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Technical In-Service Needs of Agriculture Teachers in Georgia by Career Pathway

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Abstract

A teacher's content knowledge, coupled with skilled teaching and a disposition for classroom service, all have a positive effect on student outcomes. This study assessed the in-service professional development needs of Georgia agriculture teachers' in the seven career pathways defined in the Agricultural Education curriculum: Agribusiness Systems, Animal Systems, Environmental Service Systems, Food Products and Processing Systems, Natural Resources, Plant Systems, and Power and Technical Systems. Multiple areas within pathways were found to be beneficial for professional development according to teachers including: lab management, lab safety, greenhouse management, nutrition, feeds and feeding, market research, business plan development, etc. Teachers at all levels of experience noted additional professional development in plant systems and lab safety would be beneficial and teachers with less than 10 years expressed need for training in power and technical systems. Significant differences were found between male and female teachers in the area of power and technical systems, with males expressing need for additional professional development. Rural teachers saw more benefit in food processing professional development than their urban counterparts. Future research should investigate trends in professional development as it pertains to gender to provide a more tailored understanding of factors contributing to the individual needs of teachers, especially in the power and technical systems pathway. Additionally, research is needed to assess other elements of effective professional development in Agricultural Education such as the value of duration, collaboration, and reflection.

Keywords: teacher; inservice; professional development; career pathway

Introduction

A teacher's content knowledge, coupled with skilled teaching and a disposition for classroom service, have a positive effect on student outcomes (National Research Council (U.S.), 2010). A teacher's personal background, prior experience in agricultural and natural resources, and their selection of technical content training experiences influence their knowledge, abilities, and skill transference in educational settings. As technological advances occur in agriculture, food, and natural resources management, in-service professional development for teachers should provide training to improve related content-area knowledge. Research literature related to this subject suggests teacher in-service professional development would be helpful to teachers, even on the first day on the job. Levine (2006) found that the majority of the nation's teachers are prepared in programs that have both low

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admission requirements and low graduation standards. Both state education agencies and accreditation agencies have found it difficult to assure that America's teachers are ready for the classrooms in which they will teach. It has been argued that we should further our understanding of how teachers acquire knowledge best (Darling-Hammond et al., 2017; Lieberman, 1995). Levine (2006) recommended transforming schools of education into professional schools focused on classroom practice to ensure that graduates gain an enriched academic subject experience and the ability to communicate that subject matter to students.

It has been argued that teachers graduate from educator preparation programs with inadequate skills to be effective teachers. The curriculum provides inadequate transition from basic skill development to advanced technical skill levels in upper-level college courses (Levine, 2006). Agricultural education promotes acquisition of knowledge and skill development in many of the courses taught. Examples of courses where technical skills are focused include animal science, plant and soil science, agricultural engineering, forestry and natural resources, food processing, and agricultural business management. Technical lesson content refers to the elements of the lesson designed to provide students with instruction, practice, and review of information related to the agricultural sciences.

Having a deep understanding of the technical lesson content provides teachers with a larger variety of effective teaching methods. Teachers who possess depth and breadth of content use that knowledge to guide students in examining errors in reasoning (Marzano, 2017). One of the more powerful teaching methods teachers can deploy involves examining the similarities and differences between concepts (Dean & Marzano, 2012; Marzano, 2009). Students compare technical content, classify it, and determine relevant connections. In the agricultural education classroom, teachers arrange learning experiences in a manner that allows students to interact with technical lesson content through comparison and contrast. Through this process, students add knowledge to that previously learned, thus deepening their understanding and increasing their ability to transfer learned knowledge to new and different situations (Dean & Marzano, 2012; Wiggins & McTighe, 2005). Teachers who have limited knowledge of technical course content are limited in their ability to implement effective teaching strategies (Walshaw, 2012).

A student's prior knowledge has a profound effect on learning (Bransford et al., 2000). Students build new knowledge based off previous learning. That is, they must have some way to connect information they have already learned to the new information they are learning, in order to retain and make meaning from the new information. It is important that a student's prior learning be as accurate as possible. If a student's knowledge of agriculture is built upon misconceptions and inaccurate information, then it becomes more difficult for the student to learn new information and subsequently apply the new knowledge arising from it (Ambrose et al., 2010). A teacher's intellectual proficiency contributes to effective teaching. Strong preparation in content areas, coupled with pedagogical skills is essential (Allen et al., 2005).

Teacher Professional Development in Agricultural Education

Teachers begin their formal teacher preparation through a pre-service program at a college or university. New teachers experience their first year through the process of induction (Moir & Glass, 2001). Induction includes ongoing training and development designed to help new teachers put necessary elements together for effective instruction. The induction phase is followed by the continuing development phase. This phase is where the majority of professional and skill development occurs. Experienced teachers then transition into the renewal stage. This involves participation in activities designed to revitalize practice (National FFA Organization, 1998).

For teachers who have completed their pre-service education and are employed in their first year of teaching, professional development in agricultural education takes on a familiar pattern that usually involves teachers attending a series of workshops based upon personal interest, technical need, and workshop availability. Smalley et al. (2019) found that teachers are engaged in professional development and it might stand to reason they are seeking enhancement of content related knowledge. Coinciding, Easterly and Myers (2019) found that teachers are involved at a high level regarding professional development. State departments of education, and state leaders in agricultural education, provide leadership for professional development for agricultural education.

Literature identifying the professional development needs of agriculture teachers has flourished in recent years (Burris et al. 2005; Easterly & Meyers, 2019; Smalley et al., 2019; Tummons et al., 2017). More content specific, deficiencies in agricultural mechanization identified the need for further training (Burris et al., 2005; Byrd et al., 2015; McCubbins et al., 2017; McKim & Saucier, 2011) and other areas such as biotechnology (Duncan et al., 2006), agribusiness (Clemons et al., 2018; Joerger & Andreasen, 2000; Layfield & Dobbins, 2002), and other technical skills are also well documented. Conversely, little support exists to understand the unique professional development needs of teachers within specific subgroups of agricultural education. Additionally, a review of AAAE supply and demand reports over the past twenty years may signal the need for research as considerable shifts in both gender of teachers and alternative pathways to certification have become more apparent. Are we meeting the needs of professionals in today's classrooms across the nation? What additional factors should be explored to determine professional development needs of agriculture teachers?

Conceptual Framework

Darling-Hammond et al., (2017) determined that effective professional development includes seven elements. Table 1 describes the seven elements that are critical and core functions of effective professional development. Professional development should focus on a rich and rigorous learning experience for teachers that focuses on the content that they will be teaching in the classroom (Darling-Hammond et al., 2017). Building on content elements that focus on active learning by teachers and collaboration among teachers is needed. Coaching is also an essential element that combines with feedback and reflection. Finally, professional development is most effective when it is of a sustained duration. Professional development must be of a duration long enough for content skills and pedagogical skills to be practiced thoroughly.

Table 1
Elements of Effective Professional Development adapted from Darling-Hammond et al., (2017)

Elements	Description
Content Focus	Effective professional development focuses on the content that teachers teach.
Active Learning	Professional development must address both the *what* and the *how* of teaching.
Collaboration	Professional development should provide opportunities for teachers to work together.

Table 1
Elements of Effective Professional Development adapted from Darling-Hammond et al., (2017), Continued…

Use of Models and Modeling	Professional development should provide clears examples, or models, of effective instruction.
Coaching and Expert Support	Professional development should provide for coaching teachers in the acquisition of new skills.
Feedback and Reflection	Professional development should promote, encourage, and provide teachers feedback on their performance.
Sustained Duration	Professional development should be of the duration necessary to allow for the six elements listed here.

Sophisticated approaches to learning are in strong demand. Professional development should be guided with a sustained content-focused approach (Darling-Hammond et al., 2017). Content-focused professional development is most valuable when it is job-embedded (Desimone et al., 2006). That is, learning in the classroom allows teachers to practice the same skills, and utilize the same knowledge that students are being asked to demonstrate. The common thread weaved among all of these seven elements is the quality of the teacher's knowledge of the technical content as applied in agricultural sciences.

Technical content knowledge in agricultural education is categorized into elements that correspond with the seven major areas within the agricultural sciences. These elements, or pathways, are focused on the production, processing, and distribution of agricultural commodities. Identified pathways (Table 2) also focus on natural resources management (Advance CTE, 2018).

Table 2
Agriculture, Food & Natural Resources Career Pathways Adapted from Advance CTE (2018)

Pathway	Description
Agribusiness Systems	The financing and development of activities that produce agricultural commodities and prepare them for human consumption.
Animal Systems	The study of the processes involved in the growth, reproduction, nutrition, and health of domesticated farm animals.
Environmental Service Systems	The systems that monitor, mitigate, and contain waste and pollution.
Food Products & Processing Systems	The development of new food sources, and methods for safely producing, packaging, and preserving foods.

Table 2
Agriculture, Food & Natural Resources Career Pathways adapted from Advance CTE (2018), Continued…

Natural Resources Systems	The management of forests, wildlife, and other natural resources for recreation, conservation, and preservation.
Plant Systems	The study of plants and how they grow, including plant reproduction, nutrition, crop protection, and agronomic value.
Power, Structural & Technical Systems	These systems involve theoretical and practice applications of physics, with the context of hydraulics, pneumatics, electronic controls, power, and structural design and construction.

The pathways guide instruction in agriculture throughout the nation. Because of the impact the identified pathways have towards education about agriculture, understanding needs of agricultural education teachers is warranted.

Purpose and Objectives

The purpose of this study was to investigate the professional development needs within the national career pathways in agricultural education. The elements of effective professional development guided this investigation and framed the objectives of study. The primary research objectives were to: 1) describe the demographics of teachers who participated in the study, 2) determine the professional development needs within each of the seven career pathways, and 3) compare professional development needs of teachers by gender, years of teaching experience, and geographic location within Georgia.

Method

The purpose of this cross-sectional study was to assess in-service professional development needs of Georgia agriculture teachers' towards the seven career pathways defined in Agricultural Education curriculum: Agribusiness Systems, Animal Systems, Environmental Service Systems, Food Products and Processing Systems, Natural Resources, Plant Systems, and Power and Technical Systems (Advance CTE, 2018). This snapshot study design provided the opportunity to compare variables associated with specific needs of agriculture teachers in each of the seven technical skill areas (Lavrakas, 2008).

A questionnaire was developed to address each research objective including eight demographic questions and 50 Likert-scale items as topically defined within the seven career pathways: Power and Technical Systems (16), Plant Systems (8), Natural Resources (4), Food Products and Processing (7), Environmental Service Systems (5), Animal Systems (7), and Agribusiness Systems (7). These career pathways were developed by the United States Department of Education Clusters Project in 2003 (National Council for Agricultural Education, 2009) and resulting standards validated by a panel of experts ($N = 257$). Participants rated each item according to their level of perceived benefit *if* provided in-service professional development training (1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential). Gathered data (Qualtrics) were entered into SPSS® version 24.0 to calculate means and standard deviations for analysis of objectives one and two. Although commonly considered as ordinal data in the field, many experts have concluded that through appropriate analysis of the population and data (normally distributed) that the use of parametric procedure is a valid and robust treatment of the data (Norman, 2010). Therefore, data was analyzed towards distributions of normality and the data was found to be normally distributed and means and standard deviations are reported for items encompassing each construct to further delineate the data presented. Further analysis was conducted through the use of *t*-tests to determine significance between variables of interest.

The content of the questionnaire was considered valid because items were drawn directly from curriculum objectives listed in the seven career pathways developed for Agricultural Education as defined by the consortium Advance CTE. Once draft forms of the questionnaire were completed, a panel of teachers (not included in this study) reviewed the questionnaire and provided feedback regarding the clarity of items, instructions, overall layout, and face validity. Reliability of the questionnaire was estimated by conducting a pilot test (Beebe, 2007), which included a sample of 14 pre-service agriculture teachers. This sample population was chosen based on their similar characteristics to the population of study albeit a smaller and more manageable group for testing (van Teijlingen & Hundley, 2001). The test re-test method was employed to ensure concurrent reliability and analysis revealed no difference in the findings based on the employed method. Resulting data were used to estimate reliability of the instrument (internal consistency), yielding Cronbach's alpha coefficients ranging from .83 to .91 (.70 or higher acceptable range) (Creswell, 2012; George & Mallery, 2003). Post-hoc analysis of the instrument to ensure reliability was also utilized to investigate the researcher developed instrument and revealed an overall valid measure ($\alpha = .86$).

A census of agricultural educators in Georgia (N= 453) during the 2018-2019 academic year via the email listserv provided by the Georgia Agriculture Teacher's Association Executive Board was undertaken. Following Dillman's Tailored Design Method (2014) for instrument implementation, a prenotice letter was sent out (listserv) asking for participation. Second, the instrument was engaged to participants through an opt-in email directing them to a Qualtrics hyperlink. Lastly, two follow-up reminder emails sent to non-respondents over the course of three weeks. No differences were seen when comparing responses ($p = .65$) of early and late respondents (Lindner et al. 2001). The final response rate gained was 52.09%. Although response rate was low, increased response rates are less likely to be achieved unless coercively administered (Rogelberg & Stanton, 2007). It has been noted (Baruch, 1999) that recently, rates have declined from approximately 65 to 48 percent when utilizing electronic survey methods. Moreover, Mavis and Brocato (1998) explained that lower response rates are to be expected in today's electronic age. Specifically, when using SBAE (agriculture teachers) as a population (Fraze et al., 2003) it has been shown that they responded less to electronic surveys and time was perceived as critical due to their busy schedules.

Results

There were 118 males (49.57%) and 120 females (50.42%) identified in this study. With proportional respondents representing each gender type, responses should also be proportional. It should be noted that the division of gender in somewhat equal percentages does not parallel the gender represented in the state towards professionals in agricultural education.

Participants (n = 238) in this study indicated a range of experience from 0 to 30 years of experience with a mean years of experience equaling 10.49 (SD = 8.32). Respondents to this survey are aligned to one of the three geographic regions within Georgia: North, Central, and South (Table 3). The North, Central, and South regions of Georgia have unique characteristics that differ from each other. The North region has a large number of fruit and poultry farms. The Central region has a large livestock industry presence, along with fruit farms. The South region is comprised of predominantly row crop farms (College of Agricultural and Environmental Sciences, 2018). The North region was represented to a greater degree than the other two regions with 94 participants (39.5%). The South region was represented by 75 respondents (31.5% and the Central region by 69 participants (29%).

Table 3
Participant Representation by Agricultural Education Service Region in Georgia

Region	*f*	%
North	94	39.50
Central	69	29.00
South	75	31.50
Total	238	100.00

To determine the preparation of participants, participants were asked to describe how they earned teacher certification. The majority of participants indicated they gained certification to teach through an undergraduate teacher education program (*f* = 149, 62.6%) and the remaining participants exhibited similar responses regarding other pathways such as a graduate program (*f* = 28, 11.8%), a combined program with undergraduate and graduate (*f* = 31, 13.0%), and an alternative route to certification (*f* = 30, 12.6%). Of note, 89 participants held a Bachelor's degree only (37.60%), and 86 reported having earned a Master's degree. Among the participants, 52 held a specialist degree (21.90%) involving coursework beyond the Master's degree, and 10 held a doctoral degree (4.20%).

Teacher Professional Development Needs Within The Seven Career Pathways

Participants were asked to describe their professional development needs by indicating the benefit of professional development on technical content in each of the seven career pathways. Seven pathways were outlined: Power Technical Systems, Plant Systems, Natural Resources, Food Processing, Environmental Systems, Animal Systems, and Agricultural Business. All perceptions gathered for each statement was summated to develop constructs based on each pathway. Each pathway was categorized, and variables of interest were assessed to determine their impact towards professional development needs.

Overall, data were compiled by pathway and each comprised of related statements to determine teacher perceptions towards the "essential" nature of professional development or it being "not beneficial". The following series of tables report the perceptions of respondents with regard to each of the seven areas within the Agricultural Education career pathway. One additional table reports the respondents' opinion with regard to lab safety and management.

The largest subset of data within the survey was in the power and technical systems section. This was due to the large number of different areas that must be addressed within power and technical systems. This section asked teachers to provide their opinions on the benefits of professional development and areas related to engines, welding, the use of power tools, electrical power generation and the installation of electrical systems. This section also addressed the construction trades taught in an Agricultural Education program, such as masonry, painting, fencing, building construction, and machinery maintenance. Technical systems such as surveying, the use of GPS and GIS systems, and computer aided design were also addressed. For power and technical systems (Table 4), training needs in *safe and proper use of power tools* received the highest rating (*M* = 3.80, *SD* = 1.28) and closely followed by *GPS/GIS systems* (*M* = 3.60, *SD* = 1.27) and *principles of electricity and electrical systems* (*M* = 3.54, *SD* = 1.38).

Table 4
Benefit of Power and Technical Systems Professional Development to Teachers in Georgia

Item	*M*	*SD*
Safe and proper use of power tools	3.80	1.28
GPS and GIS systems	3.60	1.27
Principles of electricity & electrical systems	3.54	1.38
Ag. machinery maintenance and operation	3.54	1.37
Service and repair of small engines	3.49	1.39
Surveying and mapping	3.44	1.27
Safe and proper use of welding and metalworking equipment.	3.41	1.50
Installing fencing	3.18	1.35
Building construction	3.16	1.37
Plumbing equipment and fixtures	3.13	1.34
Power generation, energy sources, and power systems efficiency	3.12	1.36
Computer-aided design of blueprints and construction plans	2.97	1.34
Paints and protectants	2.88	1.32
Principles of hydraulic systems, service and repair	2.84	1.37
Masonry and bricklaying	2.82	1.33
Service and repair of power train and transmission systems	2.79	1.31
Power and Technical Systems	3.23*	1.35

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Data were further analyzed to determine teacher perceptions towards professional development for plant systems (Table 5). The plant systems section of the survey instrument asked teachers to determine the benefit of all aspects plant production, including crop production. This section also addressed horticultural elements such as floral design plant identification, and greenhouse management. Training needs in the area of *greenhouse systems and management* received the highest rating (*M* = 4.26, *SD* = 1.09), closely followed by *plant identification* (*M* = 4.25, *SD* = .95) and *conducting soil testing labs* (*M* = 4.23, *SD* = 1.00).

Table 5
Benefit of Plant Systems Professional Development to Teachers in Georgia

Item	*M*	*SD*
Greenhouse systems management	4.26	1.08
Plant identification	4.25	0.95
Plant reproduction and propagation	4.23	1.00
Plant nutritional requirements and environmental conditions	4.16	1.03
Conducting soil testing labs	4.14	0.94
Plant anatomy and physiology	4.10	1.06
Floral design	3.85	1.15
Managing land labs	3.73	1.21
Plant Systems	4.09*	1.05

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

As mentioned previously, the lab safety and management section of the survey instrument queried teachers to determine the benefit of professional development in the safe operation of agricultural labs. Lab management was a topic that cut across all sub elements within the Agricultural Education pathway. For ease of survey implementation, these items were combined into one section of the survey instrument. Respondents indicated that lab management and safety was a concern (Table 6). Training in first aid and CPR (*M*=4.11, *SD* = 1.05) was identified as the most beneficial professional development needed followed by safe and efficient lab management procedures (*M*=3.99, *SD*=1.44).

Table 6
Benefit of Lab Safety and Management Professional Development Needs to Teachers in Georgia

Item	*M*	*SD*
First Aid and CPR	4.11	1.05
Managing a safe and efficient shop and lab	3.99	1.14
OSHA and industry standards for shops and labs	3.79	1.16
Using programmable logic circuits in the lab	2.96	1.22
Lab Safety	3.71*	1.14

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Natural resources education is an element within the agricultural education career pathway. The functions of natural resources management, including management of national forests, falls within the scope and responsibilities of the United States Department of Agriculture. In Georgia, approximately 1 million acres are under conservation easement, and almost 1,750,000 acres of farmland are being cultivated using reduced tillage practices. More than 205 woodland farms exist within Georgia generating approximately 1 million dollars in timber sales annually (National Agricultural Statistics Service, 2017). When evaluating the area of natural resources (Table 7), training needs in area of *wildlife and plant species identification* received the highest rating (*M* = 4.31, *SD* = .88), followed by *forest management* (*M* = 3.97, *SD* = 1.04).

Table 7
Benefit of Natural Resources Professional Development Needs to Teachers in Georgia

Item	*M*	*SD*
Wildlife and plant species identification	4.31	0.88
Forest management	3.97	1.04
Beekeeping and Basic entomology	3.84	0.96
Basic geology and land judging	3.78	1.10
Natural Resources	3.98*	1.00

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Food products and processing includes all aspects of the preservation and marketing of processed foods. This includes the processing evaluation and marketing food products within the scope of regulations designed to protect the public's health and safety. Because Georgia has a large number of school-based canning plants, this item was added to the survey instrument to identify the specific benefit of offering professional development in the management of these canning plants (Table 8). When evaluating responses towards the focus are of food products and processing, the area of *meat evaluation* was regarded as the biggest need (M = 3.76, SD = 1.15), followed by *agricultural marketing* (M = 3.64, SD = 1.10).

Table 8
Benefit of Food Products and Processing Professional Development to Teachers in Georgia

Item	*M*	*SD*
Meats evaluation	3.76	1.15
Agricultural marketing	3.64	1.10
Food preservation and packaging	3.56	1.19
Food processing, handling and storage	3.54	1.20
Dairy foods evaluation	3.37	1.22
Health, safety and environmental regulations	3.27	1.32
Canning plant management	2.61	1.57
Food Products and Processing	3.39*	1.25

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

The Agricultural Education career pathway further identifies environmental systems as a distinct element within the pathway. This includes training in the technology for the management and of water resources, and instruction in waste management (Table 9). In this section, respondents identified professional development that addressed the operation of basic laboratory equipment as most beneficial (M=3.50, SD=1.25).

Table 9
Benefit of Environmental Service Systems Professional Development to Teachers in Georgia

Item	*M*	*SD*
Operating basic laboratory equipment	3.50	1.25
Hydrology and wetlands management	3.21	1.15
Utilizing electronic monitoring equipment	3.14	1.14
Waste management	3.06	1.17
Water and wastewater treatment	3.03	1.16
Environmental Service Systems	3.19*	1.17

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Animal systems dealt with all aspects of animal production and management including basic instruction in anatomy physiology, and advanced instruction in nutrition, disease management, genetics and evaluation, and agricultural structures related to agricultural production in the animal sciences. Respondents indicated (Table 10) that the most beneficial training should be in *nutrition, feeds and feeding* (*M* = 4.07, *SD* = 1.13) with *evaluation and selection* (*M* = 4.04, *SD* = 1.18) and *animal disease* (*M* = 4.00, *SD* = 1.10) also being highly perceived as needs.

Table 10
Benefit of Animal Systems Professional Development to Teachers in Georgia

Item	*M*	*SD*
Nutrition, feeds, and feeding	4.07	1.13
Evaluation and selection, judging	4.04	1.18
Animal diseases	4.00	1.10
Genetics and Reproduction	3.97	1.15
Anatomy and physiology	3.96	1.18
Animal behavior	3.92	1.19
Animal housing, fencing and structures	3.91	1.13
Animal Systems	3.98*	1.15

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Finally, teachers were asked to determine the benefit of professional development in agricultural business systems. This includes the development of sound business practices related to accounting and inventory management, marketing, merchandising and sales of agricultural products. Respondents indicated that *developing business plans and mission statements* (*M* = 3.44, *SD* = 1.14) would be of the most benefit with *marketing and market research* being the lowest benefit (*M* = 3.23, *SD* = 1.10).

Table 11
Benefit of Agribusiness Systems Professional Development to Teachers in Georgia

Item	*M*	*SD*
Developing business plans and mission statements	3.44	1.14
Utilizing the Agricultural Experience Tracker (AET)	3.38	1.33
Basic principles of accounting	3.38	1.16
Inventory management	3.38	1.11
Developing a marketing plan	3.30	1.16
Merchandising and sales	3.29	1.14
Marketing and market research	3.23	1.10
Agribusiness Systems	3.34*	1.16

Note. Scale: 1 = not beneficial, 2 = of little benefit, 3 = no opinion, 4 = somewhat beneficial, and 5 = essential. * Indicates Grand Mean (*GM*)

Professional Development Needs By Gender, Years Of Teaching Experience, And Location

To utilize Likert and dichotomous data to conduct a *t* test (normally not considered a continuous variable), multiple items (constructs) were summated to develop a continuous measure for each pathway. Likert, or ordinal variables with five or more categories can often be used as continuous without any harm to the analysis (Johnson & Creech, 1983; Norman, 2010; Sullivan & Artino, 2013; Zumbo & Zimmerman, 1993). With regard to the data gathered by gender ($t(213) = 6.88$, $p = .02$), it was apparent that significant differences existed in responses to items in the power and technical systems pathway. Data suggested (Table 12) males perceived the benefit of topics to be provided based on their present role whereas females did not see the benefit of training topics related to power technical systems. None of the remaining pathways exhibited significant differences (see table 3) when evaluating the effects of gender towards their perceptions of benefit of training topics presented. Males wanted more natural resources ($M = 3.99$, $SD = .79$) whereas females believed it more essential to receive training in animal sciences ($M = 4.04$, $SD = 1.06$).

Table 12
Comparison of Professional Development Needs of Teachers in Georgia by Pathway

Gender	*n*	M_1	*SD*	*df*	*t*	*p*
Male (M)	101	3.46	0.89			
Agriculture Business				205	1.82	0.82
Female(F)	106	3.22	1.02			
Male (M)	102	3.92	1.05			
Animal Systems				207	0.83	0.83
Female(F)	107	4.04	1.06			
Male (M)	102	3.36	0.99			
Environmental Systems				209	2.57	0.83
Female(F)	109	3.01	1.05			
Male (M)	103	3.39	1.01			

Table 12
Comparison of Professional Development Needs of Teachers in Georgia by Pathway, Continued…

Food Processing				210	0.14	0.07
Female(F)	109	3.41	0.89			
Male (M)	103	3.99	0.79			
Natural Resources				209	0.51	0.53
Female(F)	108	3.94	0.74			
Male (M)	104	3.96	0.86			
Plant Systems				211	2.18	0.55
Female(F)	109	4.21	0.75			
Male (M)	105	3.55	0.83			
Power Tech Systems				213	6.88	0.02*
Female(F)	110	2.71	0.97			

Note. [1]Likert Scale of 1 to 5 with 1 representing *not beneficial* and 5 representing *essential*. * denotes significance at $\alpha = .05$.

When analyzing data by experience level ($t(213) = .49$, $p = .05$), significant differences were found when evaluating the effects of experience towards power and technical systems training. Data indicated (Table 13) a greater need for training in power and technical systems for those professionals with less than 10 years of experience than those with greater than 10 years of professional experience. No significant differences were found when analyzing pathways by experience level. It was interesting to note that for each experience level group; "plant systems" was rated highest, thus indicating a need for further training.

Table 13
Comparison of Professional Development Needs of Teachers in Georgia by Experience Level

Professional Experience	*n*	*M*[1]	*SD*	*df*	*t*	*p*
Less than 10 yrs	106	3.39	1.03			
Agriculture Business				205	0.63	0.09
Greater than 10 yrs	101	3.30	0.88			
Less than 10 yrs	107	4.10	1.01			
Animal Systems				207	1.80	0.45
Greater than 10 yrs	102	3.84	1.09			
Less than 10 yrs	110	3.10	1.00			
Environmental Systems				209	1.27	0.72
Greater than 10 yrs	101	3.27	0.95			
Less than 10 yrs	110	3.44	0.91			
Food Processing				210	0.80	0.62
Greater than 10 yrs	102	3.34	0.98			
Less than 10 yrs	109	3.94	0.80			

Table 13
Comparison of Professional Development Needs of Teachers in Georgia by Experience Level, Continued…

Natural Resources				209	0.42	0.30
Greater than 10 yrs	102	3.98	0.73			
Less than 10 yrs	111	4.14	0.81			
Plant Systems				211	1.05	0.50
Greater than 10 yrs	102	4.02	0.82			
Less than 10 yrs	112	3.16	0.94			
Power Tech Systems				213	0.49	.05*
Greater than 10 yrs	103	3.09	1.06			

Note. [1]Likert Scale of 1 to 5 with 1 representing *not beneficial* and 5 representing *essential*. * denotes significance at $\alpha = .05$. Experience level represents overall years of teaching experience.

Location Of Respondents In The State

When analyzing data by geographic location ($t(213) = .24$, $p = .02$), significant differences were found when evaluating the effects of location towards food processing systems training (Table 14). Data indicated there was a greater need for training in food processing systems for those in rural areas than those in urban areas. No significant differences were found when analyzing other pathways by geographic location. Of note, "plant systems" was rated highest again by each group towards its "essential" stature for further training by both location groups.

Table 14
Comparison of Professional Development Needs of Teachers in Georgia by Location of Program

Geographic location	*n*	M_1	*SD*	*df*	*t*	*p*
Rural	140	3.32	0.99			
Agriculture Business				207	0.48	0.19
Urban	69	3.39	0.89			
Rural	140	3.95	1.07			
Animal Systems				209	0.64	0.50
Urban	71	4.05	1.03			
Rural	143	3.17	1.03			
Environmental Systems				211	0.37	0.11
Urban	70	3.23	0.86			
Rural	143	3.41	1.01			
Food Processing				213	0.24	0.02*
Urban	72	3.37	0.81			
Rural	142	3.99	0.75			
Natural Resources				212	0.34	0.54
Urban	72	3.95	0.8			

Table 14
Comparison of Professional Development Needs of Teachers in Georgia by Location of Program, Continued….

Rural	144	4.03	0.85			
Plant Systems				214	1.59	0.17
Urban	72	4.22	0.72			
Rural	144	3.22	0.98			
Power Tech Systems				216	1.87	0.56
Urban	74	2.95	1.00			

Note. 1Likert Scale of 1 to 5 with 1 representing *not beneficial* and 5 representing *essential*. * denotes significance at $\alpha = .05$.

Conclusions and Implications

The purpose of this study was to investigate the professional development needs within the national career pathways in agricultural education. The number of respondents in the study were divided approximately equally between male and female, experience in teaching ranged from 0 – 30 years with an average of 10.49. A majority of the respondents classified their school as rural. However, this did not seem to influence opinions with regard to training needs.

Respondents indicated professional development needs towards plant sciences as beneficial, regardless of whether they were in a rural or urban setting or experience level. A great majority of programs in Georgia have a plant science laboratory or greenhouse which may explain the frequency of this answer. Furthermore, the integrated aspect of plant sciences in these programs may have increased the perceived need by participants which aligns with findings seen in Smalley, et al. (2019). It should also be noted that when examining the role of gender in this state and towards the future of certified teachers (Smith et al., 2019), the importance of plant sciences may increase and should be further evaluated.

Data revealed a significant difference between rural and urban respondents with regard to food processing. Rural teachers saw more benefit in food processing professional development. In rural areas, agricultural teachers still operate canning and food processing facilities for their respective communities. Although not prevalent across the nation, canning plants came about during the 1930s and 40s in response to community need to preserve foods (Croom, 2008). It should be noted canning plants are not as prevalent in urban settings in this state (Georgia Agricultural Education Program, 2019) although the data did not differ when analyzing responses by location. Grocery retail outlets are plentiful in most urban areas and their tradition of canning and preserving foods does not carry the same importance as it does in rural areas. Therefore, one could expect rural teachers to find food processing professional development to be beneficial.

With regard to power and technical systems, a significant difference existed between male and female respondents. Male respondents found more benefit in professional development than female teachers. This finding could be interpreted to explain that more male teachers are involved in agriculture mechanics type courses. Consistent with previous research (Burris et al., 2005; Byrd et al., 2015) that needs toward further training in mechanization is warranted. Based on responsibilities and previous content knowledge, the assumption that female teachers are not interested in mechanized courses may be short-sighted. Further understanding of these differences might reveal factors associated with more identified needs, specific teaching loads, and cultural differences experienced across the country. Additional consideration should also be given to the finding by Tummons et al., (2017) that female teachers were hampered by thoughts of danger in the laboratory, to the point that planning and organizing lab instruction was hindered.

Closely aligned in the area of agricultural mechanization, it was found that teachers with less than 10 years of experience saw greater benefit in professional development in power and technical systems. Experienced teachers have likely developed a certain degree of comfort with regard to agricultural mechanics (McKim & Saucier, 2011), whereas teachers in the initial stages of teaching still see a need for professional development in this area (McKim & Saucier, 2011; McCubbins et al., 2017). Agricultural power and technical systems often require practicing a high level of psychomotor and cognitive skill in order to experience mastery where coaching and expert support could be helpful (Darling-Hammond et al., 2017).

When evaluating the needs of teachers in natural resources, it was interesting to note more foundational needs being identified. This aligns with one of the elements of effective professional development (content focus) and is assimilated with beginning needs of teachers (Darling-Hammond et al., 2017). This may coincide with little to no prior experience in this content area. Therefore, further research should investigate this finding to determine the impact further training in this area can have toward teachers in Georgia.

Recommendations

Based on the findings of this study, further research is recommended to determine if there are trends in professional development needs related to gender. As the population of certified teachers' increases (Smith et al., 2019) understanding more individualized needs is imperative. It is further recommended that an aligned research focus attempt to understand shifts in demographic factors related to gender. Some may assume female teachers do not feel the need for professional development towards agricultural mechanics' topics because they are less experienced in the power and technical systems laboratory or that this is not an area they are instructing. Are teachers with limited prior experience being employed in multiple teacher programs where they are able to focus only on areas aligned with their perceived efficacy level in instructional area(s)? Is this a valid assumption? What other factors contribute to whether or not females teach agricultural mechanics?

As the impact of agricultural education grows from rural to urban areas and the diversity of experience and understandings occur in the profession, further investigation of the variables associated with professionals and the curriculum they will be teaching should be a constant inquiry of researchers in the future. Nationally, there is a shift in population from rural areas to urban areas (Parker et al., 2018). Yopp et al. (2018) argued more traditional programs may be located in urban areas and that urban students may be more engaged in traditional agricultural education curriculum. Because conflicting standards exist to qualify a school as urban, suburban, or rural, the classification of schools as such is difficult to determine, especially in the context of agricultural education research (USDA, 2019). However, this need to classify may be limiting our understanding of program needs and thus, our ability to provide rich and rigorous learning experiences for teachers in the specific content areas they are teaching in their classrooms (Darling-Hammond et al., 2017).

Finally, the objectives of this study were specifically associated with assessing in-service professional development needs of Georgia agriculture teachers' in each of the seven technical skill areas. Our focus on specific professional development needs in the seven technical skill areas only provides understanding to one element of the Elements of Effective Professional Development (Darling-Hammond et al., 2017). Future research should investigate additional elements associated with the *what* and *how* of professional development for agriculture teachers including, but not limited to: the optimum duration of professional development sessions, the need for collaboration between teachers, opportunities for active learning, incorporating the use of models and modeling, the need for coaching and expert support, and the value of feedback and reflection.

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