges in sorting out and focusing on the critical elements to reflect; having under-developed schemata on meaning-making processes from their classroom experiences.

Metaphors as Tools for Teachers' Professional Growth

Metaphors have shown significant impact on the learning process of K-12 students, teachers, and researchers (Duit, 2006; Jakobson & Wickman, 2007). Sfard (1998) observed "metaphorical projection is a mechanism through which a given culture perpetuates and reproduces itself in a steadily growing system of concepts" (p. 11). Due to reformed-based teaching efforts, Sawyer (2004) pointed out a shifting of the meaning in "teaching as performance" metaphor, from creative teaching to scripted teaching. Consequently, the scripted performance metaphor introduced a new set of languages to describe teachers' practices, especially urban school districts (e.g., actors on a stage, enacting a performance, audience, rehearsal, stage presence, voice, movement). However, for Sawyer (2004), the scripted performance metaphor was problematic due to the message that it delivered, "if you can perform well from a script, you can teach" (p. 12). In contrast, Sawyer (2004) positioned teachers as "creative professionals" (p. 17) and suggested a "teaching as creative performance" metaphor, which respects teachers' creative potential, constant decision-making, and disciplined improvisation.

Mellado's (1998) case studies of four prospective science teachers demonstrated science teachers' learning-to-teach in a personal manner. Specifically, the ways the teachers' past experiences and preconceptions influenced their teaching (e.g., teacher as father, as brother, as guide). Based upon her findings, Mellado (1998) recommended the need of including metaphors for science teaching that connects FYSTs' personal values, beliefs, attitudes, roles, and knowledge to teacher initial training and professional development. Furthermore, Bullough and Stokes (1994) proposed the use of personal teaching metaphors as a productive thinking tool for teacher candidates to reflect deeply about their role as teachers. They advocated even the use of metaphoric images such as parables and storytelling to help teachers' self-understanding and endless meaning-negotiation with their teaching experiences.

Alger (2009) generated six teaching metaphors informed by organizing principles of other teaching metaphor studies: teaching as guiding, as nurturing, as molding, as transmitting, as providing tools, and as engaging in a community. These six metaphors were then grouped either as teacher-centered or student-centered. Alger (2009) found that 80% of the secondary teachers envisioned teacher-centered classrooms during their early years as a teacher. Of 110 secondary teachers, 86 reported that their metaphors had changed over time due to forces of change (e.g., new understandings about students, students' low level of preparedness and lack of motivation). While 47 secondary teachers reported that their current teaching metaphors were different from the teaching metaphors that they would like to have due to several obstacles (e.g., students, curriculum, lack of resources, lack of respect for teachers, administration).

Similarly, Thomas and Beauchamp (2011) used extensive analysis of metaphorical responses of first-year Canadian teachers to follow the changes in their professional identities. They found that new teachers' perceptions changed from "being ready for a challenge focusing on students" to "being preoccupied with their own survival". They pointed out "new teachers are constantly confronted with the results of their interventions with students, which impacts on their sense of self" as confident professionals (p. 767).

Metaphors of Teachers

Martinez et al. (2001) advocated metaphors as blueprints of thinking about teaching and learning. They studied conceptual metaphors held by both teacher candidates and experienced teachers from three metaphoric points of view, namely, a behavioristic (e.g., learning as obtaining information), a constructivist (e.g., learning as laying the bricks of a house), and a situative/socio-historic (e.g., learning as joint work). They found that metaphors used by teacher candidates were very different from those of experienced teachers in that the majority of the experienced teachers held behavioristic perceptions of learning and teaching whereas the teacher candidates held constructivist views.

Saban et al. (2007), using metaphor analysis, studied teaching and learning metaphors of 1142 teacher candidates in Turkey and identified two metaphor themes: teacher as facilitator/scaffolder (e.g., teacher as compass, lighthouse, taxi driver, road map) and teacher as cooperative/democratic leader (e.g., teacher as tour guide, conductor). They found a significant association among some conceptual metaphors with teacher candidates' gender and their teacher education program types. Specifically, female teacher candidates perceived teaching as transmitting knowledge, as growth- and counseling-oriented as opposed to their counter partners' perceived teaching as facilitation- and cooperation-oriented. As for the teacher education program types, the teacher candidates in classroom teaching held more shaping-, growth-, and counseling-oriented metaphors, the teacher candidates in English education held more facilitation-oriented metaphors, and finally the teacher candidates in instructional technologies held more transmission- and cooperation-oriented metaphors.

Haney and McArthur (2001) considered teacher metaphors as possible predictors for prospective science teachers' intents for implementing constructivist practices. Their case study on beliefs identified teacher metaphors from four prospective science teachers: teacher as efficient manager, teacher as motivator, teacher as tour guide, and

teacher as resource. Haney and McArthur (2001) compared these metaphorical teaching roles to their peripheral beliefs and found that often they were not well aligned. However, the prospective science teachers used these teacher metaphors in identifying and articulating their belief structures.

Mahlios et al.'s (2010) review study illustrated the teaching metaphors, beliefs, and practices between teacher candidates from elementary education and those of secondary programs. There were differences between elementary and secondary teachers' perceptions of teaching in that elementary teachers perceived teaching as nurturing while secondary teacher candidates perceived teaching as intellectual. Yet, Mahlios et al. (2010) indicated that both groups appeared to have highly similar teaching metaphors (e.g., teaching and learning as organic growth/development). The teacher candidates' programs provided no effect on teachers' belief and practices. Their previous life experiences and their student teaching experiences, however, had an effect.

Methods

This study applied different theoretical and conceptual frameworks to re-analyze data from our previous study. This study was designed to construct meanings through metaphors in teaching dilemmas that emerged from the boundaries of online mentoring dialogues. We embodied Lincoln and Guba's (1985) axioms of naturalistic inquiry, which recognized the existence of multiple realities and also the nature of interactive relationship between the researchers and the phenomenon being studied. We used computer mediated discourse analysis (CMDA) in order to reveal conceptual metaphors and coherent structures within the metaphors (Herring, 2004). Specifically, this study was based on a pragmatic paradigm which incorporated the interpretation of a speaker's intentions, as well as discourse that occur during the exchange of knowledge and negotiation of meaning (Herring, 2004). Ultimately, this study was designed to construct reasonably transferable and tentatively applicable claims and interpretations (Lincoln & Guba, 1985).

Context and Research Design

This study took place in a multi-state online mentoring program called eMentoring for Student Success (eMSS) in the United States. Jaffe et al. (2006), the leaders of the eMSS program, envisioned a teacher induction and professional development program to support not only new science teachers but also veteran teachers. According to Jaffe et al. (2006), the eMSS mentoring model was innovative in its approach in that it aimed to establish science and discipline-specific pedagogy and to develop a cadre of veteran teacher leaders.

The eMSS program matched veteran teachers (teachers with more than five years of teaching experience), who served as online science mentors, with FYSTs based on the disciplinary areas and grade levels. The mentees and mentors were connected through a web-based course tool (WebCT) that used a written discourse platform (Bhatia, 2005; Hoey, 2001). Each FYST was able to log onto a private server-space, *Pair Place,* and engage in online one on one discussions with her or his mentor. Public spaces in WebCT were also provided to the FYSTs and their mentors to participate in collective inquiries and discussions regarding pedagogy and content questions with other teachers and mentors.

Weekly and asynchronously, all members of the online mentoring community connected through computer-mediated written discourse. Along with their mentors, the FYSTs could post and read comments. As matched pairs, they were required to design two inquiry-based science lessons per academic year. Table 1 displays the summary of the study's design.

Participants

Nine of 20 FYSTs who demonstrated exemplary participation were selected. Each FYST's participation was measured by using an online mentoring program official activity rubric, which included weekly number of clicks, posts and reads, degrees of critical reflections, and overall professional online presence. The participating FYSTs included six female and three male science teachers who taught mostly in urban school districts in one of the Southwestern states in the USA. Eight were European and one Latinx. Numbered IDs were used to protect the identities of the research participants.

Data Collection and Analysis

Data were collected from three sources including yearlong online written dialogues from *Pair Places*, semi-structured monthly interviews, and bi-monthly classroom observations. The year-long archived online dialogues constituted the study's main data. The latter two data sources served to crosscheck teaching practices and contexts (Creswell & Creswell, 2018). Six to eight trained researchers conducted the interviews and the classroom observations. Further details of the interview and classroom observation instruments and protocols can be found in Luft et al. (2011).

Table 1. Summary of the Study's Design

Theoretical Framework: Conceptual Metaphor Theory (CMT) (Lakoff & Johnson, 2003)								
			Adopted the Naturalistic Inquiry Paradigm (Lincoln & Guba, 1985)					
Three Major goals		Questions	Discourse Analysis paradigm and domain of language	Study Participants	Research Techniques & Data Collection	Meeting Venue	Unit of Analysis and Analysis	
Goal One	Exploring major patterns while mapping out the online written dialogues of the first-year science teachers based on the Four Dilemma	Q1. What were the major patterns that emerged from year-long online mentoring dialogues of first-year science teachers?	Pragmatics: Doing things with words	9 first-year secondary science teachers (FYSTs)	Archived online written dialogues of the first-year teachers (Total of 114 threaded subjects or 238 postings)	Online pair place	Phenomena: Instances of teachers' dilemmas categories	**Draw Conclusions**
Goal Two					Monthly	Phone	Theme/ Color coding	

	Categories of Constructivism in Practice (FDCCP)			interviews (8 times per FYST)	
	Discovering the conceptual systems of first-year science teachers in *teaching* through the lens of metaphors. (Pervasiveness)	Q2. What were the metaphorical concepts of the first-year science teachers that pertained to the concept of *teaching*—within the context of conceptual, pedagogical, cultural, and political dilemmas?	Domain of Meaning: exchange and negotiation of meaning	Bi-monthly classroom observations (4 times per FYST)	Face-to-face Classrooms
Goal Three	Identifying the schematic elements in *teaching* within the discovered metaphorical concepts (Coherency=fitting togetherness)	Q3. What were the underlying organized patterns within the discovered metaphorical concepts of first-year science teachers?			

Of the online dialogues, 114 threaded subjects were collected from the nine FYSTs' year-long written dialogues (see Table 3). These threaded subjects consisted of 238 mentee-posts and were re-organized into one master file. In addition to a teacher profile and analysis spreadsheet. Using the FDCCP coding table (see Table 2 for the summaries of the four dilemma categories and 12 sub-categories), the first author conducted a preliminary analysis of the mentee-posts. As part of this process the researchers identified 55 posts as 'non-dilemmas' and eliminated them (e.g., posts representing descriptions of facts, discrete information sharing, or non-teaching related personal matters were considered 'non-dilemmas').

We grouped our data with the closest fit to the Windschitl's (2002) FDCCP; yet, a few posts were grouped loosely (e.g., posts that represented significant degrees of dilemmas but with a low level of constructivism in practice), and included as dilemmas. In order to protect confidential information, some threaded subjects were modified without harming the integrity of the original topics (e.g., names, locations, dates). Finally, when acronyms were used, we replaced them with full phrases.

Following Srivastava and Hopwood's (2009) analytic reflexivity of iteration framework, the 183 posts were again pattern-coded in light of the research questions and the interview and observation data for each FYST. We compared and contrasted the initially coded dilemma categories with science teaching practices and concerns that were lived, narrated, and re-lived by the FYSTs as well as observed by the researchers (Miles & Huberman, 1994). When multiple dilemmas presented in a threaded topic, a simultaneous coding was conducted.

Once the written dialogues of each FYST were divided into the salient dilemma categories, we iterated the coding process of each dilemma category to discover metaphorical concepts and schematic elements. Specifically, we operationalized the phrase "metaphors or conceptual metaphors" by adopting Jäkel's (2002) proposed basic tenets of the CMT. According to Jäkel (2002), the domain, unidirectionality hypotheses and metaphorical expressions should be treated as "the systematic connection of two different conceptual domains, one of which functions as the target domain (X), with the other supplying the source domain (Y)" (p. 21). In simple terms, X is conceptualized as Y, therefore, irreversibly linking an abstract and complex target domain (X) with a phenomenon that needs to be explained and a more concrete source domain (Y) as explanation of the phenomenon (Jäkel, 2002).

This study used "teaching" as the unit of cognition while applying the conceptual, pedagogical, cultural, and political dilemma categories as the units of analysis. The nature of conceptual metaphors was analyzed by (a) identifying target domain Xs and related metaphors, and (b) by looking for patterns in search of more concrete source domain Ys. After a representative source domain and related metaphors were disclosed, we searched for the underlying schema—an organized pattern of thought—for each domain. This illustrated how the source metaphor was formulated, and how it was widened or narrowed to cover related aspects of reform instructions.

Table 2. Windschitl's (2002, p. 133), the Four Categories of Dilemmas Encountered in the Practice of Constructivism

Dilemmas	Sub-categories	Summary
1. Conceptual	1-1. Conc-Grasping	Grasping the underpinnings of cognitive and social constructivism
	1-2. Conc-Reconciling	Reconciling current beliefs about pedagogy with the epistemological orientations necessary to support a constructivist learning environment
2. Pedagogical	2-1. Peda-Honoring students	Honoring students' attempts to think for themselves while remaining faithful to accepted disciplinary ideas

Dilemmas	Sub-categories	Summary
	2-2. Peda-Developing SMK	Developing deeper Subject Matter Knowledge (SMK)
	2-3. Peda-Mastering facilitation	Mastering the art of facilitation
	2-4. Peda-Managing D & CW	Managing new kinds of Discourse and Collaborative Work (D& CW) in the classroom
3. Cultural	3-1. Cult-Becoming conscious	Becoming conscious of the culture of one's own classroom
	3-2. Cult-Questioning assumptions	Questioning assumptions about what kinds of activities should be valued
	3-3. Cult-Taking advantage	Taking advantage of experiences, discourse patterns, and local knowledge of students with varied cultural backgrounds
	3-4. Cult-Managing collective transformation	Managing the collective transformation of students' beliefs and practices in accordance with constructivist norms
4. Political	4-1. Poli-Confronting accountability	Confronting issues of accountability with various stakeholders in the school community
	4-2. Poli-Negotiating support	Negotiating with key others and the authority and support to teach for understanding

Trustworthiness

This study's dependability and auditability of the processes came from the fact that the FYSTs and the two authors actively followed the rules and procedures of the multi-state online mentoring community. There were also weekly formative assessments of the participants through various modes of communication. In addition, the authors regularly submitted mandatory reports to the online mentoring program staff; thus, there were audit trails (Miles & Huberman, 1994). Internal validity was accrued from the convergence of three data sources. For instance, science teaching practices and contexts of events shown in archived online written dialogues were crosschecked and extrapolated with the interview and observation data. Therefore, this may increase the credibility of the data (Miles & Huberman, 1994). Finally, the presence of multiple trained researchers who conducted the data collection and analysis can also enhance the relative neutrality of this study (Miles & Huberman, 1994).

Findings

A total of 143 dilemma instances were identified from the 183 posts. Table 3 displays the results of the first research question. The results indicated that the FYST-generated teaching dilemmas contained pedagogical and political dilemmas the most, and conceptual and cultural dilemmas the least. Specifically, 92 posts (64.3%) were identified as pedagogical dilemmas and 32 posts (22.4%) were political. The two dilemma categories that rarely

appeared in the dialogues were the conceptual dilemma (11 posts, 7.7%) and the cultural dilemma (8 posts, 5.6%).

Within the pedagogical dilemma, the teachers' posts were mostly related to mastering the art of facilitation. As for the political dilemmas, the teachers' posts were mostly related to passively or internally confronting issues of accountability with school administrators and parents. The conceptual and cultural dilemma posts were mostly related to the first sub-category of the FDCCP, grasping the underpinnings of cognitive and social constructivism (1-1 codes), and becoming conscious of the culture of their own classrooms (3-1 codes), respectively. Finally, some conceptual dilemma posts (1-2 codes) were negatively related to the FYSTs' teaching practices. For instance, some FYSTs had compromised their inquiry-based teaching and learning beliefs to support a more directed or teacher-led lecture-style learning environment, and not to support a constructivist learning environment.

When a threaded subject was used as a unit, approximately 25% of the total threaded subjects were identified as mixed dilemma threads (MDT). These threaded subjects were not mutually exclusive but were intertwined within other dilemma categories. The two most frequently combined dilemma categories within the threaded subjects were pedagogical-political dilemmas and pedagogical-conceptual dilemmas. Except for T7, the FYSTs had mixed dilemmas in their online dialogues. T4 had the most mixed dilemma threads (10 MDT out of 32 threaded subjects) and T2 had the second most mixed dilemma threads (5 MDT out of 16 threaded subjects).

Of the 12 sub-categories of dilemmas (see Table 2), five codes of teaching dilemmas were not identified in the data. These sub-categories were the following: pedagogical dilemma (2-4 code: managing new kinds of discourse), cultural dilemma (3-2 code: questioning assumptions on types of activities valued, taking advantage of learners' experiences, 3-3 code: discourse patterns, and local knowledge of students, and 3-4 code: managing the collective transformation of students' beliefs and practices), and finally political dilemma (4-1 code: negotiating with key others and authority).

Table 4 displays the results of pervasive conceptual metaphors and their coherent schematic elements. The widespread conceptual metaphor and its organized pattern within the conceptual dilemma category was "Teaching is a trip" with a path schema. The FYSTs conceptualized teaching as having three very distinctive pathways with a similar end-goal in mind (e.g., one being a great scientist). The three pathways identified were the following: (1) walking alone on an inspiration path, (2) walking on an unknown path with students and the teacher next door, and (3) walking with other teachers on the ready-made path. On these paths, the FYSTs positioned themselves as leaders with multiple roles such as performers and science geeks.

The inspiration paths led the FYSTs to have either unconditional or biased interests in teaching science and in choosing scientific topics. For instance, some FYSTs considered themselves lifelong learners and willing to learn anything related to science and develop knowledge of subject matter, even outside of their expertise. Some FYSTs conceptually limited themselves, and their teaching practices stayed within the boundaries of their expertise and favorite scientific topics.

The unknown paths led the FYSTs to conceptualize teaching science as playing a survival game in which they were sometimes rewarded or punished with negative or positive emotional energy. The main source of the reward and punishment were the students' level of enthusiasm and respect. Other main contributors of reward and punishment were the FYSTs themselves (e.g., anxiety over making mistakes in front of students, boredom, self-blaming) and support from other teachers. Finally, the FYSTs perceived teaching as travelling with other teachers on a previously made path. This aligned with their teaching practices that demonstrated that they were following a given curriculum, instructional materials, or textbooks.

The conceptual metaphor and its schemata discovered for the pedagogical dilemma category was "Teaching is a race" with a visual field schema. The main goal of this 'race' was to find directions for student success. Most of the FYSTs expressed a great degree of 'aloneness', feeling lost and stranded while accommodating academically low achieving students. Teaching practices of the FYSTs within the pedagogical dilemma included the challenge of creating labs and activities, navigating classroom management, grading and paper work, working under time pressure, and lacking subject matter knowledge.

Table 3. Instances of the Four Dilemma Categories of Constructivism in Practice (FDCCP) during the First Year (N=9)

Framing 114 threaded subjects/183 posts of 238 posts (55 posts were eliminated)									
Total of 143 identified dilemma instances: Conc. 7.7% (11 posts) - Peda. 64.3% (92 posts) - Cult. 5.6% (8 posts) - Poli. 22.4% (32 posts)									
T1 [a] M-LS-M.Ed. (HS-LS) 7/15(0) [c] SDT: 4 & MDT: 3 3-5-0-2 [d]	Hello (3) [b] *Pedagogical Political*	Swiped Ideas (3) *Pedagogical Conceptual*	Ending a quarter (2) *Pedagogical*	Electron Configuration (1) *Political*	Fall Inquiry (1) *Pedagogical*	Cells (1) *Conceptual*	Classroom Management (4) *Pedagogical Conceptual*		
T2 F-LS-M.Ed. (HS-LS) 16/39(4) SDT: 11 & MDT: 5 4-13-2-2	3,2,1 (1) *Conceptual*	Check this out tonight if you have time (2) *Pedagogical*	Bill Nye (1) *Pedagogical*	Big Bang (2) *Pedagogical Political*	Two questions to start (1) *Conceptual Pedagogical*	Inquiry in Lab (3) *Conceptual Pedagogical*	Getting back to you and state conference (4 of 6) *Pedagogical*	Mini inquiry (1) *Pedagogical*	Signal (2) *Pedagogical*	Turkey day teaser! (3 of 4) *Pedagogical*
	New Semester (6) *Cultural Pedagogical*	Winter inquiry topic (4) *Pedagogical*	Class visit (1) *Pedagogical*	Exotic Places (1) *Conceptual*	Help!!! (1 of 2) *Cultural*	Earth Science (2) *Political Pedagogical*				
T3 F-Chem.-M.Ed. (HS-P) 7/16(2) SDT: 5 & MDT:	Hello (1 of 2) *Pedagogical*	Curriculum (1) *Pedagogical*	Dilemma (1) *Pedagogical*	How is your week going (4) *Pedagogical Political*	Inquiry (4 of 5) *Pedagogical Cultural*	First semester (1) *Pedagogical*	Back in the swing (2) *Pedagogical*		

2 0-7-1-1										
T4 F-LS-M.Ed. (HS-P & ES) 32/81(17) SDT: 22 & MDT: 10 2-20-5-16	Howdy!!! (1) *Conceptual*	Introductions (1) *Political*	Cheating (2) *Political Pedagogical*	Free time (2) *Pedagogical Political*	Local Science Conference (2 of 3) *Cultural Political*	Grading Period and Sub Plans? (1) *Political*	Great to Meet You! (1) *Political*	New Problem (2) *Pedagogical*	Capital Needs (1) *Political*	New Students (5) *Political Pedagogical*
	Climate Change (1) *Pedagogical*	Fire event (1) *Political*	Oceanography (4 of 6) *Political Pedagogical*	What's New? Inquiry (6) *Pedagogical Political*	Out of Town (1 of 2) *Pedagogical*	Inquiry (4 of 6) *Pedagogical Cultural Political*	Christmas (2) *Pedagogical*	New schedule (3) *Political Cultural*	Microscopy Class (2 of 4) *Pedagogical*	Balancing Life (1) *Political*
	Thank you!! (2) *Pedagogical*	Kids at school (3 of 4) *Political*	Brain freeze (1) *Conceptual*	New Inquiry & Moon Calendars (2) *Pedagogical*	Day off (4 of 10) *Cultural Political*	Good Break? (1 of 2) *Pedagogical*	Astrobiology (1 of 2) *Pedagogical*	Back in Town (1) *Pedagogical*	Lesson planning mistake (1) *Pedagogical*	Messy room (1) *Pedagogical*
	Technology (2) *Cultural Pedagogical*	Update (2) *Pedagogical*								
T5 M-Chem.-PhD (HS-Chem.) 5/8(1) SDT: 3 & MDT: 2 2-4-0-1	In anyone out there? (2 of 3) *Pedagogical Conceptual*	Greetings from Green Lake (1) *Pedagogical*	New Q on labs (2) *Pedagogical Political*	Just Checking in (1) *Conceptual*	Follow-up (1) *Pedagogical*					
T6 F-Chem.-M.Ed. (HS-P & Math) 13/29(7) SDT: 11 & MDT: 2 0-13-0-2	First 2 weeks (1) *Pedagogical*	3rd week done! (1) *Pedagogical*	4th week Almost Done (2) *Pedagogical*	Winding up the quarter (1) *Pedagogical*	Countdown!! (2) *Pedagogical Political*	Any ideas on inquiries? (1 of 3) *Pedagogical*	Easing back in…(2) *Pedagogical Political*	Mini Inquiry begins! - Classroom Procedures (3) *Pedagogical*	Happy New Year! (2) *Pedagogical*	Winter Inquiry (3) *Pedagogical*
	Continuing Winter Inquiry (1) *Pedagogical*	Spring Inquiry (2 of 5) *Pedagogical*	Winding Down (1 of 3) *Pedagogical*							
T7 F-LS-M.Ed. (HS-LS & Math) 17/24(3) SDT: 17 & MDT: 0 0-16-0-1	Hi G (1 of 3) *Pedagogical*	Summary2 (1) *Pedagogical*	Sunday (2) *Pedagogical*	Local Science Teachers Conference (1 of 2) *Pedagogical*	Reflection template and inquiry registration (2) *Pedagogical*	Management - nightmare (1) *Pedagogical*	Your Management Plan (1) *Pedagogical*	Update of reflection/ inquiry (1) *Pedagogical*	Hi! (1) *Pedagogical*	OOOPs! Forgot something (1) *Pedagogical*
	Yesterday (1) *Pedagogical*	Inquiry (1) *Pedagogical*	Howdy partner! (1) *Pedagogical*	Week from hell, etc. (1) *Pedagogical*	Plan (2) *Pedagogical*	Inquiry reflection more! (1) *Pedagogical*	Hi from G (2) *Political*			

T8 M-LS-M.Ed. (HS-LS) 9/12(2) SDT: 7 & MDT: 2 0-6-0-5	Finally on! Yeah (1) *Pedagogical*	Performance Assessment (Projects) (1) *Pedagogical*	Rubrics, etc. (1) *Pedagogical Political*	Cell Reproduction (1) *Pedagogical*	Adaptation, Diversity Ideas (1) *Pedagogical*	Genetics Lesson (1 of 2) *Political*	Mini-inquires (1) *Political*	Observation Lesson (2) *Pedagogical Political*	Read this (1 of 2) *Political*
T9 F-Chem.-M.Ed. (MS-GS) 8/40(19) SDT: 6 & MDT: 2 0-8-0-2	Hi! (2 of 3) *Pedagogical*	Checking in (2 of 7) *Pedagogical*	Fall Inquiry - Procedures (8 of 10) *Pedagogical Political*	Preferred Activity Time Continued (1) *Pedagogical*	Winter Dilemma (3 of 7) *Pedagogical Political*	Winter Inquiry - PRACTICE (1 of 3) *Pedagogical*	REFLECTION (1 of 6) *Pedagogical*	Spring Inquiry - lesson Design Planning (3) *Pedagogical*	

Note. [a] Designated teacher IDs, Gender-Major-TEP (Grade Level-Teaching subject).

[b] Threaded Subjects of the First Year (Total number of mentee postings) Dilemma category.

[c] Total number of threads included/Postings included (eliminated). Total number of Single Dilemma Threads (SDT) & Total number of Mixed Dilemma Threads (MDT)

[d] # of identified dilemmas in the order of Conceptual – Pedagogical – Cultural – Political categories.

Table 4. Findings of the Conceptual Metaphors and Schematic Elements of First-Year Science Teachers

Four dilemmas		Conceptual dilemmas	Pedagogical dilemmas	Cultural dilemmas	Political dilemmas
First-Year Secondary Science Teachers' Teaching Dilemmas Question Two	Source domains	Teaching is* a trip.	Teaching is a race.	Teaching is policing.	Teaching is building a house.
	Conceptual Metaphors	Teaching is conceptualized as making trips within a preferred path of my own and traveling a ready-made path with colleagues--as well as leading a journey for learners with a goal in mind, but no clear path towards that goal. Teaching is conceptualized as playing a survival game repeatedly during a journey with	Teaching is conceptualized as keeping up with, staying on top of, getting ahead of, playing catching up, or being behind in relation to time, content knowledge, tasks, ideas, lesson planning, grading, and learners. Teaching is conceptualized as having a visual field that consists of learners at different ranges and relatively lonely teachers.	Teaching is conceptualized as the art of sanctioning instigators, problem causers, and unwilling learners. Teaching is conceptualized as having few oppressors, and few who are oppressed. Well-behaved learners are readily affected by few oppressors, which create uproar and chaos among teachers, and teachers' allies.	Teaching is conceptualized as ordered activities of starting, developing, restructuring, configuring, and aligning activities. Teaching is conceptualized as involving the constant reporting of progress made (learning), being positively and negatively evaluated--based on performance--while strictly abiding by ready-made blueprints.

		learners. Teaching is conceptualized as having moments of chaos, a nemesis, and rewards. Teaching is conceptualized as wearing multiple hats.		Teaching is conceptualized as giving rewards when appropriate, and triggering punishments for bad behaviors.	Teaching is conceptualized as non-negotiable-doing as told without wasting contract time. Teaching is conceptualized as enduring workloads given by a new world while dealing with different elements of feeling, self-awareness, and inner voices.
Question Three	Schemata	Path schema	Up-down and More-less schema A visual field schema	A sanctioned land schema	A construction site schema
	Schematic elements	Three roads to travel: ▪ Path1: To love teaching science and scientific topics (unconditional vs. biased). ▪ Path 2: To establish a viable road through negotiation. ▪ Path 3: To follow science textbooks and school science curricula. Finish line: **Being great scientists**. Teaching schedules, science supplies and equipment, experiencing punishments (e.g. losing respect from students, making mistakes, boredom and self-blaming), and getting rewards (e.g. support from the	Up is good: science-teaching ideas for labs, activities, and movies, classroom management, grading, and time management. Down is bad: lack of subject knowledge, pressure of time, and organizing grading and paperwork. More: Simplifying a grading strategy, controlling student behaviors through an immediate threat (e.g. being kicked out), time for vocabulary building and informal reviews, and more rigid and standardized daily procedures. Less: Using analogies, videos, lab time, and teaching ideas. Entailment of the visual field: Noticing learners as having different ranges (e.g. C and D ranges), setting up labs, keeping classrooms clean and quiet, student behaviors (e.g. cheating situation, noise, and off-task	Purpose: Helping learners able to **see the world of unlimited options/possibilities**. Helping learners break down their own barriers. Caveat: Learners should be partially trusted. Intensive sanctioning can cause teacher burnout. Assumptions: Teachers know best what works for the learners. Learners are fearful of breaking down their own barriers, or seeing the world of unlimited options. Rules: Learners must behave well. Learners should independently catch on to key concepts and vocabs. thrown to them by teachers. Bad behaviors:	Blueprints: State, district, and school standards. **Excelling school according to State Standards.** The given resources: Shared labs with outdated materials and poorly functioning equipment. Semi-teaching assistants (TA) & other science teachers who may function as collaborators, bystanders, or adversaries. Teacher having multiple roles: builders of good lessons for students, supervisors/managers of progressive learning against administrators, presenters of difficult issues or situations for parents (e.g. email, phone calls, and face-to-face meetings). Entailment of teacher options (salary vs. workload, work vs. life): Quitting, threating to

	teacher next door, respect from students, and receiving positive emotional energy and enthusiasm from students). Teacher's multiple roles: a leader, a performer, a science geek, and a clairvoyant. Learner's ability: High and low calibers.	students), teachers feeling lost, stranded and physically tired, and finally learners accept, reject, or get confused when teachers offer **directions for success**. Most discussed learners: one or two kids who disrupt the flow of teaching by constant talking, LD, academically challenged students, ELLs, and widely known problem kids.	Cheating/copying, bullying, name calling, instigating, making inappropriate comments, stealing supplies, and not turning homework or in-class assignments in. Punishments: Being excluded from class (e.g. time-outs), having seats changed, being sent to one of the teacher's allies (e.g. the assistant principals), being called to one of the teacher's allies (e.g. parents).	quit, being laid back, negotiating prep, or just being a push over. Structures of feeling (embodied resources): Hope, humor, wisdom, guilt, anxiety, confusion, feeling drowned, desperate, isolated, stressful, being taken advantage of—by not being appreciated, disappointed, and being forgotten as a first year teacher. Self-awareness (reality check or questioning career choice): love for teaching vs. low salary & many hours of work Inner voices: say no, don't do it, step away.

*Shorthand for representing "some set of experiences on which the metaphor is based and in terms of which we experience it." (Lakoff & Johnson, 2003, p. 20).

Another theme was the steadily evolving and devolving teaching. FYSTs found themselves increasingly simplifying grading, spending more time managing student behavior, and following rigid and standardized procedures. However, the FYSTs showed concern with their reduction of analogies and videos, allotting less time for lab, and generating fewer teaching ideas.

The conceptual metaphor and its schemata connected to the cultural dilemma category, the least salient dilemma, were the following: "Teaching is policing" with a sanctioned land schema. The FYSTs aimed to help learners see the world of unlimited options and possibilities and seemed to be gradually aware of the culture of their own classrooms and their students. The FYSTs perceived that their teaching practices could not be negotiated or co-constructed, but needed to be sanctioned by other teachers and teachers' allies (e.g., well-behaved learners, parents, teacher-next-door, assistant principals).

The conceptual metaphor and its schematic elements discovered within the political dilemma category were the following: "Teaching is building a house" with a construction site schema. The FYSTs conceptualized their teaching as starting, developing, restructuring, configuring, and aligning their science practices to excel at their schools, which were the first new sites at which to grow their professional lives. For the FYSTs, the blueprints that strictly defined their teaching practices were the national and state standards and work place standards. The given resources and conditions for their teaching practices were mostly having shared labs with outdated science materials and poorly functioning science equipment. Occasionally, the FYSTs had the support of teaching

assistants and other science teachers. Yet, these helpers functioned as collaborators, bystanders, or adversaries while the FYSTs participated in what they had perceived as non-negotiable teaching practices. The FYSTs perceived their roles as builders of good lessons, defenders of progressive learning against administrators, and presenters of difficult issues or situations for parents via emails, phone calls, and face-to-face meetings.

Along with the creation of these extrinsic political dilemma structures, three internal structures also emerged from the data: structures of feeling, structures of self-awareness, and structures of inner voices. The structures of feeling included (1) having hope, humor, and wisdom mainly to abide by the ready-made curriculum, (2) feeling of guilt, anxiety, and confusion for compromising their teaching practices and being negatively evaluated, and (3) feeling drowned, desperate, isolated, stressed, being taken advantage of, under-appreciated, and being forgotten that they were first year teachers.

The structures of self-awareness illustrated the FYSTs' internal confrontations with the realities of the teaching professions. For instance, they loved teaching but had internal conversations over their career choices as science teachers (e.g., overwhelming workload and low salary, love for teaching vs. low salary, and many hours of work during non-contract time). Finally, the structures of inner voices generated three mantra-like phrases among the FYSTs: 'Say no,' 'Don't do it,' or 'Step away.' These internal structures seemed to act as embodied resources to cope with politically difficult situations.

Discussion and Implications

This study aimed to understand first-year teaching experiences by unpacking online mentoring dialogues of the nine FYSTs. The topic of this study was tied to Windschitl's (2002) four dilemma categories, as they served not only as our major phenomena under investigation, but also as macro-units of analysis. Each identified macro-unit of dilemmas was then further analyzed through the lens of CMT (Lakoff & Johnson, 2003).

The CMT was used to guide our capacity to think of and then communicate about the FYSTs' teaching practices within the conceptual, pedagogical, cultural, and political categories. Figure 1 illustrates the conceptual model built from this study. Three discussion and implication topics surfaced during this study: (1) the conceptual and the cultural dilemma categories as black box dimensions, which must rise above their mysterious and fractured ideal status, (2) the untapped areas within the pedagogical and political dimensions such as embodied resources, and finally (3) the unforeseen discoveries of the mixed dilemma categories to gain insights in teachers as critically reflexive practitioners.

The Black Box Dimensions: Conceptual and Cultural Dilemmas

A strong schism was found between the FYSTs' teaching practices in the conceptual and cultural dilemmas and those of the FDCCP framework. For the conceptual dilemmas, the FYSTs seemed to follow the ready-made curriculum and teaching practices of other teachers as opposed to grasping and balancing their understandings of social constructivism, belief systems, and teaching practices. While internalizing others locally-historically

bounded curriculum, few expressed "feelings of guilt" for not practicing reformed-based teaching.

Routinely, the FYSTs chose not to *explicitly* walk down the pathways that were identified as inspiration-based and amorphous-based. The inspiration-based path seemed to be affecting their teaching practices as either a liberating or a limiting factor. For some it was a liberating factor since their inspiration paths were manifested mostly outside of contract time. For others, it was a limiting factor as they insisted staying within that inspiration-based path. Overall, the FYSTs seemed to choose activities that mostly stimulated them and feared learning areas outside of their disciplinary expertise.

Another revealed structure was the amorphous path. The data indicated that the FYSTs seemed to have "*a conceptually undecided space*" that they kept close to themselves as opposed to outright resisting internalizing others' structures and practices. Within this undecided space, the FYSTs seemed to have internal conversations, mainly triggered by implementing particular kinds of pedagogical strategies of others. Through these internal conversations, the FYSTs displayed various amounts of reflection about what they believed about inquiry-based teaching practices, what the actual science teaching practices were, and internally questioning different ways to teach science.

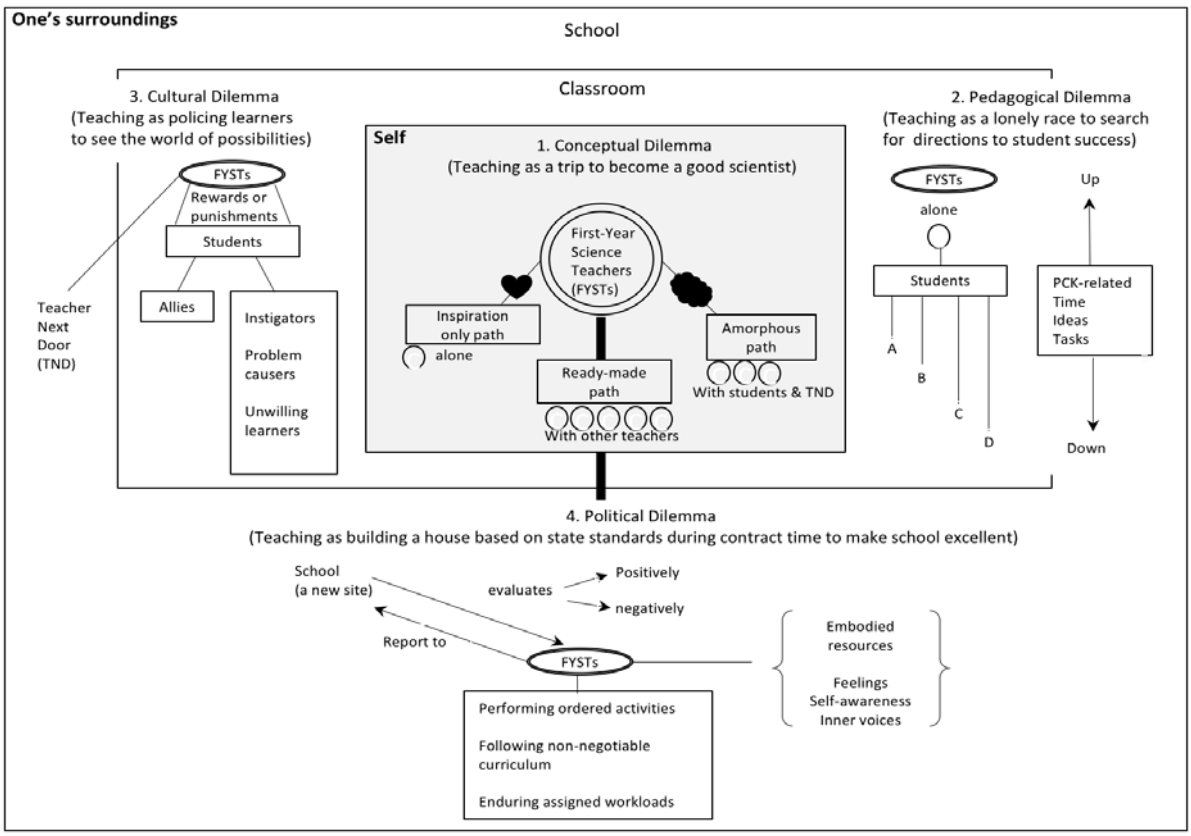

Figure 1. A Conceptual Model Built from this Study

For the cultural dilemmas, the FYSTs seemed to position themselves as the knower-and-learner for the students, especially for the instigators, problem causers, and unwilling learners. The FYSTs seemed to make consistent efforts to seek information and advice about these students and how to deal with them. As their knowledge grew,

their teaching practices appeared to be operated under sanctioned classrooms dichotomous logics (e.g., rewards vs. punishments; allies vs. enemies; good behaviors vs. bad behaviors). Consequently, their teaching practices were not centered on questioning their own assumptions about science activities, spending time on noticing and respecting the students' beliefs, discourse patterns, previous knowledge, and cultural backgrounds. Rather, the FYSTs appeared to be policing learners, which, seemed to correlate with teacher burnout.

In order to attain conceptual understanding and cultural consciousness, we suggest enabling FYSTs' conceptually hidden structures and helping them break their dichotomous world view. We urge that teacher preparation and mentoring programs should provide ways to recognize and develop various mediating mechanisms of the "internal-external worlds" or "personal-public worlds" or "personal-professional selves" (Bullough, 2009; Schön, 1983; Volkmann & Anderson 1997). We also advocate Mellado's (1998) suggestion on including teachers' personal history as an anchor point for the science teacher's professional knowledge.

The FYSTs' Dilemma Structures in the Pedagogical and Political Dimensions

Our data showed that the FYSTs were confronted the most with dilemmas in the pedagogical category the most. Yet, the attributions to their pedagogical dilemmas were found not to be extensive. The salient features of the FYSTs teaching practices were that they raced back and forth against time, activity ideas, and tasks while dealing with academically different ranges of students. Most of the FYSTs expressed the feeling of aloneness in the race on searching for directions to student success.

The political dilemmas ranked second in the FYSTs' online mentoring dialogues. There was clear evidence that the FYSTs were confronting issues of accountability. The problem, due to the seemingly top-down and negative-positive evaluation structures, seemed to be that they were doing this passively and internally. The structures found in the political dilemmas were similar to oppressor-oppressed relationships. For instance, the FYSTs seemed to view themselves as workers who were given non-negotiable blueprints under the name of standards and were given resources that could be a hindrance to their needs. Compellingly, the FYSTs established internal structures, which they used as embodied coping resources: feelings, self-awareness, and inner voices.

Volkmann and Anderson (1997) urged science educators and policy makers not to impose new sets of expectations upon newly hired professionals; rather respect and include knowledge, skills and wisdom of veteran teachers and have them support new comers to find their personal and professional selves through teaching metaphors. Along with this approach, Archer's (2003) discussions on the low and high levels of reflexivity and followed-suit actions that dealt with social expectations and unscripted contingencies might inform us on how to support FYSTs to confront and negotiate the contextual continuity and discontinuity.

The Development Continuum: Single Dilemma Threads vs. Mixed Dilemma Threads

Although the threaded topics of the single dilemma were the dominant theme, one or two combined dilemmas revealed some insights about the thinking levels and patterns of the FYSTs and the possible growth buds for

teacher effectiveness. Generally, the mixed dilemmas appeared in the form of pedagogical dilemmas coupled with political dilemmas. The mixed dilemmas predominantly appeared as paired dilemmas, and there was only one instance in which a threaded subject was a triad of dilemmas: T4's 16th topic (pedagogical-cultural-political dilemmas combined).

Further investigation into the nature of these single and mixed dilemmas is needed as we are positioning, along with other scholars, teachers as critically reflexive-cultural thinkers and problem-solvers under various given circumstances (Archer, 2003). Pietig (1997) stressed the role of foundations of education in teacher education programs, since they endorsed an integrated approach to teaching. Based on the results of this study, a good starting point can be empowering FYSTs through an established safe space where the FYSTs can reveal and notice the deeper structures of their challenges and have sustained experiences on problem-solving their dilemmas as they mature into *uniquely* confident and competent professionals.

Metaphors-in-Teaching Dilemmas as Personal and Professional Growth Tools

The results of this study indicate and highlight, the possible ways that metaphors-in-teaching dilemmas can be implemented as personal and professional growth tools. We advocate the arguments made by the following scholars and their approaches: (1) Carter and Doyle's (1996) approach of considering learning-to-teach as a deeply personal matter; thus, it should be one's life story, (2) Maulucci's (2012) ecological perspective, (3) Tobin and Lamaster's (1995) consistent voting for the functions of metaphor as foundations for teacher change processes, (4) Archer's (2004) concept of reflexivity and action, (5) Kegan's (1982) concept of self-authoring and self-transforming, (6) Volkmann and Anderson's (1997) science teacher change through a teaching metaphor and its connection to identity, and finally (7) Britzman's (2003) argument of the dynamics of biography and social structure. For our model, we propose organizing these insightful arguments, which respect "self and self-interests" as well as their social environments, within Wenger's (1991) communities of practice that also *value* diversity, equity, and community.

Online Mentoring Program for Teacher Effectiveness

Through the metaphors-in-teaching dilemmas, we hope to contribute to the understanding of challenging factors that FYSTs face and the detailed mechanism of how they *encounter* their first year as secondary science teachers. In this study, we also hope to offer a vision for supporting early-career science teachers and to provide functionality of the conceptual metaphors.

It is evident that the science and discipline-specific online mentoring program has provided a third place for FYSTs to virtually and safely hangout while talking about their teaching practices in real and ideal forms (Bang & Luft, 2014; Bang & Luft; 2015; Bang, Wong, Firestone, & Luft, 2014; Oldenburg, 1989). Through this study, at least, we were able to identify some hidden, untapped and growing buds of the FYSTs as they are standing within a development continuum.

Pietig (1997), in her critical review of Shulman's scaffolding metaphor, stressed the role of foundations of education in teacher education programs, since they endorsed an integrated approach to teaching. Based on the results of this study, a good starting point can be empowering FYSTs through an established safe third place where the FYSTs can reveal and notice the deeper structures of their challenges and have sustained experiences on problem-solving their dilemmas as they mature into *uniquely* confident and competent professionals.

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