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Preservice Agricultural Education Teachers' Experiences in and Anticipation of Content Knowledge Preparation

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Abstract

This study explored the experiences of preservice agriculture teachers in content knowledge preparation for pedagogical content knowledge (PCK) development. The researchers employed a phenomenological approach in which six preservice teachers were interviewed the semester prior to student teaching. The researchers found there was general dissatisfaction with the majority of agriculture content courses among preservice teachers in terms of quality, quantity, and transferability of content. Interest in agriculture content areas, their views of expertise, and what they want their students to gain from their teaching were found to be possible influencers affecting the PCK development of preservice agriculture teachers. These findings provide support for further research to explore gaps in content knowledge and the professions' understanding of PCK development in novice agriculture teachers. Recommendations include considering ways to incorporate content knowledge in pedagogy courses or working with content faculty on developing assignments to help preservice teachers learn content in meaningful ways.

Keywords: Pedagogical Content Knowledge; Preservice Agriculture Teachers; Content Knowledge Preparation

According to the United States Department of Education (2004-2005), teacher attrition rates have doubled in the past fifteen years, and the cost of teacher turnover is an estimated 4.9 billion dollars per year (Alliance for Excellent Education, 2005). Improved content knowledge development and preparation could be one way to counteract the teacher attrition problem. Better preparation of teachers doubles their likelihood of remaining in the profession (Gardner, 2006). The role of teachers' content knowledge expertise and its effect on the classroom has been a highly explored area of research. Possessing content knowledge has a substantial influence on instructional practice and how teachers think about learning, teaching, and curriculum (Stodolsky & Grossman, 1995). A quality teacher knows the content of their discipline and is able to communicate that content knowledge to their students (Okpala & Ellis, 2005). If teachers are not well-versed in their subject matter, they are in danger of passing on misconceptions and inaccurate information to students (Ball & McDiarmid, 1990). Most agriculture teacher educators believe beginning teachers would not be effective without agriculture content knowledge (Edwards & Thompson, 2010).

However, in agricultural education, more and more teachers are entering programs with limited content knowledge. Houck and Kitchel (2010) found a large variance of agriculture content preparation for agricultural education preservice teachers at the University of Kentucky. Variability in content preparation could lead to unprepared teachers having to teach a variety of subjects within agriculture (Houck & Kitchel, 2010). Beyond the University of Kentucky, teacher educators have expressed a decline in opportunities for preservice teachers to learn technical agriculture content at many institutions across the United States (Edwards & Thompson, 2010).

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Expected agriculture content knowledge of teachers can span eight different pathways including plant systems, animal systems, agribusiness systems, and power, structural and technical systems (National Council for Agricultural Education, 2009). It was recommended professionals re-evaluate the base content knowledge of incoming students to determine their curricular needs (Houck & Kitchel, 2010). In 2011, the Educational Testing Service (ETS) announced a three year pilot study to incorporate questions in optional sections of the Praxis II series for some subject areas to improve the measurement of content knowledge. The new questions include scenarios applying content to teaching to more accurately assess content knowledge for teaching (ETS, 2011). This could imply teacher education, via the changes in the Praxis II, also acknowledges a problem with both teachers' content knowledge and the current methods of determining teachers' content knowledge.

Other education fields, such as science education, have conducted research to determine how preservice and beginning teachers use content knowledge to facilitate student learning (Loughran, Berry, & Mulhall, 2012). In a study by Halim and Meerah (2002), the majority of beginning science teachers had problems understanding the scientific subject matter. Teachers' subject matter coursework led to basic skills but not always a deeper understanding of the content in history and math teachers (Floden & Meniketti, 2005). Henning and King (2005) discovered preservice teachers in social studies and science often did not have enough content knowledge to develop lessons for student understanding. Deep understanding of the content is essential for effective teaching (Darling-Hammond & Bransford, 2005). However, to meet teacher preparation program requirements, preservice teachers often simply plug activities into their lessons without reflecting on the ideas (Borko et al., 1992). In a study of preservice music education teachers, it was revealed preparation programs did not adequately address music knowledge and skill and how it applies to the classroom (Ballantyne & Packer, 2004). Whereas music educators are trained in a variety of content, from instrumental to voice, and a variety of different ages, there could be similarities to the breadth of content issues agriculture teachers face.

In a recent study exploring how beginning agriculture teachers' break down content knowledge for their students, teachers in the study indicated content knowledge deficiency in various agriculture subjects (Rice & Kitchel, 2014). This lack of content knowledge subsequently impeded the teachers' ability to break down content effectively for their students and resulted in various coping mechanisms being utilized when teachers felt deficient in content (Rice & Kitchel, 2014). This content knowledge deficiency may have resulted from preparation, as agricultural education teacher educators state there is a lack of practical experience in current agriculture teacher preparation programs and a disconnect exists between the theoretical and practical coursework (Edwards & Thompson, 2010).

Contextual Framework

Preservice teachers spend years in preparation programs with the purpose of gaining knowledge they can effectively pass on to students. According to Shulman (1987) there are seven categories of knowledge for teaching including: *content knowledge, pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts,* and *knowledge of educational ends*. These knowledge bases all play a critical role in the teachers' ability to facilitate learning in their students (Shulman, 1987). A deep understanding of content knowledge is necessary for a teacher to have expertise in any area (Darling-Hammond & Bransford, 2005), including agricultural education. Teacher preparation program accreditation entities such as the Council for Accreditation of Educator Preparation (CAEP) (2013) state teacher candidates must possess content knowledge, pedagogical knowledge, and professional knowledge, among other knowledge bases. In agricultural education specifically, to become a licensed teacher, a candidate must have strong agriculture content knowledge (Talbert, Vaughn, & Croom, 2005). Some content knowledge areas in an agriculture

program could include: agricultural mechanics, plant science, animal science, agricultural business, agricultural communications, natural resource management, agricultural biotechnology, and other areas as the agriculture industry continues to grow and develop (National Council for Agricultural Education, 2009). Because agriculture teachers often have command of such a vast array of content, they are often looked to as the expert in the field of agriculture for the community in which they teach (Barrick & Garton, 2010).

Beyond expertise in content knowledge, *pedagogical content knowledge* (PCK) is a crucial component of teacher knowledge. PCK is a specific type of knowledge for teaching, existing at the intersection of pedagogy and subject matter (Shulman, 1986). This knowledge base is where content knowledge expertise is put into practice (Shulman, 1986). The true complexity of PCK lies in how content knowledge expertise is transformed into something students can understand (Halim & Meerah, 2002). It would be extremely difficult for teachers to take into account both the content and how students learn the content without the depth of understanding PCK entails (Ball, Thames, & Phelps, 2008). Knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum are all components of a teacher's PCK knowledge base (Hill, Ball, & Schilling, 2008). Teachers who possess PCK in a subject are able to identify the critical components in a concept, make connections between concepts and topics, and display the skills and methods needed to break down material (Chick, Baker, Pham, & Cheng, 2006). To generate new explanations, representations, or clarify materials to students, PCK is essential (Shulman, 1986). Out of the knowledge bases, PCK may have the greatest effect on teaching in the classroom (Gess-Newsome & Lederman, 1999).

Grossman (1990) identified four sources in which development of PCK can occur: disciplinary education, observation of classes, classroom teaching experiences, and specific courses or workshops. According to Van Driel, De Jong, and Verloop (2002) out of the many sources for PCK development, experience in the classroom had the strongest impact on the development of teachers' PCK. However, PCK can begin to develop during teacher preparation for preservice teachers (Magnusson, Krajcik, & Borko, 1999). Courses in teacher preparation traditionally separate educational theory and methodologies of teaching (Ball, 2000; Haston & Leon-Guerrero, 2008), despite recommendations from literature to the contrary. This could lead to a discrepancy between methodology and application to the classroom for preservice teachers. Despite the importance of subject mastery, Gess-Newsome and Lederman (1999) discovered preservice biology teachers often had vague and fragmented content knowledge. In physics and mathematics education, preservice teachers completed coursework without developing a true understanding of the subject matter (Ball & McDiarmid, 1990). Teachers need to understand central concepts and their relationships in order to instill deeper understanding in students (Kennedy, 1998). Teacher preparation programs should create partnerships with other disciplines were both content and practice meets (Sion & Brewbaker, 2001). More opportunities to develop PCK should be provided to preservice teachers through university coursework (Borko et al., 1992).

The importance of content knowledge preparation for PCK development and its impact on student learning warrants further investigation in the field of agriculture. The topic specific nature of PCK (Etkina, 2010; Gess-Newsome & Carlson, 2014; Hashweh, 2005; Magnusson et al., 1999; and Van Driel & Berry, 2012) and the uniqueness of agricultural education programs as compared to core content curriculum are also causes for exploration. In addition to being experts in subject matter, agriculture teachers need to know how students learn, believe all students can learn, and possess pedagogical content knowledge (Knobloch, 2002). Fundamental ways to purposefully examine, unpack, and value PCK should be encouraged in all disciplines (Loughran et al., 2012). How are preservice teachers gaining content knowledge and planning to utilize this content knowledge in the form of PCK in the classroom? This study aims to unpack preservice teachers' experiences with content preparation at the collegiate level. Preservice teachers were chosen to investigate because they could readily reflect on their content preparation experiences.

Content preparation is the focus of these experiences, but PCK was chosen to bracket this study because it takes into account both the content knowledge of teachers and how they utilize that knowledge in the classroom. Because of the exploratory nature of this work within agricultural education and the complex nature of PCK, qualitative methods were utilized.

Purpose and Research Questions

The purpose of this exploratory study was to understand how preservice agricultural education teachers gained content knowledge and planned to utilize their content knowledge in the classroom through qualitative methods. The following key questions guided the study:

1) What are your (preservice teacher) experiences in regard to developing expertise in agriculture content?
2) How do you (preservice teacher) anticipate using that content expertise in your teaching?

These research questions align with the 2011-2015 National Research Agenda for agricultural education. Priority four, meaningful engaged learning in all environments, provides focus to "deepen our understanding of effective teaching and learning processes in all agricultural education environments" (Doerfert, 2011, p. 9). This particular study focused primarily on the development of preservice teachers in regards to learning and teaching agriculture content.

Methods and Procedures

This exploratory study employed a phenomenological approach utilizing interviews to answer the research questions. The purpose of a phenomenological study is to describe a common meaning for a group of individuals of a shared phenomenon (Creswell, 2013). In this study, the phenomenon was the content preparation experiences of preservice teachers and their utilization of that content knowledge. A phenomenological approach was chosen to explore the phenomenon from the perspectives of the teachers' shared experiences to develop a better understanding of not only what experiences they are having, but how they are experiencing it (Creswell, 2013). By exploring the development of content knowledge in preservice teachers, the researchers hope to gain valuable insight into PCK that can provide direction for future quantitative and qualitative studies in this area.

As a former high school agriculture teacher who struggled with content knowledge acquisition and its application, I (the primary investigator) admit potential bias and have attempted to bracket those experiences and focus on the participants. Bracketing experiences is recommended by Creswell (2013) for phenomenological studies to separate the researcher's experiences from the data.

Theoretical Lens

This study was conducted within a cognitive constructivist lens. In cognitive constructivism, which has roots in the research of Jean Piaget (1952), individuals construct new knowledge through a personal cognitive process that connects to their previous knowledge (Schunk, 2012). This lens was appropriate for a study utilizing PCK as the contextual framework. A critical component of PCK is knowledge of content and students, which combines a teachers' knowledge of content with their knowledge of students (Hill et al., 2008). In cognitive constructivism, the role of the teacher is to assist students in actively constructing new knowledge (Schunk, 2012). This role requires knowledge of students' prior knowledge, knowledge of students' misconceptions, and knowledge of appropriate instructional sequences, among others, all components of a teachers' PCK. Though cognitive constructivism does place emphasis on the

student in the learning process, it still requires the teacher possess strong content knowledge (Toh, Ho, Chew, & Riley, 2003).

Participants

The population of the study was senior preservice agricultural education teachers at the University of Missouri. Given the nature and variety of sources to which someone can develop content knowledge, a homogenous purposeful sample was selected. The sample consisted of six preservice teachers, five females and one male. Pseudonyms were utilized throughout the findings to protect the identities of the participants (Creswell, 2013). For a phenomenological study, it is recommended by Polkinghorne (1989) to interview five to twenty-five individuals who have experienced the phenomenon being investigated. All six preservice teachers in the study were set to enter student teaching the following spring semester. Seven students were originally asked to participate in the study, but one declined due to time constraints. These students were chosen because they all had followed the agricultural education coursework at the University of Missouri, came from production agriculture backgrounds (and therefore had similar content knowledge experience or opportunities), were representative of preservice teachers at the University of Missouri, and were applying content to the classroom in a simulated microteaching experience.

For the University of Missouri, 45 total credit hours of technical agriculture content are required for agriculture teacher certification. Specifically, preservice teachers must complete a minimum of 3 credit hours in agronomy, 6 credit hours in horticulture, 6 credit hours in agricultural mechanics, 9 credit hours in animal science, 9 credit hours in agricultural economics/business, 3 credit hours in leadership, and 9 credit hours of agricultural electives. Preservice teachers finishing their final semester of coursework before student teaching were specifically chosen as participants because they could reflect on those recent content preparation experiences. Additionally, they had begun applying that agriculture content in a microteaching setting providing an opportunity for PCK development to begin to take place.

Data Collection and Analysis

Data were collected through one-on-one semi-structured interviews lasting 30-45 minutes each. Consent was obtained by the researcher immediately before conducting the interview. The interviews were audio-recorded for transcription purposes. Participants were asked the following main questions in a semi-structured format: 1) How do preservice teachers become experts of content, 2) what is the college teacher's role in developing your expertise, 3) what do you take into consideration when planning a lesson, and 4) how do you deal with teaching content that is unfamiliar or difficult for you. A typical follow-up question for the first question included: what does it look like to be an expert in your content area as a teacher and do you have somebody in mind? A typical follow-up question for question two included: what strategies work well for novice learners in agricultural education? A typical follow-up question for question three included: how do you decide what content to teach? A typical follow-up question for question four included: what strategies have you used?

Data were analyzed according to guidelines from Moustakas (1994). Upon transcription of the interviews, the first step in the data analysis process was to review the transcripts in their entirety to obtain a sense of the data as a whole (Moustakas, 1994). Then in a process known as horizonalization (Moustakas, 1994), data were read through several times and important statements were identified and underlined. Next, these significant statements were grouped according to clusters of meaning (Moustakas, 1994). The original transcripts and developed clusters of meaning were presented to the secondary investigator who reviewed both documents to determine that the clusters of meaning were developed accurately from the data (Creswell,

2013). Next, the clusters of meaning were elaborated upon and collapsed into themes (Moustakas, 1994). Finally, the raw data was revisited by the primary investigator to justify interpretations of themes and to establish that the essence of the phenomenon was captured (Creswell, 2013).

To ensure trustworthiness of the data, member checking was utilized (Creswell, 2013). Participants were contacted after the findings were developed to ensure accurate representation of their message and themes were adjusted based on participant feedback. Rich descriptions of the participants' experiences were utilized to capture the essence of the content preparation and PCK development (Creswell, 2013). Further interviews were not conducted because the researchers felt saturation of the data had taken place (Creswell, 2013). Relevant literature was used as a basis for discussion and conclusions. Finally, the primary investigator engaged in reflexivity throughout the study, acknowledged bias as it related to content knowledge acquisition, and attempted to bracket those experiences as recommended for phenomenological studies (Creswell, 2013).

Findings

Five main themes were developed based on the descriptions of the phenomenon from the participants. These themes were centered on the participants' experiences with content knowledge preparation and their budding development of PCK, facilitated through simulated micro-teachings in a methods course.

Content Knowledge Preparation was not Adequate for the Preservice Teachers

The preservice teachers in this study indicated they did not feel like experts in agriculture content. Amy commented, "I feel I'm getting ready to go into student teaching and I don't feel like I know the content at all in some subjects." Lack of preparation was not limited to one content area, as Lindsay articulated how many areas in which she felt deficient. "I personally do not feel prepared to teach something like soils or certain animal science. I have hardly learned anything about food science." When asked how they felt about teaching subjects they were unfamiliar with or had less knowledge in, all of the teachers indicated nervousness and insecurity. Becca stated, "One of my biggest fears is being in a class and teaching something and the students knowing more than me." One of the primary barriers to acquiring content knowledge for agriculture teaching was found within their college content courses. There was a general dissatisfaction with the majority of agriculture content courses among the preservice teachers in terms of quality, quantity, and transferability.

When asked if there was a college content course that challenged or pushed her more toward becoming an expert, Emily replied,

> Obviously my ag ed professors, I feel like they are getting me to the expert level as much as they can, but I can't think of anything when it comes to content. I know that sounds awful. I never had a teacher make me want more than the grade, that made me want the knowledge, and that's just disappointing from an educator standpoint because I want to do more than that for my students.

The amount of agriculture content received in the teacher preparation program was also a concern. Shane said, "I think college is great, I think you get a lot of different opportunities; however, I think they need to work on content and the amount of content we get." All acknowledged there was not a way to learn everything in agriculture before entering the field because of its breadth. Lindsay commented, "I think it would be impossible in four years to become an expert in just the content of agriculture overall. But I don't know if you could like choose more of an emphasis area." Amy discussed the impact of her lack of content knowledge on classroom teaching, "In my [teaching] lab I've seen it time and time again how when things didn't go the way I thought because I wasn't knowledgeable with the subject. It just stresses you

out; it makes the lesson not as relevant." The feeling of inadequate content area preparation pervaded the interviews with the participants, making this theme one of the strongest of the study.

A Lack of Application of Content Courses to Teaching Existed

All six preservice teachers identified themselves as hands-on learners. Shane said, "The quickest way to learn is to get out there and do it, to submerse yourself in it." An agricultural mechanics class, taught by an agricultural education faculty member, was mentioned by multiple preservice teachers as a class having really helped with their content knowledge development. In response to a question regarding how the content class had helped her move from novice to expert, Becca responded, "He challenged us, he gave us the information but then he challenged us to apply it." Despite preservice teachers identifying themselves as hands-on learners and high praise for the agricultural mechanics class that combined both content and teaching, most of their college experiences regarding content knowledge acquisition were very different. In reference to her content courses Becca stated, "They were usually more lecture based and factual and just give you the information and testing you over it rather than giving you opportunities to apply it." Another similar comment from Shane was, "I feel like in college it's more of a pump you full of information, you either retain it or you don't type of situation." To explain further, Amy talked about her current experience in a meats science course,

> I'm getting some valuable knowledge and I'm gaining some experience; however, I'm not getting the connection to how I'm going to be teaching this to my students, so there's this gap. I think it's the teachers', the college teachers', responsibility to make sure that those gaps are closed.

All of these quotes exemplify missing components of application and transferability in the preservice teachers' development of content knowledge expertise and subsequently their PCK development.

Lack of Interest in a Specific Area of Content Perceived as a Barrier to Developing Expertise

Another barrier to developing expertise in agriculture content was the preservice teachers' interest in the subject matter. When asked about becoming an expert, Lindsay said, "So you have to have interest in that subject to want to become an expert." Shane also claimed, "You have to be passionate about what you are teaching." Interest seemed to be an important motivator to learning more about a subject. Sara stated, "I've taken a lot of plant science classes because that is what I like more." Becca declared her strategy for teaching subjects outside of her interest area, "Well obviously I have my favorite subjects in agriculture. So, subjects that I'm probably not as keen to teaching I would definitely rely on experts in the field." In describing one of her agricultural systems management courses, Lindsay illustrated how lack of interest affected her content efficacy. "I don't remember hardly anything from it; it didn't interest me that much so I don't feel very prepared to teach much about agriculture systems." Becca made a similar comment regarding a content area in which she had little interest, "I would say I definitely don't feel as confident in it because obviously I don't know much about it and it's not my favorite area to teach." Content interest also influenced whether the preservice teacher planned to teach that particular subject. Lindsay stated, "plant propagation for example, I would probably never do that in this class as of now because I don't really particularly care for plant sciences much." Although it seems logical, a lack of interest due to the breadth of content in agricultural education could bring about a barrier that is unique compared to other education disciplines.

The Definition of Content Knowledge Expertise was Expressed in Affective Terms

When describing individuals they considered to be content experts in an agriculture area, preservice teachers did mention content knowledge expertise, but focused more heavily on personality characteristics (affective terms) unrelated to content expertise (cognitive terms). Said another way, the preservice teachers commented more about how the teachers treated their students than the methods and strategies utilized while teaching the content. When asked what made a particular teacher an expert the response from Amy was, "He's really patient. He's willing to say why don't you give it a try first and then we will go back and tell what is wrong and then you can try it again to fix it." For some they almost placed the expert on a pedestal. Emily stated,

> I think it is…it's an essence you can't necessarily describe. It's something that if, they're down to Earth enough that you feel you can come and talk to them when you have problems, but they are also a role model you can look up to. You feel comfortable around them but they are still above you and you still respect them. That is something that I aspire to.

Another description of an expert teacher from Emily was, "You feel comfortable and safe around him which I think is huge." There were some hints of important strategies necessary for content expert teachers. Becca stated such a teacher needed, "the ability to motivate their students and kind of light the fire in them." Overall, preservice teachers saw experts as being able to create the felt need to learn, challenge students, and being willing to listen to others' opinions. Although some of these characteristics could relate to strategies content experts needed, they were implicitly stated as opposed to explicitly stated.

The Use of Content in the Classroom had a Specific End Goal: Agricultural Literacy

The primary focus for most preservice teachers regarding students' absorption of content in future classrooms was agricultural literacy. Amy said, "I know we definitely need advocates and so if I can instill the importance of the agriculture industry into my students and they can go out and share that with the world then I think I've done my job." This desired end result played a role in the topics and information the preservice teachers planned to focus on. Becca explained,

> I want my students to have that basic knowledge so that when something comes up on the ballot, they can think back and things just come to their mind and they can make an informed decision. So I want to pick topics and information that is going to be most important.

Emily said her goal was, "[For students] to be smarter consumers all around and appreciate their farmer." Knowing how preservice teachers frame the use of their students' knowledge could have implications for how content knowledge should be further constructed or perhaps, if this approach is not adequate for the profession, how such knowledge schemas should be reconstructed.

Summary of the Essence of the Phenomenon

Overall, the preservice teachers in this study indicated a disconnection between the content they were learning in their teacher preparation programs and application of that content for teaching. This contributed to a low self-efficacy for teaching various areas of agriculture content. The content preparation program at the University of Missouri did provide some opportunities through an agricultural mechanics course to learn content and pedagogy together, but as a whole the preservice teachers described that they struggled with learning relevant content they could use in their current methods course and in their future classrooms to promote student learning. Preservice teacher experiences indicated that the structure of how content knowledge was acquired inhibited their PCK development because they were unsure of how to apply the content effectively in their microteaching simulations. The participants experienced frustration with the current system of content knowledge acquisition, suggesting various solutions such as

specialization areas, increased self-reflection, and beginning earlier with developing the importance of content knowledge development for teaching. Shane describes his thoughts on working with freshmen agricultural education majors in regards to the importance of content knowledge,

> Especially if you are expecting to be certified as a teacher, to just start getting in that mindset that you are going to have to teach this someday. By instilling that early in their mind, they are going to be more apt to pay attention and to really work and think it through rather than just writing down notes and memorizing it for a test.

However, the preservice teachers also indicated that there was no way to learn everything within the four years of college and that beginning teachers will ultimately have gaps in their knowledge regardless of the quality of their preparation. When asked how he would deal with teaching content that was unfamiliar to him Shane responded, "But the main thing is to do something about it and not just accept the fact that I don't know anything about that…you need to learn new things, you never stop learning."

Discussion

Deep content knowledge is first necessary for the development of PCK, followed by an understanding of the processes of learning (Etkina, 2010). The preservice teachers interviewed identified various areas of agriculture they did not feel proficient in teaching, ranging from animal science to agriculture systems management. Similarly, Henning and King (2005) found in the fields of science and social studies, preservice teachers did not possess enough content knowledge to make meaningful lessons. The first theme regarding inadequacy of preparation seems to echo these findings. With the wide breadth of agriculture content, this may be a bigger issue in agricultural education than other education disciplines. Agriculture teachers are often expected to be content masters in a variety of agriculture subjects including: agribusiness systems, animal systems, biotechnology systems, environmental service systems, food product and processing systems, natural resource systems, plant systems, and power, structural and technical systems (National Council for Agricultural Education, 2009). Some of these content areas have roots in science, some in mathematics, and others in the social sciences. Each of these content areas would require separate PCK development due to the topic specific nature of PCK (Etkina, 2010; Gess-Newsome & Carlson, 2014; Hashweh, 2005; Magnusson et al., 1999; and Van Driel & Berry, 2012). This could create issues in developing content knowledge specifically for teaching an agriculture subject.

Many of the content courses taken by the participants were not taught by agricultural education faculty members and were instead intended for majors in animal science, plant science, or other specific agriculture disciplines. The motives of an instructor often dictate how the subject matter is approached (Cruickshank, 1996), which may not provide the optimum learning experience for education majors. Improvement in teacher preparation programs is needed, including courses supporting conceptual development of subject matter (Borko et al., 1992). Solely increasing the amount of content classes required will not be enough to impact a teachers' content knowledge and their ability to use it effectively in the classroom (Ball, 2000). Van Driel, Verloop, and De Vos (1998) posited that subject matter deficiencies in teachers can be combated by integrating courses on subject matter, pedagogy, and field experiences. "It is the function of agriculture teacher education to prepare teachers, but it is the responsibility of the entire college and the university, since teachers of agriculture must draw upon the various disciplines in order to be successful" (Barrick & Garton, 2010, p. 33). Therefore, it is recommend teacher educators consider ways of either integrating more content knowledge in pedagogy courses or work with content faculty on developing explanations or assignments which help preservice teachers learn the content in a meaningful way, where the end-goal would be for them to ultimately teach the

content. In addition, measures should be considered in quantifying the actual gaps in content knowledge as opposed to the perceived gaps identified in this study.

Application of the content knowledge learned to the future classroom was also an area of dissatisfaction for preservice agricultural education teachers. This echoes the study of Ballantyne and Packer (2004), which found music knowledge and skills were not addressed adequately in music education preservice preparation programs and should be examined in combination with their application to the classroom. One preservice teacher highlighted gaps in her knowledge and stated it was the responsibility of the university to help her establish those connections between content knowledge and the classroom. Without developed knowledge of content for teaching (Hill et al., 2008), agricultural educators could have barriers to facilitating student understanding of their subject matter. All six preservice teachers in the study identified themselves as hands-on learners, but reported the college content courses they had taken were taught primarily by lecture. Lecture as a teaching method works well for recitation but poorly for developing understanding (Halpern & Hakel, 2003). When asked how they were best moved from a novice to an expert, applying the knowledge surfaced in most of the interviews. Having recitation knowledge is not enough to answer questions and facilitate effective instruction (Kennedy, 1998). Again, the aforementioned recommendation regarding retooling pedagogy courses or working with faculty on content courses applies. In addition, spending time in the freshmen year with incoming students in introductory agricultural education courses to develop their understanding of the importance of content knowledge classes for teaching may also be helpful in creating a felt need to learn. For students to develop content knowledge effectively some of the responsibility does need to be placed on students for their own learning, which was mentioned by the preservice teachers in the interviews. It is recommended that preservice teachers take an active role in their learning process in order to become better prepared once they enter the teaching field.

The majority of participants in this study appeared to avoid additional classes in areas of agriculture outside of their topics of interest, possibly contributing to their self-expressed lack of content knowledge in these areas. Interest in the subject matter as a barrier to developing expertise is a problem that may be unique to disciplines such as agricultural education, music education, and other disciplines that have a wide breadth of knowledge and require certified teachers to be able to teach a variety of content areas. If the current certification systems continue in place and agriculture teachers are widely certified to teach all of the content areas in agriculture, teacher educators may want to find ways to individualize the content knowledge development of their students through curriculum and/or field experiences. Garritz (2010) proposed that future research in PCK should pay attention to the affective domain including: motivation, goal orientations, interests, values, and self-efficacy related to subject matter. Future research recommendations include investigation into the role of content area interest on PCK development of preservice agriculture teachers and exploration into this affective domain. Possible influencers such as comfort and experience with the content, perceived ability of content mastery, and other motivations for learning the content are all potential areas to be explored.

Related, one participant mentioned having possible emphasis areas in agriculture. In the field of science, for example, there are certifications in a variety of areas such as biology, chemistry, and physics. Is this something that is possible for agricultural education? Teachers in many disciplines are often responsible for teaching courses beyond the scope of their college instruction (Ball & McDiarmid, 1990); however, is this problem exacerbated for novice agriculture teachers? It is believed that PCK is topic specific (Etkina, 2010; Gess-Newsome & Carlson, 2014; Hashweh, 2005; Magnusson et al., 1999; and Van Driel & Berry), which may further the need for limiting the breadth of topics one teacher is required to master or certified to teach. It is recommended agricultural teacher educators investigate the impact of teacher content knowledge interest on student learning and achievement. In addition, investigations should be conducted regarding the breadth of agricultural education and its effect on instruction. Finally, as PCK literature develops, multiple models may need to be developed by content area. A model for

developing PCK in plant sciences, for example, may differ from a model needed for agricultural systems management.

A significant portion of the descriptions of content experts by preservice teachers were expressed in affective terms. Dispositions such as patient, role model, and good listener were most prevalent when describing experts in the field. While these are important aspects for a teacher to have, it does not address content expertise. It remains uncertain if the preservice teachers in this study truly know what being a content expert entails, possibly contributing to the clear disconnect between the concepts of being a "good" or effective teacher and possessing content knowledge. If one of the goals of teacher preparation is to develop content expertise, then preservice teachers should be able to articulate expertise in order to develop this skill. And even if the preservice teachers interpreted the questions about expert teachers as more related to the global perspectives of being a master teacher, why didn't expertise in content become more prevalent in their responses? Further research needs to be conducted to determine both how preservice teachers' view of expertise affects content knowledge development and how teacher educators help preservice teachers understand how content knowledge expertise is built.

Most preservice teachers expressed wanting their students to take away from their classroom the ability to be informed consumers, voters, and advocates for the agriculture industry. What is the primary mission of agricultural education - is it to teach agricultural skills for career preparation or agricultural literacy? Agriculture is not the only discipline struggling with a definition of what it is to teach. There is no single definition of subject matter and its relationship to education standards for any discipline (Darling-Hammond & Bransford, 2005). In a philosophical article, Roberts and Ball (2009) discuss the possible implications for teacher educators when designing curriculum for teacher preparation. It is not known at this time if existing teacher preparation programs are acknowledging the multiple roles agriculture may play in students' lives. Frazier (2009) discovered, in a study of agricultural education professionals, that leadership skills were a key focus and many were not sure whether traditional production agriculture was still the purpose of current agriculture programs. A framework for science PCK by Magnusson et al. (1999) included orientations to teaching subject matter and emphasized the importance of both knowledge and beliefs of teachers. This framework could be one way to investigate how teachers' views of agriculture shape their teaching. Additionally, Hashweh (2005) included aims, purposes, and philosophies of education in his PCK framework. A clear basis for the use of content knowledge by students is essential for teacher educators as such basis for use would direct a preservice teacher's framework for content knowledge. On a practical level, it would help teacher educators in selecting type, amount, and scope of content in each agriculture content area. Therefore, it is recommended further research be conducted to establish a direction for the future of content knowledge use in agricultural education.

In summary, preservice teachers in the study expressed dissatisfaction with the quality, quantity, and transferability of agriculture content to their future classrooms. They all expressed nervousness associated with teaching content they were unfamiliar with. Their interests in agriculture content areas, how they viewed content knowledge expertise, and what they wish students to gain from their teaching are all possible influencers effecting the development of their PCK. From an overall perspective, it is recommended research be continued to explore gaps in content knowledge and the professions understanding of PCK in beginning agriculture teachers. This could include studying teaching methods courses in agricultural education to examine the focus these courses place on content knowledge, pedagogical knowledge, and PCK. Additionally, exploring preservice teachers perspectives prior to and at the completion of their teaching internships could provide additional information on the development of their PCK. The importance of PCK and its role in student learning makes it a top priority for further research (Loughran et al., 2012). Ultimately, ways to strengthen PCK in beginning teachers could lead to increased student progress (Baumert et al., 2010).

It is also recommended overall, the profession explore how this facilitation of content expertise plays out in the classroom setting. Examining agriculture teacher knowledge utilizing the Hill et al. (2008) model as a guide could provide insight into potential gaps in knowledge. This study was limited to interviews of preservice teachers' experiences, but observations of beginning teachers in the field could further shed light on how this knowledge is developed and utilized. Examining college teachers of agriculture content courses and their role in preparing agriculture teachers also warrants further examination to determine possible changes at the teacher preparation level in terms of content coursework.

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