Peer Interactions and the Development of Science Teaching Identity

In Elementary Education Majors¹

Steven D. Wall², Janice Anderson³, Julie Justice⁴

¹ This work is supported in part through a UNC—Lenovo Innovative Technologies Grant.

² PhD Candidate, University of North Carolina-Chapel Hill School of Education, Peabody Hall, 307 CB #3500, Chapel Hill, NC 27599-3500, sdwall@email.unc.edu

³ Assistant Professor of Science Education, University of North Carolina-Chapel Hill School of Education, Peabody Hall, 307 CB #3500, Chapel Hill, NC 27599-3500, anderjl@email.unc.edu

⁴ Assistant Professor of Literacy Education, University of North Carolina-Chapel Hill School of Education, Peabody Hall, 307 CB #3500, Chapel Hill, NC 27599-3500, jjustice@email.unc.edu
Introduction

Through methods coursework pre-service teachers (PSTs) are introduced to experiences involving the culture and language of science teaching and learning. The goal of these courses is to produce an environment aimed at the development of skills and knowledge appropriate to teaching science at the elementary school level (Collett, 1977; Cote & Levine, 2002). The process involves exposure to a variety of new experiences that emulate good teaching and the use of authentic practices, and historically has involved knowledge acquisition and individual orientation towards acceptable understandings of professional practices. However, contemporary advances afforded through the use of social media provide new opportunities for PSTs’ development as science teachers.

Where historical practices rely upon the individual’s acquisition of knowledge through academic coursework, social media generate opportunities for more participatory practices that value the co-construction of knowledge amongst peers (Anderson & Justice, 2013). This affordance of social media relies upon ideas associated with constructivism, yet in reviewing the current research most published findings are not focused upon the PSTs development. Rather, the focus is upon elementary student learning, classroom practice and factors that may influence these practices (Savasci & Berlin, 2012). Though constructivism is more commonly embraced then in the past (Leach & Scott, 2008), little research has been conducted in situations where a strong component of the academic coursework is participation amongst peers through engagement in a participatory community. Ideally, participation can be encouraged through such a community (Wall, Anderson, & Justice, 2012) and learning can occur through interaction (Barab, 2001) and socially-mediated communication (Luehmann & Borasi, 2011; Luehmann & Tinelli, 2008). The idea being that this type of practice (e.g. blogging) leads to communication
about science and enhances the development of the PSTs through the posting of reflections and comments, and the communication establishes a form of ongoing dialogue amongst community members (Yang & Chang, 2012).

Research reveals (Anderson & Justice, 2013; Anderson et al., 2013; Wall et al., 2012) that PSTs blog with a competence viewed as acceptable regarding perspectives and development as beginning science teachers. Though reflections posted through blogging and responses to blogs reveal growth (Harland & Wondra, 2011), interactions amongst PSTs rarely produce ongoing or meaningful dialogues in a manner that is representative of a professional discourse (e.g. Anderson, et.al., 2012, Wall, et.al., 2013).

Even with the scaffolding provided by the academic context, the need for development of strong science teaching identities at the elementary grade level remains. 21st century teacher education has an opportunity to uniquely contribute because of what social media (e.g. blogging) can reveal about the level of competence of PSTs, their identity standards, their reflective discourses, and the dialogues that the PSTs generate amongst themselves. Given current trends for PSTs to revert back to established beliefs and expectations (Akkerman & Meijer, 2011; Bautista, 2011; Matkins & Bell, 2007), understanding the thought process of the PSTs can aid teacher educators in the development of good practices for the preparation of future teachers.

**Research Question**

Challenges are common with the use of social media. Blogging is viewed as a questionable practice by PSTs or posts are typified by a lack of commenting or interaction (e.g. Anderson, et.al., 2012). The absence of response occurs even when initial posts are well-written reflections on teaching experiences or practices and seen as typical to a good teacher (Fairbanks et al., 2010). Based on limited findings because of minimal interactions amongst a peer cohort
involved in a larger study, a second research study was conducted to analyze the findings of a unique interaction that occurred among a group of three students enrolled in a science methods course. Using understandings and ideas associate with identity theory, social media, and science teacher expertise, we analyzed the development of a unique cell of students and sought to answer the question: *What is revealed about the identity standards of members of a small cell group and how do member interactions influence the development of science teaching identity amongst members of the cell group?*

**Literature Review**

Identity theory proposes that development occurs because of human cultural norms, cultural values, symbols, and social processes and that these influences can be either objective, contextual variables or subjective, individualistic ones (Paul, 2005). Whether objective or subjective, factors and their associated variables produce influences upon development that are processed based upon established roles and expectations associated with these roles (Burke & Stets, 2009; N. H. Kang, 2008). Published research on science teaching, participatory learning, social media and identity produces “suggestions” of what should be relevant amongst the numerous stimuli experienced by individual PSTs.

**Individual Identity and Contextual Influences**

Given the current practices of elementary PSTs to teach science and the subculture of elementary schools regarding science teaching practices, an expert science teacher identity is the ambitious goal of teacher education (Akkerman & Meijer, 2011; Callero, 2009; Gee, 2000; Lawler, 2008). However, reality frequently does not manifest such an identity. Some individuals exhibit a personal ability to create a learning environment that does not require scaffolding (Holland, Skinner, Lachicotte, & Cain, 1998), while others show a hesitation in
teaching science that is the result of adverse influences in the elementary school context (Meier, 2012). Though the PSTs exhibit an ability to adopt and integrate new practices during academic coursework, the presumption of an expertise is tentative: PST cohorts are generally populated by undergraduates with provisional identities (Anderson et al., 2013) that occur as a response to the scaffolding of their environments (Ford, 2004; Habermas, 2001).

An emphasis on identity and its role in the development of the science teaching ability of elementary PSTs is grounded in the perspective that individual choices for exposure to certain practices beyond the academic classroom are the result of established or developing identities. These identities are typified by a personal determination to pursue development (Allport, 1968; Koballa, Glynn, Upson, & Coleman, 2005; Lawler, 2008) and recognition of the need to transition from a novice to a developing expert (Koballa et al., 2005). These developing identities are important, yet faced long-term challenges because elementary school subcultures (Baggott La Velle, McFarlane, John, & Brawn, 2004) do not afford the scaffolding or discourse (Luehmann & Tinelli, 2008) found in academic environments. Though the subculture may not influence further development of the PSTs’ science teaching expertise, PSTs with a developing expertise and recognition of their competency, present or future, would seek exposure to appropriate experiences, alignment with an affinity group defined by discourses and practices (Gee, 2000; Lawler, 2008), and roles (Anderson, et.al., 2013) specific to science teaching and learning.

Development involves complicated interactions that involve both individual and contextual factors that include the social forces of membership with a discourse group, roles established for and by the group (Worchel & Coutant, 2003), individual beliefs (Bryan, 2003), personal educational experiences, and perceptions (Burke, 2007; Forssell, 2009). In the
academic classroom, a convergence of these important variables occurs influencing interactions that produce influences upon the agency of the PST (Ohana, 2004). The PST is inclined by the confluence of these critical interactions which produces a provisional identity, but this identity is subjected to the popular, acceptable expectation of the immediate environment (Burke & Stets, 2009): Ideally, these expectations align with meaningful science teaching practices designed to produce long-term practices whatever the context (Burke & Stets, 2009; Holland et al., 1998).

Identity and Expertise: Interactions

Useful and reliable knowledge is often appropriated by educational contexts that utilize it to educate or at least generate an environment beneficial to learning. The degree that this knowledge is employed varies based on the expertise of the individual, so how the individual interacts with their context and what the context offers becomes crucial. For teacher education this interaction of individual identity and context involves the development of pedagogical expertise; an ability to create an environment that encourages student growth. This type of expertise means that the individual is not bound by limitations produced by the educational context (e.g. Holland, et al., 1998) and that they are capable of inducing the academic growth of students (Milner, Templin, & Czerniak, 2011; Roth, 2001; Salter & Atkins, 2011). For this research, since observing elementary student growth is problematic, a focus will be placed upon the contextual influence that is generated by peers.

To determine if expertise is developing, this project looks at the practices and discourse of the PST in academic contexts. These practices can be evaluated based on the skillsets utilized (Salomon, 2001), and the hope is that the PSTs practices will be effective for the development of expertise associated with the establishment of a science learning environment beyond the scaffolding of methods courses (Bleicher, 2007; Eick, 2009; Rozelle & Wilson, 2012).
Theoretically, development occurs because the PSTs are learning and integrating practice theories and patterns of action that represent effective science teaching (Fairbanks et al., 2010; Schussler, Stooksberry, & Bercaw, 2010). Whatever occurs can be evaluated because the PSTs are making efforts to resolve challenges caused by understandings or misconceptions of teacher practice (T. Brown, 2006; Cooper, 2007; Galman, 2009); largely because of a personal identity standard maintained up to and during enrollment in academic coursework (Forssell, 2009; Powers, 2005).

Evidences of expertise that can be evaluated are manifested in the following: a) The interactions of PSTs within contexts of academic coursework (Schussler et al., 2010), and b) the PSTs’ attempts to reconcile their own beliefs and practices with academic expectations and perceptions associated with teaching science (C. Brown, 2010; Smith & Southerland, 2007; Tillema, 2009). While these efforts are qualified as temporary practices intended to insure acceptable outcomes based on established norms and expectations (Akerlof & Kranton, 2010; Wortham, 2006), they can be observed to make determinations about the development of expertise. What is produced is based on variables such as contextual standards, as well as the PSTs commitment to their academic practices (Bryan & Atwater, 2002; Hubbard & Abell, 2005; Warburton & Torff, 2005; Wortham, 2006), and within scaffolded academic coursework, at least three dyadic tensions important to development can be observed. These tensions include a first variable in combination with a second; the variables are individuality, context, and content (Steele, Brew, Rees, & Ibrahim-Khan, 2013).

**Individual and Contextual Interactions.** For contexts to be conducive to science teacher identity development, they have to involve elementary grade level learning that is subject to science content, utilize epistemic science practices, and enable science teaching (Fairbanks et al.,
A context that is rich with such affinities and discourses aligned with the expectations of expert communities (Figure 2.1) produces an opportunity for development or reinforcement of a science teaching identity (Bhattacharyya, Volk, & Lumpe, 2009), while one that lacks such affinities and discourses limits possibilities. Positive evidences in such contexts include personal comprehension of content and practice, along with adherence to authentic science practices. Individuals with such inclinations also integrate new ideas because a personal belief about content and associated practices compels this (Grier & Johnston, 2009). Together with formative environments, expertise is present because the coupling of contexts with individuality produces interactions that encourage adherence to and valuation of teaching and learning centered upon science.

![Individual and Context](image)

*Figure 2.6 Individual and Context*

In this particular project, the context is the participatory community produced by the cell group, which is embedded within the larger community of an academic cohort. This unique interaction amongst members of the cohort is a proxy for the subculture of the elementary school and so any interactions that occur are construed as a reflection of the in-service environment that the PSTs will occupy upon their induction into service.

**Science Teacher Expertise**

When considering science teacher expertise, multiple variables need to be taken into account. Since expertise involves both development of an ability to teach science and bring about learning in others, defining expertise must involve influences on pedagogical development
and how this development in turn impacts the learning of others (Jones & Carter, 2007; Loughran, 2007). Research already reveals that components of individuality (e.g. beliefs, epistemologies, etc.,) and the context are involved in development, so how these two influences interact is important for bounding ideas of science teacher identity and the development of expertise. A second component of development as a science teacher involves student learning as an indicator, and though this component cannot be ignored, this study will maintain a focus upon influences that are the direct result of academic work, specifically the interaction of peers.

Science Teacher Identity

Though sociocultural contexts are designed for learning the skills associated with science teaching (Vygotsky, 1996; 1978), the PSTs development involves navigation through a number of contextual influences. These include recognition of domain-specific subcultures (Meier, 2012; Ohana, 2004), content knowledge discourses (Akerson, Buzzelli, & Eastwood, 2011; Baggott La Velle, McFarlane, John, & Brawn, 2004; Holland, et al., 1998; Howes, 2002), professional expectations and roles (Anderson et al., 2013), appropriate curriculum, varied standards (Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012), and testing (AAAS, 2012; Britton & Schneider, 2007; Bybee & Deboer, 1994). The PST must not only navigate and integrate these influences, he/she must weigh their value in light of individual identity influences that include gender (Brotman & Moore, 2008), race and culture (Parsons, 2008), beliefs (Bryan & Atwater, 2002; Fairbanks et al., 2010; Warburton & Torff, 2005), personal epistemologies (Chinn & Buckland, 2011; Hofer & Pintrich, 1997; Nussbaum & Edwards, 2011), and experiences. Each contextual variable produces a unique influence that is also compared to a personal standards (Burke & Stets, 2009; Nilsson & Loughran, 2011), and as PSTs participate in the academic practices designed to imitate authentic practices (Barab, Barnett, & Squire, 2009;
Lave & Wenger, 1991) they develop an identity based on their own positionality and insights (T. Brown, 2006; Cooper, 2007).

For this study the idea was to define science teacher identity as a specific facet of the PST’s individuality and then focus on its role in the PSTs development as a teacher. This process was influenced by the fact that some evidences were unique to teaching and learning science content (Nebel, 2010) while others were neutral, easily transferred from one content domain to another. Skill associated viewed as neutral included continual engagement of students and the development of critical thinking, while content-specific skills involved activities, authentic questions, scientific knowledge, scientific reasoning, and the use of lab processes and methodologies (AAAS, 1990, 1993, 2012; "National Assessment of Educational Progress," 2012). Though important in labeling a science teaching identity, this project considered evidence such as the use of specific types of discourse, responsibility for pedagogical practices (Grier & Johnston, 2009; Zemba-Saul, Blumenfeld, & Krajcik, 2000), and a developing or recognized ability to create a classroom culture conducive to science learning (e.g. Holland, Skinner, Lachicotte, & Cain, 1998). Though most evidences were bound by contextual necessities, i.e. students actively learning, we wanted focus on what was available through blogging, the PSTs’ awareness of students, the manifestation of an ability to problem-solve around issues of pedagogy and content practice (Hilton, 2010), complex communication based on multiple levels of understanding of science (Loughran, 2007), and acclimation to content knowledge practices and professional expectations.

Social Media

Though not universally accepted, social media do offer benefit (Harland & Wondra, 2011) that warrants investigation. Teacher education programs that utilize the affordances of social
media help the PSTs to form a network (Hsi, 2007; Luehmann & Tinelli, 2008) that has the potential to aid future development by producing opportunities not associated with the limited face-to-face encounters of the academic classroom (Loving, Schroeder, Kang, Shimek, & Herbert, 2007). One of these affordances are reflections that offer support because they provide opportunities for interaction and critique (Killeavy & Moloney, 2010). This ability to belong to a group is extended beyond the classroom and will ideally move beyond the academic context as the PSTs are inducted into service rationale: an important affordance because PSTs develop a rudimentary knowledge and method that does not enjoy the same prominence either individually or contextually beyond the academic environment (Bagcott La Velle et al., 2004; Marbach-Ad & McGinnis, 2008; Meier, 2012; Milner et al., 2011).

PSTs develop provisional practices beneficial to effective science teacher pedagogy because the activities of academic classrooms are salient at the time. However, the challenge is in the transfer of concept beyond the academic setting (Hanuscin, 2013) because PSTs typically revert back to what is comfortable upon graduation from carefully scaffolded academic settings (Hanuscin, 2013; Matkins & Bell, 2007; Patchen & Crawford, 2011). Though what the PSTs are comfortable with is not qualified as unacceptable for their careers, what typically occurs is a minimization of science teaching and learning (Steele et al., 2013). Solving this minimization of science involves aiding the PSTs in the competent transfer of what they have conceived and done in the methods course to the local school context, without the scaffolding afforded by the academic environment. This transfer of concepts is a long-term goal of education and is oriented around the desire to help PSTs develop proper conceptions of content and learning associated with it (Kuhn, Cheney, & Weinstock, 2000; Leach & Scott, 2008; Vosniadou, 2008).
Theoretically social media have the potential to enhance development and encourage long-term practices beyond academic studies (Anderson et al., 2013; Lankshear & Knobel, 2006; Miranda & Damico, 2013), because tools such as blogs extend the academic classroom and generate beneficial practices (Killeavy & Moloney, 2010; Watters, 2000). Research (e.g. Yang, 2009; Nardi et al., 2004) reveals several attributes that contribute to the effectiveness of blogs as tools for this development. First, blog entries appear in reverse chronological order and are accessible from a single site, making it easier for users to read prior entries and discern development over time (Nardi, Schiano, Gumbrecht, & Swartz, 2004; Yang & Chang, 2012). Additionally, bloggers can enhance posts through tools such as embedded hyperlinks, graphics, videos and comments which may facilitate the evaluation and problematizing of practice (de Moor & Efimova, 2004). Luehmann (2008, 2011) also notes that blogging can be used to support the development of new types of professional teacher identities. These identities are generated through the sharing of personal educational autobiographies (Fairbanks et al., 2010), engaging peers in opportunities for critical inquiry-based reflection, engagement in community-based interactions (Ohana, 2004), the studying of practice in a way that is connected to, yet removed from, content-specific daily practice (Luehmann & Borasi, 2011; Luehmann & Tinelli, 2008), consideration and integration of an expert voice (Anderson et al., 2013), and sustained engagement in thoughtful, intentional professional practices (Luehmann & Borasi, 2011). These opportunities through self-reflection and the study of others practices through learned lessons and engagement with like-minded peers are not new to teacher education, yet they are the beneficiary because of access not previously known.

Social media allow for the production of reflections because they involve narratives about shared experiences, the academic classroom, or historical experiences (Davis, Beyer, Forbes, &
Stevens, 2011; Fairbanks et al., 2010; Hanuscin, 2013). These reflections in turn represent a new professional teacher identity because the PSTs are engaged in role-specific discourses (Gee, 2005) beyond the context in which they would normally occur (Luehmann, 2008, 2011). This reflection illuminates what is forming or changing (Hilton, 2010; Sutherland, Howard, & Markauskaite, 2010) because participation is a type of discourse that allows for self-recognition and recognition by an affinity group associated with teaching (Gee, 2005). For PSTs, this artifact of events includes narrations of field experiences, observations of other teachers, autobiographical and biographical accounts, and a variety of pedagogical practices (Luehmann & Borasi, 2011; Luehmann & Tinelli, 2008; Sutherland et al., 2010). The production of these artifacts has the potential to enhance the development of expertise because meaning can be made through what is constructed while producing opportunities for critical self-reflection or reflection from others (Luehmann & Borasi, 2011; Luehmann & Tinelli, 2008; Sutherland et al., 2010). These critical reflections can be integrated into future practices by individuals (Burke, 2007; Burke & Stets, 2009; Forssell, 2009) making input from social media a unique and new component of a participatory community. Another reason that blogs are beneficial is because they and any resultant reflections are shaped by the internal dynamics of individuals who operate with specific perceptions about current and future roles (Burke & Stets, 2009). As individual PSTs share perspectives comprised of practices and beliefs specifically associated with science teaching and learning they create opportunity for interaction and feedback. In turn, this feedback generates the potential for modification of behavior that is aligned with the social situation or role being encouraged (Burke & Stets, 2009).

Though this initial research will examine social media in a short-lived setting, the long-term goal is that the PSTs will modify behaviors or ideas to the point that what is reinforced
through the interactions associated with the participatory community leads to the prolonged use of practices characteristic of a science teacher. The possibility does exist that a lack of modification may be a positional or ideological stance reflective of an individual’s critical philosophy (Bryan, 2003), yet ideally the PST who exhibits a willingness to modify attitudes or practices do so because the practice being altered or reinforced is acceptable as pedagogical content knowledge (PCK) beneficial for student learning (Shulman, 1987).

Science Teacher Education, Social Media and Participatory Pedagogies

Most approaches to science teacher education are based on instructional strategies for teaching science to students, the use of laboratory instruction, and the acquisition of knowledge for science teachers (Gabel, 1994), so the use of social media is an uncommon practice. While reflections and reflexive practice are encouraged during methods courses (e.g. Harland & Wondra, 2011), most are structured around an approach that does not include digital communication (Luehmann & Borasi, 2011). How instruction occurs is not formulaic as revealed by the extant research, but most practices are structured around the idea of a teaching cycle (Lotter, Singer, & Godley, 2009; Shulman, 1987) that offers a framework for thinking about the different aspects of successful science teaching. Individually, PSTs are encouraged in the clarification of what learning goals and objectives should be utilized in defining their classrooms through the analysis of curriculum (Steele et al., 2013), the use of extended field experiences (Bhattacharyya et al., 2009; Ohana, 2004), daily or weekly exposure to authentic school environments and their agents, partnerships with established teachers (Mintzes, Marcum, Messerschmidt-Yates, & Mark, 2012; Miranda & Damico, 2013; Tillema, 2009), and lab-based practices (Watters, 2000). Through the use of these methods, PSTs are encouraged to develop understandings of what constitutes effecting planning and teaching strategies by designing
lessons around specific content and goals for that content (Bybee & Deboer, 1994). Established methods course goals provide exposure to authentic experiences useful to the PST’s development as a teacher in local elementary schools. When well done, they place an emphasis on the development of individuals who produce classroom that value science-related practices and outcomes (e.g. Holland, et al., 1998).

Through designing and implementation of their own lesson plans the PSTs learn to reflect upon and revise their practices by assessing what they are individually learning and what they have attempted (Marbach-Ad & McGinnis, 2008; Smith & Southerland, 2007). Social media affords opportunities to enhance this learning by producing a space where individualistic reflections can be shared amongst members of a participatory community. Through sharing the PSTs engage in discussion and reflective writing on meaningful experiences along with an audience of peers. These reflections of personal thoughts and perceptions about what the members of the community are doing, and responses to the reflections of others, serve to enhance the PSTs development (Danielowich, 2012; Deng & Yuen, 2013; Wood, 2012). Where general practices involve the use of reflexive practices and reflection papers that are individually authored evaluated by a professor or course instructor, social media produces a space for community authorship which then produces a pathway for previously unavailable critique from peers. The merit of reflection is not denied, yet based on the idea that co-construction of knowledge is an important component of growth (Anderson & Justice, 2013; Lotter et al., 2009), these socially-mediated reflections offer unexplored possibilities to further enhance the growth and development of PSTs through undergraduate coursework.

Theoretical Lens

The position that PSTs’ participation in a cell group can foster identity development is supported by the theoretical perspective of perceptual control theory (Forssell, 2009). According
to perceptual control theory, identity development is dependent upon the internal dynamics of individuals that operate within specific roles and the integration of contextual inputs as the individual enacts a perceived role. We already know that PSTs inhabit an academic context and that the contextual meanings for science teaching aid the identity development of the PSTs. Using the lens of perceptual control theory, there is potential for science teacher identity development because PSTs perceptions exhibit a form of complex communication (Hilton, 2010) about the teaching of science. This communication is expressed among peers in a cell group within the context of an academic class and amongst members of a cohort.

Recognizing the variables present, identity development through a perceptual control lens can be explained through the presence of a feedback loop (Burke & Stets, 2009) comprised of four components: an identity standard, perceptual input, a comparison process, and output. An identity standard is defined as individual perspectives comprised of beliefs about knowledge and/or practice specifically associated with science teaching and learning. Perceptual input is generally described as how one sees their own practice in conjunction with how others see their practice, and with this project, we have specifically focused upon the idea of input from an external source. A comparison process is explained by how the PST evaluates and compares the identity standard and perceptual input. The final component is output, which can be described as the adjustment in the behavior prescribed by both the individual and the context. The feedback loop works when the PST modifies behavior to align outputs to the social situation (Forssell, 2009). The result is either a modification of behavior/identity that reflects authentic science teaching practices or affirmation of an existing identity. Ideally, any modification reflects meaningful science pedagogical content knowledge (PCK) (Shulman, 1987)). For elementary PSTs who are learning science methods, perceptual control theory is useful because the PSTs’
teaching identity is derived from personal values for science, contextual input derived from the reactions of others, and actions that are defined by common meanings within the science teaching context that the PST inhabits.

**Methodology and Research Design**

**Study Context**

This design study was part of a larger study conducted at a large research institution located in the Southeastern United States. Participants were senior elementary education majors that participated in methods courses in literacy, science, mathematics, exceptional children, and language minorities during the fall semester of their senior year. In the spring, these same students participated in their student teaching practicum and seminar. As part of the designed instruction during both semesters, students blogged regularly using established prompts and accepted posting formats. Directions to assignments, and the design of the blog, which was placed on a Ning afforded varied formats for reflection and free response to blog entries throughout the senior year.

**Data Sources and Research Design**

Data was collected from pre-service teacher blog entries and spontaneous responses to these blogs that were posted by other PSTs in the voluntary cell group. Researchers examined blog entries and comments and evaluated the data presented using a grounded theory design with a constant comparative method (Corbin & Strauss, 2008b). Data collection and analysis were an iterative and inductive processes. The blog entries were organized into core categories (Corbin & Strauss, 2008), which provided a framework for observing and analyzing the identity standards of the PSTs. In considering the data, we chose to specifically focus on individual and contextual variables. We specifically focused on belief statements that reflected a critical positionality,
historical or contemporary experiences that the PSTs viewed as influential, and any epistemological statements that revealed how the PST valued content knowledge. Contextually, we looked at the perceptual input that the PSTs received from experiences, local school agents (e.g. school culture, cooperating teachers), students, and peers. Also, since this research project was embedded in a larger study, we utilized the results from the larger study to help frame what we observed while utilizing new codes original to the three blogs that we analyzed.

**Data Analysis**

Blog content was coded using grounded theory with a constant comparative method (Corbin & Strauss, 2008a) with data analysis utilizing an iterative and inductive process (See Figure 2). In analyzing the blogs, we developed and used a list of codes that came from emergent open coding. An initial blog was coded using grounded theory. Once coded, a second blog was coded using these codes and a comparison process to determine if the codes were similarly used in both blogs. Discrepancies were investigated and interrogated to develop rigorous checks to avoid this from occurring. Upon completion of this check, a third blog was coded using the updated codes from the second blog. Definitions were refined and finalized with this third round of coding. While the possibility of new codes was accepted, a degree of intrarater reliability was established (r=0.90). Codes were assigned on a line-by-line basis using Hyper-research© qualitative software.

*Figure 2: Grounded Theory—Coding Chronology*
Results and Discussion

Theory acknowledges social structures and individual affinities as important in the manifestation and development of identity. Social structures are generally well-established, having a culture that produces certain types of affinities and discourses that in turn shape expectations for roles within the structure. Individual affinities shape the PST’s perceptions of these affinities and discourses and how they and any experiences associated with them are processed involves the individual’s own beliefs, experiences, and epistemologies. Both the social structure and the individual have established expectations and so posts and comments made by the PSTs were evaluated for what their content represented about the individual engaged in the context that was designed to aid their development as science teachers.

Identity Standards

We operated with two standards in mind in the evaluation of the blog posts. One was that observations of factors associated with the PSTs own identities were an integral part of their science teacher practices during field experiences, and that these identity standards would be present in the discourse represented by each PST’s personal responses to their own experiences or the experiences of others. Though these posts were guided by established prompts intended to
place some bounds on what was shared, we assumed that what was produced was based not so much on academic salience, but a preference to share what was prominent to the PST while they were producing their initial posts or responses. The preference for open-ended responses was aimed at understanding more about the identity standard of the PSTs and their likely practices beyond the academic classroom.

These identity standards were revealed in comments prompted by peers and their evaluation of practices within educational settings. They were found in statements that involved comparison of personal practices with those of one of the cell group members. For example, a comment from ERK, after reading KM’s blog was, “Asking students to draw out their parachutes before constructing them is a really great idea!” This comment was the result of input from KM. Because of the commonality of experience that both shared, ERK had a frame of reference regarding the activity and actually integrated KM’s input regarding the future activity. Though only a short response to what occurred, ERK’s statement revealed that she had learned and integrated procedural information referenced from a recent experience. Her refabrication of future practices through a new methodology was at least partially based on input she received from her peer’s blog post. In a different post, KM received a detailed response from EMK (second quote).

*After giving the students about 15 minutes to construct the parachutes, each group presented their parachute. We had the partner groups describe the thought process they went through while making the parachute. All of the classmates who were listening to the groups had an observation sheet where they were writing down the main points of what the groups were saying (ex: weighted paper clip, cup shape, knots on the corners)...After all of the groups went we talked about which parachute went the slowest and which went the fastest...Because the students were so full of ideas and connections, we began talking about what other things besides parachutes are affected by air resistance. We even decided that people are affected by air resistance....—KM*

*KM, I like how you all asked the students to draw a picture of their parachute before constructing it. At times, I felt like our students were making decisions regarding the*
structure of their parachute as the lesson progressed. Had we asked them to draw a picture, the construction process might not have taken so long. We also used an observation chart/recording sheet. I thought this was extremely helpful so that so that the students could remember what they observed prior to the changes to the structure and then have something to compare it to after they made the changes to the structure of the parachute.—EMK (response to KM)

Though the experience and the method utilized were valuable in accomplishing meaningful goals, which was acknowledged by both PSTs, we thought these two posts offered additional insights. First, it was interesting that the PSTs did not comment on the specific role of experience though they tacitly acknowledged it. For example EMK noted how she liked that KM had them “draw a picture” and the role that might have played in the length of the activity both PSTs attempted. The initial post and response accepted experience as a norm, which was evidenced in numerous other statements that focused on the content versus the idea of the students “having an experience.” The PSTs were clearly utilizing student-centered, hands-on experience. Also, the posts revealed the value of interaction embedded in a shared context when EMK considered future outputs based on KM’s input. Finally, KM whom we learned through the project struggled with historically negative experiences with science, received a form of validation that could only serve to encourage her developing competency as a science teacher.

Other inputs that we viewed as indicators of an identity standard often included short agreement statements that revealed a facet of belief or epistemology. For example, EMK noted, “I like how you compared “unpacking” the standards and understanding the content to students “unpacking” their own thoughts and ideas,” and ERK noted, “I definitely agree that teachers should look at different curriculum with a critical eye and tweak them so that they fit the needs of their classrooms.” These brief statements revealed a practical belief that each PST used in approaching the role of curriculum in student learning. Another, more substantive prompt, further revealed facets of the identity of ERK.
I agree that it is important for teachers to slow down and allow for students to ask questions and engage in meaningful talk. Because of all the pressures to perform on EOGs, I think teachers are scared to set aside the time to allow their students to ask questions and simply have time to think. However, if we don’t allow this time for information to “digest,” the students will forget the information that is taught. In order for information to actually “stick,” students need to participate and engage in conversations and tasks that are meaningful! –ERK

In this post, ERK spoke specifically to process, “slow down and allow for student to ask questions and engage.” Her post also addressed limitations of the educational environment by referencing pressures placed upon teachers; a perspective that learning was not benefited by such burdens. While her post was based on limited experience in the educational environment, her own identity standards were revealed because of her positionality regarding student learning and contextual influences placed upon teachers.

To further understand more about the identity standards of the group we looked at statements that prevalently considered science. These tendencies were considered potential revelations of beliefs. Theoretically, these beliefs were seen as strong encouragements (Fairbanks, et al., 2010) that influenced approaches to teaching, generating personal expectations for the PSTs concerning content knowledge and practices (Howes, 2002). These beliefs were important because the could lead to personal theories about knowledge and the process of knowing (Hofer & Pintrich, 1997). Belief statements were not demonstrative, but did represent a personal stance about what had or should occur. For example, KM noted, “I think implementing discourse/argumentation in the classroom is a vital part of instruction in the classroom.” She also noted:

> We sometimes shortchange our students by not allowing appropriate time for discussion of ideas and thoughts. If students are only given the opportunity to regurgitate facts and terms they have learned and not think deeply about what they are saying, chances are that information will be as good as gone after a few weeks. –KM
KM’s responses to experiences associated with her academic coursework revealed critical beliefs about the role of students and effective methodologies. Her stance on processes such as argumentation, a practice based in the use of evidence and logic, were complementary to science and also revealed a belief about classroom practice that was not contrary to sound science teaching. She also revealed the strength of her stance in a later post.

In some cases, teachers will lead students to stray from these types of answers (ambiguous) and probe them until they get to the answer the teacher expects to receive. These cases, however, provide perfect evidence as to why discourse and argumentation is important to use in the classroom –KM

KM’s critique affirmed the fact that her initial statement, which was in response to a designed prompt, was more than academic. Her post revealed a preference for potential ambiguity and acceptance of the tentative nature of scientific knowledge.

**Experiences**

Another component of individuality was the role of experiences that shaped perceptions of practice or roles. These could be historical or contemporary and were constituted by either unfavorable or favorable memories of science, formally or informally. While our desire was to focus upon contemporary experiences, past ones also played an influential role. Reflections, past or present, revealed values associated with science and were analyzed in order to generate recognition of the PSTs perceptions about science as a content area, and when possible, to reveal what they valued with regards to good science teaching.

* I was not really encouraged to think outside of the box and expand my science knowledge past the classroom. I think this negatively impacted me because it was hard for me to begin to make connections as the sciences got harder, so I always like I was doing something that was intangible and beyond my reach. –KM

In this post, we discerned a perception about the type of learning that should occur. While KM did not elaborate upon the idea of “outside the box,” we discerned that she was referring to
connecting science to everyday life because of the qualifying phrase “past the classroom.” This experience also revealed that KM saw science as lacking relevance, which was compounded by increasing levels of complexity through her academic career.

Negative perceptions were present for each cell member, yet many of the group’s posts reflected upon positive components of experiences. The common thread was the role of hands-on learning. While posts referring to such activity often lacked details, positive experiences produced recall of specific details indicating that the PSTs valued experiential, hands-on experiences. KM noted, “I know that a lot of the science I remember enjoying came from experiments.” EMK produced the following post:

My earliest and most vivid memories of science are of projects and the many experiments I conducted with my mom and twin sister in third grade... certain memories are more vivid than others such as the science fair project I created on tadpoles, making leaf prints using wax paper in the driveway and learning about why leaves change colors, planting seeds in my own garden and watching them grow into vegetables, studying the different stars late at night, and examining the parts of the body using a fake skeleton. Through all of these experiences, I was able to discover more about the world around me, understand how things work...—EMK (Pseudonym; blog post)

Further enhancing the importance of experience was this post made in response to EMK. In this situation, KM acknowledges once again the important of experience and adds how the experience should be emulated for younger students.

My situation is similar to yours. I remember the big exciting things such as experiments from elementary school and began to feel like my upper grades science was a chore. I think it is a good thing that you began to understand how to apply science to your life through what you learned in school...I agree with the method your teacher uses of a lot of tangible science items while students are young. This will allow the students to create a concrete understanding of science from the beginning that they can build on.—KM (response to EMK’s post about past experience)
Other posts reflected either a positive and a negative or a lack of value claim associated with what was experienced. These posts indicated that the PSTs saw value, but were not making a direct connection to what the experience offered. For example:

*My experiences have shaped my definition because when I think about science I think about the things I created or worked with. All of these things were done to help me explore a part of my world or the things around me, even if I was not aware of it at the time.* –KM

It is unclear if KM was speaking of hands-on experiences or other components of science. Also, her acknowledgement of being helped to “explore a part of my world or the things around me” had added significance because KM had previously alluded to the idea that she had not been encouraged to think outside the box, a statement seemingly indicating that she did not see connections. While this post could have been viewed as conflicting with her previous statement, our perception was that KM had an identity-based belief influenced by the importance of connecting science to real life.

**Epistemology—Nature of Science**

Evaluating the PSTs epistemology was done by primarily considering how the PSTs viewed outputs received from students. Though these statements were considerably less common, the role of epistemology was perceived as too important to ignore in the development of the PSTs. By looking at what they thought of student responses to certain types of activities or affordances provided by the nature of science (NOS) or its role, an epistemological preference was revealed. For example:

*I think often times teachers engage in IRE (inquiry, response, evaluate) exchanges where they ask a question and receive a response. Then, teachers evaluate the student response as either right or wrong.* –KM

*Science is also a more ambiguous subject that allows students to have a variety of thoughts and explanations for what they are observing or learning. It is important to have a subject that has this space for students.* –KM
In the first posts, the PST reveals a subtle disregard for right or wrong answers, which was affirmed in a statement made in the second post. KM specifically acknowledged the ambiguity of science and how this permitted students to comprehend what they were learning and experiencing. KM’s epistemology was further highlighted by a post in which she responded to a fictional situation where she was asked to address the minimization of science by a local school administrator.

*What they don't realize is that there are many different literacy and mathematical concepts involved in science lessons. I would begin my response by telling the board member that he is not alone in his thoughts about literacy and math trumps science but that he is dealing with a misconception about the educational world. --KM*

In this post KM shows a valuation of science as an important component of the instructional day. While she does not specifically detail the importance of any of the subjects beyond the context of the academic classroom, her post reveals an elevation of science to the point that a critique of academic settings and general educational practices occurred. Such statements were less common, and we presumed two reasons for this. First, the PSTs were not asked to specifically comment about the role of content and student learning. Second was based in what extant research previously revealed about the PSTs perceptions of science.

**Perceptual Input**

For each of the three group members, perceptual input was viewed as a statement or response to something observed that led to or produced potentiation for the adaptation of practice. Many of the posts that we included in the results and discussion reflected this idea of perceptual input, but while many of these were peer-oriented, perceptual input was not just a peer-to-peer interaction. It also involved the processing of input from experience, past or
present. Whatever the input, the key was that it was used as a referent for future activity or adaptation of practice.

For each of the three PSTs we observed and analyzed, experience was a key component of this perceptual input because it provided a reference point. This input involved the PSTs sharing ideas about common experiences or science-oriented materials and often produced agreement about outcomes or what was perceived upon the conclusion of the input. For example:

KM—Your point about the way a teacher uses a curriculum was very interesting to me. I definitely agree that teachers should look at different curriculae (sic) with a critical eye and tweak them so that they fit the needs of their classrooms. My teacher is using the Foss kit and told me at the beginning of the year that she tries to follow the curriculum, but often time they change the lessons by integrating more hands-on and engaging activities. --ERK

In this response to an initial blog based on a curriculum evaluation by KM, ERK shared an elaborated agreement. Her response was based upon her own experience and interaction with a cooperating teacher (CT) that was serving as a mentor; it also reinforced her peer while illuminating her own positionality. This response revealed the importance of experience for enhancing development because of perspectives associated with the use of curriculum. We also saw the previous post as a validation of social media use because it was socially-mediated and enculturated by the background of the PSTs. This was evident in the following two posts.

"From as far as I can remember, science in school was never something I was comfortable with or necessarily good at. I barely remember what we did in elementary school as far as science goes, and some of the only things I remember were making "gak" and homemade ice cream. –KM (Pseudony; blog post)

My earliest and most vivid memories of science are of projects and the many experiments I conducted with my mom and twin sister in third grade... certain memories are more vivid than others such as the science fair project I created on tadpoles, making leaf prints using wax paper in the driveway and learning about why leaves change colors, planting seeds in my own garden and watching them grow into vegetables, studying the different stars late at night, and examining the parts of the
body using a fake skeleton. Through all of these experiences, I was able to discover more about the world around me, understand how things work...—EMK (Pseudonym; blog post)

For KM, the input from her experiences were not all positive, and contrasted with other members of the group. While the potential interaction was one we desired to see more of through posts and response, it did not materialize in this data. However, KM’s explicit acknowledgement of the lack of experiences were magnified when contrasted with other members of the cell, EMK and ERK. Since both EMK and ERK explicitly described numerous hands-on experiences and the role of these experiences in shaping their views and wonders of science, the potential for the social media interaction to influence KM’s development as a science teacher was generated. The value that EMK and ERK placed on meaningful experience was different than that of KM, who had noted that science, as an educational phenomenon, was detached from her.

Another form of perceptual input occurred through the influence of contextual sources. These could be cooperating teachers, administration, or even expert voices (e.g. research articles or classroom instructors).

As far as the representation is concerned, the teacher finds many ways to present material for the students. She finds movies, powerpoints, trade books, and websites that all discuss the topic they are working on in different ways. For example, when learning about the earth and sun relationship, Mrs. M had the students do a reading by themselves and answer questions, conducted a read aloud about the relationship with a cartoon book, and found several useful movies and clippings on the internet that demonstrated the material that was being learned in different ways. —KM

Or

I thought your discussion about "engagement" in terms of UDL was very similar to my own teacher's. The students in my class also have a reading response journal where they reflect on the reading they are doing and the strategies they are using every day. Often times, my teacher will collect the journals and respond
to the students thoughts. It's very similar to a pen-pal system. I feel like this is an excellent way to encourage students who may not be as motivated. –ERK

These posts revealed that the PSTs received input from multiple sources and that the input was at least integrated into their memory. We deemed that such observations were based on practicality and relevance to the PSTs own experiences either through a specific method experience or personal history. Both KM and ERK frequently referred to input from a CT, acknowledging agreement and acceptance of the practices observed. And though the PSTs acceptance occurred in the form of a reflection upon an observation, such postings were deemed relevant because the PSTs acknowledged them from amongst a number of other possible inputs. These observations relayed something about the perceptions of teaching practice and how it would proceed, and the rationale for acceptance of these inputs as an indicator of development or a present science teaching identity was based on the idea of commonality—the PSTs knew and understood something about what was observed and this in turn amplified their awareness of its importance. Though not the input of an immediate peer, the sharing of these posts continued to enmesh the social media culture of the cell group with a culture conducive to the development of science teaching identity.

**Conclusions and Implications**

In answering the research questions, *What is revealed about the identity standards of members of a small cell group and how do member interactions influence the development of science teaching identity amongst members of the cell group?* any analysis of the data has led to several caveats. First is recognition of the need for a high degree of subjectivity. The reason for this is that the findings either illuminate something new, the initial development of a science teaching identity, or something enhanced, an already established identity standard that would
lead to science-oriented classroom practices. Either position could be defended based upon the data collected, and so for now our initial observation is that the blogging project has illuminated what is present as a result of the scaffolding and experiences that occur. We are hesitant to make broads generalization about the use of social media associated with this project because this data only looks at the academic components of the PSTs service; there are no longitudinal investigations that involve the study of PSTs beyond this project.

A second caveat involves the newness of this data to the broader realm of science teacher education. How does one compare the content of a blog post to what normally occurs. The practice is new and therefore little data exists based upon already established precedents. This limit in the amount of research present means that any conclusions are speculation without a reference point to validate. Though we believe that there are some unique contributions, we don’t have the historical background to verify them at this time. However, we do believe are findings are worth sharing and hope that they will build upon a growing knowledge base investigating the use of social media.

Our first finding involves what we learned about the identity standards of the PSTs. Upon commencement of this research process, we believed that PSTs were governed by various degrees of fear and anxiety with regards to science. While not definitively refuted, the blogs and interactions of the PSTs clearly revealed identity standards conducive to the effective teaching of science at the elementary level. While PSTs may vocalize about anxiety with science, these findings reveal an acceptable level of competence. All three of the PSTs showed beliefs and an ability to process inputs from experiences and/or each other to improve their approaches to science. Even when an interaction amongst the PSTs was not apparent, the data we analyzed revealed the presence of already established beliefs or perceptions about educational practice that
we deemed worthwhile for the science education of elementary age students. The PSTs processed input and adapted ideas from this input with multiple evidences revealing individuals with inclinations to integrate new ideas because a personal belief about content and associated practices (Grier & Johnston, 2009).

The PST were navigating and integrating influences and their postings revealed components of an individual identity that involved beliefs (Bryan & Atwater, 2002; Fairbanks et al., 2010; Warburton & Torff, 2005), personal epistemologies (Chinn & Buckland, 2011; Hofer & Pintrich, 1997; Nussbaum & Edwards, 2011), and the integration of historical and contemporary experiences. Contextual variables produced a unique influence and we saw that the PSTs were comparing and generally in agreement with what they experienced or saw. The PST involvement in authentic practices (Barab et al., 2009; Lave & Wenger, 1991) produced at least a positionality and insight reflective of a beginning teacher. This was evidenced by their attempts to problem-solve around issues of pedagogy and content practice. Though complex communication based on understandings of science content (Loughran, 2007) were absent, the PSTs did exhibit an acclimation to content knowledge practices, and alignment with acceptable professional expectations.

The second finding involved the role of interaction amongst peers. Though we wanted to track the number of interactions that occurred we specifically focused upon sentences as a unit of analysis which skewed actual numbers of peer interactions. However, we did notice that the members of the cell group had more responses per group member than the at-large community by an almost two-to-one ratio. Some students in the at-large group had zero comments while each cell group member had comments from the other member of the group. We attributed this to the fact that the cell group members knew each other from previous academic courses and
voluntarily agreed to post with each other. This allowed for new degrees of commitment and an already established level of comfort with communication that was not common in the at-large group. This trust was significant because the success of blogging practices needed some basis in relationships that allowed for the manifestation of the identity standards of the individual PSTs. The PSTs coupled contexts with their individuality producing interactions that advantaged adherence to and valuation of teaching and learning centered upon science.

Also important to interactions was that the cell group voluntarily formed and was never specifically prompted to respond in a way that was unique to the partnership that formed. As noted we saw a direct impact being an increase in the number of response interactions than the at-large community. We also saw a trend that paralleled previous research findings—interactions were not authored to challenge or critique peer experiences to align with criteria associated with a prominent science teacher identity (e.g. why is this important?). Instead, most posts were an elaborated agreement with a previous experience or reflection on a specific practice that was the result of an established prompt. Though we would have liked to see disagreement where appropriate, the lack of critique was not considered a limitation of the practice because we saw any interaction as an extension of academic practice beyond the context in which it occurred. The process of interaction revealed a desire for improvement that we had not previously observed in the larger community.

A final conclusion involves the second component of the research question with its specific focus upon the impact of the interactions that occurred: The premise being that the post-response nature of blogging would lead to a long-term benefit from the interactions. While an interaction was present, the specific data produced from this project was limited to undergraduate, academic practices. What was absent was a lack of longitudinal data that could be used to find a specific
relationship between the development of a science teaching identity and the interactions that occurred through cell group blogging.

While it was noted that the discourse of the PSTs was reflective of beliefs acceptable to science teaching practices, without a corresponding observation upon the PSTs’ induction into service, any assumption about long-term growth/development was speculative. This finding remains a challenge for the role of blogging, yet we do believe the following claim can be supported. Based on the evidence of this project and other research involving the use of blogging, a reasonable assumption is that blogging, at least, maintains an influence comparable to what already occurs in the methods course. We further accept the notion that the extension of the classroom through the use of social media improves the impact of the methods course and is beneficial for the development of the PSTs.

**Limitations of the Study**

A limitation involved in this project is the correlation being attempted. Though supported by various theoretical frameworks, to successfully speculate that development is the result of undergraduate interactions only is problematic. Other variables influence the development of the PSTs, including established beliefs about teaching roles and scientific knowledge, the influence of the methods course, and other historical or contemporary experiences. Ideally, this project has revealed the presence of development with a specific, scaffolded environment designed to enhance the development of the PSTs. With this knowledge, future studies need to be designed that focus upon gathering observations about the development of the PSTs as a result of their academic careers beyond the academic context that they are involved in.

**References**


