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Agricultural Technical Skills Needed by Entry Level Agriculture Teachers: A Modified Delphi Study

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Abstract

Many students currently in preservice agricultural education teacher education programs do not have traditional agricultural backgrounds. Many of those students are experiencing skills they will be required to teach or utilize upon employment for the first and sometimes only time in introductory course work within their teacher education programs. This study utilized an expert panel from within the Southern Region of the AAAE composed of teacher educators, teachers that have taught for more than five years (veteran teachers), and teachers with less than three years' experience (new teachers) in a modified Delphi technique to develop a consensus list of technical agricultural skills that preservice agricultural teachers should possess prior to their first teaching job. Beginning agricultural education teacher skills were declared across seven categories. The agricultural mechanics category had the most (31 skills), followed by horticulture (24 skills), and animal science (14 skills). The remaining skills fell in the categories of business/program management (8 skills), natural resources/soils (5 skills), food safety/food science (5 skills), and safety (4 skills). An emergent finding showed differences in opinions between new teachers, veteran teachers, and teacher educators in how many skills new teachers should possess.

***Keywords*:** technical skills; agriculture teachers; new teachers; preservice teachers

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Introduction

A current and common concern among educators is teacher attrition. Nationally teachers are leaving the profession within their first five years of service for reasons of dissatisfaction including conditions, pay, resources, student behavior, accountability, opportunities for development, autonomy, and school leadership (Ingersoll, Merrill, & Stuckey, 2014). Arguably those challenges are increased for new school based agricultural education (SBAE) teachers. New SBAE teachers, in comparison with general education teachers, report having a multitude of additional responsibilities with roles managing agricultural lab/land space, supervised agricultural experiences (SAE), and career development events (CDE) (Lemons, Brashears, Burris, Meyers, & Price 2015). Agricultural educators are required to have both subject specific and technical knowledge requiring an appropriate amount of knowledge and skill to be considered an expert while constantly adapting to new technologies and practices in the field (Roberts & Ball 2009). New SBAE teachers will find themselves needing technical skills to manage and teach, skills that are also required for the management of one or more teaching facilities beyond the classroom including but not limited to a land lab/farm, greenhouse, shop, livestock

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facilities (Lambert, Stewart, & Claflin, 2018). Rice and Kitchel (2016) stress the need for pedagogical content knowledge (PCK) in agricultural education. The content SBAE teachers must apply to the mixture of pedagogy and technical skills required is contextually and geographically based including but not limited to biology, chemistry, mathematics, animal husbandry, horticulture, agronomy, business, mechanics, leadership, and government. Perhaps better prepared teachers might not leave the profession at the same rates as underprepared teachers. Darling-Hammond and Bransford (2005) proposed that teachers need knowledge of the learners, knowledge of teaching, and knowledge of the subject matter. This study focused specifically on the subject matter knowledge. Specifically, this study focused on the technical skills needed by preservice teachers, which Edwards and Thompson (2010, p. 127) acknowledged "stand as a formidable challenge for teacher educators." This study aligns with Research Priority 3 in the AAAE National Research Agenda (Roberts, Harder, & Brashears, 2016).

Theoretical Framework and Literature Review

The overall framework for this study was built on experiential learning (Dewey, 1938; Roberts, 2006). The opportunities for experiential learning in SBAE serve as the platform on which historically has been a standard practice of agricultural education (Roberts, 2006). One required experiential learning tool for new SBAE teachers to facilitate is SAE, the opportunity for a student to have an agricultural experience applying what was learned in the classroom in a supervised real environment (Talbert, Vaughn, Croom, & Lee, 2007). Retallick (2010) highlighted inadequacies in the administering of SAE in its intended role and called for a melding of theory and practice in agricultural teacher education programs observing that though teachers spoke of utilizing SAEs in SBAE norms some teachers were not actually practicing their claims. A diverse list of contextual reasons has been suggested for not utilizing the SAE (Retallick, 2010). It is plausible that a lack of teacher efficacy in a given area could result in the teacher discouraging students from engaging in SAE projects in this area.

A potentially related occurrence to the underuse of SAE was the agricultural curriculum changes called for in the 1990's that altered the traditional curriculum to an integration of academics and agricultural skills (Myers & Dyer, 2004). Recent incentives to develop science, technology, engineering, and mathematics (STEM) skills for students gives a new legitimacy to SBAE as a context to apply STEM skills and has altered the way we train teachers (Stubbs & Myers, 2015). Leiby, Robinson, and Key (2013) stated the need to prepare preservice SBAE teachers in agricultural mechanics as imperative due to the amount of technical skills found in SBAE curriculums. Concerns for the adequacy of agricultural mechanical technical skills provided in teacher education programs began to surface predominantly in the literature after the federal government influenced state and local curriculum initiatives with the 2001 *No Child Left Behind Act* (Stair, Warner, Culbertson, & Blanchard, 2016). Validity has been established for the need to find more time for technical training within agricultural teacher education programs (Byrd, Anderson, Paulsen, & Schultz, 2015). Currently the use of STEM incorporation has helped to emphasize the need for agriculture within the mix of education and can be effective in contextually enhancing the general education STEM subjects (Swafford, 2018). A need for more technical experiences for preservice SBAE teachers has found validity. Increased focus on pedagogical knowledge, teaching skills, and STEM incorporation has also found validity but takes time which was traditionally provided to technical skills acquisition. Could there be an underlying issue besides time that is not being fully addressed?

Progression of agricultural teacher education curricula since the push for academic integration has helped programs produce arguably more prepared preservice teachers than ever before. In parallel to this change in teacher education, students currently enrolled in teacher education programs have less of a traditional agricultural background than in the past (Phipps, Osborne, Dyer, & Ball, 2008; Shoulders, Wilder, & Myers, 2011). Generally, theories on experiential learning begin for any one person with an initial experience and are strengthened through facilitation and guided practice (Roberts,

2006). A potential threat to the newly hired SBAE teacher is a lack of experience. Preservice teachers in agricultural education programs may be experiencing technical agricultural skills for the first time as they complete their degree, which may not be sufficient for mastery. The potential curriculum expectations that new SBAE teachers will teach can range the full gamut of agricultural topics depending on location (Leiby et al., 2013). Some preservice SBAE teacher candidates will find employment in programs that understand an individual's agricultural specialization and others will be hired where there is little culture of agriculture at all. Shoulders, Blythe, and Myers (2013) found current SBAE teachers attributed little concern to the background of students as it affected experiential learning in secondary education agricultural laboratories. One could posit that these teachers felt a lack of concern for previously held student knowledge due to confidence in their ability to not only do the task but teach that task to students with no prerequisite of skills required. This confidence arguably is present for veteran teachers or new teachers with confidence in the skill to be taught. New SBAE teachers may only have the initial experience in a technical skill from preservice teacher training that might have been concrete or might have been abstract depending on factors like time and resources for that class day (Kolb, 1984). Upon being hired, a new teacher could immediately be asked by an assuming administrator to manage and teach a technical skill or lab in which their experience may be inadequate. A recent assessment of Oregon agriculture teacher's use of school farms called for teacher educators to better educate preservice teachers in agricultural laboratory settings to guide intentions and behaviors (Lambert et al., 2018). Teacher education programs strive to provide a foundation for preservice SBAE teachers to move beyond the initial stage of teacher survival and disillusionment (Kagan, 1992)

However, therein lies the problem. Given the evolution of the SBAE curricula, which technical skills are most important for preservice teachers to acquire during their teacher education program? A majority of current agriculture students in teacher education programs have less experience in traditional agricultural technical skills due to societal changes (Phipps et al., 2008; Shoulders et al., 2011). Strengthening teaching skills and pedagogical knowledge with progression of agricultural education's inclusion into STEM initiatives have left teacher training programs with limited time for content. If students are coming to agriculture teacher education programs with limited backgrounds and receive limited or no experiences with skills, they will be expected to teach then a deficit in skills-based knowledge could exist. With the established difficulties and responsibility load of new SBAE teachers heavily present in the literature, could lack of self-efficacy in technical agricultural skills be part of the problem?

Purpose

This study sought to utilize an expert panel of agricultural educators to develop a consensus list of technical skills deemed necessary for graduating preservice SBAE teachers to be prepared to enter their first teaching job. Such a list can provide insight for teacher educators as they seek to continually refine the curricula in their programs, especially as related to technical agriculture coursework.

Methodology

A modified Delphi technique was used to develop the list of technical skills (Sackman, 1975), using an approach similar to the National Research Agenda (Roberts et al., 2016). Given the regional nature of agriculture the researchers of this study elected to utilize the list of southern region member institutions of education in the American Association of Agricultural Educators (AAAE) (American Association for Agricultural Educators, 2017). According to the AAAE (2017) Oklahoma and Texas have the option to participate in either the southern or the western region of the association so they were included in data collection. Though Puerto Rico is included in the AAAE southern region it was excluded from this study as its geographical designation as an island and its tropical climate is unique

and therefore may require skills not required in the contiguous United States. To provide diversity in thought, diversity in the expert panel was sought. This included teacher educators, veteran teachers, and new teachers. To create the expert panel, an email was sent to the coordinators of agricultural teacher education and/or department heads at AAAE southern region institutions requesting participation as an expert panel member and some suggestions of secondary SBAE teachers in their state falling into two categories: (a) SBAE teachers having taught more than 5 years (veteran teachers) and (b) SBAE teachers having taught less than 3 years (new teachers). Of the 47 institution members contacted and the many teacher suggestions provided, a total panel of 69 experts agreed to take part in the study.

Round 1 Data Collection and Analysis

A questionnaire was developed in Qualtrics stating "What practical agriculture skills are needed by newly hired agricultural education teachers?" A clarification of terms was provided stating: "A **skill** is the ability to **use** one's knowledge effectively to execute a performance." A text box was then provided with instructions asking panelists to offer technical skill suggestions. Each suggested skill was organized into general categories. The categories created were: (a) animal science skills, (b) horticulture skills, (c) agricultural mechanical skills, (d) natural resource/soil skills, (e) food safety/food processing skills, (f) safety skills, (g) business/program management skills, and (h) agriscience/laboratory skills. These categories may differ from similar studies that utilized state specific designation of career pathways (Ramsey & Edwards, 2012). Most of the skills rejected during analysis were focused on knowledge (as opposed to skills) or on pedagogical skills (rather than technical skills).

Round 2 Data Collection and Analysis

A second questionnaire was developed in Qualtrics asking panelists to rate their level of agreement on a five-point Likert type scale for the technical skills that should be possessed by beginning agriculture teachers. The list of skills from round one was offered in the categories previously mentioned. Further clarification was provided to panelists defining *beginning agriculture teacher* as a teacher in his/her first year of teaching agriculture and *technical skill* as the ability to use one's knowledge effectively and readily in performance of a given technical task (i.e. the ability to do something). Panelists were also given an individual opportunity for each of the skills to provide suggestions for alternate wording. At the end of each of the eight categories a text box was provided and respondents were prompted to provide any additional skills not found on the list. A 2/3 consensus was accepted as a minimum to retain the skill (Roberts et al., 2016).

Round 3 Data Collection and Analysis

A final questionnaire was prepared in Qualtrics for round three. Any suggested rewordings were considered by the researchers and changed if the alteration was deemed clearer than the original wording. Any new skill offerings were also judged to be technical skills and then included on the final questionnaire. The panelists were again asked on a five-point Likert type scale for the technical skills that should be possessed by beginning agriculture teachers. The same directions and clarifications were provided as were for round two including suggestion boxes for rewording and additional skills. A 2/3 consensus was again accepted as a minimum to retain the skill (Roberts et al., 2016)

Findings

Out of 69 agricultural educators agreeing to participate in the study 41 responded to at least one of the three rounds of questions. Fifteen participated in all three rounds of the study, eleven participated in at least two rounds of the study, and fifteen for only one round. No demographics were

collected other than their experience level and the type of institution of which they are affiliated. Veteran teachers and new teachers were validated by the teacher education coordinator by which they were suggested.

Round One Findings

Round one yielded 27 total responses, nine of whom were teacher educators, six new teachers, and 12 veteran teachers. A total of 168 skills were suggested and put forth for round two. The 168 technical skills recorded in round one were organized into eight categories reflecting the generality of the skills that were suggested and the differing state curriculums in which the panelists practice.

Round Two Findings

Round two was sent again to the original 69 Round two yielded 29 total respondents composed of 10 teacher educators, eight new teachers, and11 veteran teachers. The 168 skills were offered in the verbatim presentation originally provided by the round one expert panel. A 2/3 consensus of agreement assessed on a five-point Likert type scale yielded 116 agreed upon technical skills and eight new suggestions. It should be noted that category of agriscience/laboratory skills was eliminated by the panel in round 2.

Round Three Findings

The list of 116 technical skills from round two were organized into seven categories was sent for the final time to the 69 original participants asking them to rate their level of agreement Round three yielded a total of 26 respondents composed of 10 teacher educators, 5 new teachers, and 11 veteran teachers. After a 2/3 consensus was utilized as in round two, 91 technical skills in seven categories were agreed upon by the expert panel shown in Tables 1 through 7.

Table 1

Agricultural Mechanics Skills Needed by Preservice SBAE Teachers

Skills	% Agreement
Run a bead with a shielded metal arc welder ("arc/stick")	100%
Read a ruler	100%
Drive a nail	100%
Turn a screw with a screwdriver to fasten materials together	100%
Use a nut and a bolt to attach materials together	100%
Use the proper glue to attach materials together	100%
Operate/set correct settings on a welder	96%
Attach two pieces of metal together through welding	96%
Cut wood with multiple stationary electric saws (Band Saw, Table Saw, etc.)	96%
Apply lab and workplace safety procedures	96%
Plan projects	92%
Set and cut metal with an oxyacetylene torch	92%
Cut wood with multiple portable electric saws (Jig Saw, Circular Saw, etc.)	92%
Change the oil in a small engine	92%
Implement simple wiring skills	88%
Run a bead with a gas metal arc welder (MIG)	88%
Cut and strip Romex cable	85%
Read and follow plans for a simple construction project	85%
Use and maintain a lawnmower	85%

Table 1

Agricultural Mechanics Skills Needed by Preservice SBAE Teachers Continued…

Use and maintain a weed eater	85%
Wire a 3-way circuit	81%
Wire a single pole switch	81%
Wire a duplex receptacle	81%
Set and cut metal with a band saw	81%
Calculate board feet	81%
Apply stain or paint to a project	81%
Troubleshoot circuits using a multimeter	77%
Set and cut metal with a plasma cutter	73%
Use concrete in a construction project	73%
Trouble shoot small engines	73%
Pull and back a trailer	73%

**All wording is according to panel suggestions.*

Table 2

Plant Science Skills Needed by Preservice SBAE Teachers

Skills	**% Agreement**
Transplant plants	92%
Water a plant	88%
Propagate a plant from a cutting	88%
Use landscape and garden equipment	88%
Perform an inventory of a greenhouse	88%
Manage plant nutrition	88%
Apply fertilizer properly	85%
Propagate a plant from division	81%
Take stem tip cuttings	81%
Prepare a seedbed	81%
Order plants for an annual sale	81%
Mix potting soil	77%
Take leaf cuttings	77%
Take root cuttings	77%
Prevent disease in plants	77%
Calculate and mix fertilizer	77%
Read and follow plans for any landscaping project	77%
Landscape plant installation	73%
Program greenhouse temperature	73%
Develop irrigation schedules	73%
Prune hardwood landscape plants	73%
Diagnose plant health issues	73%
Treat greenhouse pests	69%
Compost	69%

**All wording is according to panel suggestions.*

Table 3

Animal Science Skills Needed by Preservice SBAE Teacher

Skills	**% Agreement**
Read feed labels	100%
Handle animals	96%
Exercise care to an animal	88%
Maintain livestock facilities	88%
Calculate rations using a Pearson square	85%
Diagnose animal health issues	81%
Ear tag an animal	81%
Evaluate live animals	81%
Treat minor animal injuries	77%
Treat minor animal illnesses/sickness	77%
Give subcutaneous injections	77%
Give intramuscular injections	73%
Clean and change animal bedding	73%
Evaluate carcasses	73%

**All wording is according to panel suggestions.*

Table 4

Business and Program Management Skills Needed by Preservice SBAE Teachers

Skills	**% Agreement**
Write receipts	100%
Keep accurate up-to-date records	100%
Manage a budget	96%
Estimate costs	96%
Read, use, and manipulate a spreadsheet	96%
Order supplies	92%
Manage money	92%
Create purchase orders	85%

**All wording is according to panel suggestions.*

Table 5

Natural Resource/Soil Skills Needed by Preservice SBAE Teachers

Skills	**% Agreement**
Utilize the field test for soil texture	88%
Take a soil sample	85%
Read and follow a soil report	85%
Conduct a water test	77%
Measure agricultural land	69%

**All wording is according to panel suggestions.*

Table 6

Food Safety and Food Science Skills Needed by Preservice SBAE

Skills	**% Agreement**
Handle food	88%
Store food	85%
Utilize food sanitizing techniques	81%
Process food	69%
Preserve food	69%

**All wording is according to panel suggestions.*

Table 7

Safety Skills Needed by Preservice SBAE Teachers

Skills	**% Agreement**
Administer basic first aid	92%
Use a fire extinguisher	92%
Apply proper safety colors in the classroom	88%
Maintain chemical inventory and storage	81%

**All wording is according to panel suggestions.*

Emergent Findings

Although not part of the original purpose of this research, differences in responses between teacher educators, veteran teachers, and new teachers were observed and deemed worthy of reporting (Tables 8 and 9). The number of skills that were rejected by each of the three demographics varied greatly as seen in tables two and three. Teacher Educators rejected 39 of 168 skills in round two with an accept rate of 77% and rejected 26 of 116 skills in round 3 with an accept rate of 78%. New teachers rejected 26 of 168 skills in round two with an accept rate of 85% while rejecting only 7 of 116 skills in round three with an accept rate of 94%. In stark contrast to new teachers, veteran teachers rejected the most skills from the list rejecting 87 of 168 in round two with an accept rate of 48% and rejecting 46 of 116 skills in round three with an accept rate of 60%.

Table 8

Round Two: Technical Skills Preservice SBAE Teachers Should Possess upon Completing Teacher Education Accepted or Rejected Per Type of Educator

Respondent Type	*n*	Skills Accepted	Skills Rejected	Total Skills
Teacher Educators	10	129	39	168
New Teachers	8	142	26	168
Veteran Teachers	11	81	87	168

Table 9

Round Three: Technical Skills Preservice SBAE Teachers Should Possess upon Completing Teacher Training Accepted or Rejected Per Type of Educator

Respondent Type	*n*	Skills Accepted	Skills Rejected	Total Skills
Teacher Educators	10	90	26	116
New Teachers	5	109	7	116
Veteran Teachers	11	70	46	116

Conclusions / Recommendations / Implications

Based on the data collected in this study, there are 91 technical skills needed by beginning agricultural education teachers across seven categories. The agricultural mechanics category had the most (31 skills), followed by horticulture (24 skills), and animal science (14 skills). The remaining skills fell in the categories of business/program management (8 skills), natural resources/soils (5 skills), food safety/food science (5 skills), and safety (4 skills). Based on these results, teacher educators in the southern region of AAAE should evaluate their curricula to see if these skills are appropriately addressed and make necessary changes.

The agricultural mechanics content area received the most recommended skills which helps to describe a majority of literature about technical agricultural skills in agricultural mechanics. (Burris, Robinson, & Terry, 2005; Byrd et al., 2015; McCubbins, Anderson, Paulsen, & Wells, 2016) These recent studies highlight a collective need in agricultural mechanics but as the list in this study establishes, the new SBAE teacher will have the expectations of skills and knowledge found in agricultural mechanics in addition to all or a combination of different content areas.

Any one item on the list of skills in Tables 1-7 might easily be assumed that a student would come to a teacher education program with some base knowledge, for example: water a plant, use and maintain a lawn mower, handle food, and drive a nail. Even students with some prior knowledge in a given skill, welding for example, may know how to attach two pieces of metal together through welding, but not know the proper safety procedures. It is currently unknown if post-secondary agricultural teacher education programs perform any physical assessment of technical agricultural skills as prerequisites for acceptance. A current standardized list of technical skills that expert agricultural educators agree upon as base needs for preservice students to be best prepared once employed could be invaluable. If the technical skills are not required as a prerequisite to agricultural education programs, are only offered in limited capacity during their teacher education and are not professionally developed post-graduation the situation could be a catalyst for attrition for new SBAE teachers. It is not difficult to posit that new teachers are being hired without needed technical skills provided in an adequate experiential manner (Dewey, 1938; Roberts, 2006). The amount of skills agreed upon in this study strengthens the argument for a students' need for preservice self-efficacy in technical skills while in teacher education programs (McCubbins et al., 2016). If new teacher self-efficacy in the gamut of expectations could be maximized in the beginning years of teaching, especially those with limited experience, perhaps there will be one less thing of concern for the surviving teacher (Kagan, 1992). Similar studies and the current list of technical skills presented here can be utilized to prepare a more well-rounded expectation of a technical skill set needed for preservice SBAE teachers.

Several additional research recommendations are also suggested. First, this study was limited to states in the southern region of AAAE. This research should be expanded to a national audience to see if similar trends hold true for the rest of the country. Second, the SBAE curricula is continually evolving, so the needs today may not be the same in the future. This research should be replicated in the future to see if the skills needed by beginning teachers change. Third, this research does not address the best way to help preservice teachers gain these skills. Future research should examine which approaches are most effective at skill development.

Based on the results, we also concluded there were differences in opinions about the necessary skills based on the different types of respondents in the expert panel. New teachers thought 85% of the skills suggested in Round 2 should be retained, followed by teacher educators (77%), and then veteran teachers (48%). Teacher educators seemed to be moderate in comparison to practicing new and veteran teachers, attempting to shed the list of unnecessary skills while at the same time maintaining inclusivity

at a rate of 78% acceptance in the final round. New teachers were very inclusive accepting 94% of the skills in round three while the veteran teachers rejected the most skills by far only accepting 60% from round three. With such a difference in acceptance rates one could posit that veteran teachers have a more intimate knowledge of the needs of their specific programs. Another position would be that veteran teachers never needed some of the specific skills the list provided and yet another could be that these teachers do not possess some of the skills, so they developed ways to not use the skills and therefore deem them unnecessary.

The current study was not designed to examine this issue, but the emergence of this finding does raise many questions. Are we asking too much of new teachers? Do veteran teachers in SBAE programs have insight into needed/unneeded skills that teacher educators should be further tapping into? Are veteran teachers finding ways to survive by not including certain skills due to resource or skill deficits? Would more formalized focus groups or needs assessments yield insights revealing where SBAE programs are currently operating? Can teacher education programs sufficiently prepare SBAE teachers or is a more prescribed dose of professional development a way to provide for inadequacies of technical experience for the new SBAE teacher?

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