Deconstructing Content Knowledge: Coping Strategies and their Underlying Influencers for Beginning Agriculture Teachers

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Abstract

The purpose of this grounded theory qualitative study was to explore how beginning agriculture teachers break down content knowledge for student understanding. The overarching theme that emerged during data collection and analysis was beginning teachers self-perceived content knowledge deficiency in various subjects within agriculture. This initial finding guided subsequent collection and analysis which focused on how teachers coped with this feeling of inadequacy in content and the underlying influencers that guided those actions. Various coping strategies occurred during planning and in-the-moment teaching stages. Underlying influencers for choosing a particular coping strategy included a combination of internal and external influencers. External influencers included structure of the school environment, individual department structure, and offering agriculture courses for core content credit. Internal influencers included teachers' content interest, perceived credibility as a content teacher, and philosophies regarding agricultural education. Recommendations include reconciling the purpose of agricultural education in teacher preparation programs, creating more accessible professional development opportunities, and examining experienced teachers in the field for similar findings.

Keywords: Beginning agriculture teachers; content knowledge; pedagogical content knowledge; content knowledge deficiency

Introduction

Differences among students make it necessary for teachers to look at content and pedagogy together (Enfield, 2012). Teachers' content knowledge and understanding of material is influential in their ability to break down such content for their students (Diakidoy & Iordanou, 2003). In particular, "teachers need to be able to respond to questions and hypotheses that they might not have anticipated, provide students with guidance when they get in over their heads, clarify confusions, and ensure that misconceptions are not perpetuated" (Kennedy, 1998, p. 252). Agriculture teachers must have both breadth and depth of content knowledge (Barrick & Garton, 2010) to achieve these tasks. When preservice teachers engage in student teaching for the first time, they must be adept at using content expertise to describe content to students; create illustrations, demonstrations, and analogies to explain content; and accurately address student questions (Shulman, 1986). This goes beyond tips and tricks for instructional strategies and delves into an understanding of how students truly comprehend subject matter (Van Driel & Berry, 2012).

Transforming content knowledge in ways that yield student understanding is not an easy task. It requires critical interpretation, representations of ideas in various forms, choosing specific instructional methods for topics, and tailoring adaptations based on the needs of students (Shulman,

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1987). Due to the complexity of this process, beginning teachers often struggle to figure out how this deconstruction of knowledge occurs. When compared to expert teachers, beginning teachers often demonstrated fewer of the knowledge bases necessary for teaching, including content knowledge and pedagogical knowledge (Turner-Bissett, 1999). Examining agricultural education beginning teachers' process of breaking down subject matter could aide teacher preparation programs in developing curriculum to better prepare preservice teachers.

The Knowledge Gap from Current Theory and Literature

Frameworks and literature surrounding pedagogical content knowledge (PCK) were first examined to determine the gaps this grounded theory study should address. PCK refers to knowledge of subject matter and instructional strategies incorporating subject matter, combined with knowledge of students' learning difficulties (Van Driel, De Jong, & Verloop, 2002). Since Shulman (1986) first coined the phrase PCK, many research studies have been conducted and models developed in an attempt to explain this complex phenomenon. PCK is crucial for the deconstruction of knowledge (how knowledge is broken down). Teachers' actions in the classroom are greatly influenced by their PCK, making it an essential part of their learning (Solis, 2009). Many teaching tasks depend on a teacher's understanding of content knowledge including giving explanations, asking productive questions, and assessing students' learning (Ball & McDiarmid, 1990). Teachers need to be able to respond to questions and address student misconceptions of content (Kennedy, 1998). Without a strong understanding of content, teachers will struggle to help students learn in meaningful ways (Ball & McDiarmid, 1990). It is more than just knowing the content; it is applying content in the classroom for student understanding.

In a study investigating science teachers' PCK of chemical reactions, Van Driel, Verloop, and De Vos (1998) found teachers lacked theoretical arguments to promote student comprehension. Science preservice teachers in the field of physics also struggled to transform subject matter for their students due to incorrect content knowledge and an inability to predict and address student prior knowledge of the content (Halim & Meerah, 2002). Science education is not the only discipline to find teachers having difficulty reconciling their PCK. Borko et al. (1992) found middle school mathematics teachers were unable to provide explanations for the material that was relevant and on the students' level. "Understanding teachers practice in terms of PCK may be helpful in making explicit and refining teachers' professional learning about practice" (Loughran, Berry, & Mulhall, 2012, p.14). With the broad scope of agricultural education, from animal sciences to agricultural communications, there may also be a need for increased incorporation of content knowledge and how to use it effectively into the teacher preparation curriculum.

The science and math education fields are at the forefront of research related to PCK. Pedagogical and Professional Experience Repertoires (PaPeRs) was developed by Mulhall, Berry and Loughran (2003) to represent the PCK of expert science teachers through a narrative. The exploration of specific topics included how the teacher approached the topic and why it is approached in that manner. The goal of this research was to produce something useful for preservice and inservice teacher education (Mulhall et al., 2003). A framework by Chick, Baker, Pham, and Cheng (2006) clarified what characteristics teachers exhibit when tapping into their PCK, specifically for mathematics education. The content knowledge in a pedagogical context portion of the framework was of particular interest. One of the categories in this framework is deconstructing content to key components. The characteristics of teachers exhibiting these PCK strategies included: exhibiting deep conceptual understanding, the ability to make connections and apply concepts, and the ability to break down content knowledge for students (Chick et al., 2006).

Hashweh (2005) elaborated on other areas related to PCK including aims, purposes, and philosophies of education. Magnusson, Krajcik, and Borko (1999) included orientations of teaching in their discussion of PCK, stating these orientations have a vital impact on teacher knowledge, almost serving as a filter for PCK to pass through during development. Friedrichsen, Van Driel, and Abell (2010) recommended that further exploration on the role of science teaching orientations in PCK should be considered, specifically including the concepts of beliefs and philosophies.

Despite research being conducted on PCK in disciplines spanning from English to music education (Ball, Thames, & Phelps, 2008), research in agricultural education related to PCK has been limited to a handful of studies. Rice and Kitchel (2015a) discovered that preservice agriculture teachers at the University of Missouri perceived their content knowledge preparation as inadequate and felt there was a lack of application of their content courses to teaching, which is important for PCK development. Recommendations included integrating content and pedagogy courses in agricultural education and exploring how PCK develops over time for agriculture teachers (Rice & Kitchel, 2015a). A subsequent study examined practicing agriculture teachers at various stages of their careers to determine if a relationship existed between sources of content knowledge and development of PCK through quantitative measure (Rice & Kitchel, 2015b). Professional development, years spent teaching, and university preparation were the most significant content knowledge source predictors for PCK (Rice & Kitchel, 2015b). Recommendations included emphasis on these content knowledge sources be continued and future studies should consider an instrument to measure PCK because these findings were limited to teacher perceptions (Rice & Kitchel, 2015b). Finally, one study in agricultural education focused on the technological pedagogical content knowledge (TPACK) of agriculture teachers (Stewart, Antonenko, Robinson, & Mwavita, 2013). TPACK takes the concept of PCK a step further to include technology integration with teaching (Mishra & Koehler, 2006). Stewart et al. (2013), discovered intrapersonal factors including self-efficacy, interest, and expectations of outcomes influenced agriculture teachers' TPACK.

These exploratory studies in agricultural education barely scratch the surface of agriculture teachers' PCK. While the agricultural education discipline can arguably draw on the fields of science and math PCK research, the breadth of agricultural education includes knowledge bases outside science and math, such as leadership and communication (National Council for Agricultural Education, 2009), that are largely unexplored. Additionally, while agriculture is most similar to science education in many ways, its roots lie in experiential learning (Knobloch, 2003) in comparison to science which has claimed a more inquiry based approach. With the breadth of content in agricultural education, it became important to first explore how teachers are able to take content and break it down into something students understand. If the concerns regarding content knowledge and PCK in beginning agriculture teachers are similar to other education fields, how does that unfold? Therefore, the emergent design of grounded theory became an appropriate research route.

Purpose and Central Research Question

The purpose of this study was to understand how beginning agriculture teachers were breaking down their content knowledge in the classroom through qualitative methods. The following central question, which aligns with the 2011-2015 National Research Agenda for agricultural education priority four, meaningful and engaged learning in all environments (Doerfert, 2011), guided the study: What is the process beginning agriculture teachers go through when breaking down their content knowledge for teaching?

Methods

In this qualitative study, a grounded theory approach was utilized. The grounded theory method is appropriate for analyzing a process to describe what it is and discover how it works (Corbin & Strauss, 2008), which aligns with the central research question being explored. Grounded theory was chosen because research on agriculture teachers' deconstruction of content knowledge is limited and agricultural education is different from many education disciplines in the breadth of content that teachers are expected to master. Specifically, this study's methodology was guided by the work of Corbin and Strauss (2008). From a personal standpoint, difficulty with content knowledge acquisition and more specifically putting content knowledge into practice was something I (the primary investigator) have experienced firsthand as an agriculture teacher without roots in traditional production agriculture. Personal experience can be a valuable indictor of a research problem worthy of further exploration (Corbin & Strauss, 2008). As a current teacher educator, I see the potential implications this study could have on agriculture teacher preparation programs. The links between how teachers make sense of content and how they decide on strategies for teaching content are of particular interest to me.

Site and Participants

This study was conducted with Missouri agriculture teachers having two to four years of classroom experience. According to Darling-Hammond and Bransford (2005) five to seven years of experience is when expertise begins to be achieved. With this in mind, the range of two to four years of classroom experience was chosen to keep the focus on beginning teachers' development. First year teachers were excluded from consideration of this study because they would be less likely to reflect on past experience teaching a subject and would not be able to compare their thoughts and strategies over the course of multiple years. All participants recruited were graduates of the University of Missouri and had similar teacher preparation courses and experiences. Thirteen teachers fit these two requirements; in addition, these teachers were within a 180 mile radius of the University of Missouri so fieldwork could be conducted. Out of these thirteen teachers, five agreed to participate. Due to the variation in content that can be taught in an agricultural education program, the decision was made to focus on a lesson integrating science concepts, primarily plant or animal science.

The accepting sample consisted of two males and three females. Two of the participants were teachers in the same school district. One teacher had two years of experience, three teachers had three years of experience, and one teacher had four years of experience. One of the teachers was in a single teacher department and the rest were currently in a multi-teacher department but may have worked in a single teacher department previously. Four of the teachers were employed in schools in rural Missouri and one of the teachers was employed in a suburban school district.

Data Collection and Analysis

There were multiple forms of data collected. First, data were collected using video recorded classroom observations of one class period lasting at least 45 minutes in length. Second, field notes were taken during the observation of the lesson to capture reactions of students and interactions between the teacher and students not captured on video. Observations were included to create a comprehensive picture of this deconstructing phenomenon because often people are either not aware of what they are doing or are unable to recall what actually happened (Corbin & Strauss, 2008). Third, one-on-one semi-structured interviews were conducted after the observation and were 30-45 minutes each. Preliminary interview questions included: what are the things that prepared you to know the content of this lesson well, what are the most important concepts in this lesson, what strategies or methods do you use to teach this lesson and why, what difficulties and limitations are associated with teaching this lesson, and how do you know when your students have learned

the content in this lesson. These questions evolved throughout the grounded theory process to meet the needs of the concept being investigated (Corbin & Strauss, 2008). As data collection and analysis continued, teachers in the study were contacted via e-mail for follow-up information as a part of the constant comparative analysis of grounded theory. The data from these e-mails were used to corroborate findings and establish relationships between data. All video and audio recordings were transcribed verbatim.

Field notes, transcriptions of the teaching videos, and transcriptions from the interviews were used to form the initial codes through open coding via NVivo 10 software. As data were collected, a constant comparative method was used to compare data against data (Corbin & Strauss, 2008). Interview questions were also adapted to follow emergent categories. Categories were then collapsed into the final themes for the findings. Multiple models emerged and transformed along the way as new data were gathered and participants were consulted. To ensure trustworthiness of the data, member checking was utilized as the study evolved and after the findings were developed to ensure accurate representation of the message (Creswell, 2013). Relevant literature was also utilized as a basis for discussion. Credibility of the data was insured by the richness of the data obtained and reflexivity through extensive memoing throughout the data collection and analysis process (Corbin & Strauss, 2008).

Findings

Content Knowledge Deficiency

The initial central question guiding the study was to explore how beginning teachers were able to take their knowledge of an agriculture subject (specifically a science-based concept) and break it down for students utilizing their knowledge of content and knowledge of pedagogy. However, a pervasive overall theme began to emerge with the first teacher observation and interview and continued throughout subsequent teacher interactions. Because the agriculture teachers in this study viewed themselves as deficient in their content knowledge from the beginning, many of their deconstructing strategies were first filtered through an overall umbrella we have termed *content knowledge deficiency*. Due to the implications this positioning might have on future studies of agriculture teachers' PCK, we made the decision to explore how the beginning teachers were coping with this self-perceived content knowledge deficiency in the classroom, including strategies they used when they felt deficient in content and the underlying influencers that motivated them to use those specific strategies.

Before discussing further how this overall theme of content knowledge deficiency shaped the teachers' decision making processes, it is important to describe this emerging theme in more detail. All of the beginning teachers had specific areas of content ranging from animal science to farm management in which they felt deficient, evidenced from both the teacher interviews and the classroom observations. It was expressed in different ways depending on the teacher, but common descriptions included: second guessing your knowledge base, dreading being asked questions about content, feeling unable to explain the "why" behind the content, doubting your effectiveness as a teacher of certain content, and feeling like students are "smarter than you" in content. Mary gave an example from her first year of teaching: "I had to teach an equine science class my first year and I've never ridden a horse. And so I was not very confident in that class, I'm not sure anybody learned anything in that class my first year." Answering questions was a source of anxiety for teachers, specifically with content that they feel deficient in. When discussing a plant science course, Tiffany described her feelings of uncertainty by stating, "I grew up on a row crop farm so I reference corn and soybeans in every example because I know them. And when the kids are like, what about flowers? I'm like I don't know let's figure this out later." When teaching a unit on grasslands in her third year, Melissa described herself as "feeling totally lost" when it came to the

content. Beyond specific content areas there was also a sense of "feeling deficient" in agriculture content as a whole. Jeff stated, "I feel like I was prepared to be a good classroom teacher, but I don't feel like I was prepared with what knowledge to teach."

Most of the teachers in the study expressed wanting more content knowledge at the teacher preparation level. Jeff discussed various content areas he did not feel comfortable in upon graduation, "But I kind of feel like I didn't learn how to teach parli [parliamentary procedure], I didn't learn how to teach my food science stuff, I didn't learn how to teach biotechnology." Tiffany also stated her desire for more content knowledge, "I know that they have to teach us how to be teachers and they can't do it all, but there definitely needs to be more content." Mary and Melissa both discussed specializing in areas and how this might impact their content efficacy. Currently in each of their school's multi-teacher programs there was a push for individual teacher specialization in agriculture. For Mary it wasn't just more content courses at the preparation level but how they were taught, "I almost wish the content specific courses, and I know this is probably impossible, were taught more at like a high school level. Here's how you would teach it if you were teaching high school."

Coping Strategies for Content Knowledge Deficiency

When agriculture teachers felt deficient in content knowledge for a specific piece of subject matter, it influenced their choices on how to proceed during both the planning and in-the-moment teaching stages (see Figure 1). Professional development workshops, seeking help from other teachers, and researching on their own were all viewed by the teachers as viable ways to compensate for content knowledge deficiency during the planning stages of teaching. The most emergent strategy discussed by teachers was researching and studying on their own. Textbooks, the internet, and various curriculum resources were all mentioned by the teachers, with Instructional Materials Lab (IML), a state resource, being referenced by all five participants. During observations, two of the teachers actually pulled out IML to demonstrate where they got the content for their lesson. Despite frequent use, there was still some dissatisfaction with IML, particularly with the lack of activities to enhance the content and lack of a "why" curriculum. Tiffany explained, "Even if you have a curriculum, it's not necessarily a "why" in the curriculum. Its here's what you tell them; here's what they need to know. And I still feel like there can be more content…" Another frequently utilized strategy during planning was requesting help from others, which primarily included other agriculture teachers and core content area teachers. These individuals provided basic content information, suggestions on implementation of content, and clarification when there were specific questions about content. When asked about sources of content knowledge Melissa said, "I was actually really lucky and my agriculture teacher gave me everything he has and so I stemmed a lot from that."

Sometimes the teacher was unable to plan for their content knowledge deficiencies and had to react in-the-moment. Prevalent in-the-moment coping strategies while teaching included: admitting they didn't know, referencing what they did know, and encouraging students to learn on their own. Encouraging students to learn on their own is a strategy many of the teachers used. Instead of teachers seeking out information themselves, if a student had a question they had them look it up, either in-the-moment or later at home for homework. This solution was witnessed in action during one of the teacher observations. When I asked Mary if she typically had students look up answers she didn't know she gave me an example of a student asking how long a cow sleeps and her instructing the student to come in the next day and report on the question to the class. Some teachers viewed this as a learning opportunity for the students. Tiffany echoed this sentiment when describing her new greenhouse class, "Since we haven't done this before, we really do not know what questions we will have until they come up. Solving these problems or answering the questions that arise provides a learning opportunity." As the teacher became more comfortable with the

students they were more readily able to admit they didn't know. Often ignoring or glossing over a subject was done in response to fear of being asked more questions about a certain subject. Sometimes instead of admitting they did not know teachers would reference similar content. I witnessed this in an observation with Tiffany during a plant science lesson. She used crops for every example because she was from a row crop farm and rarely discussed flowers, even in response to direct inquires about flowers from the students.
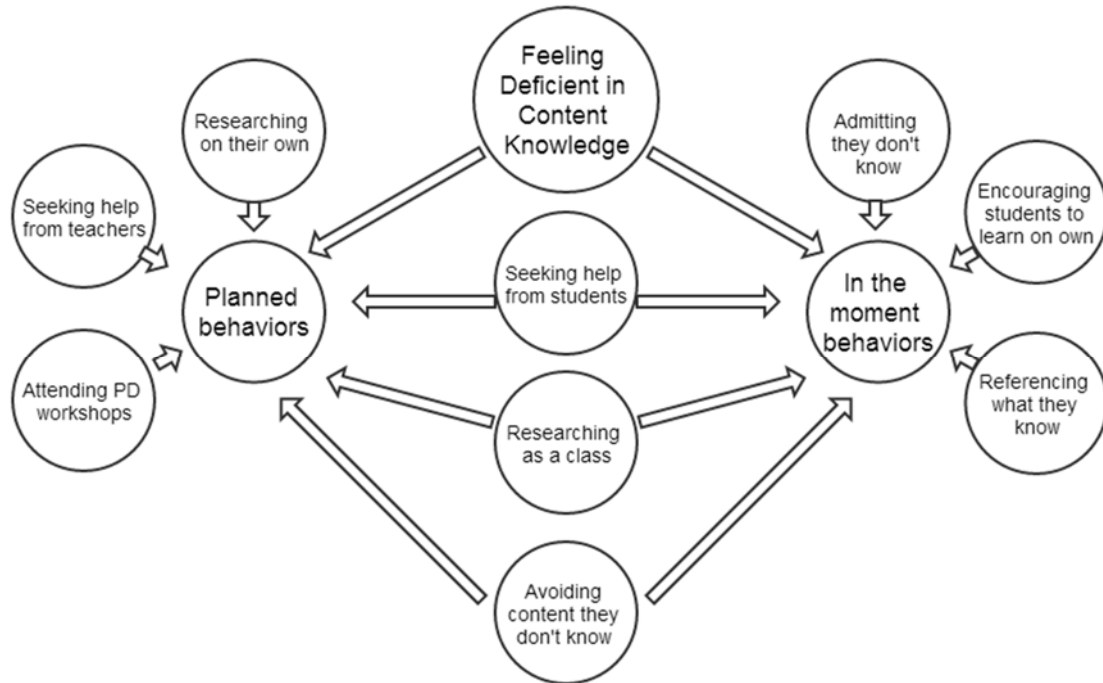

Figure 1. Coping strategies when teachers feel deficient in content knowledge

Three of the coping strategies surfaced both during planning and in-the-moment stages. Seeking help from students emerged as a coping strategy during both stages. Mary relied more heavily on students in her equine class who had expertise in the content she was teaching during the planning stages, specifically students who owned horses and were national competitors in 4-H. Melissa also described utilizing student knowledge in her wildlife course, but from an in-the-moment teaching perspective to answer a question. She said, "Even if I don't know something, someone in the class typically does." If the teacher viewed the atmosphere of a classroom as a collaborative learning environment, then asking for student assistance was seen as a viable option. An additional coping strategy that occurred during the planning and teaching stages was the teacher avoiding certain content. Sometimes the teachers simply chose not to teach a particular topic or unit during planning. Other times, content was avoided in-the-moment. During an observation with Tiffany, I witnessed her tell a student they would "come back to that topic tomorrow". In the interview following the observation, Tiffany admitted she did not know much about the subject and had not prepared to go in-depth with her explanation. Finally, researching as a class was utilized during planning and in-the-moment teaching. If the teacher was unfamiliar with the content they would often plan for the class to do a research project, as witnessed with Melissa during a unit on wildlife management. Sometimes in response to a question, the teacher would choose to stop the class lecture and initiate a mini-research project in which the students would get on the computers or iPads and look up the information. Overall, the teachers used a variety of coping strategies when dealing with content knowledge deficiency.

Underlying Influencers of Coping Strategies

There were a variety of underlying influencers affecting the type and frequency of strategies teachers used when they felt deficient in content. These influencers included external circumstances of the teachers' school structure and environment, type of teaching department, and course offerings, and internal circumstances included the teachers' perceived credibility, interest in the content they are teaching, and philosophies about the purpose of agricultural education (see Figure 2).
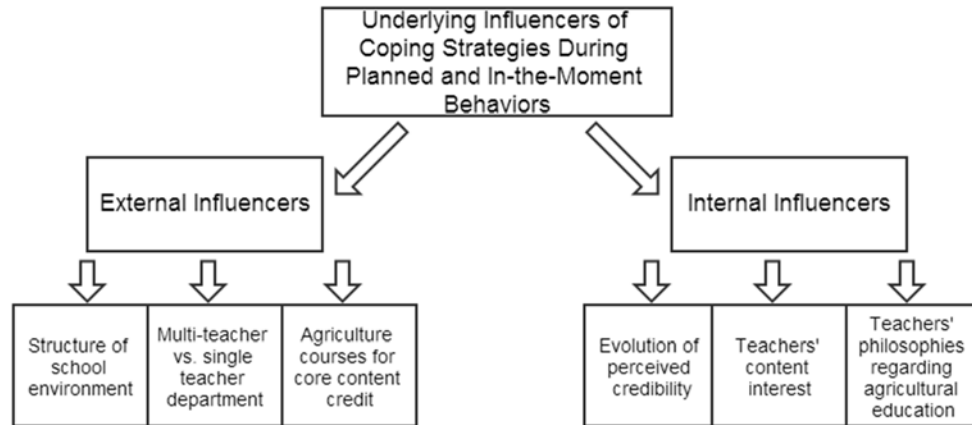

Figure 2. Underlying external and internal influencers of coping strategies

External influencers: Structure of the school environment. Underlying influencers affecting how a teacher coped with feeling deficient in content knowledge was often related to the structure of the school environment and included many interworking parts: time (or lack thereof), funding, and technology. The agriculture teachers identified various constraints regarding time including amount of time to plan, amount of time in a given class period, and amount of time dedicated to a course overall. Tiffany noted she prepped at the beginning of the year because she did not have time on a daily basis to prepare for six different classes. Agriculture teachers may have a different class each period to prepare for, especially if they are in a single teacher department. Jeff discussed how he managed his time when he feels deficient in the content by stating, "The ten percent rule TJ told me- just stay 10% ahead of your students. So like right now I'm on unit 4 trying to read the unit I want to teach two days from now…" Simply having more time in an individual class period can influence how a teacher copes with feeling deficient in content. Melissa compared two scenarios, "50 minutes you can get by easier than 90 minutes. You will probably have to answer some type of question you don't know in 90 minutes." Funding was another aspect of the school environment affecting content knowledge acquisition. Attending professional development workshops was mentioned as a way to cope with content knowledge deficiencies by multiple participants. Specifically, summer institute at the University of Missouri was discussed as a way to gain content specific knowledge during planning. Tiffany said, "I think that Missouri does a good job of offering institutes on that, like the summer institutes where you can go learn about agronomy specifically- I've done that one." However, some participants also indicated these types of programs could be time and cost restrictive.

Availability of technology for the students to use also influenced what coping strategies the teachers utilized. Schools having iPads for students, easily accessible computer labs, students with laptops, and less limits on copies made it easier for the teacher to assign research projects.

Melissa described the influence of technology on this method by stating, "It's been easier to do things for them to learn on their own. They are in that mode now. They want to research it; they want to use their iPads." Students as a whole seemed to respond well to the research projects according to the teachers. Tiffany directly connected her perceived amount of knowledge with her strategies for teaching by stating,

> Because I feel like my content knowledge is limited, I pretty much use all of my knowledge in the lessons, when I am asked to elaborate on something, sometimes I've used all I had already. In this case we just have to do more research as a class to answer questions.

Despite feeling like research projects were a viable way for students to learn, when asked if after she felt stronger in the content if she would continue with the research projects Melissa said, "That's an easy answer- No". Melissa's comment exemplified the motivation behind choosing to do research projects versus lecture, which partially rests with how comfortable the teacher feels with the content knowledge. Melissa went on to explain she would probably do more lecture and more discussion where she was able to draw the students into the discussion.

External influencers: Multi-teacher versus single teacher department. Impacts of the school environment also related to being in a multi-teacher or single teacher department. If the other teachers in the department were more experienced in a content area, a beginning teacher in their second to fourth year were more likely to use coping strategies that seek out additional knowledge during planning in an attempt to keep up with his/her colleagues. According to Melissa, "There has been a big push across the board to teach similar content from the different schools. I have been trying to do that." This accountability piece between teachers in a department appeared to increase the pressure of a beginning teacher to learn new content. When I asked Melissa about her old position in a single teacher department she stated she was more likely avoid content she was unfamiliar with because "no one would know." Due to the autonomy many teachers have within their programs, particularly in single teacher departments, teachers often taught and referenced what they already knew or left out content with which they were not as comfortable. They chose lessons based on their strength areas in agriculture or gave examples based on previous knowledge. An example from Tiffany, who was in a single teacher department at the time of this study, was, "I lean towards agronomy rather than towards floriculture when I talk about the different kinds of plants because I am familiar with it." Melissa discussed how the autonomy to teach what she wanted could be an issue in agricultural education; "It's a good thing about teaching agriculture, but at the same time maybe it's a little strange. It's not good all the time."

For some teachers there was pressure to seek additional content through research or professional development avenues during planning. Melissa said this in response to a question on how much content an agriculture teacher needs to know, "I feel like I need to know a little about everything." However, most of the teachers had low expectations in terms of mastering content knowledge in their careers. When asked what it would look like to be an expert in plant science content, Tiffany commented, "When I get asked to put on an agronomy or horticulture contest, I will consider myself an expert, which is likely to be never." If the teachers planned to seek out additional knowledge one of their primary sources was other agriculture teachers. Tiffany said, "I mean other agriculture teachers too. I mean we use the term 'don't re-invent the wheel' all the time, so I steal from them and try to use what they have used." The phrase 're-invent the wheel' came up in four of the five teacher interviews. It appeared most teachers felt comfortable asking for assistance within their profession. However, for some in multi-teacher departments, like Melissa, there was a feeling of burdening others with questions and to avoid "feeling like I am stepping on their feet" she utilized other content knowledge sources. Overall, belonging to a multi-teacher department influenced a beginning teacher to choose more coping strategies during the planning

stages due to the accountability they felt to their colleagues and the inability to hide their perceived lack of content knowledge.

External influencers: Agriculture courses for core content credit. If the agriculture program offered classes for core content credit (such as science credit), the accountability for content in that school environment also influenced how a teacher coped with feeling deficient in content knowledge. Teachers who offered a class for science credit tended to collaborate with science teachers and indicated an increased pressure to learn the content. Similar to being in a multi-teacher department, being accountable to another teacher increased the necessity most teachers had for seeking out knowledge during planning. Specifically, mathematics and science teachers were mentioned as sources of content knowledge if they appeared knowledgeable and accessible. Tiffany often collaborated with the science and math teachers in her school as a way of seeking help from teachers,

> I look through and I review and if I have questions I go ask James or Regina our biology and chemistry teachers. …when we get into farm management and some of our more advanced equations and stuff in there I go talk to the math teachers.

Tiffany confirmed part of her rationale for seeking help was the fact that her agriculture students could take three agriculture courses and receive one science credit for graduation. Additionally, if the school required certain classes or content to be taught the teachers had to operate within those constraints. Some teachers were given flexibility over the courses they were allowed to offer while others inherited programs with specific courses already laid out. When specific courses were inherited, teachers were more likely to seek out additional knowledge during planning if they felt deficient in a specific topic.

Internal influencers: Evolution of concerns regarding perceived credibility. Teachers often felt not being able to answer student questions hurt their credibility within their students' eyes. Mary described this when stating, "Like my first year when they ask you questions you want to just give them an answer so that they don't think you are dumb or a bad teacher." Tiffany echoed this sentiment; "I mean I remember my first year if I didn't know every answer I freaked out." Specifically, with content in which they felt deficient, answering questions was a source of anxiety for teachers. Tiffany expressed this fear particularly in plant science; "The chemistry part of it, like we talked about these formulas and I am sitting there like oh don't ask me questions…" This desire to prove their credibility led teachers to using more strategies during planning involving new knowledge acquisition. However, over time, this need to know the answers became less of a priority with teachers. Often this fear dissipated as they grew more comfortable with their students. Mary described this transformation; "But now it's kind of like, because I've been here all three years they know I am dumb (laughs). So if they ask me a question and I don't know I'm not afraid to say I don't know."

While all of the teachers were able to admit they did not know an answer they differed in how they handled not knowing. Some would admit to the students they did not know. An example from a teaching observation with Tiffany demonstrated this strategy. "Student: Can you give us an example (of biennial)? Tiffany: No, I'll tell you tomorrow, I don't know." This was the fourth time Tiffany had taught this specific plant science lesson in her classroom. When asked how she felt about admitting she did not know, Melissa said she "felt bad" sometimes but not all of the time. An instance in which she did "feel bad" was when she, herself, brought up the topic and then the students asked her questions she did not know. However, a question off topic but loosely related to the day's topic did not seem to cause the same concern to her perceived credibility. Mary described admitting when she doesn't know an answer by stating, "So if they ask me a question and I don't know I'm not afraid to say I don't know, we will look it up or you can look it up and come in tomorrow…" In Mary's case sometimes they researched as a class and sometimes she expected the

students to learn on their own. When admitting they didn't know there were few instances in which the teachers mentioned researching it themselves; instead the responsibility was often put on the collective "we" of the class or the individual student asking the question. Mary said, "I used to be afraid for what they asked me because I would be afraid I didn't know the answer, but now it's like, it's more of a conversation." The pressure to prove credibility seemed to dissipate overtime, allowing the teachers more comfort in admitting they don't know an answer. Being more comfortable with the class environment and students also played a role. Over her three years teaching Mary said she came to this realization, "The one thing I've realized is I don't have to learn everything." The pressure to know the answers was less prevalent after the first and second years of teaching.

Internal influencers: Teachers' content interest. Interest in the content also influenced the teachers' choice of coping strategies. When describing a piece of content in which he felt strong, Jeff said, "I consider myself pretty good at meat science and that was honestly just reading a lot of stuff, stuff you are interested in is easier to become an expert on I guess." If the teacher was not as motivated to spend time learning the content they were more likely to encourage the students to learn on their own, research it as a class, or avoid the parts of the content that did not interest them as much. Tiffany showed the contrast between two topics of varying interest by stating, "I love biology I am good with this, I either know it or I can learn it easily. The chemistry part of it though scares me because it's not something I got an awesome grasp on in high school." Melissa pointed out teachers' content interests can also change, which could result in a shift in coping strategies. She described dreading deer processing before teaching the unit and afterwards being excited about it and spending time toward structuring it better for the next year. She also expressed difficulty motivating students for certain units by saying, "Getting them excited is hard when you don't care." Passion for a subject made it is easier for the teachers to spend the time reading like Jeff did with meat science. Melissa said she would probably gloss over a lot of the content not peaking her interest by using this strategy, "Let's look this up or do this project and do a two-week unit on it at the end of the semester."

Internal influencers: Teachers' philosophies regarding the purpose of agricultural education. Teacher philosophies about the purpose of agricultural education played a major role in how they decided to cope with feeling deficient in specific agriculture content. For the majority of teachers in the study, the focus was on agricultural literacy. Mary claimed, "So I might be a little bit different from other agriculture teachers because I don't necessarily stick to the basics and the technical skills." Melissa said, "In the career center they push skills, however, with common core we also hear a lot about agricultural literacy." If the end goal for student learning is agricultural literacy, teachers were less likely to use as many coping strategies that occurred during the planning stages. When the teacher was not having students master a specific skill, they in turn did not need to have mastered a specific skill. Research groups were a more viable option for exploring an agriculture topic versus mastering traditional career preparatory skills within that topic.

Part of the reasoning behind a focus on agricultural literacy was the type of students enrolled in current programs. Many students were not planning to pursue traditional agriculture careers. For her freshmen students, Mary described her literacy focus, "I focus on, especially with them, understanding what agriculture is and how it relates to them." However, this may change as the students become more literate in agriculture. At this point, teachers discussed a shift to an emphasis on developing career preparatory skills. Mary illustrated this shift, "So I kind of try to stay more bigger picture, agricultural literacy, this is how it relates to you with them and then I think Jordan gets a little bit more precise in agriculture two…" Jeff experienced an inner struggle with where to put his focus, exemplified by his comments in the beginning of the interview stating he wanted his students to be able to use practical knowledge when grocery shopping and transitioning to this comment, "We need to be preparing kids for a job. And if they know, if they

are just literate about agriculture, that's not good enough in my opinion. They should have certain skills when they leave here." When I discussed the goal of student learning with teachers most responded with an agricultural literacy focus so it could "apply to their everyday lives", but imbedded in the conversations was also a need for their students to develop career preparatory skills.

Summary and Recommendations

Information about coping strategies frequently utilized by agriculture teachers could be useful for teacher preparation programs as they instruct future preservice teachers entering the field. Knowing what strategies teachers generally gravitate toward could be helpful in making preparation decisions. There appeared to be a struggle for many teachers between balancing their external influencers (school structure and environment, type of department, and core content influence) and their internal influencers (content interest, evolution of perceived credibility, and philosophy regarding the purpose of agricultural education). With 81% of teachers in the United States reporting at least two or more computers in the classroom or access to a computer lab with 25 or more computers (United States Department of Education, 2003), the teacher is no longer the primary source of knowledge for students. Researching in groups and students learning on their own has become more of the norm in classrooms across the country with more than half of teachers reporting frequent use of technology for instructional purposes (United States Department of Education, 2003). This can lead to relying on researching as a class or encouraging students to learn on their own instead of the teacher seeking out additional knowledge when they feel deficient in content. For some of the beginning teachers, they still felt like a true expert teacher was one who can lecture, lead discussion, and knows the "why" behind the content. These teachers often felt compelled to seek out additional knowledge during the planning stage, but may be restricted by time or funding.

Many of the teachers in the study discussed feeling inadequately prepared in content from their teacher preparation program, which echoes the findings of other education disciplines including Ballantyne and Packer (2004), Borko et al. (1992), and Haston and Leon-Guerreo (2008), among others. This perceived lack of preparedness in content and application of content knowledge also corroborates findings from Rice and Kitchel (2015a), who reported similar perceptions from preservice agriculture teachers. Investigation and conversation about the role of agriculture teacher preparation seems worth the time and resources, including exploration into the possibility of specialization areas for specific content within agriculture.

Professional development was cited as one of the most significant content knowledge source predictors for agriculture teachers' PCK according to Rice and Kitchel (2015b). Making professional development opportunities for agriculture teachers more accessible in cost, when they are offered, and how much time they take to complete could help to alleviate the issues described by teachers in this study related to time and funding. Because PCK, which includes the ability to break down knowledge for student understanding, is a complex knowledge base and develops over time (Hashweh, 2005), it may be unreasonable to expect teacher preparation programs to completely prepare preservice teachers before they enter the field. This points to professional development and other sources of content knowledge and PCK as being crucial components of beginning agriculture teachers' success in the classroom.

The debate over whether agriculture programs should focus on career preparatory skills or agriculture literacy is not new in agricultural education (Roberts & Ball, 2009). The teachers in the study expressed conflicting philosophies about the purpose of their agriculture programs. This discrepancy between philosophies needs to be resolved by the profession. Teacher preparation programs should be on the same page regarding the messages they are sending about the purpose of agricultural education in the 21st century world, so teachers can have a clear vision for the

preparation of their students. The teacher knowledge necessary to have a program with agriculture literacy focus will likely look different from a program with a career preparatory focus.

Recommendations moving forward from this study include a more in-depth exploration into the impact of teachers' philosophies regarding agricultural education related to the concepts of orientation discussed by Magnusson et al. (1999) and Friedrichsen et al. (2010), and the role of beliefs on teachers' PCK described by Hashweh (2005). Because this study was limited to five agriculture teachers, observing and interviewing additional beginning agriculture teachers to see if the findings are similar or if there are additional pieces to the puzzle is also recommended. It is unclear whether the coping strategies described occur in stages or if the type of content the teachers felt deficient in played a role in how they decided to cope.

Additionally, investigating experienced agriculture teachers could provide insight into the emergence of PCK as the beginning agriculture teacher becomes more of an expert. As teachers' time in the profession increases do their coping strategies evolve and look different? How often do they plan to seek out additional content knowledge at later stages of their careers? Finally, if many teachers are avoiding content they don't know often what type of impact could this have on student achievement? Being an exploratory study there are many questions left to answer regarding beginning teachers' deconstruction of agriculture content for teaching.

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