

Determination of the Profile of the Agricultural Education Teachers of Puerto Rico Aimed at Identifying Needs to Establish a Professional Development Plan

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Abstract

Educators face countless challenges in the 21st Century, reflecting consequences such as rapid changes in population, sociocultural dynamics, technology, and education. Among these challenges are the integration of emerging technologies, diversity and inclusion, and continuous professional development to stay ahead. To understand the current profile of agricultural education teachers working in the public schools of the Department of Education of Puerto Rico, this quantitative study aimed to describe the characteristics of teachers serving students in agriculture courses and to explore their existing professional development needs. Data were collected using a questionnaire completed by 111 agricultural education teachers across Puerto Rico. The results revealed 45% of them did not hold a teaching certification. The major needs faced by these teachers included the design and implementation of irrigation systems, financial support opportunities for students, the integration of better technological tools, SAE agreements, proposal writing, and hydroponics. It was noted that teachers with less than five years of experience had more professional development needs compared to those with more than five years of experience. Based on the results obtained, it is recommended to coordinate efforts between the Agricultural Education Department of UPR-Mayagüez and the Puerto Rico Department of Education to seek alternative options for collaborating on the certification process of agricultural education teachers, develop a professional development plan in technical areas, and create a continuous mentoring plan.

Introduction and Literature Review

One of the biggest challenges in recent years for educational systems both across the United States and internationally has been a shortage of qualified teachers. The teacher shortage in the United States and Puerto Rico has reached critical levels, impacting the quality of education and the functioning of educational institutions (Kwadwo, 2024). One of the principal reasons for this shortage is low salaries and benefits (Avila, 2022). Teachers' salaries in the U.S. have not kept in pace with inflation, making the profession less attractive. According to the National Education Association (2020), the average teacher salary has decreased in real terms over the past decade. Also, a great number of teachers have faced high levels of stress and burnout due to increased administrative duties, standardized testing pressures and lack of support. This has led to high turnover rates and a shrinking pool of experienced educators (Sutcher, et al., 2016). Moreover, there has been a decrease in the enrollment in Teacher Preparation Programs, leading to a reduced supply of qualified teachers (Partelow, 2019). The American Association of Colleges for Teacher Education reported a significant decline in enrollment over the past decade (AACTE, 2020).

It is no secret that teacher recruitment in the United States currently represents a challenge (Touchstone, 2015). The shortage of teachers, including those in school-based Agricultural Education, has

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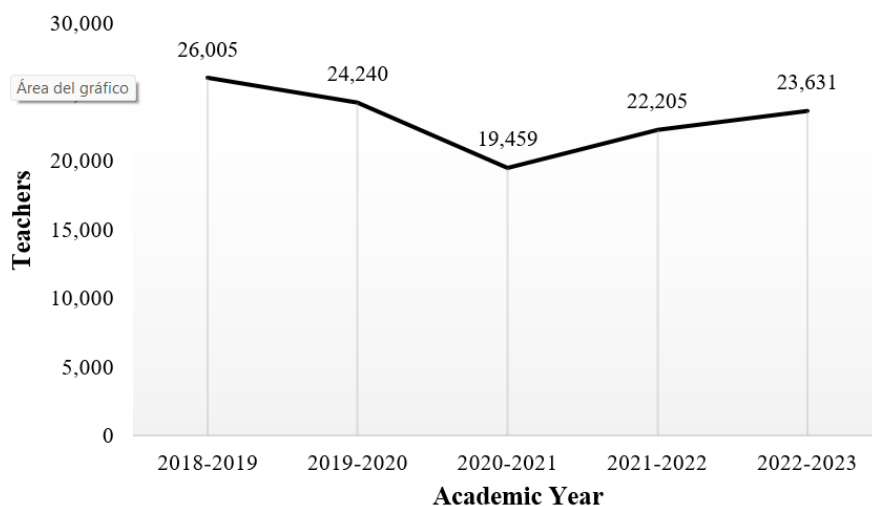
been documented across various disciplines since 1965 (Kantrovich, 2010; Smith et al., 2017). States such as Idaho and Texas have seen a decline in the recruitment of agricultural education teachers (Touchstone, 2015; Frost & Rayfield, 2020). A study conducted by the American Association of Agricultural Educators (2024) reported that in 2023, 25 out of 45 states identified the loss of programs and positions in agricultural education. Additionally, around 1,000 educators reported that they would not return to teaching during the 2023-2024 academic year. A study conducted by Smith et al. (2017), identified certain problems in agricultural education programs, including decreased enrolment, the constant shortage of qualified teachers, and changes in licensing requirements. Another study surveying 41 state supervisors of agricultural education reported there were 8,367 agricultural education programs employing 13,349 teachers, of which 12% were newly recruited (Smith et al., 2022). Additionally, in 2018, there were 1,594 open positions nationwide within school-based agricultural education (SBAE) due to teachers retiring, moving to new schools, or leaving the teaching profession entirely (Smith et al., 2019). Of these open positions, 576 were filled by alternatively certified individuals, non-licensed hires, or went unfilled (Smith et al., 2019).

The teacher shortage situation has also significantly impacted Puerto Rico, mirroring the challenges seen across the mainland United States. Puerto Rico's prolonged economic crisis has resulted in budget cuts for education (Caraballo-Cueto, 2020), this has led to teachers not receiving competitive salaries on the Island. Additionally, it has resulted in temporary teachers not having their contracts renewed and positions being frozen (Aviles, 2022). Furthermore, this has contributed to teachers resigning and emigrating to the U.S. mainland in search of better salaries and opportunities in states such as Florida, Texas, Virginia, Maryland, and New Jersey (Melendez, 2018; Figueroa, 2024). Hurricanes and earthquakes have damaged schools and disrupted education. The aftermath of Hurricane María saw many teachers leave the island due to displacement and deteriorating living conditions (Vargas-Díaz & Zambrana, 2019). Additionally, teachers have faced administrative challenges within the Department of Education, including a significant restructuring of their retirement system that substantially worsened their retirement conditions during the height of the COVID-19 pandemic (Vanes, 2020). During this period, the Department of Education received 3,000 retirement applications, compared to previous years, which averaged 500 applications (Vanes, 2020). This situation triggered a large wave of teacher resignations and retirements in 2020-2021 (Falcon, 2022). The "Great Resignation," a term used by Mildred Falcon (2022), refers to the mass exodus of teachers who began resigning from their positions starting in 2020 for reasons ranging from dissatisfaction and working conditions to COVID-19, among others. All of these issues have created a challenge for the Puerto Rico Department of Education. For the 2021-2022 academic year, they needed to recruit 4,240 teachers (Rivera, 2021), while for 2022-2023, they needed to recruit 2,000 teachers of all subjects (Rivera, 2022).

Currently, Puerto Rico has 851 schools, staffed by 23,630 teachers, serving 250,668 students for the 2023-2024 academic year (Puerto Rico Department of Education, n.d.). The agricultural education program is currently offered in 128 schools across the Island, led by 153 agricultural educators. These programs serve approximately 7,000 students, which represents about 3% of the total student population in Puerto Rico.

Figure 1

Active teachers in the past 5 years in the Department of Education of Puerto Rico



Recognizing the consequences that the teacher shortage has brought to the educational system in Puerto Rico, such as increased class sizes and a decline in student performance, the Department of Education implemented changes to address this issue. These changes included modifications to the teacher recruitment process, amendments to regulations and policies concerning teachers' certification, and a historic salary increase of \$1,000 per month (González, 2023). As a result, a significant number of teachers were hired who did not possess teaching certificates or meet the necessary requirements for certification. This situation has compelled professionals hired without the required teaching certification to return to university to complete the necessary courses and fulfill the Department of Education's requirements. This is a critical step for them to achieve a teaching certification and secure tenure as educators. Teachers who lack certification in agricultural education are at a disadvantage compared to those who met these requirements before graduating. These disadvantages include, but are not limited to, a lack of skills and expertise in agricultural tasks, instructional material design, and the selection of effective educational strategies. This has generally impacted on the quality of agricultural education, highlighting the urgent need for professional development for these teachers.

Although the topic of professional development has been studied multiple times, there are no previous studies identifying the professional development needs of agricultural education teachers in Puerto Rico. Golden (2013) mentions it is imperative to identify the needs of agricultural educators and address them to maintain relevance in agricultural teaching, utilize technology effectively, and meet the changing program needs. Stair (2019) states that for teachers to remain relevant, they need continuous seminars on pedagogical and technical topics in agriculture.

Undoubtedly, preparing future agricultural teachers falls on those universities that offer academic programs in agricultural education. In Puerto Rico, the only academic institution that trains future agricultural education teachers is the University of Puerto Rico at Mayagüez. The professors at this institution, together with the Department of Education of Puerto Rico, can help address the deficiencies of teachers and improve their courses if they are aware of the needs that exist in the job market.

Theoretical Framework

The Self-Determination Theory developed by Richard Ryan and Edward Deci focuses on promoting human growth, motivation, and well-being. Ryan and Deci (2000) argue that individuals have three basic psychological needs that must be satisfied for optimal development and intrinsic motivation: Autonomy, Competence, and Relatedness. Autonomy involves feeling in control of one's actions and decisions. Competence refers to the need to feel capable of facing challenges. Relatedness involves feeling connected and belonging to others. These theorists assert that when individuals meet these needs, they feel more motivated and engaged.

Applying this theory to educators, the need for Autonomy allows teachers to choose the professional development courses and workshops that interest them or meet their needs. The need for Competence is addressed when educators participate in training that challenges them and helps them identify their strengths and areas for improvement. These challenges provide a positive impact on the environment (Stover et al., 2017). Relatedness is fulfilled when educators build communities to share, learn from one another, and support each other. This phase also includes mentoring and opportunities for collaboration among colleagues. In the workplace context, teachers who fail to meet these needs experience higher levels of work-related stress and absenteeism, whereas those who do meet these needs exhibit higher motivation and greater satisfaction (Vargas, 2012).

Kurt Lewin's Organizational Change Theory (1947), structured in the phases of unfreezing, change, and refreezing, provides a clear framework for implementing professional development programs in educational institutions. This theory can be applied to enhance the effectiveness of such programs. In the unfreezing phase, teachers are prepared for change by raising awareness of the need for new skills or the lack of certain competencies. Additionally, it involves understanding the current status and the new scenarios that demand new actions (Sandoval, 2014). During the change phase, new skills, methodologies, or technologies are introduced and practiced. Finally, in the refreezing phase, these new knowledge and practices are consolidated into teachers' daily routines, ensuring long-term sustainability. The world is constantly changing, and adaptation is undoubtedly a necessity (Gasbarrino, 2022). By combining these theories, professional development not only motivates and engages teachers, but also facilitates a structured transition towards innovative educational practices, improving the quality of agricultural education in a contemporary 21st-Century context.

Purpose and Research Objectives

With the purpose of creating a professional development program for agricultural education teachers in Puerto Rico, the following objectives were determined for this study:

1. Describe demographic characteristics of agricultural education teachers of Puerto Rico.
2. Determine the current profile of the agricultural education teacher working for the Department of Education of Puerto Rico
3. Identify the professional development needs of agricultural education teachers working for the Department of Education of Puerto Rico.

Methods

Population and Sampling

To achieve the objectives of this study, descriptive research was conducted using a questionnaire developed by the researchers. The target population for this study was all Puerto Rico Agricultural Education teachers working for the Department of Education during 2023-2024 academic year ($N = 153$). From this population ($N = 153$), 111 teachers completed and submitted the questionnaire for a 73% response

rate. For this study, a confidence level of 95% with a confidence interval of 5% was selected. The minimum sample size to be achieved was 110 individuals as established by Krejcie & Morgan (1970). Based on this, the total number of participants met the required sample; therefore, the results obtained are representative of the population on which the study was based.

Instrumentation

For this study, the researchers designed a questionnaire in Spanish which had the purpose of inquiring among teachers their professional development needs based mostly on the components of the School Based Agricultural Education model (SBAE): classroom/laboratory, Supervised Agricultural Experience program, and National FFA Organization. This questionnaire was divided into four sections. The first section included three questions to identify demographic characteristics of survey respondents. The second included 71 questions covering potential agricultural educator needs. These questions were divided into six categories: agricultural knowledge and skills, school farm management, skills in FFA, classroom skills, SAE, and other related topics. This section included a Likert scale of five points to categorize teachers' necessity from: no necessity (1), some necessity (2), moderate necessity (3), strong necessity (4) and great necessity (5). The third section of the questionnaire consisted of 23 questions to determine agricultural education teachers' profiles. This section included questions regarding academic background, teaching experience, and certification status among other topics. The fourth section included an open question so teachers could identify areas of need not included previously in the survey. The questionnaire was designed through the Qualtrics platform and sent through email to the agricultural education teachers for their completion.

Validity and reliability

The questionnaire was submitted to the validity and reliability process. To conduct the process of validity of the questionnaire, a panel of experts consisting of five individuals was identified. This panel included individuals with experience and knowledge in teacher preparation programs, school administration, and secondary agricultural education. The panel consisted of a former agricultural education teacher, two specialized agricultural school principals, a Career and Technical Education Teacher Facilitator and an agricultural education graduate student. They were instructed to carry out a review process, evaluating whether the premises were aligned with the study objectives, checking for wording errors, and determining if the language used was appropriate. Additionally, they were informed that this instrument would be submitted virtually to teachers between the ages of 22 and 65 years.

To ensure reliability, a pilot study was performed with 10 Agricultural Education teachers randomly selected from each educational region of Puerto Rico. The pilot study was conducted through pre- and post-testing, administering the questionnaire with a one-week interval between tests. Eight responses were received and correlated, resulting in a Cronbach's Alpha of 0.80, which is classified as good (Cortina, 1993).

Procedures and data collection

One of the initial steps in conducting the study involved obtaining the necessary permissions from the relevant institutions. This process is crucial for ensuring that the research is ethically and legally sound. After the reliability process concluded and the recommendations were received and implemented, the questionnaire and other documents were submitted to the Assistant Secretary for Transformation, Planning, and Educational Performance (SATPRE) of the Department of Education of Puerto Rico, and later to the Committee for the Protection of Human Subjects in Research (CPSHI UPRM). After obtaining the required permission, pilot testing was conducted to determine the reliability coefficient. After establishing reliability, the teachers were invited to complete the questionnaire electronically using the Qualtrics online platform. Teachers received the questionnaires through their institutional emails. Five reminders were sent via email and WhatsApp. The data were collected during a period of three weeks.

Data analysis

The collected data were analyzed using Microsoft Excel, where statistical computations were performed to evaluate the results. A statistical analysis was conducted for questions related to the profile of the agriculture teacher, reporting frequencies, percentages, means, and standard deviations. For each category of needs, overall means and standard deviations were reported. An independent sample t-test was used with a significance level of $p \leq 0.05$ to compare educators with less than five years of experience versus those with more than five years. This independent sample test was analyzed through Infostat.

Results and Findings

Objective 1: Describe the demographic characteristics of Agricultural Education teachers in Puerto Rico.

Of the 111 participants who responded to the survey, 60% were female ($f=67$), 39% were male ($f=43$), and 1% identified as non-binary ($f=1$). Regarding age, 5.4% were between 21 and 25 years old ($f=6$), 21.6% were between 26 and 30 years ($f=24$), 12.7% were between 31 and 35 years ($f=14$) and 14.4% were between 36 and 40 years old ($f=16$). Additionally, 15.3% were between 41 and 45 years old ($f=17$), another 21.6% were between 46 and 50 years old ($f=24$), 7.2% were between 51 and 55 years old ($f=8$), 0.9% were between 56 and 60 years old ($f=1$), and 0.09% were between 61 and 65 years old ($f=1$).

Objective 2: Determine the current profile of Agricultural Education teachers working for the Department of Education of Puerto Rico.

Among the seven Educational Regional Offices (ORE) used by the Department of Education of Puerto Rico to divide the municipalities, 29.7% ($f=33$) belonged to the Mayagüez ORE, 26.1% ($f = 29$) were from the Arecibo ORE, and 20.7% ($f = 23$) were from the Ponce ORE. Additionally, 12.6% ($f = 14$) were from the Bayamón ORE, 6.3% ($f = 7$) from the Caguas ORE, 2.7% ($f = 3$) from the San Juan ORE, and 1.9% ($f = 2$) from the Humacao ORE. These regions have five types of schools, with the highest frequency of teachers teaching in General Course Schools ($f = 50$), followed by Vocational Schools ($f = 26$), Schools with both General and Vocational Courses ($f = 18$), Specialized Schools ($f = 12$), and Adult Schools ($f = 4$). Of the teachers that answered the questionnaire, 67.6% indicated their school was located in a rural area, while 32% stated their school was in an urban area. The student population of these schools' ranges from pre-kindergarten to 12th grade, including special education programs such as independent living and adult education. The grades most taught by agriculture teachers were eighth grade ($f = 35$), seventh grade ($f = 25$), twelfth grade ($f = 25$), and eleventh grade ($f = 23$).

In relation to academic preparation, a total of 111 teachers provided their responses. The most common level of education was a bachelor's degree ($f = 73$), followed by a master's degree ($f = 32$), credits leading to a bachelor's degree ($f=3$), a doctoral degree ($f = 2$), and an associate degree ($f = 1$). Among those who completed a bachelor's degree ($n = 107$), the majority had a specialty in Agricultural Education ($f = 40$), followed by Animal Science ($f = 22$), Agricultural Extension ($n = 8$), Agronomy ($f = 7$), and General Agricultural Sciences ($f = 7$). Other specialties included Horticulture ($f = 6$), Agricultural and Environmental Systems ($f = 5$), Crop Protection ($f = 3$), Agribusiness ($f = 3$), Sustainable Agriculture ($f = 3$), other agriculture-related programs ($f = 2$), and Agricultural Economics ($f = 1$). When asked about their teaching certification status, 111 teachers responded. Out of the total, 61 teachers had teaching certification, 10 had completed the requirements and were awaiting approval of their teaching certification, 28 were taking courses to become certified, and 12 were neither taking courses nor certified. This means that 55% of the teachers are certified, while 45% are not.

Table 1

Reasons identified by Agricultural Education teachers for not yet completing the certification requirements.

Reasons	Frequency (<i>f</i>)
Lack of offerings in online courses	8
Lack of time	5
Cost of college courses	4
Lack of orientation regarding teacher certification requirements	4
Lack of agronomist license	3
Delay in response from the certification office	2
Course convalidation*	1
Academic curriculum not aligned with the Department of Education	1
Lack of agricultural education courses	1
Lack of programs for accelerated certification	1
Obstacles to being admitted to university courses	1

Note: *Teachers enrolled in courses that are not required for teacher certification and face problems getting them validated.

Of the teachers who have a teaching certificate ($n = 61$), 41 had a non-occupational teaching certificate, and 20 had both non-occupational and occupational teaching certificate. When asked about the type of position they hold, 70.2% ($f = 71$) were in non-occupational teaching positions, and 36% ($f = 40$) were in occupational teaching positions.

Regarding their experience as educators, 42.3% ($f = 47$) of the teachers had between zero to five years of experience, 22.5% ($f = 25$) had between six to 10 years of experience, 8.1% ($f = 9$) had between 11 to 15 years of experience and 10.8% ($f = 12$) had between 16 to 20 years of experience. Additionally, 9.9% ($f = 11$) had between 21 to 25 years of experience, and 6.3% ($f = 7$) had between 26 to 30 years of experience. Concerning professional development, teachers were asked how many hours they had received professional development trainings during the 2022-2023 school year. Thirty-seven percent of the educators had received between zero to 10 hours of professional development, 40% had received between 11 to 20 hours, 10% had received between 21 to 30 hours, and 13% had received more than 30 hours of professional development. Furthermore, 77% of the teachers had never participated in an induction program, while 22% had. Induction programs aim to offer a structured process focused on the professional development of new teachers, where mentoring is integrated to transfer the knowledge acquired by colleagues as well as school authorities (Rodríguez, 2024). Additionally, 92% of the surveyed educators had never participated in a mentoring program, while 8% had participated in such a program.

Objective 3: Identify the professional development needs of Agricultural Education teachers working for the Department of Education of Puerto Rico.

The three professional development topics identified as having the greatest need in the category of agricultural knowledge and skills were agricultural biotechnology ($M=3.72$, $SD=1.11$), agricultural engineering ($M=3.53$, $SD=1.18$), and dairy products processing ($M=3.46$, $SD=1.23$).

Table 2*Agricultural knowledge and skills*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
Agricultural Biotechnology	111	3.72	1.11
Agricultural Engineering	111	3.53	1.18
Dairy products processing	111	3.46	1.23
Arboriculture	111	3.45	1.18
Veterinary Sciences	111	3.43	1.26
Agricultural machinery	111	3.37	1.20
Alternative agricultural production systems	111	3.35	1.18
Research in Agriculture	110	3.33	1.15
Hydroponics	109	3.30	1.28
Agricultural products processing	111	3.29	1.23
Floristry	111	3.19	1.24
Agroecology	111	3.16	1.25
Agribusiness	111	3.12	1.23
Floriculture	111	3.12	1.24
Fruticulture	110	3.00	1.18
Starchy Crops	109	2.97	1.14
Ornamental Plants	111	2.89	1.20
Soil Science	111	2.81	1.08
General Animal Science	111	2.76	1.30
Natural Resource Conservation	111	2.75	1.17
Careers related to agricultural sciences	111	2.64	1.24
General agricultural production	111	2.62	1.17
Horticulture	109	2.59	1.12
Total	111	3.12	1.19

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

In the category of School Farm Management, the three professional development needs were: Design and implementation of irrigation systems ($M=3.63$, $SD=1.10$), Design and construction of animal structures ($M=3.38$, $SD=1.24$), and Marketing and sale of agricultural products ($M=3.20$, $SD=1.19$).

Table 3*School Farm Management*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
Design and implementation of irrigation systems	111	3.63	1.10
Design and construction of animal structures	111	3.38	1.24
Marketing and sale of agricultural products	111	3.20	1.19
Nursery and shade house management	111	3.10	1.17
Proper management of agricultural products	111	3.04	1.20
Inventory of equipment and materials	110	2.65	1.22
Management of agricultural tools and equipment	111	2.50	1.24
Total	111	3.07	1.18

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

In the area of FFA Skills, educators identified the greatest needs in the following areas: Financial support opportunities for students ($M=3.78$, $SD=1.11$), parliamentary procedures ($M=3.42$, $SD=1.14$), and public speaking skills ($M=3.42$, $SD=1.24$).

Table 4*FFA Skills*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
Financial support opportunities for students	111	3.78	1.11
Parliamentary Procedures	111	3.42	1.14
Public Speaking Skills	111	3.42	1.24
Opportunities in FFA (example: Band, Chorus, Educational Programs, Conventions, Assemblies, others)	111	3.41	1.19
Knowledge in Leadership Development Events	110	3.25	1.24
Requirements for FFA Degrees (Discovery FFA Degree, Greenhand FFA Degree, Chapter FFA Degree, State FFA Degree and American FFA Degree)	111	3.13	1.32
FFA Program of Activities	111	3.09	1.29
Opening Ceremony, Closing Ceremony, and Initiation Ceremony	111	3.04	1.34
FFA members recruiting strategies	111	2.98	1.42
Leadership development strategies	111	2.92	1.24
Total	111	3.24	1.25

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

In the category of Classroom Skills, agricultural educators identified the greatest needs in the following areas: integration of better technological tools ($M=2.97$, $SD=1.11$), agricultural education program standards ($M=2.91$, $SD=1.21$), and motivation strategies ($M=2.78$, $SD=1.17$).

Table 5*Classroom Skills*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
Integration of better technological tools	111	2.97	1.11
Agricultural Education Program Standards	111	2.91	1.21
Motivation strategies	111	2.78	1.17
Tools to Help Students with Special Needs in the Classroom	111	2.71	1.12
Department of Education Public Policies	111	2.69	1.15
Recruitment and Promotion of New Students	110	2.65	1.16
Strategies for Assessing Student Learning	111	2.62	1.10
Lesson Plan design and writing	111	2.62	1.14
Teaching Scheduling	111	2.62	1.19
Search and identification of teaching resources	111	2.62	1.17
Instructional and educational objectives writing	111	2.61	1.14
Group management strategies	110	2.58	1.14
Teaching Methodology	111	2.55	1.17
Inclusion, diversity and equity in the classroom	111	2.49	1.21
Total	111	2.67	1.26

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

In Supervised Agricultural Experience Programs (SAE), teachers identified the greatest needs in the following areas: SAE agreements ($M=3.12$, $SD=1.25$), portfolio design for evaluating SAEs ($M=3.12$, $SD=1.23$) and the role of employers in SAEs ($M=3.12$, $SD=1.26$).

Table 6*SAE*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
SAE agreements	111	3.12	1.25
Portfolio design for evaluating SAEs	111	3.12	1.23
The role of employers in SAEs	110	3.12	1.26
The role of parents in SAEs	111	3.02	1.28
Placement plan for SAE Students	111	2.97	1.27
The role of the teachers in SAEs	111	2.91	1.30
Identifying types of SAE	111	2.71	1.19
Total	111	2.99	1.26

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

Regarding other topics related to the agricultural education program that do not necessarily fall under any of the previously explained categories, educators identified the greatest needs in "grant proposal writing" ($M=3.65$, $SD=1.28$), "Work-Based Learning (WBL) for high school students (9th-12th grade)" ($M=3.14$, $SD=1.32$), and "STEAM focused on agricultural sciences" ($M=3.11$, $SD=1.20$).

Table 7*Other Related Topics*

Items	<i>n</i>	<i>M</i>	<i>SD</i>
Grant proposal writing	111	3.65	1.28
Work Based Learning (WBL) for high school students (9-12th grade)	111	3.14	1.32
STEAM focused on agricultural sciences	110	3.11	1.20
Employability skills for students	110	3.03	1.17
Advisory council	111	3.00	1.14
Skills for teaching primary grades (pre kinder to fifth grade)	111	2.98	1.39
Identifying community resources	111	2.85	1.23
Program promotion in the community	111	2.85	1.20
Managing social media as a promotional mechanism	111	2.73	1.22
Community relations	111	2.70	1.23
Total	111	3.00	1.24

Note: Likert Scale from 1 to 5, where No necessity (1), Some necessity (2), Moderate necessity (3), Strong necessity (4), and Great necessity (5).

Through an open-ended question, educators were asked to identify the five topics they were most interested in receiving as professional development training. The educators identified 79 different topics. Below are the 11 most frequently mentioned topics.

Table 8*Open Questions*

Items	Frequency (<i>f</i>)
Hydroponics	22
Lesson planning	19
FFA	16
SAE	15
Irrigation systems	10
Animal Health	8
Educational Strategies	8
Educational Technology	7
Agricultural Machinery	6
Beekeeping	6
Biotechnology	6

The needs of teachers with less than five years of experience were compared to those with more than five years of experience as agricultural education teachers. The independent samples t-test showed overall that there are significant differences between the needs of teachers with less than five years of experience and those with more than five years. The categories that reflected significant differences were: "Agricultural knowledge and skills", "FFA skills", "Classroom skills", "SAE" and "Other related topics". Refer to Table 9 for a breakdown of the t-tests conducted.

Table 9

Comparison of Needs Between Teachers with Less Than Five Years of Experience and Teachers with More Than Five Years of Experience.

Agricultural Education Teachers							
Categories of needs	Less than five years of experience (n= 47)		More than five years of experience (n= 64)		Diff ^a	t	p-value*
	M	SD	M	SD			
1. Agricultural knowledge and skills	3.33	1.31	3.01	1.09	0.32	3.25	0.0022
2. School farm management	3.18	1.30	3.00	1.08	0.18	0.85	0.4132
3. FFA skills	3.73	1.25	2.88	1.12	0.85	6.60	<0.0001
4. Classroom skills	2.84	1.30	2.54	1.02	0.30	5.41	<0.0001
5. SAE	3.37	1.50	2.70	0.98	0.67	8.08	<0.0001
6. Other related topics	3.22	1.37	2.72	1.07	0.50	5.32	<0.0001

^aDifference in means between sample 1 and sample 2. *p < 0.05

Discussion and Conclusions

The intention of this study was to identify the current profile of Agricultural Education teachers working for the Department of Education of Puerto Rico (DEPR) and to pinpoint areas where there is a need for professional development. The survey included 111 educators, with slightly more than half being female and 42.3% having between zero to five years of teaching experience. This significant number of less experienced teachers is a result of the Department of Education's recruitment efforts to replace the 2,700 educators who retired in 2023 (Jover, 2023) and in previous years.

Most educators classified their schools as being in rural areas. This is likely because agricultural education programs were initially concentrated in rural and agricultural vocational schools to improve agricultural efficiency and productivity (Carrión-Guzmán, 2021). Consequently, many of these schools continue to offer agricultural education and maintain school farms in rural areas. Forty-five percent of educators were not yet certified, citing delays in certification, ongoing courses, or not taking courses. This number increased compared to 2017, when 30% of agricultural education teachers in Puerto Rico were uncertified (González, 2018). Of those surveyed, 40 educators held occupational positions, but only 20 were certified to teach occupational courses. To obtain an occupational agricultural education certification, teachers must have a non-occupational agricultural education certificate, complete 1,000 hours in the agricultural science field of specialization, earn nine university credits in the specialty, and take an agricultural safety course as indicated in Certification No. 9375 of April 28, 2022 (Departamento de Educación, 2022). These findings align with the shortage of certified educators being recruited by the Department of Education with a bachelor's degree in any agricultural science field, who must follow a non-traditional certification route to eventually achieve tenure (El Nuevo Día, 2021).

One of the greatest needs among educators in Puerto Rico was agricultural biotechnology. A study by Smalley et al. (2019) also found that educators in Iowa identified agricultural biotechnology as a significant area for professional development. The courses offered by the Faculty of Agricultural Sciences

at the University of Puerto Rico in Mayagüez, while covering a wide range of courses in the sciences, do not include teachings in agricultural biotechnology. Despite this, the Curriculum Framework states that agricultural education teachers can teach biotechnology systems courses at either an occupational or non-occupational level (Department of Education, 2017). Vidor (2017) points out that educators mainly face the challenge of how to integrate agricultural biotechnology into their classes and emphasizes the importance of this field for students to understand technological and scientific advancements. Other notable needs included the design and implementation of irrigation systems, financial support opportunities for students, integration of better technological tools, SAE agreements, grant proposal writing, and hydroponics. Undoubtedly, these are areas where professional development should focus, as they are not necessarily covered during university courses and add great value to agricultural education programs. The study by Smalley et al. (2019) also highlighted needs in financial support opportunities and technological tools. The lack of knowledge in certain agricultural and pedagogical areas may be due to the fact that 45% of educators have less than five years of experience and may lack certain skills that come with time and practice. This is also reflected in the t-test comparing teachers with less than five years of experience to those with more than five years of experience. This test showed a significant difference between the needs of both groups, indicating a greater need among educators with less than five years of experience. The significant differences highlight the critical gap in preparation and support for new teachers in agricultural education. This underscores the importance of targeted professional development opportunities to bridge these gaps and support educators early in their careers, specifically those with less than five years of experience. Additionally, these findings could inform updates to university-level teacher preparation programs, ensuring that graduates are better equipped with the necessary skills for agricultural education.

Forty percent of educators received between 11 to 20 hours of professional development; however, the study did not specify the topics covered in these training sessions. The training that educators receive is not based on real-world problems, as educators continue to face challenges in areas related to agricultural sciences. It is possible that these trainings are not based on evidence from previous studies or documented consultations with educators. This could lead to a lack of interest from educators during the training sessions and result in the training being of minimal use to their professional areas. Addressing deficiencies in agricultural and pedagogical areas can be achieved through continuous professional development tailored to actual needs. Touchstone (2015) emphasizes that addressing the professional development needs of inexperienced or new teachers is essential for increasing teacher retention and enabling them to acquire classroom experience and skills over time. Smalley et al. (2019) concluded that retaining novice educators partially depends on meeting their perceived professional development needs, thereby alleviating the shortage of educators and reducing the frustrations and stress faced by new recruits.

Seventy-seven percent of educators surveyed had never participated in an induction program. When a teacher begins their career for the first time, it is the most important stage of their professional journey. Induction is a tool used by institutions to help new staff integrate into their roles quickly, adapt to the culture, and understand the processes (García et al., 2018). Rodriguez (2024) found no protocol within the Department of Education of Puerto Rico for implementing induction programs for occupational teachers. The Department delegates the implementation of induction plans to each school principal or leader, without a protocol that considers the educator's needs or teaching level. Rodriguez (2024) indicates that induction processes are crucial for occupational levels, as educators must be specialists in their respective subjects. Induction programs play a specific role in ensuring that the teacher succeeds in their career and gains the trust and respect of their colleagues, parents, and students (Marcelo & Vaillant, 2017). Ninety-two percent of surveyed educators had never participated in a mentoring program. Wilcoxon et al. (2019) found that mentoring positively impacts new educators, providing guidance in technical and pedagogical knowledge.

Recommendations

This research reveals that educators in the agricultural education program have diverse professional development needs ranging from technical agricultural aspects to pedagogical skills. These needs reflect the evolution of the agricultural sector and the importance of adapting education to 21st-century technologies. Addressing these needs requires implementing a professional development program focused on the areas identified in this study. Enhancing educators' knowledge through professional development allows them to remain relevant and effective in the classroom, benefiting their students and communities. Additionally, more support should be offered to teachers in completing the certification requirements for agricultural education.

The findings suggest a concerted effort should be made to align the Department of Agricultural Education at UPR-Mayagüez with the Department of Education to explore collaborative pathways for the certification of agricultural education teachers. Establishing a formal partnership between the Department of Agricultural Education and the College of Agricultural Sciences at UPR-Mayagüez is essential. This partnership would involve faculty, agricultural extension agents, specialists, and researchers serving as vital resources for providing technical professional development to agricultural education teachers. Furthermore, it is recommended that the Department of Education implement a structured induction program for newly hired teachers, in collaboration with the Department of Agricultural Education and the College of Agricultural Sciences. This initiative should foster mentorship and collaboration between novice teachers and their more experienced counterparts who have demonstrated successful educational projects. Additionally, there should be encouragement to create a comprehensive resource bank where educators can access a variety of instructional materials, including lesson plans, videos, and other resources in Spanish. This repository would address gaps in specific agricultural and pedagogical topics, thereby benefiting both current and future educators within the Department of Education. Such strategic collaborations and resources are anticipated to enhance the effectiveness and professional growth of agricultural education teachers, ultimately contributing to the quality of education provided.

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