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Analyzing Student Teacher Critical Thinking through Blogs in an Electronic Community of Practice

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Abstract

Technology is becoming increasingly popular in higher education in the way students are asked to communicate and collaborate. The student teaching experience is an integral part of developing critical thinking skills in pre-service teachers. During this experience, it is important that student teachers practice the theory they have been taught in their preparatory programs. This study determined the frequency in which student teachers at Iowa State University posted blogs in an electronic community of practice at each level of critical thinking, the relationship between the number of blogs posted by each student teacher and student teachers' average level of critical thinking displayed in those blog posts. The Florida Taxonomy of Cognitive Behavior was used to code student teacher blog posts. Six levels of critical thinking, according to Bloom's Taxonomy of Educational Objectives, were present. Of the student teachers' blog posts (n=942), 89.5% (f = 843) were at lower-order levels of critical thinking, consistent with prior research. The results did not indicate a significant relationship between the number of posts per student teacher (N=21) and student teachers' average level of critical thinking. Teacher preparation programs should focus on modeling critical thinking in order for student teachers to incorporate and practice problem-solving, evaluating, creating, and many other critical thinking skills during the student teaching experience.

Keywords: agricultural education; pre-service teachers; student teachers; teacher preparation; critical thinking; blogs; community of practice; social constructivism

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Introduction

In many realms of professional development, theory and practice are presented as two important but separate concepts, and opportunities are rarely given to establish links between the two (Berggren & Soderlund, 2011). To effectively bridge the gap between theory and practice, teacher education programs must encourage awareness, reflection, and experimentation with new concepts (Berggren & Soderlund, 2011; Gallos, 2008). Teacher preparation programs must reach beyond traditional methods to immerse pre-service teacher candidates into field experiences (e.g., student teaching), and guide them in a dual process of constructing practical knowledge while integrating reflection with a purpose (Pena & Almaguer, 2012; Perry & Power, 2004).

It is important for pre-professionals to think critically in order to develop an intellectual sense of confidence in reason (Paul & Elder, 2006). Furthermore, it is important for student teachers to utilize higher-order skills that enable them to analyze, assess, and improve thinking skills (Paul & Elder, 2006). Higher-order cognitive skills, such as critical thinking, prepare student teachers to overcome challenges they may encounter during their personal lives and careers (Tsui, 2002). Critical thinking can best be defined as "a reasoned, purposive, and introspective approach to solving problems or addressing questions with

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incomplete evidence and information for which an incontrovertible solution is unlikely" (Rudd, Baker, & Hoover, 2000, p. 5). O'Hare and McGuinness (2009) suggested critical thinking can be used in "challenging a claim or opinion (either one's own or another person's) with the purpose of finding out what to believe or do" (p. 123) while Scriven and Paul (1987) stated that critical thinking involves analyzing information gathered through reflection. There are pressures in teacher preparation programs to develop more pre-professionals with strong critical thinking skills in education (Berggen & Soderlund, 2011; Gallos, 2008; Paul & Elder, 2006; Pena & Almaguer, 2012; Perry & Power, 2004; Szabo & Schwartz, 2011).

Though instructional approaches in higher education, such as student-centered learning, can positively influence students' critical thinking skills, there is still debate as to which practices most efficiently cultivate and assess critical thinking (Perry, 2014). However, due to the complexities of critical thinking and other cognitive behaviors, educators and researchers often may not agree which strategies or assessments are most effective in determining a learner's ability to think critically (Friedel, Irani, Rhoades, Fuhrman, & Gallo, 2008; Perry, 2014; Stedman & Adams, 2012).

Paulsen, Smith, and Anderson (2015) found face-to-face peer feedback to be beneficial when reflecting on pre-service teacher's lesson plans. As the adoption of technology as a means of communication continues, additional viable options for peer feedback and reflection have become available. In an attempt to increase reflection, articulation, and social negotiation—components of higher-order thinking—higher education faculty are using asynchronous communication technologies to enhance course discussions and the quality of student learning (Gilbert & Dabbagh, 2005; Vonderwell, 2002). As student teachers participate in an authentic learning experience at a distance from their University faculty and peers, technology offers the opportunity to enhance the learning process through social engagement in an environment outside of the classroom through online discussions or blogs (Szabo & Schwartz, 2011). It is essential to integrate critical thinking skills into online discussions so students are challenged intellectually and experience relevant learning experiences (Pena & Almaguer, 2012). This opportunity for personal learning, however, poses a challenge in that responsibility falls on the student teacher to use online learning environments in a manner that promotes critical thinking (Szabo & Schwartz, 2011). Though they may be keenly aware of, and perhaps active participants in various Web 2.0 technologies, student teachers may not understand the purpose or possibilities of these technologies in education. Web 2.0 technologies—which include social networking sites, web applications, and weblogs—have recently received increased interest in higher education (Halic, Dee, Paulus, & Spense, 2010). The term weblog is a contraction of web log, often referred to as a 'blog'; it is an Internet-based platform in which users can post text, images, or video-based materials for others to view. Users may utilize blogs to facilitate an information exchange and collaboration network to support teaching and learning processes (Cakir, 2013). Blogs are convenient for producing and sharing student reflections and "offer an audience for students' writing within the safety of a learning community thus offering opportunities for collaborative learning" (Robertson, 2011, p. 1628). "Blog[s] are considered a great tool for…student teachers to record their growth and changes as well as build a learning community" (Yang, 2009, p. 18). It is becoming more common to witness the use of blogs as a tool that supports student teacher reflection (Walker, 2005; Williams & Jacobs, 2004), which in turn may increase the depth of a student teacher's critical thinking (Sessa, Matos, & Hopkins, 2009).

Blogs can be housed in an electronic community of practice (CoP). CoPs offer teacher educators and preservice teachers the opportunity to reflect through blog posts on public or private discussion boards (Walker, 2005; Williams & Jacobs, 2004; Yang, 2009). A CoP is a group of people "bound together by shared expertise and passion for a joint enterprise…[that] share their experiences and knowledge in free-flowing, creative ways that foster new approaches to problems" (Wenger & Snyder, 2000, pp. 139-140). Communities of practice are diverse and assist in developing the professional skills of participants (Killeavy & Moloney, 2010; Wenger & Snyder, 2000; Yang, 2009). Some refer to the CoP as a community of inquiry, a very valuable tool for enhancing higher-order learning (Garrison, Anderson, & Archer, 2001; Halic et al., 2010). Online CoPs can foster development of the critical thinking processes of pre-professionals, such as student teachers.

Many studies have been conducted to investigate the use of blogs in educational settings (Chuang, 2008; Top, Yukselturk, & Inan, 2010; Wang & Hsua, 2008; Yang, 2009). Though blogging serves as an environment that may foster higher-order learning, recent research shows that online environments are not being utilized to their full potential. Most notably, Garrison et al. (2001) and Gilbert and Dabbagh (2005) evaluated critical thinking in online discussions and found that 75% to 80% of students' online postings were at the lower-order thinking levels of Bloom's Taxonomy of Educational Objectives (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956; Duron, Limbach, & Waugh, 2006). Conversely, in a study conducted by Szabo and Schwartz (2011), online discussion forums increased critical thinking skills and initiated higher-order thinking by preservice teachers. The need for deeper connections and critical thinking skills can be fostered through the use of effective higher-order thinking, probing, and reflective questioning skills (MacKnight, 2000; Pena & Almaguer, 2012). The structure of online discussions and question prompts may be key reasons that student teachers' postings reflect relatively low levels of critical thinking (Bradley, Thom, Hayes, & Hay, 2008). "By using collaborative online discussions, teacher candidates have the opportunity to gain a deeper understanding of learning" (Pena & Almaguer, 2012, p. 26).

Though an educational learning community cannot be forced, Hoadley (2012) offers techniques in which technology can be used to foster a learning-oriented CoP. The first is connectivity; if users do not identify the central members of an already existing group, it is important that they locate others who share similar practices (Hoadley, 2012; Kimble, Hildreth, & Bourdon, 2008) to perhaps establish a new CoP. Another technique for supporting an online CoP is by allowing its members a private space for conversation. Further, Hoadley (2012) suggested that educators must help student learners establish themselves in "supportive authentic contexts, or create quasi-authentic contexts in which they can 'do' the knowledge that is desired; mere regurgitation is not enough" (p. 290). Finally, Gokhale (1995), Marzano (1993), and Paul and Elder (2006) suggested student teachers should understand the purpose of collaborative learning in social contexts. Since blogs can serve as a vehicle for users to exchange ideas and share experiences, when used within an online CoP, they become an optimal setting for social constructivist learning (Ferdig & Trammell, 2004) by those who utilize collaborative learning methods. Social constructivism has been considered "the most accepted epistemological position associated with online learning" (Kanuka & Anderson, 1998, p. 5).

Theoretical Framework

Since the mid-twentieth century when Lev Vygotsky (1978) developed social constructivist theory, educators, and psychologists have been seeking evidence that learning and knowledge develop through social interaction (Santrock, 2011). More recently, learning has been perceived from a "cognitive and constructivist perspective [that] emphasizes what learners know (knowledge) and how they think (cognitive processes)…as they actively engage in meaningful learning" (Anderson & Krathwohl, 2001, p. 38). Approaches to instructional strategies can be classified as constructivist or direct instructional in nature (Santrock, 2011). "A focus on meaningful learning is consistent with the view of learning as knowledge construction, in which students seek to make sense of their experiences" (Anderson & Krathwohl, 2001, p. 65). Constructivist learning, or meaningful learning, requires that instructors eliminate instructional methods that simply present factual knowledge and move towards assessments which demand students practice more than simple recall and recognition of factual knowledge (Bransford, Brown, & Cocking, 1999; Lambert & McCombs, 1998).

The constructivist approach, unlike direct instruction, is learner-centered and emphasizes teachers as facilitators, rather than purveyors of knowledge. Those who utilize the constructivist approach believe individuals should actively construct their own knowledge and understanding; be encouraged by the teacher to explore the world around them; and discover, reflect, and think critically (Bonney & Sternberg, 2011). In today's educational society, the constructivist approach emphasizes collaboration and working with peers to construct knowledge and understanding (Slavin, 2011; Wentzel & Watkins, 2011). Vygotsky's (1962) social constructivist theory emphasized the importance of social interaction on learners' cognitive

development. Vygotsky believed dialogue was critical to student learning. Vygotsky (1978) developed the concept of the zone of proximal development (ZPD) as it pertained to student learning. This is a term for a range of learning tasks, from those that are too difficult for the learner to complete without assistance, to skills that can be completed by the learner working independently (Santrock, 2011). Scaffolding is the support offered to the learner based upon their ZPD or current learning capabilities (Santrock, 2011). As the learner begins a new task, she/he may need direct instruction; as the student's competence progresses, less assistance is given (Santrock, 2011). By asking probing questions a teacher may scaffold learners to help them think more critically (MacKnight, 2000; Wang & Hsua, 2008).

Finally, Vygotsky (1962, 1978) believed in transforming the classroom with tools that give attention to learners' cultures, ZPD, scaffolding, and shared activities (collaboration). As computers and electronic communication have made their way into the 21st century culture, it would be appropriate to assume Vygotsky would support the use of online means of interaction (Jost, 1999) and Web 2.0 technologies in developing student learning through collaboration and communication in social environments. This research aims to study student teachers' blog posts in an electronic community of practice to explore the potential of social constructivism for teacher education, through an interpretive and collaborative approach.

Purpose and Objectives

Though critical thinking has become an anticipated outcome in higher education, students in colleges of agriculture have been found to have insufficient critical thinking skills (Flores, Matkin, Burbach, Quinn, & Harding, 2010; Rudd et al., 2000). In an attempt to improve agricultural education programs, teacher educators in agricultural education have increased their focus on research and education with regards to comprehension and applying cognitive function (Boone, 1990; Cano, 1993; Dyer & Osborne, 1996; Jones & Williams, 1986; Lamm, Rhoades, Irani, Roberts, Snyder, & Brendemuhl, 2011; Parr & Edwards, 2004; Rollins, 1990). It is important for agricultural education student teachers to think critically; "therefore, a need exists to assess those skills in college students and examine whether they have acquired these skills through their college experiences" (Odom, Shehane, Moore, & McKim, 2014, p. 218).

The present study aligns with the American Association for Agricultural Education's National Research Agenda Priority 4: Meaningful, Engaged Learning in All Environments. This area suggests research in Agricultural Education should "assess various learning interventions and delivery technologies to increase problem-solving, transfer of learning, and higher order thinking" (Doerfert, 2011, p. 9) and to "examine various meaningful learning environments…for their impact on specific cognitive, affective, and psychomotor outcomes" (p. 9). The purpose of this study was to explore student teacher levels of critical thinking in blog posts housed in an electronic CoP. The following objectives guided this study:

1. Determine the frequency and the average level of critical thinking exhibited by Iowa State University agricultural education student teachers' reflections through blog posts in an electronic community of practice.
2. Determine the relationship, if any, between the number of blogs posted by each student teacher and the average level of critical thinking displayed by student teachers within their respective blog posts.

Methodology

Researchers have recently moved away from measuring interactions quantitatively (e.g., number of blog posts) to more qualitative measures (e.g., quality of blog posts) (De Wever, Schellens, Valeck, & Van Keer, 2006), since an increase in the number of posts does not necessarily mean an increase in quality of learning (Vonderwell, 2002). These more qualitative measures have often been studied in relation to critical thinking (Ertmer & Stepich, 2004; Lee, 2005; Walker, 2004).

Sample

We utilized a convenience sample of student teachers (*N*=21) during the fall 2013 and spring 2014 semesters, due to the accessibility and cooperation of the Department of Agricultural Education at Iowa State University. Agricultural education student teacher participants were required to compose and submit weekly blogs to a private, asynchronous discussion forum housed in the National Association of Agricultural Educators CoP as part of their regular student teaching requirements. Chuang (2008) suggested the importance of having a private discussion board in order for student teachers to openly express their thoughts and opinions. Blogs posted during the fourteen-week student teaching experience were part of the final assessment for the student teaching experience; however, specific grades for student teacher blog posts were not assigned. There were no specific discussion topics or recommendations given to the student teachers for the CoP.

Instrument

This study interpreted qualitative data from a quantitative perspective. Creswell and Plano Clark (2011) and Tashakkori and Teddlie (2003) determined that studies such as this explore the manner in which qualitative data can be transformed into quantitative data to determine descriptive measures (i.e., frequencies and percentages). Bloom et al.'s (1956) Taxonomy of Educational Objectives is widely accepted in educational research as a means of categorizing learning behaviors into levels of cognition. Bloom et al.'s (1956) Taxonomy recognizes six levels of cognitive abilities and skills in a hierarchical order: *knowledge* (requires the least cognitive processing), *comprehension*, *application*, *analysis*, *synthesis*, and *evaluation* (requires the most cognitive processing). Based on Bloom et al.'s (1956) Taxonomy, Duron et al. (2006) determined higher-order thinking to be skills or behaviors demonstrated at the levels of analysis, synthesis, and evaluation. Thus, lower-order thinking skills would be those at the levels of knowledge, comprehension, and application (Duron et al., 2006).

Though recent revisions have been made to the original Taxonomy (Anderson & Krathwohl, 2001), a useful tool for observing critical thinking in the classroom is the Florida Taxonomy of Cognitive Behavior (FTCB) (Brown, Ober, Soar, & Webb, 1970), which is directly derived from Bloom's original Taxonomy (Ulmer, 2005). The validity for the FTCB instrument was based upon its direct development from Bloom et al.'s (1956) Taxonomy (Ball & Garton, 2005; López & Whittington, 2001; Miller, 1989; Whittington, 1991; Whittington & Newcomb, 1993). Miller (1989) stated, "the FTCB can be considered valid in light of the support generally given to Bloom et al.'s (1956) Taxonomy as a means of identifying specific behaviors in the various levels of cognition" (p. 43). The FTCB (Brown et al., 1970), with its 55 behavior descriptors, was used to analyze and code student teachers' blog posts for critical thinking.

Due to the qualitative nature of the data in this study, instrument reliability was established by using peer review (Johnson & Christensen, 2014). As suggested by Johnson and Christensen (2014), the researchers discussed the process of coding and interpretation of the data with a peer reviewer throughout the course of the study. Johnson and Christensen (2014) identified this special type of peer reviewer as a *critical friend*; Creswell (2007) recognized this sort of external check as peer debriefing. Thus the critical friend asked challenging questions about the methods, meanings, and interpretations of the researchers who coded the data (Johnson & Christensen, 2014). During analysis, the critical friend coded randomly selected blog posts utilizing the FTCB, and compared results with those of the researcher. This assisted the critical friend in understanding the coding process and in providing feedback for the researcher prior to coding all student teacher blog posts. The critical friend's results were compared with the researchers' results, and discrepancies were discussed. Sankey and Foster (2012) used a similar procedure when they employed a content analysis of teaching philosophy statements. We found discrepancies in results were most notably identified in blog posts coded differently within higher-order or lower-order level groupings; much less often were discrepancies coded differently across lower- and higher-order level groupings. However, it should be noted that careful consideration and detailed notes were taken to ensure consistency within the coding system.

Analysis

Given that a student teacher's blog post may elicit many levels of critical thinking within a blog, any change in thought, idea, or topic determined where a code was assigned. This follows Garrison, et al.'s (2001) suggestion that a "message-level unit" (p.16) was most appropriate for such dialogue analysis. "The message as unit is also attractive because the length and content of the message is decided upon by its author, rather than by coders…[and] provides coders with sufficient information to infer underlying cognitive processes" (Garrison, et al., 2011, p. 17). A student teacher may have posted several sentences or multiple paragraphs within one blog, however, these sentences may have been broken up into several 'posts' that elicited multiple critical thinking codes. Some posts were a paragraph long, others only a sentence. Each code was considered a 'blog post' and was then assigned a number, providing a total number of blog posts (N= 1,016). Some methodologists recommend that the researcher determine the choice of coding method prior to the study, "to harmonize with [the] study's conceptual framework paradigm, and to enable an analysis that directly answers your research questions and goals" (Saldaña, 2013, p. 62). We used provisional coding because each level of critical thinking was a predetermined category anticipated from the literature review (Saldaña, 2013), and previous research findings (Bradley et al., 2008; Garrison et al., 2001; Gilbert & Dabbagh, 2005; Walker, 2004). Blog posts were manually coded at one of six levels of critical thinking, based on Bloom et al.'s (1956) Taxonomy and the FTCB (Brown et al., 1970): knowledge, comprehension, application, analysis, synthesis, and evaluation. On the FTCB, comprehension is broken into sub-categories: translation and interpretation. To ensure the blog postings were coded in a manner that was consistent with the Taxonomy and the FTCB, each were regularly studied and consulted during the coding process.

Each blog post was coded twice at four-week intervals and compared. Critical thinking levels assigned to blog posts from the first coding interval were compared with corresponding codes from the second coding interval and entered into an Excel file. Corresponding blog posts not coded at the same level of critical thinking were recoded for a third time after a third four-week interval. Posts that were not consistently coded at the same level of critical thinking after the third coding interval were not used in the study. Intrarater reliability was established as excellent for the present study (α=.93) by coding the blog postings three times at four-week intervals (Weir, 2005). Weir (2005) suggested that an intrarater reliability code of zero indicated no reliability, while a code of 1.0 indicated perfect reliability. The usable codes (n= 942) were then copied to a new Excel file.

The blog posts were sorted. Three Excel sheets were utilized to keep the data separated: total blog posts at each level of critical thinking, total blog posts per student teacher, and total blog posts at each level of critical thinking per student teacher. The average level of critical thinking reflected in student teacher blog posts was determined. Because the data were ordinal (Urdan, 2010) with critical thinking being coded among six hierarchical levels, each level was given a multiplier (1: knowledge, 2: comprehension, 3: application, 4: analysis, 5: synthesis, 6: evaluation). The multiplier is similar to that of using a weighted system as suggested by Miller (1989) and Newcomb & Trefz (1987). The total number of blog posts at each level of critical thinking was multiplied by the appropriate multiplier, then divided by the total number of posts, resulting in the average level of critical thinking per student teacher.

The total number of posts and the average level of critical thinking were entered into IBM SPSS Version 22.0 and Spearman's rho was calculated to determine if correlational relationships existed between the number of blog posts and average level of critical thinking per student teacher. Spearman's rho was the statistical procedure of choice because of the small sample size in this study, and because the parametric alternative of Pearson's r assumes a randomized sample, which was not appropriate for the present study (Pallant, 2013). Preliminary analyses were performed to ensure linearity (Pallant, 2013). Although data did not demonstrate true linearity and displayed a more curvilinear relationship with the small sample that was used, it was decided to leave all data points for analysis (Pallant, 2013). Based on the design of this study, limitations should be considered. The results of this study are limited to student teachers who participated in a capstone teaching experience during the semesters of this study. Although results of this study should

not be generalized beyond the convenience sample as participants are not representative of all student teachers, valuable information can still be obtained (Creswell, 2012).

Results

Objective one sought to determine the level of critical thinking exhibited by Iowa State University student teachers through blogs housed in an electronic CoP. Table 1 provides selected examples of posts that were coded at each level of Bloom's Taxonomy of Educational Objectives utilizing specific observations listed on the FTCB.

Table 1

Example Student Teacher Blog Posts Coded Utilizing the FTCB (Brown et al., 1970).

Level of CT	Example Post	Observation
Knowledge	*Well, I started off my student teaching experience with three full days of in-services. During the course of those three days we covered ALICE training…the new Infinite Campus grading system, how to 'teach like a pirate'…*	Tells about an event
Comprehension	*Thanks for the inspiring words, because I am another detail-oriented person who struggle[s] to remind myself of the larger picture, let alone my students.*	Gives reason (tells why)
Application	*At this point I'm more strict… which doesn't match my personality. From my little experience so far it's more of a class by class and age issue…I can…micromanage less with the juniors and seniors, and that's not the case with the freshman and sophomore classes…*	Applies previous learning to a new situation
Analysis	*Does giving them a leadership role like that reward them though? For instance, they may realize I am giving them something unique and not offering it to other students…I have seen it work before, but what is your opinion on that?*	Infers purpose, point of view, thoughts, feelings
Synthesis	*I … am currently working on a word search… to give to my Animal Science class just in case I get done early. This will have all the terms we've gone over so far and will be a good review. I'll just ask that the students keep this in their binders and pull it out if I run a few minutes fast…*	Produces a plan, proposed set of operations
Evaluation	*I thought our mid-term meeting was really great. I … enjoyed the peer reviews of our lesson plans. To be honest, I think I got more out of that than any other evaluation thus far this semester. My group had some wonderful ideas and it got me to thinking…why didn't I think of that to begin with[?] Do you ever notice that when in the thick of things, those awesome ideas are harder to come by. I wonder why that is? Is it because I am too focused on one thing and not looking at the bigger picture? When I am processing things in preparation for my lesson plans, am I really taking things I have learned before into consideration?*	Evaluates something from evidence

Student teachers' blog posts demonstrated each of the six of Bloom et al.'s (1956) levels of critical thinking. Table 2 displays the number of posts (n=942) coded for each level of critical thinking. The student teachers' blog posts demonstrated critical thinking at the knowledge (n=441, 46.82%), comprehension

(*n*=344, 36.52%), application (*n*=58, 6.16%), analysis (*n*=51, 5.41%), synthesis (*n*=31, 3.29%), and evaluation (*n*=17, 1.80%) levels.

Table 2

Frequencies and Percentages of Student Teacher Blog Posts (n=942) at each Level of Critical Thinking

Levels of Critical Thinking	*f*	*%*
Knowledge	441	46.82
Comprehension	344	36.52
Application	58	6.16
Analysis	51	5.41
Synthesis	31	3.29
Evaluation	17	1.80

Table 3 displays the results for Objective Two: the total number of blog posts each student teacher posted over the duration of the semester, and each student teacher's average level of critical thinking as reflected in his/her blog posts. The highest number of posts by one individual was 97 and the lowest was eight. On a scale of one to six, with knowledge being one and evaluation being six, the highest mean level of critical thinking reflected in student teachers' blog posts was 2.73, between the comprehension and application levels. The lowest average level of critical thinking was 1.38.

The relationship between the number of posts and the average level of critical thinking was investigated using Spearman's rho correlation coefficient. Preliminary analyses were performed to ensure no violations of the assumptions of linearity by generating a scatterplot (Pallant, 2013). Pallant (2013) suggested that a scatterplot is useful before calculating correlations because it provides an indicator of whether or not the variables in the study are related, and if they are related, the direction and magnitude of the relationship. A scatterplot also identifies extreme outliers in the data (Pallant, 2013). It was found that the data set displayed slight curvilinearity rather than a normal straight-line scatterplot. No statistically significant correlation (Cohen, 1988) was found between the number of posts and the average level of critical thinking (r_s = .154, N = 21, p < .505).

Table 3

Total Blog Posts (n = 942) per Student Teacher and Student Teachers' Average Level of Critical Thinking

Student Teacher	*n*	*M*	Student Teacher	*n*	*M*
1	11	2.73	12	40	1.75
2	30	2.27	13	8	1.75
3	58	2.16	14	11	1.73
4	74	2.07	15	97	1.69
5	27	2.07	16	25	1.68
6	87	2.05	17	67	1.67
7	56	2.05	18	32	1.63
8	33	2.00	19	39	1.44
9	65	1.89	20	12	1.42
10	96	1.88	21	16	1.38
11	58	1.85			

Note. Data is organized from highest to lowest average level of critical thinking. *M* = the average level of critical thinking where 1 = knowledge, 2 = comprehension, 3 = application, 4 = analysis, 5 = synthesis, and 6 = evaluation.

Conclusions and Discussion

The first objective of this study was to determine the frequency of blog posts and average level of critical thinking exhibited by Iowa State University agricultural education student teachers through blog post reflections housed in an electronic community of practice (CoP). When considering the findings of this study, we conclude that student teachers demonstrated critical thinking at the lower levels of Bloom et al.'s (1956) Taxonomy when blogging in an electronic CoP. Student teachers were anticipated to utilize higher-order thinking skills since blogs promote thoughtful reflection and a CoP serves as an environment in which these skills can be enhanced (Garrison et al., 2001; Gilbert & Dabbagh, 2005; Halic et al., 2010; Killeavy & Moloney, 2010; Vonderwell, 2002; Wenger & Snyder, 2000; Yang, 2009). However, knowledge, comprehension, and application represented 89.5% (*f*=843) of the total blog posts, accounting for approximately ten percent more blog postings at lower-order thinking levels than findings by Garrison et al. (2001) and Gilbert and Dabbagh (2005). The results of this study support the notion that student teachers were allowed to discuss and reflect upon whatever topic they wished at any point in the student teaching process, and responded to their peers with self-determined deadlines and levels of critical engagement. Though this is a benefit of asynchronous discussion, no expectations were established in order to encourage students to blog with a purpose and not just to meet the minimum blogging requirements.

The inadequacy of demonstrated cognitive behaviors at the levels of analysis and synthesis could be attributed to the ideas of effort and risk (Garrison et al., 2001). Student teacher behaviors at the analysis and synthesis levels - detecting an error in their own thinking or that of their peers, inferring purpose, point of view, thoughts or feelings, or formulating hypotheses and intelligent guesses - require time of the student teacher that may not be abundant in their busy schedules. Furthermore, "it may be more risky to offer tentative solutions or hypotheses in that their ideas may be rejected" (Garrison et al., 2001, p. 20) by peers in the CoP. Some student teachers may have worked solely from the need to overcome their concerns

developed during the student teaching experience (Fritz & Miller, 2003), which might increase the difficulty of efforts to merge theory with practice during the student teaching experience.

Since the student teachers minimally utilized the cognitive behaviors required to demonstrate the application, analysis, and synthesis levels of Bloom's Taxonomy, there was little reason for them to utilize evaluation levels of critical thinking. Evaluation requires that the student teacher make "judgments about the value, for some purpose of ideas, works, solutions, methods, [and/or] materials" (Bloom et al., 1956, p. 185). If student teachers propose lesson plan ideas, ask for suggestions on particular teaching methods, or offer classroom management ideas—behaviors of previous higher-order levels—at limited levels, there becomes little need to "evaluate based on criteria" (Ewing & Whittington, 2007) in order to determine effective or accurate application of those methods or ideas (Bloom et al., 1956). Another factor may explain why student teachers exhibited less cognitive behavior at higher-order levels. Garrison et al. (2001) stated that "collaborative learning in an educational sense is more than a mindless free-for all…interaction must be coordinated and synergistic" (p. 21), thus requiring an instructional or facilitator presence in order to attain higher-order outcomes. University supervisors did not have an active role in the CoP in our study, which may have contributed to a lack of higher-order thinking demonstrated by student teachers.

Conclusions from this study are limited to student teachers who participated in this study, though they add to the existing body of research regarding cognitive development in teacher education. It is difficult to determine the reasons as to why a lack of higher levels of critical thinking occurs during the pre-service student teaching experience. In relation to social constructivism (Vygotsky, 1962, 1978) and the CoP in which student teachers posted blogs (Wenger, 1998), it should be kept in mind that no learner in the CoP was perceived as expert in agricultural education by the participants. Hoadley (2012) suggested that learners in a community of practice should be able to identify an expert in their field.

Since the majority of the student teachers' blog posts were at the lower-order level of critical thinking, it is presumed that they were not able to assess, analyze, or evaluate (Brown et al., 1970) their peers' learning experiences because they hadn't experienced the same learning practice or situation. Therefore, with no expert (e.g., a University supervisor or an experienced agricultural education teacher) present in the conversation in the CoP to facilitate these interactions, the lack of higher levels of critical thinking could be attributed to the inability of students to relate their experiences to one another, a key component of an educational CoP (Kimble et al., 2008; Wenger, 1998; Wenger, McDermott, & Snyder, 2002). Not being able to relate to one another may be attributed to the fact that not all student teachers were teaching the same content throughout the student teaching experience.

Wenger (1998) described community expectations as "a way of talking about the social configurations in which participation in the community is acknowledgeable as competence" (p. 5). Those student teachers who blog considerably less than their peers, or demonstrate a low level of critical thinking, may not be participating with a complete understanding of their contribution to collaborative learning (Gokhale, 1995; Marzano, 1993; Paul & Elder, 2006). Those students who post a high number of posts or display a lower average level of critical thinking may be bored with the daily routines of student teaching or may not be challenged enough by the discussions or degree of peer collaboration in the CoP. Conversely, students who post a lower number of blogs, or display a low level of critical thinking as compared to their peers, may be towards the end of the spectrum of their ZPD (Vygotsky, 1978) which may require facilitation or assistance in the CoP to enhance their critical thinking skills (Santrock, 2011). Additional assistance may be needed to help students maintain a level of identity (Wenger, 1998) by contributing meaningful discussion (Garrison et al., 2001; Haavind, 2006; Krathwohl & Anderson, 2010; Liu &Yang, 2012) to the CoP by posting blogs more often and at higher levels of critical thinking.

Implications

If student teachers are not consistently utilizing higher-order thinking in online environments, what does this suggest for student teachers and the Iowa State Univeristy teacher education program? Student teachers are taught how to develop educational objectives that encourage their learners to utilize higher-order thinking; however, what is being done in the teacher preparation program to demonstrate the use of critical thinking skills for student teachers? Are student teachers being taught to think critically, or have faculty adequately modeled critical thinking in a manner such that student teachers can replicate these skills during the student teaching experience and beyond? Furthermore, if critical thinking is not modeled in content or pedagogy preparation courses, where would this modeling be most appropriate, and how could faculty align coursework so that pre-service teachers progressively learn how to apply critical thinking?

Student teachers may need more experience prior to student teaching in providing meaningful feedback to their peers. Paulsen, Smith, and Anderson (2015) determined that pre-service teachers "found peer feedback beneficial when reflecting on previously implemented lesson plans" (p. 5). Additional experiences collaborating with peers within the preservice teacher education program may be beneficial. These conclusions have implications for teacher education faculty, especially University supervisors who organize and structure the CoP for agricultural education student teachers. It is common that student teachers feel overwhelmed with the prospect of responding to all members of a group and all conversations posted to a discussion board. In this situation, student teachers may be experiencing feedback fatigue, limiting their thoughtfulness in their responses to peers. If the number of blog posts per student teacher does not correlate with student teachers' average level of critical thinking, should there be a set requirement as to *how much* student teachers are expected to post blogs over the duration of a semester? Or, perhaps, should the focus remain on the *quality* of blog posts?

Recommendations

The following recommendations are based upon the conclusions and implications of this study. If the goal of teacher preparation programs is to guide student teachers in the process of constructing practical knowledge and reflecting with purpose (Pena & Almaguer, 2012; Perry & Power, 2004), it would be appropriate that University supervisors play a more involved role in guiding learners through the student teaching experience. However, Szabo and Schwartz (2011) and Gilbert and Dabbagh (2005) recognized the importance of students taking responsibility for their own learning through the constructivist approach inherent in learning environments such as a CoP.

We recommend that University supervisors implement question prompts (MacKnight, 2000; Pena & Almaguer, 2012) and specific discussion topics to encourage students to utilize higher-order thinking skills within asynchronous discussions. If designed to develop higher-order thinking, question prompts may serve as a guide for student teacher learning (Pena & Almaguer, 2012; Perry & Power, 2004); however, responsibility remains with the student teacher (Szabo & Schwartz, 2004) to respond and collaborate with his/her peers to determine the appropriate analysis or evaluation of a situation. In addition, if University supervisors utilize prompts, they must find credible and reliable resources that suggest ways to format and ask probing questions that will encourage student teachers to utilize higher-order thinking skills.

In contrast to having University faculty involvement in the CoP, Hoadley (2012) suggested that an important aspect of gaining true insightful conversations in a CoP is the notion that it is private. As researchers, we must consider the idea of University supervisors remaining completely absent from the CoP. Would there be different results if the student teachers had complete privacy from University supervisors? Conversation topics, the quantity of posts, and the amount of critical thinking may differ. Student teachers may feel more freedom to talk about their preparation, or lack thereof, in the teacher preparation program. They may also utilize the affective domain more in their reflection and feedback to their peers, including emotions, attitudes, and feelings, knowing that University faculty will not read their discussions.

The layout of the CoP must also be user-friendly, not overwhelming. If an environment develops in which the CoP becomes a free-for-all where student teachers are not encouraged to participate within prepared, organized threads, discussions will fail to have a focus, and student teachers' thoughts and discussions may not reach higher-order levels of thinking. In addition, it might be valuable to assign student teachers to groups of three or four, in which they can focus their feedback and ask for suggestions. This will help reduce the pressure on student teachers to read and reply to all of their peers' reflections and discussions, and allow them to provide more meaningful feedback for a few, rather than less thoughtful feedback for many.

It is recommended that teacher education faculty who utilize Web 2.0 technologies during the student teaching experience establish a baseline level of critical thinking expectations, in order to determine a satisfactory level of critical thinking. Whittington and Newcomb (1993) and Whittington, Stup, Bish, and Allen (1997) recommend higher education students perform at higher levels of cognition - considering other related factors - but do not recommend a specific critical thinking level which students should achieve. We recommend that a goal for student teacher critical thinking is necessary, before analysis or assessment of critical thinking, in order to determine if online technologies can be used to enhance student teachers' critical thinking skills and abilities. However, this was a baseline study, and establishing such a specific level of critical thinking as an expected outcome would not have been supported by literature or previous research.

In relation to the instrumentation of this study, several recommendations should be considered. Though there are many critical thinking assessments available, it is difficult to find a suitable instrument to analyze critical thinking through discourse in an online CoP. The FTCB is a valuable tool, but it would be valuable to design an instrument specific to analyzing critical thinking in reflective writings and asynchronous discussions via online environments. Garrison et al. (2001) utilized content analysis when evaluating online discourse, but also recognized the difficulty in obtaining an accurate account of interaction, as what would be collected in a face-to-face setting. However, if the FTCB remains an effective tool in measuring critical thinking in online environments, measures need to be taken in order to ensure reliability of the instrument. Though Whittington (1991) received training in the use of the FTCB before implementation, University supervisors who utilize the instrument may not have a background in critical thinking or wish to seek such training. Therefore, an instrument should be devised that would be user-friendly and easy to adopt. Additionally, it is recommended that future research consider the interaction between participants in a CoP. Since Vygotsky's (1962) social constructivist theory emphasized the importance of social interaction on learners' cognitive development, it would be beneficial to consider the affect social interaction within the CoP had upon the critical thinking level of the learners' blog posts.

Finally, we suggest that in future studies student teachers are encouraged to attend a weekly focus group with the researcher(s) so that truthful and rich data can be ensured. The student teacher can then clarify any misunderstandings and confirm what was actually done in the classroom setting in relation to the context described in their online postings. A focus group with student teachers will not only add triangulation to the methodology to gain a better understanding of coding text-based messages in Web 2.0 applications, but will also provide insight to how much privacy the student teachers want, and what benefits they see of the probing questions and prompts. Replication of similar studies with other populations or conditions may help to define frameworks of phenomenon presented in this study.

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