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Preservice Teachers' Conceptualizations of Agricultural Mechanics

Rachael L. Whitehair[1], Kelsey Rae Sands Schramm[2], Trent Wells[3], and Mark S. Hainline[4]

Abstract

Agricultural mechanics laboratories are frequently available for use within school-based agricultural education (SBAE) settings. Moreover, agricultural mechanics instruction is quite common and can include a wide range of subject matter. Preservice teachers are frequently concerned about teaching agricultural mechanics, sometimes due to negative or no experiences in the subject. We sought to describe how preservice teachers, many of whom had limited experience in agricultural mechanics, conceptualized agricultural mechanics at the beginning and end of a teacher education-focused agricultural mechanics course. Conceptually framing our study using Boud et al.'s (1985) model of reflection, we used a qualitative research design to collect data from 17 preservice teachers. Two themes and four sub-themes were identified through our data analysis process. We found preservice teachers' conceptualizations of agricultural mechanics were positively impacted as a result of a semester-long course. We recommend SBAE stakeholders continue to engage preservice teachers in high-quality agricultural mechanics-related experiences to better prepare the next generation of teachers to create opportunities for their students.

Keywords: agricultural mechanics; preservice teachers; reflection; conceptualization

Author Note: Rachael L. Whitehair is now a Regional Outreach Specialist / Natural Resource Educator at the Wood County Extension Office. Kelsey Rae Sands Schramm is now an Agricultural Education Instructor (Grades 6-12) at Woodbury Central Community School. Trent Wells is now an Assistant Professor of Agricultural Education in the Department of Agriculture at Southern Arkansas University.

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Correspondence concerning this article should be addressed to Rachael L. Whitehair, Wood County Extension Office, 400 Market Street, Wisconsin Rapids, WI 54494.
Email: rachael.whitehair@wisc.edu

Introduction

Laboratory-based instruction is a focal point in school-based agricultural education (SBAE) settings (Phipps et al., 2008). Used extensively in SBAE for decades, SBAE laboratory facilities range

[1] Rachael L. Whitehair is a Regional Outreach Specialist / Natural Resource Educator in the Wood County Extension Office, 400 Market Street, Wisconsin Rapids, WI 54494, rachael.whitehair@wisc.edu
[2] Kelsey Rae Sands Schramm is an Agricultural Education Instructor (Grades 6-12) at Woodbury Central Community School, 408 S. 4th Street, Moville, IA 51039, kschramm@wcwildcats.org
[3] Trent Wells is an Assistant Professor of Agricultural Education in the Department of Agriculture at Southern Arkansas University, 100 E. University, Magnolia, AR 71753, ktwells@saumag.edu
[4] Mark S. Hainline is an Assistant Professor of Agricultural Education in the Department of Agricultural Education and Studies at Iowa State University, 513 Farm House Lane, Ames, IA 50011, mhainlin@iastate.edu

in type, size, and utility (Twenter & Edwards, 2017). SBAE laboratory facility types include meat processing, greenhouses, apiaries, livestock handling, and agricultural mechanics (Shoulders & Myers, 2012). SBAE laboratories can serve as pragmatic contexts for experiential learning (Shoulders & Myers, 2013) and project-based learning (Wells et al., 2018). Moreover, as noted by Croom (2008), laboratory-based instruction is a component of the model used to guide SBAE programming. Designed to resemble agricultural industry settings, SBAE laboratory activities are varied and can include such things as constructing woodworking projects, experimenting with food preparation methods, and so forth (Phipps et al., 2008). Focused, purposeful use of SBAE laboratories is important (Wells et al., 2018).

Agricultural mechanics laboratories are frequently available for use within SBAE instructional programming (Shoulders & Myers, 2012, 2013). Regarding prolificacy, Shoulders et al. (2013) found agricultural mechanics facilities were second in availability only to greenhouses. Moreover, Shoulders and Myers (2012) determined many SBAE teachers used agricultural mechanics laboratories as an instructional context quite frequently (i.e., at least once per day). Thus, instruction in agricultural mechanics is common (Burris et al., 2005). As a curriculum area, agricultural mechanics can include a variety of topics, including safety, small gas engines, welding and metal fabrication, electricity, carpentry and woodworking, advanced technologies such as global positioning systems (GPS), and more (Burris et al., 2005; Hainline & Wells, 2019; Shultz et al., 2014). Regarding the educational value and utility of this curriculum area, agricultural mechanics can serve as a useful, practical, and hands-on context for academic content instruction and reinforcement (Parr et al., 2006), problem-solving (Pate & Miller, 2011), and hypothesis generation (Blackburn & Robinson, 2016). Instruction and work in agricultural mechanics can also result in considerable economic impacts over time (Hanagriff et al., 2014).

A wide range of agricultural mechanics topics are regarded as important to teach (Shultz et al., 2014). As such, SBAE teachers must be prepared to deliver instruction within multiple agricultural mechanics subject matter areas (Burris et al., 2005; Hainline & Wells, 2019). Recent studies have examined different aspects of agricultural mechanics and provide greater specificity regarding teachers' needs and abilities. Saucier et al. (2014) sought to "describe the laboratory safety professional development needs of agricultural mechanics teachers" (p. 187) while Pate et al. (2012) identified various knowledge and skills SBAE teachers need to successfully deliver welding-related curricula. More broadly, Hainline and Wells (2019) determined a list of agricultural mechanics knowledge and skills important for SBAE teachers in Iowa to be competent in. Each of these studies provided numerous competencies SBAE teachers need when teaching agricultural mechanics.

Effective SBAE teachers are knowledgeable in their subject matter (Eck et al., 2019; Roberts & Dyer, 2004) and can purposefully manage laboratory settings for teaching and learning purposes (Wells et al., 2018). Thus, it becomes clear that in-service teachers bear much responsibility in the agricultural mechanics education process (e.g., maintaining laboratory environments, being prepared to teach technical subject matter, understanding the concepts important to teach, etc.). Moreover, these authors provided insight into the agricultural mechanics as related to in-service teachers. However, a question lurks: What role does agricultural mechanics play in the professional lives of preservice teachers?

Preservice teachers are frequently concerned about teaching in agricultural mechanics facilities (Tummons et al., 2017). These anxieties can be related to student supervision, laboratory management, technical subject matter knowledge, and more (Tummons et al., 2017). These apprehensions were echoed by Blackburn et al. (2015), who acknowledged preservice teachers did not perceive themselves as having proficient abilities in welding processes and skills. As noted by Rasty et al. (2017), SBAE teachers are responsible for providing students with optimal learning opportunities that will prepare

them for life beyond high school. Thus, preservice teachers should be adequately prepared to lead local SBAE programs via adequate and effective technical subject matter preparation (Burris et al., 2005; Whittington, 2005).

Leiby et al. (2013) indicated preservice teachers perceived teaching agricultural mechanics subject matter as important and further indicated confidence to teach the subject matter can be positively impacted as a result of a semester-long course. As documented by Tummons et al. (2017), some preservice teachers have limited experience or exposure in agricultural mechanics; moreover, and perhaps even more troubling, some preservice teachers have had negative experiences in the curriculum area. It is reasonable to postulate preservice teachers may not fully conceptualize the nature and scope of agricultural mechanics. Is this the case with a group of 17 preservice teachers, many of whom did not take an agricultural mechanics course during their time as secondary students?

Context of the Study

The agricultural mechanics course in our study was teacher education-focused, was 16 weeks in duration, and was designed to provide preservice teachers with a variety of experiences related to agricultural mechanics, including laboratory management, skills training, pedagogical practices, and subject matter knowledge development (Iowa State University [ISU], 2018). The course structure consisted of: (1) instructor-led subject matter knowledge and skill development exercises in electrical theory and circuit wiring, small gas engine dis-assembly and re-assembly, shielded metal arc welding (SMAW), gas metal arc welding (GMAW), oxy-acetylene cutting, and computer numerical control (CNC) plasma cutting system use, and (2) one 50-minute micro-teaching lesson presentation conducted by each preservice teacher. The micro-teaching lesson presentation topics included: (1) using measurement tools, (2) planning agricultural mechanics projects, (3) computer-aided design (CAD) software use, (4) handheld plasma cutting system use, (5) using various woodworking tools, (6) woodworking project construction, and (7) metalworking processes.

The preservice teachers were also expected to engage in various learning experiences including laboratory facility design and layout, instructional planning, safety planning, and more. As this is the only agricultural mechanics course these preservice teachers are required to complete during their agricultural teacher preparation program, it was vital the course is designed to address as many agricultural mechanics knowledge and skill areas as possible. The course was structured with a combined lecture and laboratory schedule, was taught twice a week, and met for five total contact hours (i.e., two hours on one day and three hours on the next day) each week. In the scope of our study, 19 preservice teachers were enrolled in the course during the Spring 2018 semester. Eleven preservice teachers were female and eight were male.

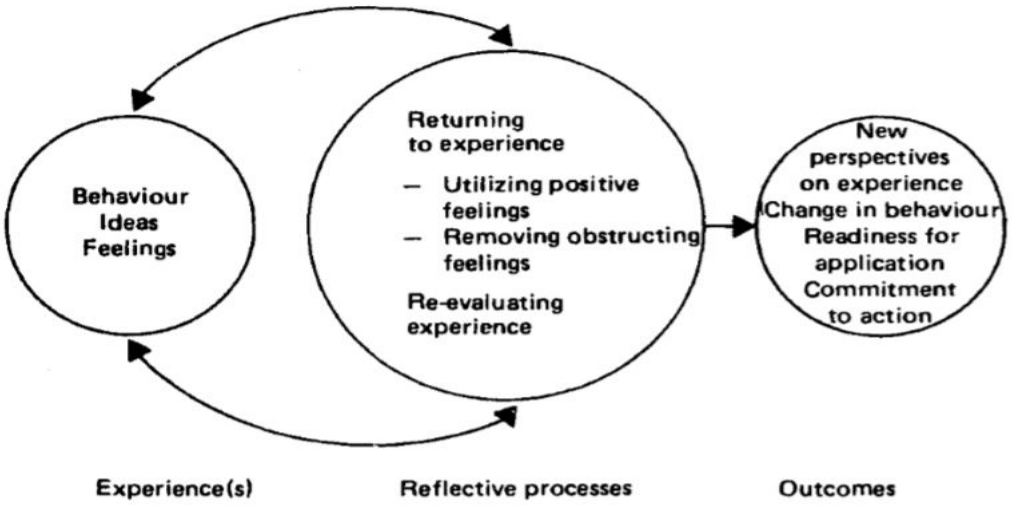
The course was taught by an assistant professor of agricultural education who taught laboratory-oriented SBAE coursework in Texas prior to engaging in his doctoral program. During his doctoral program, the assistant professor taught agricultural mechanics coursework to preservice teachers and supervised student teachers who taught agricultural mechanics courses. To aid in the delivery of the course, a graduate teaching assistant (GTA) served in different capacities (e.g., guest teaching during electrical theory and wiring demonstrations, SMAW and GMAW skill demonstrations, etc.) throughout the course as needed. The GTA was a former SBAE teacher who taught agricultural mechanics coursework in Alabama prior to initiating his doctoral program.

Conceptual Framework

Reflection is an important component of the learning process (Kolb, 2015). Per Boud et al. (1985), "[r]eflection is a form of response of the learner to experience" (p. 18). The process of reflection

allows individuals in a situation to re-assess an experience and determine a course of action for the future (Boud et al., 1985). Moreover, reflection can be an important tool for understanding and facilitating growth and change (Boud et al., 1985; Kolb, 2015) As agricultural teacher preparation programs focus on preparing effective and reflective educational practitioners (Whittington, 2005), we operationalized Boud et al.'s (1985) model of reflection (see Figure 1) as the conceptual framework for our study.

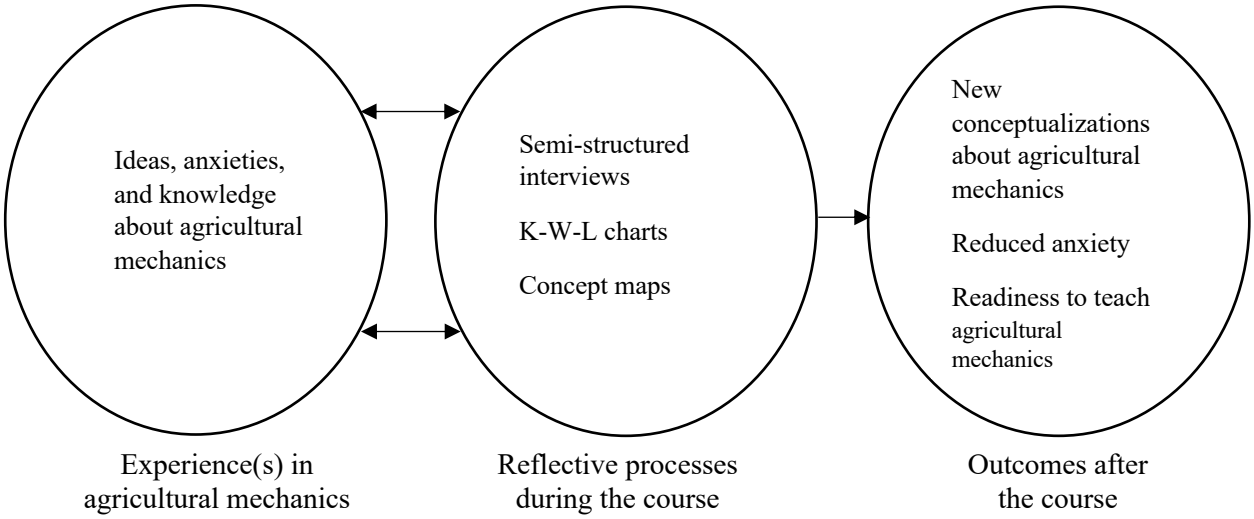
Figure 1
Model of Reflection (Boud et al., 1985)



Boud et al. (1985) noted "experience consists of the total response of a person to a situation or event: what he or she thinks, feels, or does and concludes at the time and immediately thereafter" (p. 18). We believed operationalizing this model to examine the evolution of preservice teachers' thoughts during the experiences associated with the course would better inform our study. Boud et al.'s (1985) model depicts how individuals' experiences can be influenced by behaviors, ideas, and feelings. Their model also indicates how behaviors, ideas, and feelings can be impacted based on experiences, creating a feedback loop. From those experiences, one advances through the reflective process, where they must return to the experience to analyze their feelings and in turn re-evaluate the experience. During this reflective process, the individual considers information regarding the positives and negatives of the experiences encountered. Outcomes following the reflective process include new or different perspectives on the experience, changes in behavior, commitments to action and readiness for application (Boud et al., 1985).

When applied within the context of our study, we documented preservice teachers' prior experiences with agricultural mechanics along with their ideas about agricultural mechanics at the beginning of the course. This allowed us to contextualize their prior experiences and prepare for the reflective process to occur at the end of the semester. We sought the opportunity for preservice teachers to re-evaluate their experiences through semi-structured interviews, concept maps, and *Know-Want to Know-Learned* (K-W-L) charts. Subsequently, preservice teachers were expected to use their new agricultural mechanics course experiences and their engagement in reflection to reach a decisive outcome, such as a new conceptualization of agricultural mechanics, a greater readiness to teach agricultural mechanics, and so forth. A modified version of Boud et al.'s (1985) model of reflection was developed to adequately frame our study (see Figure 2).

Figure 2
Modified Version of Boud et al.'s (1985) Model of Reflection



Purpose and Research Questions

The purpose of our study was to investigate preservice teachers' conceptualizations of agricultural mechanics prior to and after enrollment in a teacher education-focused agricultural mechanics course. The following research questions were used to guide our study:

1) What were the agricultural mechanics-related backgrounds of preservice agricultural teachers enrolled in a teacher education-focused agricultural mechanics course?
2) What are the agricultural mechanics-related perceptions of preservice agricultural teachers enrolled in a teacher education-focused agricultural mechanics course?
3) What outcomes arise from preservice teachers following reflective processes about their experiences in a teacher education-focused agricultural mechanics course?

Our study aligned with Priority 5: Efficient and Effective Agricultural Education Programs of the National Research Agenda (NRA) of the American Association for Agricultural Education (AAAE; Thoron et al., 2016). More specifically, our study sought to address Research Priority Question 3: "What are the short, medium, and long term outcomes and impacts of educational programs in agriculture and natural resources?" (Thoron et al., 2016, p. 43). SBAE, as part of career and technical education (CTE), is designed in part to provide knowledge- and skill-oriented education and training in a variety of areas related to agriculture and natural resources (Roberts & Ball, 2009; Thoron et al., 2016).

Methods

Research Design

A qualitative research design was used to address our research questions. Our study was initiated upon approval by the university's Institutional Review Board (IRB). Our research team was composed of the course instructor, the course GTA, and two graduate-level preservice teachers, neither of whom had formal educational experiences in agricultural mechanics. Data from 17 undergraduate preservice teachers enrolled in the course during the Spring 2018 semester were included in our study.

The typical preservice teacher described their hometown as rural (n = 16; 94.1%) and the gender breakdown was almost evenly split between females (n = 9; 52.9%) and males (n = 8; 47.1%).

The course assignments that informed our study consisted of graphic organizers (i.e., concept maps and K-W-L charts). During the first course meeting, the course instructor asked all preservice teachers to use two blank sheets of white copy paper to illustrate a concept map and a K-W-L chart. The purpose of these activities was to assist the course instructor and the GTA in planning for the remainder of the semester and working to ensure preservice teachers' perceived instructional needs were met. The preservice teachers were instructed to first create a concept map detailing their present conceptualizations of agricultural mechanics. The preservice teachers were then asked to create a three-column K-W-L chart detailing what they *Know* about agricultural mechanics and what they *Want to Know* about agricultural mechanics. The preservice teachers were not permitted to complete the *Learned* column until later in the semester.

During the completion of each of these activities, the course instructor and the GTA remained present to answer any questions about either of the graphic organizer activities. As graduate-level preservice teachers enrolled in the course and as co-authors of this study, we completed concept maps and K-W-L charts along with the other preservice teachers but did not include our items in the data set. After the conclusion of first course meeting, the GTA blinded the preservice teachers' names and numbered all the concept maps and K-W-L charts prior to scanning them into an electronic format. Afterward, all physical copies of the concept maps and K-W-L charts were stored in a locked facility in the course instructor's office until the final week of the semester.

During the final week of class meetings, all preservice teachers were given blue ink pens along with their concept maps and were asked to use the blue ink pens to make additions to their concept maps based on their experiences throughout the course. The blue ink helped us to distinguish between the concept map items made at the start of the semester and the concept map items added at the end of the semester. The preservice teachers were then instructed to use the blue ink pens to fill in the remaining column (i.e., *Learned*) of their K-W-L charts. The information in the *Learned* column was, in a fashion congruent with the revisited concept maps, designed to be informed by the preservice teachers' experiences after the course concluded.

Immediately following completion of the graphic organizers, preservice teachers were asked to participate in an interview with us, the two graduate students who co-authored this study. An interview protocol consisting of 10 open-ended questions was used to guide each interview. The questions were designed to provide us as researchers with an assessment of each preservice teacher's previous experiences and educational backgrounds in agricultural mechanics as well as their retrospective of perceived relevance of the course to possible future experiences in agricultural mechanics. Additionally, the interviews served as an opportunity to gain insight into the changes made by each preservice teacher to their graphic organizers. Each preservice teacher was asked to provide an explanation of their concept map during the interview process, thus granting a comprehensive understanding of each preservice teacher's concept map and helping to limit any implicit bias on the research team members' parts.

We, the two graduate students, conducted each interview in a private location away from others; in addition, each interview was audio-recorded with an electronic recording device. Field notes about each interview were taken and stored in a secure location. After all interviews were complete, we, the two graduate students, transcribed each one and conducted a member check procedure with each preservice teacher to ensure accuracy of the transcriptions. We followed the guidelines established by Lincoln and Guba (1985) to ensure trustworthiness, credibility, and reliability of the data by using research logs, conducting peer review of the data (by three members), and member checks. Further, we

as graduate students also reviewed interview transcripts and performed coding procedures separately. After these processes were complete, we also met to debrief about each interview and to develop a preliminary list of themes. Pseudonyms were assigned to each preservice teacher to protect their identity.

Coding Procedures

All data collected, including interview transcripts, concept maps, and K-W-L charts were subject to a three-part coding procedure based upon grounded theory, an approach frequently used to draw conclusions from qualitative data (Charmaz, 2006; Glaser, 1978; Strauss & Corbin, 1990). Guiding our process, grounded theory posits researchers should not begin the data analysis process with a theory and the intention to prove it. Data should be examined with interest pertaining to a specific area of study and allow what is relevant to emerge (Strauss & Corbin, 1990).

An initial phase of open coding was conducted with K-W-L charts and concept maps to tabulate word frequencies. Interview transcripts were open-coded line-by-line to identify prevalent themes. All three artifact groups underwent a second phase of focused, selective coding which utilized dominant items from open-coding to form clarified categories and themes. To ensure reliability, themes identified within each artifact group were compared with the latter two, specifically to observe the overlapping of categories. A final step of axial coding was conducted using the identified themes from all three artifact groups (i.e., K-W-L charts, concept maps, and interview transcripts) to draw conclusions about outcomes observed amongst preservice teachers following the conclusion of the agricultural mechanics course.

Subjectivity Statement

The research team was composed of the course instructor who was an assistant professor with prior experience teaching agricultural mechanics subject matter at the university level, the course GTA, and two graduate students with no formal educational experiences in agricultural mechanics. The two graduate students on the research team were concurrently enrolled in the course during the time data was collected; however, they did not contribute their course experiences or graphic organizers to the dataset. The graduate students' lack of agricultural mechanics background allowed them to collect data without prior context. The backgrounds of both the course instructor and the GTA in teaching agricultural mechanics within agricultural teacher education offered a robust context to the study. The course instructor and GTA are frequent observers of the major shortcomings of incoming preservice teachers.

Findings

Two major themes emerged from the data. The first theme included how preservice teachers developed a background in agricultural mechanics. This encompassed gathering information regarding informal and formal learning experiences related to agricultural mechanics. Additionally, the second theme focused on growth following participation in the course. Preservice teachers' growth was categorized into the following sub-themes: broadened perspectives, personal and professional growth, and motivations to learn. The preservice teachers indicated they experienced personal and professional growth as they received exposure to different topics and skills. These indications were expressed within their K-W-L charts, concept maps, and during the interviews.

Theme One: How Preservice Teachers Developed Backgrounds in Agricultural Mechanics

Almost half (*n* = 8, 47.1%) the preservice teachers indicated they had previously enrolled in agricultural mechanics or industrial technology education (ITE) coursework at the secondary level and only two preservice teachers (11.8%) reported engaging in agricultural mechanics / ITE coursework at the postsecondary level. When asked about previous experience in agricultural mechanics, Marlene provided some insight on her formal learning experiences in an agricultural mechanics laboratory setting. Marlene indicated the agricultural mechanics course she took focused on woodworking, welding and small gas engines. She stated, "[w]ith each of these [topics] in high school, we always kind of introduced [agricultural mechanics] and then we introduced the materials that were going to be used." Gayle explained her conceptualization of agricultural mechanics was developed by taking high school agricultural mechanics courses focused on safety, woodworking, small gas engines, electricity and plumbing. Gayle added, "[w]e didn't do much welding. I think we had one welding class, so I really didn't have that in mind, but I always kind of knew it was there." Similar to Gayle's background, Chris reported taking a high school-level agricultural mechanics course focused on welding, electricity, woodworking, and small gas engines.

As a part of their high school agricultural mechanics experiences, some preservice teachers reported enrolling in dual-enrollment courses at their local community colleges. For example, Tom mentioned he had the "opportunity to go up to [COMMUNITY COLLEGE] in [CITY] and take other classes. I took my welding and got that, another friend of mine did carpentry and you could also do automotive." Jean-Ralphio explained, "I had to take online classes through the community college because we didn't offer anything."

While some preservice teachers reported having minimal to no formal training in agricultural mechanics or ITE prior to taking course, they frequently mentioned informal learning experiences when asked about their backgrounds. Many preservice teachers indicated their upbringing played a part in their previous exposure to agricultural mechanics. Andy reported his experience with agricultural mechanics was tied to his childhood on a farm, where he commonly engaged in woodworking projects, tractor operation, and equipment repair. Ron shared similar background experiences working on his parents' farm and working in his family's farm equipment dealership. Ron added he never served as a mechanic at the farm equipment dealership but he often worked the parts counter and assisted with equipment procurement.

Ann reported she had the opportunity to work on trucks, tractors, and all-terrain vehicles (ATVs) while growing up on her family's farm. Mona-Lisa indicated she gained some agricultural mechanics experience by spending time in her uncle's SBAE program and his custom metal shop. Mona-Lisa stated she would visit his class and had the opportunity to work with plasma cutting systems and other metalworking equipment. Ben stated his previous agricultural mechanics experiences involved the operation of miter saws and table saws when completing woodworking projects around his home.

When the preservice teachers discussed their previous informal agricultural mechanics experiences, they commonly provided caveats associated with the quality of their previous experiences. For example, Andy stated he "helped with the tractor but… by no means kn[e]w what everything is." Ron indicated he had repaired tractors since he was 12 years old but he followed up the statement by saying, "[I was] not doing [tractor repairs] myself but kind of looking over the shoulder of somebody." Congruent with Ron's experiences, many of the preservice teachers in the course mentioned their background and previous agricultural mechanics experiences were tied to vicarious learning experiences. For example, Donna noted she had limited first-hand experience associated with agricultural mechanics but she had previously watched her father work on projects. Donna said, "I kind

of watched my dad do the work. I've never really done anything hands-on using any like tools or anything like that other than like a drill." However, Donna contributed her understanding of engine theory and ability to identify engine parts to interacting with her father while he worked on cars. While describing her experience working with her father, Donna said:

> I always like working with him. I like to ask a lot of questions, so I'[d] be over the hood of a car with my dad trying to figure out what he's doing and holding the flashlight [for him]. He's really good at explaining what he's doing because he actually learned from his dad.

Theme Two: Preservice Teacher Growth

Broadened Perspectives

There were numerous changes in the items represented on the preservice teachers' concept maps and K-W-L charts when comparing the first and final course meetings. Data collected from the concept maps are detailed in Table 1. Both the topic area and the frequency mentioned are reported. Original concept maps mostly displayed broad topic descriptors such as *welding / metalworking* or *engines / engine theory*. Preservice teachers added ancillary information to previously included topic areas when revisiting their concept maps. We also combined items within broader constructs (e.g., using a welder would have been classified within the *Welding / metalworking* item, etc.).

Several topic areas scarcely present or absent in original concept maps such as *hydroponics*, *concrete application*, and *surveying*, which were part of the course content, are heavily present in concept map additions. Moreover, preservice teachers often augmented previously identified agricultural mechanics topics to add more information about them. An example of this was noticed with the *welding / metalworking* and *welding / metalworking knowledge* items. These were tallied as two separate items. The interviews we conducted with each preservice teacher revealed this often occurred due to perceptions of increased knowledge about the topic as opposed to awareness of its existence. The occurrence of information related to a topic construct area was tallied as one instance within each individual concept map. As such, it should be noted we used frequencies and percentages to report each occurrence as well to indicate each construct area was reported no more than 17 times (i.e., once for every preservice teacher) in total within both the pre- and post-course concept maps. Percentages were used to indicate the percent of preservice teachers out of the 17 total who listed items related to each topic.

Table 1
Pre- and Post-course Concept Map Topics

Listed During First Course Meeting		Additions Made During Final Course Meeting	
Topic	*f*(%)	Topic	*f*(%)
Welding / metalworking	15(88.2)	Welding / metalworking knowledge	12(70.6)
Engines / engine theory	13(76.5)	Plumbing systems knowledge	11(64.7)
Carpentry / woodworking	12(70.6)	Carpentry / woodworking knowledge	10(58.8)
Safety	12(70.6)	Electrical systems knowledge	8(47.1)
Electrical systems	8(47.1)	Software systems knowledge	8(47.1)
Tool identification / use	6(35.3)	Surveying	8(47.1)
Machinery restoration / repair	5(29.4)	Safety	8(47.1)
Teaching methods	5(29.4)	Hydroponics	7(41.2)
Trade skills / careers	5(29.4)	Concrete applications knowledge	7(41.2)
Plasma- / metal-cutting	5(29.4)	Machinery types / operation	7(41.2)
Machinery types / operation	4(23.5)	Plasma- / metal-cutting knowledge	7(41.2)
Plumbing	3(17.6)	Engines / engine theory	6(35.3)

Data collected from the K-W-L charts are detailed in Table 2. Both the topic area and the frequency at which each topic is mentioned are reported. Improved awareness is seen greatest in areas of *welding / metalworking*, *plasma- / metal-cutting*, and *carpentry / woodworking*. Each of these areas were covered during the course. Areas which had a high frequency of presumed awareness, such as *safety practice / education*, *carpentry / woodworking*, and *engines*, are included or expanded upon in the *Learned* column following the course experience. High *Learned* column frequencies are seen for topics which were absent in *Know* columns such as *plasma- / metal-cutting*, *plumbing systems*, and *concrete application*.

Table 2
K-W-L Chart Topic Frequencies

Topic	Know[1]	Want to Know[1]	Learned[2]
Welding / metalworking knowledge	6	13	15
Plasma- / metal-cutting	-	2	14
Carpentry / woodworking	8	2	13
Engines	7	7	9
Electrical systems	3	6	8
Curriculum planning	4	4	8
Plumbing systems	-	1	8
Safety practice / education	12	7	7
Concrete application	-	-	7

Note. [1]K and W were completed at the beginning of the course. [2]Completed L and augmentations to K and W were completed at the end of the course.

The preservice teachers also indicated the course allowed them to broaden their perspectives, which allowed them to continue the growing process. Sebastian stated, "[a]gricultural mechanics encompasses so much more than what I first started my concept map. I mean you've got different cutting options with the oxy-acetylene torch or plasma cutting." Gayle explained, "[p]lumbing and electrical [were topics] I didn't visualize as an agricultural mechanics-type class just because that's stuff we did in our home improvement class in high school." Wendy further explained, "[w]e did a lot of different things that I wouldn't think of as being agricultural mechanics. For example, land surveying, concrete pouring, and [operating] the skid [steer] loader [were not things I considered to be agricultural mechanics]." Jean-Ralphio pointed out, "[i]t really encompasses a lot more than I had originally thought about. The whole classroom management thing and how you're working with different groups of people in different settings and different people have different skill levels." Ann noted, "I think agricultural mechanics is too broad of scale. I mean people kind of focus on it and think, 'Oh, it's just agriculture', but there's a lot of skills in here that correlate back to the industrial technology aspect."

Personal Growth

The preservice teachers indicated the course allowed them to grow in their personal lives as each person taking the class had different experiences. April stated, "I know this course material will be applicable, but definitely in teaching and just learning those real-life experiences, whether that's with farming or a specific shop or company." Ben explained, "Now I know all the tips, tools, and different techniques for certain shop activities that I'm going to need to know." Ann stated, "I think now with the experiences I have, I'll definitely be more willing to teach [agricultural mechanics]. Whereas before taking this class, all I had was my high school experience."

Jerry indicated, "I feel a lot more comfortable about standing up and teaching about it now than I did before I came." Marlene explained, "I think it's only made it more of a desire for me to get into

the classroom just because I love being able to get students into those hands-on opportunities and agricultural mechanics that just falls into your lap." Tammy said, "After this class, I really look forward to teaching a class like this and I feel much more confident and more comfortable, in terms of using the tools knowing how to… safely operate them and teach about them."

Professional Growth

While taking the course, the preservice teachers felt they had the opportunity to grow professionally. Wendy indicated, "I think learning more about engines and plumbing and operating other types of woodworking tools has been really helpful and I'll definitely be able to take that into a shop setting." Chris stated, "Mainly the teaching stuff to help me out as that was probably my weak area coming in." Jean-Ralphio said, "I think it will help me in my classroom if I ever have to teach agricultural mechanics classes. I have a better understanding of how to teach it so I can feel a lot more prepared." Sebastian explained, "Just being comfortable in teaching the different shop techniques. It's kind of nerve-wracking to have 20-some kids out there messing with welders. So just giving us that experience was helpful in letting us be comfortable with welders."

Leslie stated, "I feel before this class I wouldn't have wanted to take a teaching job if I had to teach agricultural mechanics, but now I'd be willing to try it out." Mona-Lisa stated, "Before, I… had always told myself that it really wasn't even a possibility for me… to teach in a program where it was a component of the classroom, but now… I would consider teaching an agricultural mechanics class." Ron said, "I knew a little bit about everything, but I wasn't anywhere close to an expert. This class really helps with these different teaching techniques and how it all kind of relates together. So I think it kind of built on knowledge to help me perform better as a teacher." Gayle explained, "It's definitely made me more comfortable in having all these kids and people around me with welders that they don't know what they're doing." Gayle also noted the class gave her the confidence to teach basic agricultural mechanics concepts.

Motivations to Learn

Several preservice teachers indicated their desire to perform in this class was from intrinsic motivation factors. Ron further explained, "[d]efinitely the aspect of how this is stuff I've always wanted to learn about and I would like to be good at and have experiences with." Mona-Lisa stated, "I feel sometimes personal interest and drive isn't always there, but for this class it's really cool, brand new stuff." April indicated, "I'd like to teach it and so I really just want to learn. I'm going to end up teaching it and I wanted to work on it to be helpful to my students."

The preservice teachers also indicated extrinsic motivation factors played a role in their performance in the course. Andy stated, "Around Iowa, some of the agricultural [education] teaching jobs are more agricultural mechanics-centered, so being able to excel in and know what I'm doing will help me find a job when I graduate." Chris said, "I want to be able to do it and demonstrate it the right way in front of my kids." Ann indicated her motivation to develop her skills in agricultural mechanics were tied to her desire to teach at a rural school—where agricultural education programs often have a strong emphasis on agricultural mechanics. With similar aspirations as Ann, Wendy indicated her desire to teach in a smaller school has motivated her to hone her skills in agricultural mechanics.

Ben explained, "[p]robably just the fact I will probably have to teach this at some point in my life and it's good skills to have and know how to do." Gayle said, "Just being able to work back home and in my classroom so I am proficient when I start teaching my students and working with my dad again." While reflecting on how the course experience could be leveraged toward a secondary setting, Jean-Ralphio stated, "[e]verything we've learned I think I'll probably end up using in the classroom and

some way or another because it's going to fit in a horticulture [course], agricultural mechanics [course], and industrial technology [course].

The desire to learn more was another motivator which pushed the preservice teachers to perform in the course. Ron stated, "I do wish we would've been able to spend more time on welding because it is something that doesn't just come naturally to many people and we only got to spend two weeks on it." Leslie stated, "I would've liked to have more time applying our skills with some of this stuff." Tom stated, "We could've delved deeper into engines because I'm not as familiar with that and I think it would better help me teach." Sebastian stated, "I thought we should have emphasized more about engines and working on tractors and cars. I've gone to multiple different agricultural [education] programs and [community members] have lawn mowers and bring in a planter to see if the agricultural [education] teacher can fix it."

Conclusions, Discussion, and Recommendations

We found growth in preservice teachers' perceived awareness of agricultural mechanics knowledge and skills occurred throughout the agricultural mechanics course. The typical preservice teacher enrolled in the course during the Spring 2018 semester had begun to develop a background in agricultural mechanics through both formal and informal means prior to enrolling in the course. Per the concept maps and K-W-L charts used at the beginning and end of the course, the typical preservice teacher added new agricultural mechanics-related topics and provided deeper details about previously identified topics on both types of graphic organizers. Preservice teachers further indicated they had several professional and personal motivations for learning and successfully applying agricultural mechanics knowledge and skills in their career and beyond. It appears that engaging, effective, and positive experiences prior to and during the course may have been influential and proactively contributed to these preservice teachers' conceptualizations of agricultural mechanics while negative experiences may have been harmful.

Experience can be a powerful source of learning, particularly when reflection based on experiences is used to identify areas of strength and weakness (Boud et al., 1985; Kolb, 2015). In the context of our study, the experiences provided for the preservice teachers via the course allowed for opportunities to contextualize experiences in agricultural mechanics prior to and after a one-semester, teacher education-focused agricultural mechanics course. Per our modified version of Boud et al.'s (1985) model of reflection (see Figure 2), reflective opportunities based on experience were given through the semi-structured interviews, concept maps, and K-W-L charts.

We found using the concept maps and K-W-L charts helped preservice teachers organize their thoughts and present them in a logical sequence. We also noted the interview process allowed for clearer articulation and deeper understanding of how and why the preservice teachers conceptualized agricultural mechanics. We recommend agricultural teacher educators consider using this reflective learning approach in their coursework to observe change in preservice teachers following instruction. As Boud et al. (1985) and Kolb (2015) indicated, reflection is a learning opportunity that complements experience. More frequent use of the concept maps and K-W-L charts throughout a course could be useful as well (e.g., once every four weeks, eight weeks, etc.), as this would allow for a more regular reflection and outcome definition process. This approach could be useful with teacher educators from other curriculum areas, such as mathematics, English language arts, and so forth, as they work to better understand their own preservice teachers' understanding of their individual discipline areas.

Agricultural teacher preparation programs provide opportunities for professional growth and development through technical agriculture courses, student teaching, pedagogy-focused coursework, and more (Whittington, 2005). To better ensure SBAE teachers are prepared to affect change through

agricultural education programming, the profession must be proactive in its approach (Thoron et al., 2016). To help better prepare preservice teachers to teach agricultural mechanics, exposure to agricultural mechanics subject matter and facilities should be conducted during EFEs, through student teaching, as well as through any available coursework during the teacher preparation phase. Having preservice teachers complete their observation hours under the direction of experienced in-service SBAE teachers may be beneficial as well, as these teachers can provide insight into specific curriculum areas, project ideas, laboratory management ideas, and so forth based on their numerous years of experience leading SBAE programming. Per the recommendations of Wells et al. (2018), intentionally placing preservice teachers in high-quality SBAE programs that effectively implement laboratory-based (e.g., agricultural mechanics) teaching and learning processes is paramount for ensuring preservice teachers are exposed to environments that leave positive impressions and can influence their perceptions and conceptualizations of a topic.

The preservice teachers in our study indicated they valued agricultural mechanics as a curriculum area in modern SBAE programs. Moreover, several preservice teachers indicated they plan to teach agricultural mechanics in the future. These results are encouraging, as preservice teachers sometimes struggle with the complexities of teaching agricultural mechanics (Tummons et al., 2017). Agricultural mechanics is broad (Hainline & Wells, 2019), in-depth, and popular in many SBAE programs (Burris et al., 2005). Thus, it is imperative preservice teachers continue to be exposed to positive experiences related to agricultural mechanics, particularly within agricultural teacher preparation programs (Burris et al., 2005). As indicated by these preservice teachers, gaps in their agricultural mechanics knowledge and skills remain. We recommend this study be replicated within other institutions' agricultural mechanics coursework to determine if other preservice teachers have similar backgrounds, experiences, ideas, and conceptualizations about agricultural mechanics as compared to the individuals within our study.

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