Wall, S. D., & Anderson, J. (2015). Peer communication through blogging. *Contemporary Issues in Technology and Teacher Education, 15*(4)514-540.

Peer Communication Through Blogging

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Abstract

With the emergence of mobile technologies, students' access to computing devices is omnipresent, as is their ability to collaborate through multiple modalities. This 21st-century affordance has generated a shift in the way preservice teachers are prepared to use, understand. and interact with social media (e.g., blogs) during their academic years. This paradigmatic shift involves a movement toward a participatory culture using Web 2.0 technologies—dynamic environments that are not limited to the interactions of academic classrooms. These changes present both new types of challenges and vast opportunities for teacher educators. Based on repeated observation of minimal interaction amongst members of a peer cohort, a research study was conducted to analyze the interactions of three students who consistently posted comments on each other's blogs in contrast to the trends found in their cohort. Analysis of their posts and comments illuminated preservice teacher expectations for science teaching roles and how preservice teachers applied their expectations when commenting on their peers. These interactions were professional in nature and revealed that previously established interpersonal relationships did not alter the type of interactions that occurred.

Background

Through methods coursework preservice 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 encouraging the development of skills and knowledge appropriate to teaching science at the elementary school level (Appleton, 2008; Bautista, 2011; 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 toward acceptable understandings of professional practices. However, contemporary advances afforded through the use of blogging provide new opportunities for PSTs to develop as science teachers.

Where historical practices rely upon the individual's acquisition of knowledge through academic coursework, blogging generates opportunities for more participatory practices that value the coconstruction of knowledge (Anderson & Justice, 2015). This affordance of social media relies upon ideas associated with constructivism, a practice that is frequently researched (Tay & Allen, 2011; Tess, 2013); yet, most published findings have been focused upon grade level learning, classroom practice, and factors that may influence these practices (Savasci & Berlin, 2012), while minimal emphasis has been placed on those who are preparing to teach.

Though constructivism is more commonly embraced now than 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 that involves practices such as blogging (Jaipal-Jamani & Figg, 2015). Current research reveals that PSTs blog with a competence viewed as acceptable regarding perspectives and development as beginning science teachers (Anderson et al., 2013; Anderson & Justice, 2015; Wall, Anderson, & Justice, 2014). However, posted reflections and responses that reveal growth (Harland & Wondra, 2011) involve minimal interactions amongst PSTs and rarely produce ongoing or productive dialog representative of a professional discourse (e.g., Anderson et al., 2013, Wallet al., 2014).

Theoretically, participation can be encouraged and learning can occur through interaction (Barab, 2001) and blogging (Luehmann & Borasi, 2011; Luehmann & Tinelli, 2008), as long as communication about science teaching occurs and the posting of reflections and comments establishes a form of ongoing dialog among community members (e.g., Jaipal-Jamani & Figg, 2015; Yang & Chang, 2012). Given trends for PSTs to revert back to established beliefs and expectations that minimize what they have learned through academic practices (Akkerman & Meijer, 2011; Bautista, 2011; Matkins & Bell, 2007), continued work is needed to understand and develop teacher education practices that utilize blogging to improve teacher education.

Blogging can be viewed as disrupting traditional pedagogies (e.g., Anderson & Justice, 2015), resulting in outcomes that further develop PSTs' science teacher identity. When PSTs reflect through blogging, their posts produce insights, but they are characterized by a lack of interaction (e.g., Anderson et al., 2013; Wall et al., 2014). Studies have shown that the absence of response occurs (e.g., Anderson & Matkins, 2011) even when initial posts are well-written reflections on practices typically viewed as good teaching (Duffy et al., 2010).

The interactions that do occur are consistent with the nonreflections of events or descriptions of established practices (e.g., how specific theoretical practices are used) common to reflective practices (Andersen & Matkins, 2011). Though these trends are

consistently observed in larger cohorts, an opportunity was generated by a group of three students in our study who consistently reflected on each other's blogs. These individuals knew each other prior to the start of the methods course, so their blogs and comments were analyzed to find what they revealed about interactions and influences amongst individuals with established interpersonal relationships. Using ideas associated with identity theory, blogging, and science teacher identity, we analyzed the blogs of this unique cell of students throughout the methods courses, examining their blogging interactions and what they revealed about the teaching identities of the group's members.

Science Teacher Education, Blogging, and Participatory Pedagogies

Educating students in the 21st century has necessitated a shift in the way in which PSTs are prepared to use, understand and interact in the classroom (McLoughlin & Lee, 2008). Deuze, Bruns, and Neuberger (2007) characterized this paradigmatic shift as a movement toward a participatory culture using Web 2.0 technologies—dynamic environments that are reshaping our educational landscape (Keen, 2007). PSTs in today's classrooms are typically technology savvy and have integrated social networks into their daily lives (Windham, 2005), and with the emergence of mobile technologies, students' access to computing devices is omnipresent (McLoughlin & Lee, 2008). Synonymous with these technological trends is an opportunity to develop collaborations through multiple modalities. These dynamic changes present both new types of challenges and vast opportunities for teacher educators.

New media, including social networking sites, have emerged as platforms for new pedagogical approaches in teacher education coursework that respond to 21st-century challenges by facilitating interaction, communication, and collaboration of educators around practice (Greenhow, Robelia, & Hughes, 2009; Hartshorne & Ajjan, 2009; Veletsianos, 2012; Veletsianos & Navarrete, 2012). These affordances can be connected to socioconstructivist pedagogies where PSTs are actively engaged cocreators of their own knowledge (Conole, 2010; Orehovacki, Bubas, & Konecki, 2009). However, little is yet known about the impact of these pedagogical tools, even with an expanding use of these new media in formalized learning contexts (Schroeder, Minocha, & Schneider, 2010), particularly within PST science methods classrooms.

Historical approaches to science teacher education are based on instructional strategies for teaching inquiry, using laboratory environments, and developing content knowledge for science teachers (Gabel, 1994), so the use of blogging within these contexts is uncommon. 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 networked communication, such as that produced by blogging (Luehmann & Borasi, 2011). Methods instruction is not formulaic but is often structured around a teaching cycle (Lotter, Singer, & Godley, 2009; Shulman, 1987) that offers a framework for thinking individually about the teaching of science with PSTs encouraged to clarify learning goals and objectives (Steele, Brew, Rees, & Ibrahim-Khan, 2013).

These practices include the use of extended field experiences (Bhattacharyya, Volk, & Lumpe, 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 & Ginns, 2000). The benefit of these practices is an emphasis on the design and implementation of lesson plans, with the PSTs reflecting privately or through forced responses, designed to encourage the revision or integration of practices through assessment of what was attempted (Marbach-Ad & McGinnis, 2008; Smith & Southerland, 2007). This type of pedagogy involves reflexive practices and reflection

papers evaluated by a course instructor, but blogging extends the practice by providing opportunity for community authorship and peer critique of experiences (Sawmiller, 2010).

Blogging. Through blogging PSTs initiate discussions and receive responses through the reflections and comments of others. These reflections and comments are new opportunities for the PSTs' development (Danielowich, 2012; Deng & Yuen, 2013; Wood, 2012) because of the coconstruction of knowledge (Anderson & Justice, 2015; Lotter et al., 2009). What occurs as the PSTs interact and reflect is a minimally researched enhancement to the PST's development as science teachers.

While PSTs individually reflect upon meaningful experiences and develop understanding of the role of collegiality (Ohana, 2004), blogging extends experiences through interactions produced as PSTs share about their struggles with various professional practices, including planning, decision-making associated with new experiences, teaching content, and pedagogy (Yang & Chang, 2012). In contrast to monologs or momentary reflections with an instructor, blogging generates new conversations and minimizes boundaries and chronological margins (Lieberman & Mace, 2009; Wolf, 2010), while also making PST perceptions of their actions and experiences available for critique.

Coupled with the PST's desire for professional growth, blogging produces great potential (Finn, Gomez, Griesdorn, & Sherin, 2008; Galman, 2009) for the development of skills associated with good teaching (Duffy, et.al., 2010: Hramiak, Boulton, & Irwin, 2009), such as mutual sharing, reflection (Harland & Wondra, 2011; Wolf, 2010), and discussion centered on individual perceptions (Akkerman & Meijer, 2011).

Blogging as contextual influence. Technology is generating new communities in which people come together to collaborate, learn and build knowledge (McLoughlin, 2007). This practice of combining learning and generative tools such as blogging has progressed to the point that its affordances need to be considered as part of the context of teacher education. The synchronous classroom can now be extended through blogging, producing multiple forms of support and additional opportunities to learn successfully (Puntambekar & Kolodner, 2005).

By producing new interactions amongst peers that are shaped by the contexts they occupy, prolonged influences are yielded for PST development. This new context for education can integrate the authentic and emergent uses of social media and interactive learning environments while also contributing to the advancement of theories of everyday learning that aid deeper understanding of how development occurs from a practice-oriented perspective (Hsi, 2007).

The use of digital networks is a disruptive pedagogy altering students' typical learning environments in several ways (Anderson & Justice, 2015). First, general trends in comments from cohort members indicate that the practice of blogging and its affordances have values that differ based on who is speaking. This idea of disruption is attributed to the fact that social network sights are public learning spaces, while typical university pedagogy privileges learning that is private (e.g., student-professor interactions; Komarraju, Musulkin, & Bhattacharya, 2010). Our disruption requires learning in public and is unfamiliar and disconcerting to many of the students who are used to learning material and practices in private spaces and chronologies (e.g., Anderson et al., 2013). These networks set up differing patterns of interaction for the students, creating dynamic power relationships within the pedagogical interactions.

Second, messy learning-in-progress is privileged over academic demonstrations of knowledge or other dominant displays of learning, as evidenced by requiring students to share their reflections and comment for and with peers. Typical academic discourse is less valued than shared reflections, peer questioning, critical perspectives and narrative voices (Wall et al., 2014). Also, the use of blogging requires students to learn as a community rather than in isolation. Not only are the PSTs learning in front of their peers, they are required to learn from their peers. The cell group's practices produce a new context that generates opportunities for learning to be situated in a participatory environment (e.g., field experiences and active discussion), which are, in turn, generated by interactions among peers (e.g., Lave & Wenger, 1991), thus giving students the opportunity to engage actively in the cocreation of their own knowledge (McLoughlin, 2007).

Identity and Development

The need for development involves individual recognition and choices for professional or personal growth (Koballa, Glynn, Upson, & Coleman, 2005), coupled with the salient influences of a relevant context (Burke & Stets, 2009). The academic context in which this development is situated becomes important because contexts such as elementary schools do not afford the scaffolding or discourse of academic environments (La Velle, McFarlane, John, & Brawn, 2004).

Experiences in the academic environment aid PSTs as they make efforts to align their own discourses and practices (Gee, 2000; Lawler, 2008) with roles specific to teaching and learning (Anderson et al., 2013). Development involves complicated interactions generated by the social forces of membership with a discourse group, established group roles (Worchel & Coutant, 2003), individual beliefs (Bryan, 2003), personal experiences, perceptions (Burke, 2007; Forssell, 2009), and the agency of PSTs inclined by these critical interactions, which produces a provisional identity that is subjected to the popular, acceptable expectation of the immediate environment. Ideally, academic and group expectations shape the context by aligning with practices beneficial to science teaching and learning by default, making interactions beneficial (Burke & Stets, 2009).

Since science teaching identities are uncommon amongst undergraduates (Anderson et al., 2013), the scaffolding of academic environments (Ford, 2004; Habermas, 2001) is important. While this academic context is designed for learning skills associated with science teaching (Vygotsky, 1978, 1996), the PSTs must learn to navigate through domain-specific subcultures (Meier, 2012; Ohana, 2004), content knowledge discourses (Akerson, Buzzelli, & Eastwood, 2011; Howes, 2002; La Velle et al., 2004), and professional expectations and roles. Each distinct variable produces a unique influence (Burke & Stets, 2009; Nilsson & Loughran, 2011), and as the PSTs participate (Barab, Barnett, & Squire, 2009; Lave & Wenger, 1991) the interactions illuminate positionalities and insights (Brown, 2006; Cooper, 2007) that can then be exposed to the PSTs' peers.

Theoretical Framework

The position that PSTs' participation in a cell group can aid development and reveal something about their identities is supported by the theoretical perspective of perceptual control theory (Forssell, 2009). According to perceptual control theory, development is dependent upon the internal dynamics of individuals that operate within specific roles and the integration of contextual inputs as the individual enacts said role. Perception will be influenced by an academic context that is deliberate in producing contextual meanings for science teaching, and these salient influences will aid the development of the PSTs (Burke & Stets, 2009; Hilton, 2010). Using perceptual control theory as a lens, the PST

blog posts and comments illuminate PSTs' perceptions, because they represent a form of communication associated with science (Hilton, 2010).

The communication that occurs through blog posts influences the PSTs and can be explained by looking at the information they contain as a type of feedback loop (Burke & Stets, 2009) comprised of four components: an identity standard, perceptual input, a comparison process, and output (see Figure 1). An identity standard is defined as individual perspectives comprised of beliefs about knowledge and practice specifically associated with science teaching and learning.

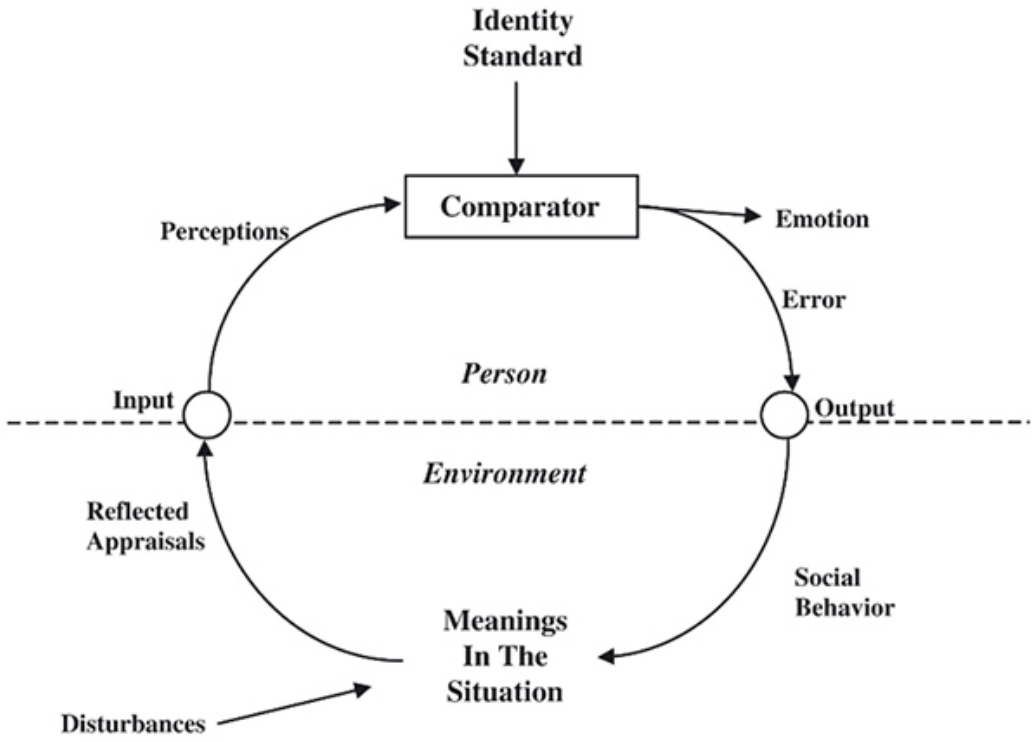

Figure 1. *Perceptual Control Theory. Components of a feedback loop associated with the theory. Derived from D. Forssell (Ed.). (2009).* Perceptual Control Theory: Science & Applications. Book of Readings. *Hayward, CA: Living Control Systems Publishing. Copyright 2015 by Dag Forssell.*

Perceptual input is generally described as the way one sees one's own practice (blog reflections) in conjunction with how others see their practice (via peer comments). With this project, we have specifically focused upon the idea of input from the external sources, peers.

The comparison process is bound by the way PSTs evaluate and compare their reflections, identity standard, and perceptual input. The final component, output, is described as an adjustment in the behavior prescribed by both the individual and the context. Though important in the feedback loop, this component is the most challenging to observe, because blog posts and comments are post hoc. However, output is documented in

instances where the PST talks about or anticipates future practices (Burke & Stets, 2009).

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 (Shulman, 1987). For elementary PSTs who are learning science methods, perceptual control theory is useful because the PST's 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.

Perceptual control theory also acknowledges the role of social structures and individual affinities as important in the manifestation and development of identity (Burke, 2007; Forssell, 2009). Social structures shape expectations for roles (e.g., science teacher), and individual affinities shape the PSTs' perceptions of experiences, illuminating individual beliefs, experiences, and epistemologies. Both the social structures and the individual affinities that manifest produce expectations for science teaching roles, so posts and comments made by PSTs can be evaluated for what their content represents about the individual and the context designed to aid their development.

The intent of our research question was the consideration of a participatory culture generated by blogging among three peers who consistently interacted with each other. By focusing our research lens on these particular PSTs, we sought further clarification of the role of blogging as an educational tool beneficial for teacher education courses and activities. We wanted our result to illuminate ideas associated with blogging and peer interaction in a teacher education context and shaped our research with the following question: What do blogging interactions that occur among members of a small cell group reveal about the teaching identities of the group's members?

Methodology and Research Design

Study Context

This study was conducted at a large research institution located in the southeastern United States. Participants were undergraduate elementary education majors who spend their first 2 years in the College of Arts and Sciences before beginning courses in the School of Education. As seniors, participants were in their second year of the elementary education program, having already completed a year of education coursework in cohorts of approximately 30 students. Seventy students were enrolled in the elementary education program senior cohort and were divided into two different cohorts. After the study design and the proposal were approved by the university's Institutional Review Board, students were invited to participate. Of the 70 students in the senior cohort, 31 chose to return consent forms.

Because the participants were students in some of our courses, we did not pursue students who chose not to participate to avoid the perceptions of undue pressure. The participants reflected the students enrolled in the School of Education, that is, predominately White, middle class women in their early 20s, with several nontraditional students (mid-30s). All students had a variety of concentrations in addition to elementary education, including English/language arts and social studies or mathematics and science.

Participants were purposefully not grouped and could respond to any of their colleagues' entries, in order to encourage a larger, course-wide conversation. However, some students created their own subgroups within the larger community. Entries and conversations that occurred within the context of the blogs were then brought back to the methods classroom, where they became the focal point of further discussion and extension. Through this participatory pedagogy the entries became the course content, coconstructed by the participants.

The cell group that was the focus of this study was comprised of three undergraduate students situated among the 31 who consented to be part of the initial study. In analyzing the data, we noted that three students consistently commented and interacted with each other through their blogs. All three students were in the same section of the science methods course. We also recognized that the three members typically sat in class together, interacting in face-to-face situations in addition to their virtual interactions. Each cell group member consistently posted on the other two members' blogs, which was not an expectation of the PSTs but a voluntary practice.

During the fall semester of their senior year participants took methods courses in literacy, science, and mathematics. In conjunction with this coursework, participants had a practicum experience 1 day a week within their student teaching placement. Their spring semester was spent student teaching. As part of an integrated project, all PSTs were required to establish and participate in a blog, specifically by posting entries, videos, comments, and artifacts and engaging with the community throughout their courses and practicum experiences. The blogs were intended to produce a social network and were introduced to all of the students through their courses at the beginning of the fall semester in their senior year. Examples of different types of entries were both demonstrated and discussed with the PSTs. Additionally, the role of blogging was presented as a means of establishing professional learning communities (Akerson, Cullen, & Hanson, 2009), with specific attention being paid to the roles of the PSTs in building a robust, participatory community.

The PSTs were required to post weekly for methods courses, as well as read and comment on their colleagues' posts. Blogging was guided by established due dates and prompts or topic ideas that were synchronized with course materials and practicum experiences. Prompts, when given, were designed to minimize student tendencies toward performance, allowing the PSTs a wide degree of latitude with regard to style and content of their entries.

For example, in the science methods, PSTs were asked to reflect upon their own scientific journeys through writing a science autobiography. They commented on practices and challenges that occurred when they integrated their own lessons for instruction while visiting local elementary schools and created critical reflections on academic writings. PSTs were also encouraged to free respond to entries. On average, each participant had nine separate science entries with two to three comments that were required. (Note that this range accounted for the fact that some students did not fully complete all of the required entries.)

Data Sources and Analysis

Data were collected from PSTs' blog entries and responses to these blogs that were posted by other PSTs in the voluntary cell group. We examined blog entries and comments and evaluated the data using a priori codes (see Appendix) developed during an earlier phase of the project using a constant comparative method (Corbin & Strauss, 2008). Data collection and analysis were an iterative and inductive processes. Blog entries were

organized into core categories, which provided a framework for observing and analyzing the identity standards of the PSTs.

In considering the data, we chose to focus on individual and contextual variables. Specifically, we focused on belief statements that reflected a critical positionality, historical, or contemporary experiences that the PSTs viewed as influential, as well as 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 and cooperating teachers), students, and peers. Since this study was embedded in a larger project, we utilized the results from the larger study to help frame what we observed while creating new, additional codes original to the cell group that we analyzed.

Data Analysis

Members of the research team, including faculty researchers and doctoral students, independently reviewed five participants' entries from the larger study and coded the responses. The team then came together to compare and condense code lists, and final definitions were created. Raters then independently coded five more entries from the defined code list looking for features that were present in the blogs but absent from the code list. Coding results were compared a second time, and a final formal description was developed for the codes that had a high level of agreement. Discrepancies were discussed until consensus was reached. Once the common codes were identified, a third set of five entries were coded, and an interrater reliability of $r = 0.90$ was established. Data were triangulated across entries, interviews, and comments in order to increase trustworthiness and validate the findings of this study (as recommended by Lincoln & Guba, 1985).

Results and Discussion

Though trends were common with the cell and the larger cohort, we analyzed the findings with an eye toward interactions reflective of dynamics beneficial to the PSTs' growth as science teachers. In the section that follows, we described these features as they manifested, considering them embodied and typified examples of a framework that demonstrated the development of the PSTs as science teachers. These features included (a) identity standards, (b) experiences and beliefs, (c) epistemologies, and (d) perceptual inputs.

Identity Standards

In analyzing the data collected from the posts, two identity standards emerged. First, factors associated with the PSTs' own identities were an integral part of their science teacher practices during field experiences. Second, these identity standards were present in the discourse represented by PSTs' responses to their own experiences as well as to the experiences of others.

Though these posts were guided by established prompts intended to place bounds on what was shared, we assumed that what was produced was based not on academic salience, but rather a preference to share what was prominent to the PST. This position was also based on the preference for open-ended responses that were aimed at discovering more about the identity standards of the PSTs and their likely practices.

These identity standards were revealed in comments prompted by peers and their evaluation of practices within educational settings. They were also found in statements that involved comparison of personal practices within cell group members. For example, a comment from Erica after reading Kaley'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 Kaley.

Because of the commonality of experience they shared, Erica had a frame of reference for the activity and integrated Kaley's input regarding the future activity. Though only a short response to what occurred, Erica'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, Kaley received a detailed response from Lisa.

> 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... (Kaley)

> KALEY, 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. (Lisa's response to Kaley)

Though the experience and the method utilized were valuable in accomplishing set goals acknowledged by both PSTs, we thought these two posts offered additional insights. First, the PSTs did not comment on the specific role of experience. Instead, they tacitly acknowledged it. For example Lisa noted how she liked that Kaley had them "draw a picture" and the role that activity 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. Additionally, the posts revealed the value of interaction embedded in a shared context when Lisa considered future outputs based on Kaley's input.

The postresponse also conveyed a sense of belonging that we saw as an identity standard that transcended the content domain of science for all the PSTs. In analyzing Kaley's posts, we noticed a trend that indicated historically negative personal experiences with science. The blog-response format represented for her a form of validation that could serve only to encourage her developing competency as a science teacher—largely, because her posts were viewed as contributing to other members of the group, who spoke in a positive manner about science in their autobiographical and contemporary reflections.

Other inputs we viewed as indicators of an identity standard often included short agreement statements that revealed a facet of pedagogy. For example, Lisa noted, "I like how you compared 'unpacking' the standards and understanding the content to students 'unpacking' their own thoughts and ideas."

In another example, Erica wrote, "I definitely agree that teachers should look at different curriculum [sic] 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 of science. Another, more substantive prompt, further revealed facets of the identity of Erica.

> 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 [end of grade exams (usually for elementary or middle school students)], 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 imformation 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! (Erica)

In this post, Erica spoke specifically to process when she stated that "it is important for teachers to 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 faced by in-service teachers.

To further understand the identity standards of the cell group, we analyzed statements that prevalently considered science. These posts were considered potential revelations of beliefs. Theoretically, these beliefs were seen as strong encouragements (as defined by 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 they could lead to personal theories about knowledge and the process of knowing (Hofer & Pintrich, 1997). Belief statements were not demonstrative, but represented a personal stance about what had or should have occurred. For example, Kaley 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.

Kaley'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.

Kaley'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 and Beliefs

Another component of individuality was the role of experiences that shaped perceptions of practice or roles. These roles could be historical or contemporary and were constituted by either unfavorable or favorable memories of science, formally or informally. Although our desire was to focus upon contemporary experiences, past experiences 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 regard 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. (Kaley)

In this post, we discerned a perception about the type of learning that should occur. While Kaley did not elaborate upon the idea of "outside the box," we interpreted this phrase as referring to connecting science to everyday life because of the qualifying phrase "past the classroom." This experience also revealed that Kaley 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. Although posts referring to such activity often lacked details, positive experiences produced recall of specific details indicating that the PSTs valued experiential, hands-on experiences. Kaley noted, "I know that a lot of the science I remember enjoying came from experiments." Lisa expressed similar sentiments in 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 <u>experiences</u>, I was able to discover more about the world around me, understand how things work...

Further enhancing the importance of experience was this post made in response to Lisa. In this instance, Kaley acknowledged once again the important of experience and added 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.

Other posts reflected either a positive, a negative, or a lack of value claim associated with the experience. 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. (Kaley)

Whether Kaley was speaking of hands-on experiences or other components of science is unclear. Also, her acknowledgement of being helped to "explore a part of my world or the things around me" had added significance because Kaley 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 Kaley had an identity-based belief influenced by the importance of connecting science to real life.

Epistemology—Nature of Science

By examining how the PSTs viewed outputs received from students, we evaluated the PSTs' epistemology, that is, their beliefs about the role of knowledge (as defined by Nussbaum et al., 2008). 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 (Allchin, 2011) or its role, an epistemological preference for the functions of knowledge and practice was revealed.

> 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. (Kaley)

> 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. (Kaley)

In the first posts, Kaley revealed a subtle disregard for right or wrong answers, which was affirmed in a statement made in her second post. Kaley specifically acknowledged the ambiguity of science and how this characteristic permitted students to understand what they were learning and experiencing. Kaley'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

> trumping science but that he is dealing with a misconception about the educational world.

In this post Kaley revealed a valuation of science as an important component of the instructional day. While she did 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, for which we presumed two reasons. First, the PSTs were not asked to comment specifically about the role of content and student learning. Second, the comment was based in what extant research previously revealed about the PSTs' perceptions of science (Kang, Bianchini, & Kelly, 2013).

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 we included reflected this idea of perceptual input; however, while many of these posts were peer oriented, perceptual input was not only 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 in the cell group, 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,

> Kaley--Your point about the way a teacher uses a curriculum was very interesting to me. I definitely agree that teachers should look at different curricula 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. (Erica)

In this response to an initial blog based on a curriculum evaluation by Kaley, Erica shared an elaborated agreement. Her response was based upon her own experience and interaction with a cooperating teacher 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 a curriculum. We also interpreted the previous post as a validation of social media use, because it was socially mediated and enculturated by the background of the PSTs. These features were 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. (Kaley)

> 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... (Lisa)

For Kaley, the input from her experiences was not all positive and contrasted with other members of the cell 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, Kaley's explicit acknowledgement of the lack of experiences was magnified when contrasted with other members of the cell, Lisa and Erica. Since they both explicitly described numerous hands-on experiences and the role these played in shaping their views and wonders of science, the potential for the social media interaction to influence Kaley's development as a science teacher was generated. The value that Lisa and Erica placed on meaningful experience was different than that of Kaley, who had noted that science as an educational phenomenon, was detached from her own life.

Another form of perceptual input occurred through the influence of contextual sources. These sources 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. (Kaley)

> I thought your discussion about "engagement" in terms of UDL [universal design for learning] 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. (Erica)

These posts revealed that the PSTs received input from multiple sources and that the input was at least integrated into their memories. We deemed that such observations were based on practicality and relevance to the PSTs' own experiences, either through a specific experience or personal history. Both Kaley and Erica frequently referred to input from a cooperating teacher, acknowledging agreement and acceptance of the practices observed. Although the PSTs' acceptance occurred in the form of a reflection upon an observation, such postings were deemed relevant because the PSTs focused on them, rather than on a number of other possible inputs. These observations relayed something about the perceptions of teaching practice and how it would proceed as they moved into their professional lives.

The rationale for acceptance of these inputs as an indicator of development of or a present science teaching identity was based on the idea of commonality—the PSTs knew and understood something about what was observed, which 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.

Limitations

In exploring the research question of this study, the analysis of the data led to several caveats. First is recognition of the need for a high degree of subjectivity. The findings either illuminate the initial development of a science teaching identity or an already established identity that would tend to produce science-oriented classroom practices. Both positions could be defended based upon the data collected, so our initial observation is that the blogging project illuminated what was present as a result of the scaffolding and experiences that occurred. As a result, we are hesitant to make broad generalizations about the use of digital media associated with this study, because these data revealed only the academic components of the PSTs' service; no longitudinal investigations were conducted involving the study of PSTs beyond this study and into their induction years.

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 in a classroom context? The use of social media is new, and therefore, little data exist based upon already established precedents. The data that do exist indicate noncritical practices (e.g., Andersen & Matkins, 2011). The limited research available means that any conclusions are speculation without a reference point to validate. Though this study provides some unique contributions, we do not have the historical background to verify them at this time. However, the findings are worth sharing and may build upon a growing knowledge base investigating the use of social media.

Finally, though supported by various theoretical frameworks, any speculation that development was the result solely of undergraduate interactions would be problematic. Other variables influence the development of PSTs, including established beliefs about teaching roles, scientific knowledge, the influence of the methods course, and other historical or contemporary experiences. Though cells are naturally occurring in classroom social interactions, they often are not indicative of the greater classroom culture for a various reasons, including the lack of personal relationship among cohort peers, differences among individuals (e.g., personal experiences), and differences in content areas (e.g., language and literacy vs. social studies). We noticed that, though it was never declared or implemented as a course requirement, these three students probably made an agreement to interact with each other because of previous relationships.

Given the small sample size of this study (n = 3), we are aware of limitations to generalizability of the findings. The group was uniquely formed and associated with a specific cohort. Given the historical nature of PSTs' anxiety associated with teaching science and the presence of uniform standards for PST cohorts, we expect that interpretation, though subject to the reader, will produce beneficial findings that contribute to the use of blogging, science education, and teacher education.

Conclusions and Implications

An analysis of the data demonstrated a number of interesting findings based upon the perceptual control theory framework (Burke & Stets 2007; Forssell, 2009; Powers, 2008). First, we gained insight into the identity standards of the PSTs. Prior to the start of this study, we believed that PSTs were governed by various degrees of fear and anxiety with regard to science and science teaching. While not definitively refuted, the blogs and

interactions of the PSTs in this study clearly revealed identity standards conducive to the effective teaching of science at the elementary level.

Though PSTs may vocalize their anxiety about teaching science, these findings reveal that some PSTs possess an acceptable level of competence with respect to pedagogy. All three of the PSTs in the cell group demonstrated beliefs and an ability to process input from experiences and each other to improve their approaches to science pedagogy. 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 were appropriate for teaching science to elementary students. The PSTs were able to process input and adapt ideas from this input, with multiple points of evidence revealing that they were individuals with inclinations to integrate new ideas based upon a personal belief about science content and associated practices (as also suggested by Grier & Johnston, 2009).

The three cell group members were navigating their experiences and integrating influences perceived as beneficial. The rationale being that the PSTs had beliefs (as defined by Bryan & Atwater, 2002; Duffy et al., 2010; Warburton & Torff, 2005) and personal epistemologies (Chinn & Buckland, 2011; Hofer & Pintrich, 1997; Nussbaum & Edwards, 2011) that governed their desires to integrate beneficial knowledge, content or otherwise, produced by their recent or more distant experiences.

The PSTs compared and were generally in agreement with what they experienced in the classroom. 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, as 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) was absent, the PSTs exhibited an acclimation to content knowledge practices and alignment with acceptable professional expectations. The PSTs fundamentally coupled experiential contexts with their individuality, producing interactions that advantaged adherence to and valuation of the teaching and learning of science.

The second finding involved the role of interaction among peers. Though we wanted to track the number of interactions that occurred, we specifically focused upon sentences as a unit of analysis. By analyzing in this way, actual numbers of peer interactions were skewed. However, what we noticed was that the members of the cell group had more responses per group member than did the at-large community by an almost two-to-one margin. Some students in the at-large group had zero comments, while cell group members had comments from the other members of the group for each blog post.

We attributed this finding to the fact that the cell group members knew each other from previous academic courses and voluntarily agreed to post with each other. This agreement 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 was linked in some manner to relationships that allowed for the manifestation of the identity standards of the individual PSTs.

An important aspect of this cell group was that it voluntarily formed and was never specifically prompted to respond in a way that was unique to the partnership that the group generated. As noted, we saw a direct impact of the group being an increase in the

number of response interactions when compared with the at-large community. We also saw a trend that paralleled previous research findings (e.g., Anderson et al., 2013)—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 practice 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. We considered any interaction to be an extension of academic experience beyond the context (the classroom) in which it occurred. The process of interaction revealed a desire for improvement that we had not previously observed in the larger community.

Finally, our data demonstrate that while interactions were present within the cell group, the specific data produced were limited to undergraduate, academic practices of the coursework, which by nature limited information associated with elementary student outcomes. No indication surfaced that cell group interactions or those associated with the at-large group would lead to long-term benefits in the PSTs' teaching practices or student outcomes. Based on this knowledge, a need exists for longitudinal data that can be used to find a specific relationship between the development of a science teaching identity and the interactions that occur through cell group blogging.

Additionally, while we noted that the discourse of the PSTs was reflective of beliefs connected to science teaching practices, without corresponding observations of the PSTs after their induction into the profession, any assumption about long-term growth or development would be speculative. This finding remains a challenge for the role of blogging, yet based on the evidence of this study and other research (e.g., Luehmann & Tinelli, 2008; Wall et al., 2014) blogging appears, at the least, to maintain an influence comparable to individual reflections common to methods courses. As a result, blogging practices can be a potential reflection of the types of interactions that can occur amongst colleagues who have a level of interpersonal knowledge of each other and practices associated with content being taught. The extension of the classroom through the use of digital media may improve the impact of the methods course and be beneficial for the development of the PSTs.

Ideally, this project has revealed the presence of development with a specific, scaffolded social media 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 they are involved in.

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

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Appendix

Data Analysis: A Priori (Sensitizing) Codes

Code	Definition	Example		Theoretical Literature
Belief	-An acceptance that a statement is true or that something exists. -Trust, faith, or confidence in someone or something	*UDL is a very important design for teachers to understand and apply in their classrooms*		Akkerman & Meijer, 2011; Bhattacharyya, Volk, & Lumpe, 2009; Burke & Stets, 2009; Bryan, 2002; 2003; Dweck, 2000; Forssell, 2009; Enyedy, et al., 2006; Fajet, Bello, Leftwich, Mesler, & Shaver, 2005; Hilton, 2010; Gee, 2000; Grier & Johnston, 2009; Hofer & Pintrich, 1997; Jones & Carter, 2007; Luehmann & Tinelli, 2008; McDevitt, Troyer, Ambrosio, Heikkinen, & Warren, 1995; Nilsson & Loughran, 2011; Spector & Strong, 2001;Weld & Funk, 2005
Experience	-The process of doing and/or seeing things related to the content area (historical or contemporary) -A skill or knowledge that is acquired by doing	*Contemporary—I think our lesson went pretty well. The students loved the video we showed at the beginning of a familiar character using a parachute. We used this video to introduce the concept of what a parachute does and how it acts with the air.* *Historical-- 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. I think the only reason I remember these activities is because they resulted in things that I tangibly was able to take home and could relate to the outside world.*		
Epistemology	A positionality regarding the role of knowledge and its influence upon student learning and practice	*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. As teachers, I think it is important for us to have a time during each of our lessons to allow for discourse and argumentation.*		
Perceptual Input	-A cognitive process involving the interpretation of sensory input -Input may be a self-reflection or from a peer, contextual agent (cooperating teacher, administrator), or expert voice (literature or instructor)	*Because there are so many different students with different learning styles and needs, teachers need to make sure they are structuring a classroom with activities that will meet the needs of every student in the room. In the classroom I am currently working in, I definitely see signs of UDL.*		