

Improving Forestry Secondary Education: Identifying Teachers' Needs

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Abstract

Industrial, technological, and societal changes require that teachers continually engage in professional learning activities that promote new scientific approaches in education and content. Providing teachers with current and relevant professional development is an important task in secondary education. This study identified the professional development needs for educators who teach forestry and forest ecosystem content to secondary students. The Delphi method employed with two participant groups investigated the diversity of thought held throughout the southeastern United States. Participants included agriculture and environmental science teachers, state department of education administrators, foresters, and environmental scientists. Participants report eleven areas of educational need: 1. Forestry career days, 2. Tree diseases and pathogens, 3. Graduation requirements limit student opportunities for electives, 4. Career counseling in forestry jobs, 5. Educate students about degrees needed for forestry careers, 6. Over commitment of students enrolled in extra-curricular activities, 7. Lack of foundational forestry knowledge, 8. Lack of forestry /agriculture programs in schools, 9. Develop forestry electives in middle school, 10. Lack of foundational forest management knowledge, and 11. Connect classroom content with FFA and Envirothon extra-curricular activities.

Keywords

forestry education, professional development, Delphi method, classroom instruction

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Introduction and Problem Statement

Undergraduate forestry programs in the United States have experienced a steady decline in enrollment over the past three decades, which corresponds with a reciprocal increase in enrollment in environmental studies programs (Sharik et al., 2015). A challenge for recruiting students into forestry programs is the perception that forestry courses are less welcoming to women and minorities than environmental studies programs (Rouleau et al., 2017). This reduction in students pursuing forestry degrees coincides with a peak in employment opportunities for recent forestry graduates (Connaughton, 2015), which leaves forestry undergraduate programs struggling with recruitment of students and looking towards secondary educators as a pipeline for potential forestry students. Most secondary science and agriculture educators identify forestry as an important topic in their classes; however, the likelihood of including forestry content in the classroom directly relates with teacher's confidence and familiarity with the discipline (Munsell et al., 2016).

Agriculture and environmental science teachers have a continuing need for in-service training ensuring that they are current with industry standards (Barrick et al., 1983). Pre-service and in-service trainings needed by teachers to keep them current on industry specific competencies, however it is difficult identifying what trainings are most appropriate (Peake et al., 2007). Teaching is not a routine job and as technology advances teachers must be continually retrained especially, in a rapidly changing global environment (Darling-Hammond, 2006). Forestry equipment will advance substantially over the 30-year span of an educator's teaching career and thus mandates the need for continuous professional development. Therefore, this study examines the professional development needs of educators assisting with increasing their abilities to teach forestry concepts and encourage students to enter the forestry profession.

The relevant forestry industry knowledge that students and their teachers must know is reflected in the state standards which are based on industry practices. The state(s) forestry standards advance in conjunction with forestry industry technology. Teachers become outdated with regards to both industry validated agricultural curricula and the state standards simultaneously.

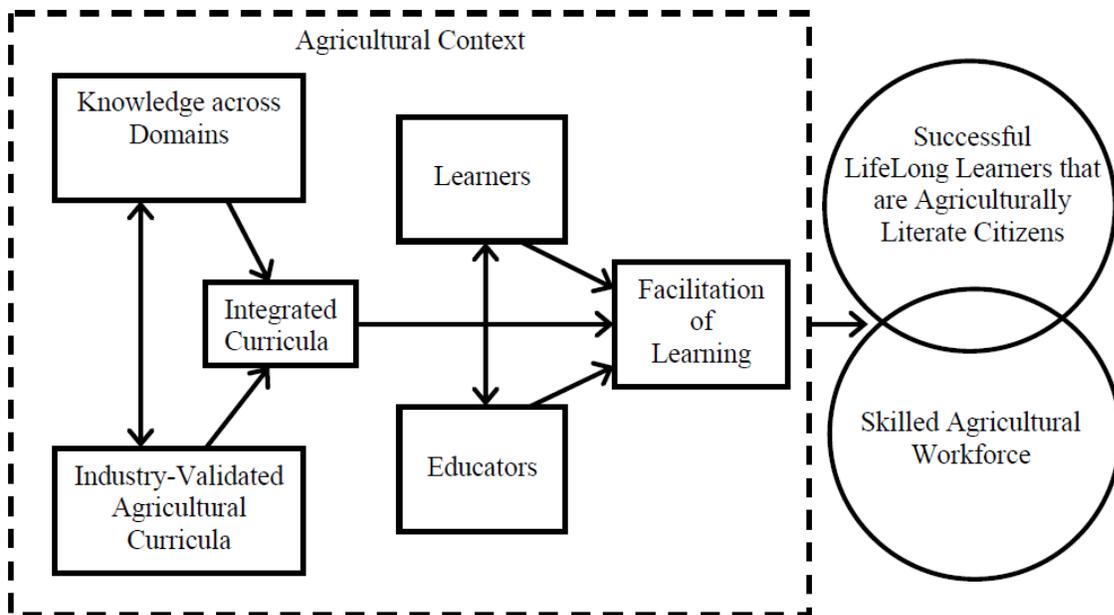
Theoretical and Conceptual Framework

Using the conceptual framework developed by Roberts and Ball (2009), the researchers in this study sought to improve forestry secondary education by identifying teachers' needs. The conceptual model for teaching agriculture as a content and context ensures all stakeholders in a community and school are engaged in the learning process, developing an educational curriculum to meet industrial and societal needs (see Figure 1). Specifically, this study examines educators' needs in development of an integrated curriculum in forestry. The educators' knowledge of the specific content area is vital for ensuring the correct skills, knowledge, and competencies have been taught to learners.

This conceptual framework requires the integrated curriculum incorporate both content substantiated in the current industrial practices and within the context of the industry. The integrated curriculum should incorporate knowledge across all core subject areas and ensure that specific industry-based skills have been corroborated by industry experts. This integrated curriculum can then be taught through a process of a facilitated learning environment between the learner and the educator. This process of instruction prepares learners entering a skilled workforce and become a forestry advocate who values lifelong learning. This conceptual model guided the creation of the research questions for this study.

Figure 1

A conceptual model for teaching agriculture as a content and context (Roberts & Ball, 2009)



Purpose

The National Research Agenda reports that the agricultural education profession must continue examining the preparation of a sufficient workforce ready to address the challenging and complex problems of the 21st century. The purpose of this study was to examine the professional development needs of educators in teaching forestry concepts in their classrooms in Georgia and Virginia. The research question posed to participants was “What are educators’ areas of concern with teaching forestry and forest ecosystems?” The objective guiding this study is identifying the professional development needs for teaching forestry and forest ecosystem content to secondary students.

Methods

To collect the necessary data from educators, the researchers employed the Delphi method. The Delphi method is employed in a true (stakeholders meet in person) and in a modified (online survey) format in agricultural education research (Franklin, 2011; Myers & Thompson, 2009; Robinson & Edwards, 2011; Rubenstein & Thoron, 2014). To collect stakeholder opinions, the Delphi method has been proven as an effective method (Landeta, 2006; Okoli & Pawlowski, 2004). Social scientists use focus groups as the qualitative tools for conducting this type of research (Sussman et al., 1991, Krueger & Casey, 2008).

Participants

A true Delphi method is employed in this study allowing participants to meet face-to-face and share their thoughts and opinions on their professional development needs. The Delphi panel size should include a minimum of four people and that the panel's composition should depend on the expert's qualifications and demographics rather than a simple count (Thangaratnam & Redman, 2005). This study was conducted in two locations ensuring that educators' concerns of different geographical areas were heard and recorded. Session one consists of six panelists who were high school forestry teachers and state Department of Education administrators from Georgia. Session two consists of 17 panelists who were educators, foresters, cooperative extension agent, and Career and Technical Education Directors from Virginia. During the study, two participant groups were examined to investigate the diversity of thought held throughout the southeast region of the United States. Specifically, teachers were included from various geographical areas, because inservice teachers' professional development needs vary within the same state or between neighboring states (Washburn et al., 2001).

Data Collection

To engage the participants in the discussion, the researchers composed the following lead question, "What are educators' areas of concern with teaching forestry and forest ecosystems?" The dialogue was led by a trained discussion leader who kept the conversation flowing and would ask appropriate probing questions ensuring each idea was clearly documented. During the discussion, a recorder typed each item into a word processing program, while a scribe wrote each item on large post-it sheets, clearly visible for all research participants.

During the first round, participants responded to the lead question by sharing their ideas, without commenting on previous participants comments. At the end of the first round all of the items were compiled, and each participant rated each item, on an electronic device using a Qualtrics survey. Each item was rated using a five-point Likert scale based on their belief/perceived level of importance that this item should be included in a professional development session on forestry and forest ecosystems. At the end of each round the participants were given a report of the mean scores. During the second round, participants discussed the potential of adding new items, combining existing items, and removing items from the list. For items to be removed or combined the discussion leader would ensure

consensus before taking any action on the item. An *a priori* score was set at a mean of 4.0 for the professional development items to be considered in the final data reporting and professional development sessions. To standardize each panelist's responses, the researchers used a z-score to create an index value for each item and establish the top areas of concerns by environmental and agricultural education educators in Georgia and Virginia. The researchers do note a limitation in the use of z-scores for this study because of the small sample size in Session one ($n = 7$). However, due to the homogeneity of the participants, the researchers found a normal distribution in their responses deeming the use of z-scores effective.

Findings

All of the participants had teaching experience in the middle school, high school, or collegiate classroom. The participants had been in the education profession between six and 31 years. Each of the participants taught forestry or forestry ecosystem content as a portion of their courses. The researchers specifically selected each of the participants based on their level of experience and background, ensuring that a thorough sample of the teaching profession was selected and created a robust list of concerns relevant to educators at all experience levels.

During Session one, the participants identified 48 professional development needs of teachers to effectively instruct students on forestry and forest ecosystems. Following round two, the panel narrowed the list to 27 items, reducing redundancies and eliminating items that had not reached consensus. Following the second round, the top four items were: tree diseases and disorders ($M = 4.80$, $SD = 0.45$), timber stand improvement/foundational knowledge ($M = 4.60$, $SD = 0.55$), forest management ($M = 4.60$, $SD = 0.55$), and FFA state forestry field exam ($M = 4.60$, $SD = 0.55$). At the end of the process, 14 items achieved a mean score above the *a priori* level of 4.0 (see Table 1).

Table 1

Round Two – Levels of Agreement: Professional Development Needs in Forestry and Forest Ecosystems (Session One)

Item	<i>M</i>	<i>SD</i>
Trees diseases and disorders	4.80	0.45
Timber stand improvement/foundational knowledge	4.60	0.55
Forest management	4.60	0.55
FFA state forestry field exam (match curriculum)	4.60	0.55

Item	<i>M</i>	<i>SD</i>
Maintenance and use of forestry equipment	4.40	0.89
Forestry equipment	4.40	0.55
GPS/GIS	4.20	0.45
Career opportunities in forestry	4.20	0.84
Regional differences in teaching forestry, pine vs. hardwood markets	4.00	1.00
Timber harvesting, sawmill, hydraulics,	4.00	1.22
Best management practices for forestry	4.00	0.00
Tree identification and collection of samples	4.00	0.71
How to teach forestry concepts that are not exact	4.00	1.22
FFA contest, regional differences	4.00	1.73

During Session two, the participants compiled a list of 93 professional development needs to effectively teach forestry and forest ecosystems. At the end of the second round the needs were reduced to 80 items by removing redundancies and those that received less than the *a priori* mean of a 4.0. The top four items on the list were: professional career speakers ($M = 4.88$, $SD = 0.33$), graduation requirements limit electives ($M = 4.71$, $SD = 0.47$), career counseling/job fairs in forestry ($M = 4.71$, $SD = 0.47$), educate students about degrees needs for forestry career ($M = 4.71$, $SD = 0.47$). At the conclusion of round two, 54 items received a mean average above the *a priori* level of 4.0 (see Table 2).

Table 2

Round 2 – Levels of Agreement: Professional Development Needs in Forestry and Forest Ecosystems (Session 2)

Items	<i>M</i>	<i>SD</i>
Professional career speakers	4.88	0.33
Graduation requirements limit electives	4.71	0.47
Career counseling/job fairs in forestry	4.71	0.47

Items	<i>M</i>	<i>SD</i>
Educate students about degrees needed for forestry careers	4.71	0.47
Over commitment of students to sports/vacation/jobs	4.71	0.59
Lack of background knowledge	4.65	0.86
Lack of forestry /agriculture programs in schools	4.65	0.61
Have forestry electives in middle school	4.65	0.61
Better community engagement by forestry professionals	4.59	0.62
Time management/proper instruction planning	4.53	0.51
Forestry/Environmental Science related clubs	4.53	1.01
High school internships with local conservation/forestry professionals	4.53	0.72
Lack of bus and transportation funding	4.47	0.72
Overall disconnect of students with the outdoors	4.47	0.87
Making forestry cross-curricular	4.47	0.51
Connection among elementary, middle, and high school curriculum	4.47	0.72
College-bound students not seen as who should be taking forestry classes	4.47	0.72
Reaching out to students on social media to educate about forestry	4.47	0.80
How to change negative public perception of forestry	4.41	1.00
Have Cooperative Extension agents visit classrooms	4.41	0.71
More time for teacher curricular planning	4.41	0.80
Reaching young kids to direct students towards forestry classes	4.41	0.80
Understanding the impact of local environmental issues	4.41	0.71

Items	<i>M</i>	<i>SD</i>
Administration doesn't value subject matter (forestry and forest ecosystems)	4.35	1.06
Lack of funding for student organizations/club activities	4.35	0.86
Connect learning standards to forestry content	4.35	0.79
Teachers from urban areas lack foundational knowledge	4.35	0.79
Lack of collaboration between Science and Ag Ed program in school	4.29	0.92
Administration viewing forestry as a lower level science	4.29	0.85
No forestry or agriculture classes offered at high school level	4.29	1.10
Grant opportunities	4.29	0.92
Connect forestry four-year degree programs with community colleges	4.29	0.59
Professional development for teachers across disciplines	4.29	0.92
More scholarships for forestry bachelor degrees	4.29	0.92
Students not interested in summer camps designed for forestry	4.29	0.77
Improve parental education about careers in forestry	4.29	0.77
Administrative removal of students from forestry classes for advising	4.24	0.83
Substitute teachers to allow teachers to plan/develop new materials	4.24	0.97
Better environmental education opportunities	4.24	1.03
Create state position to recruit and educate high school students in forestry	4.24	1.09
Increase forestry professionals on state curriculum review boards	4.19	1.05
Teacher stipend for students clubs	4.18	1.07

Items	<i>M</i>	<i>SD</i>
Increase state agencies funding for forestry education	4.18	1.07
Lack of forest teaching areas	4.12	1.05
Perceived lack of fit between learning standards and forestry	4.12	0.93
Administrative removal of student from forestry classes for remediation	4.12	0.86
Forestry/environmental science scholarships connected with science fairs	4.12	1.05
Push towards STEM - not connected well to forestry	4.12	0.99
Improve day care/after school programs outdoor education programing	4.06	1.06
Money to purchase teaching equipment	4.06	1.20
Middle and high school students make career choices late in program	4.06	1.03
Improve 4-H programs in forestry	4.06	0.90
Lack of connection between learning standards and forestry content	4.00	0.94

From Sessions one and two, 107 items were reported by the participants of the information sharing sessions. At the conclusion of data collection, the results were compiled and a ranking of the z-scores identified the top 13 areas of concern from environmental and agricultural education educators in Georgia and Virginia. The top five concern areas were: professional career speakers ($z = 2.52$); graduation requirements limit electives ($z = 1.70$); career counseling/job fairs in forestry ($z = 1.70$); education students about degrees needed for forestry careers ($z = 1.70$); and over commitment of students to sports/vacation/jobs ($z = 1.70$) (see Table 3).

Table 3*Professional Development Needs Ranked by Z-score Combined from Session 1 and 2*

Item	<i>M</i>	<i>SD</i>	<i>z</i>	Session
Professional career speakers	4.88	0.33	2.52	2
Graduation requirements limit electives	4.71	0.47	1.70	2
Career counseling/job fairs in forestry	4.71	0.47	1.70	2
Educate students about degrees needed for forestry careers	4.71	0.47	1.70	2
Over commitment of students to sports/vacation/jobs	4.71	0.59	1.70	2
Trees diseases and disorders	4.8	0.45	1.48	1
Lack of background knowledge	4.65	0.86	1.41	2
Lack of forestry /agriculture programs in schools	4.65	0.61	1.41	2
Have forestry electives in middle school	4.65	0.61	1.41	2
Timber stand improvement/foundational knowledge	4.6	0.55	1.23	1
Forest management	4.6	0.55	1.23	1
FFA state forestry field exam (match curriculum)	4.6	0.55	1.23	1
Better community engagement by forestry professionals	4.59	0.62	1.12	2

Conclusions, Discussion, and Recommendations

The educational needs identified by information sharing session participants can be divided into two overarching categories: changes in administrative constraints regarding instruction of forestry and improving educators content knowledge of forestry. Session two was dominated by a discussion of administrative constraints on forestry education and Session one was dominated by a discussion of improving forestry educators' content. These findings support the work of Washburn et al. (2001) who similarly identified that geographic and educational administrative differences influence teacher professional development needs.

These findings are especially pertinent when viewed through the lens of the conceptual framework for this study developed by Roberts and Ball (2009). Industry-validated agricultural curriculum is a key component of the Agricultural Context which is a precursor for successful lifelong learners that are agriculturally literate citizens and also a skilled agricultural workforce. More directly, an agriculturally literate citizenship and skilled agricultural workers cannot exist without industry-validated curricula.

The need for having a foundational knowledge of forestry concepts, supports the work of Lockerman Friend (2008) who identified instructor knowledge as a crucial factor for secondary instruction in forestry. The participants in the session provided specific content about what topics they felt were lacking in their own education, but which they were expected to teach in the classroom. There are two approaches for remedying this lack content knowledge: a general forestry course could be added to undergraduate agricultural teacher preparation programs or continuing education learning session could be provided for inservice agriculture and environmental science teachers by forestry experts. Forestry is a constantly changing field, both solutions should be adopted by teacher educators and agricultural education state staff providing preservice and inservice teachers with additional content knowledge and adequately preparing students for a career in the forestry industry. These solutions are not time intensive but could be as simple as the cross disciplinary peer education model proposed by Copenheaver et al. (2004), where undergraduates in forestry provided guest lectures in secondary agricultural education classes.

Session two participants focused their discussion on various administrative challenges that face them in the classroom as major areas of concern for teaching forestry content in their classes. Concerns about administrative challenges and school procedures have been voiced by many teachers as a reason for leaving the teaching profession (Skaalvik & Skaalvik, 2011). However, there is no easy remedy for this issue. Professional development will increase teacher's knowledge in forestry content areas (Velardi et al., 2015); however, there is a lack of evidence suggesting that professional development assists teachers with overcoming administrative barriers.

Based on the findings of this study the following recommendations for further research are offered:

1. A needs assessment should be conducted, examining existing teacher confidence and familiarity with the professional development needs identified in this study to better prioritize the professional development opportunities;
2. Research should be conducted, examining preservice teacher confidence and familiarity with the professional development needs identified in this study so that teacher educators can better prepare preservice teachers; and
3. Research should be conducted, examining a larger geographic area to determine if forestry content concerns identified in this study match those in other geographic regions of the United States.

Based on the findings of this study the following recommendations for teacher education are offered:

1. Require each preservice teacher complete an introductory forestry course to ensure that foundational knowledge is acquired;
2. Prepare professional development workshops with forestry experts, merging the content and pedagogy; and
3. Work with state CDE superintendents to ensure the standards being taught in forestry units/courses align with the various competitive events offered.

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