A DELPHI STUDY OF AGRICULTURAL PRACTITIONERS' OPINIONS: NECESSARY EXPERIENCES FOR INCLUSION IN AN UNDERGRADUATE SUSTAINABLE AGRICULTURAL MAJOR

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Abstract

This study elicited stakeholder input in the design of a University of California, Davis sustainable agriculture undergraduate major. A web-based, Delphi survey of agricultural professionals was conducted to determine what experiences practitioners thought undergraduate students should have while pursuing this degree. Through consensus, participants determined that students needed experiences in agronomic, environmental, and social aspects of agriculture. It was concluded that these students needed various skill-building experiences—both on-farm and in relationships with practitioners—to understand the agri-food system's complexity. Practitioners suggested pedagogical approaches that challenged the status quo of single-subject, classroom-bound teaching, with holistic and interdisciplinary learning involving discussions, team projects and practical experiences. Practical experience in the field, on-farm research experiences, team projects, and guest lectures by non-faculty were among the suggested pedagogical approaches. In addition, practitioners repeatedly emphasized the need for internships, apprenticeships, student-mentor relationships, networking opportunities, and field trips that introduced students to the diversity of California agriculture. Finally, sustainable agriculture practitioners suggested that students engage in debates and discussions with stakeholders with divergent opinions about agricultural and sustainability issues. This study has implications for curriculum design in land-grant universities seeking to meaningfully engage stakeholders.

The Morrill Act is often thought of as pioneering legislation in agricultural and mechanical arts education. Over the years, the Act, its amendments, and attendant legislation promised that land-grant universities would provide teaching, research, and service for the citizenry (Kelsey & Pense, 2001; LaMay, 2001). These universities were specifically formed to help ameliorate rural community problems by improving real situations faced in everyday life (Zimdahl, 2003; Bawden, Busch, & Gagni, 1991; Herren, 1986), with a mandate to bring higher education of a practical nature to citizens of ordinary means (National Research Council, 1996). As time has passed, other priorities have taken hold. Many land-grant faculty members perceive applied research as more responsive to stakeholders' needs, but they identify basic research as more personally valuable because promotion and tenure are often based, to a very large extent, on publishing basic research (Kelsey, Pense, & Maringer, 2002). Consequently, many (Bawden et al.; Fields, Hoiberg, & Othman, 2003; Zimdahl) have argued that the work of land-grant institutions has shifted away from research and extension that directly serves its mandated constituency.

To combat this trend, legislators and non-governmental organization staff, as well

as many within academia have made ardent attempts to remedy the situation. One result was the Agricultural Research, Extension, and Education Reform Act of 1998, which required that stakeholder input be used for priority setting (U.S. Congress, 1998). The priority setting process specifically stated that:

> Effective October 1999, to obtain agricultural research, extension, or education formula funds from the Secretary, each 1862 Institution, 1890 Institution, and 1994 Institution shall establish and implement a process for obtaining input from persons who conduct or use agricultural research, extension, or education concerning the use of the funds (Section 102c).

The Kellogg Commission on the Future of State and Land-Grant Universities (1999) highlighted the need for land-grant universities to foster more proactive engagement with their constituents to meet the intent of the Morrill Act. On the university level, the chancellor emeritus of the University of California, Davis (UC Davis) argued that land-grant universities were "in need of revitalization and renewal" (Meyer, 1995, p. 1); he suggested "to reinvent the land-grant college, efforts of individual colleges needed to change and should begin from the bottom up, institution by institution, not from the top down" (Meyer, 1997, p. 5). In other words, to fulfill their mission, land-grant universities need to re-engage internal and external stakeholders in ways that are relevant.

Today, few Americans have direct agricultural experience. In 1930, two out of ten Americans worked in agriculture; now, less than two percent of the U.S. population makes its living farming or ranching (U.S. Department of Agriculture, 1999). While people with direct experience with agricultural backgrounds declines, there remains student interest in agriculture and its related fields. A study conducted by Dyer, Breja, and Andreasen (1999), found increased enrollment in high school and college level agricultural courses, while Greene and Byler (2004), found that increasing numbers of these students came from urban or non-farm backgrounds. Realizing this trend, many land-grant university mission statements were adapted to reach out to students coming from urban areas (Fields et al., 2003). Because many of these urban students have little to no practical experience with agriculture, educators have stressed the need for the inclusion of practical learning experiences that are integrated into the formal curriculum (Andreasen, 2004; Karsten & Risius, 2004). This focus on practical education harkens back to the original intentions of the Morrill Act and the purposes of the land-grant university.

Concomitant with the trend toward a new student base for colleges of agriculture, there has been a trend toward new sectors within the agri-food system. Notably, environmentally and socially responsive sectors of the agri-food system have demonstrated rapid increases in market share. In the 1990's, the certified organic food market grew by 20% internationally and by 25% in the U.S. each year, reaching $7.8 billion in the U.S. in 2000 (Thrupp, 2002). In contrast, the conventional food sector grew by five percent annually during this time period. As agricultural practitioners shift toward more sustainable production methods, the very notion of what constitutes agriculture in the minds of consumers has expanded. The contemporary conception of agriculture has begun to encompass activities such as environmental protection, distribution, retail, diet, and even the simple, yet profound act of eating (Berry, 1990; Francis et al., 2003).

To continue to serve the public and maintain integrity as contemporary agricultural universities, land-grant institutions need to broaden their educational and research agenda to address the active transformation in public demographics and the food system as a whole (Bawden et al., 1991; Francis et al., 2003; Kelsey & Pense 2001; Zimdahl, 2003). Some land-grant institutions have started taking steps to make this a reality. For example, Dean Neil Van Alfen of the College of Agricultural & Environmental Sciences (CA&ES) at the UC Davis noted "sustainable agriculture has been recognized as field of study… that is gaining

prominence among researchers, students, industry, and the public" (King, 2003). This trend in thinking, however, is recent and has a diverse and broad spectrum of applications. One significant step toward institutionalizing the field would be to develop undergraduate majors in sustainable agriculture. There are few published studies that document U.S. land grant university progress toward the development of sustainable agriculture curricula. This study was designed to meet the needs of a specific university pursuing this end, but also provides other universities with a process that may fill the current void in this field.

Context

In 2002, a UC Davis committee of faculty involved in sustainable agriculture education, research, and extension appointed by the Dean of the CA&ES proposed the establishment of an undergraduate major in sustainable agriculture. As a result, a UC Davis curriculum committee was appointed to design the major. In the summer of 2003, the first unveiling of the proposed major was met with discontent by many external university stakeholders due to an inadequate emphasis on the social aspects of agriculture and too few applied learning experiences integrated into the curriculum.

With this feedback, Dean Van Alfen appointed another committee to develop a more broadly conceptualized course of study that incorporates the natural and social sciences and includes more alternative pedagogy. The new committee, comprised of both faculty and graduate students, believed it important to receive advice from practitioners working in the various sub-sectors of agriculture to inform the development of curriculum. The committee sought the advice of these practitioners via an extensive web-based Delphi study. This paper focuses on the experience-related feedback from these agricultural stakeholders.

Purpose and Objectives

The purpose of this Delphi survey study was to garner practitioner perspectives on the development of an undergraduate sustainable agriculture major. The specific objective was to determine what experiences to include in an undergraduate sustainable agriculture major.

Methods

The researchers used the Delphi survey technique to determine practitioner perspectives. A Delphi study is a group process to elicit, collate, and direct informed (expert) judgment toward consensus. This method was chosen because it has proven itself useful in defining issues and bringing groups to consensus.

Initially, 60 agricultural practitioners were invited to participate in the study. Nominations came from UC Davis sustainable agriculture curriculum development committee members. The committee was composed of natural and social scientist faculty and graduate students. The committee purposefully selected participant representation from the following groups: farmers, distributors, farmers' market organizers, retailers, farm labor advocacy representatives, public and private consultants, farm advisors, and representatives of governmental and non-governmental organizations.

Forty (40) practitioners responded to the first round of questions. In the second round, 73% or 29 practitioners participated. Twenty-seven (27) practitioners completed the third round. The goal of representation from the various practitioner groups was achieved and no one group was overly represented. The study was conducted from July 15 – December 15, 2004.

This was a web-based Delphi study that followed procedures described in Dillman's *Total Design Method* (2000). Each participant initially received an invitation to the study in an official letter from the CA&ES Dean, followed by an email invite to participate in the study. If they chose, participants could link directly to the study's website, read about their rights, and respond to the survey questions. Postcards were sent periodically to increase response rates and participants were telephoned approximately three days prior to each round's cut off date. All participants were phoned until live

contact was made.

This Delphi study was conducted in three stages. A panel of experts, represented by university faculty and graduate students, developed the initial phase, in which respondents were asked to answer the following open-ended question: *What experiences are necessary for students to have while pursuing a sustainable agriculture undergraduate major?*

From the qualitative text responses to this question, a list of experiences was developed. The researchers used an iterative process and the constant comparative method to distill and cluster round one responses into logical categories (Strauss, 1987). In the second round, participants were asked to score the importance of the distilled items on a Likert-type scale with "1" being *not important*, "2" being *somewhat important*, "3" being *important*, "4" being *very important*, and "5" being *extremely important*. The participants were also given an option to choose "DK", meaning "*don't know*".

To determine the most agreed upon experiences, researcher-defined criteria were employed. Statements that met these criteria moved on to the third round. Criteria were: 1) a group mean score of 3.5 or higher and 2) a standard deviation of 1.0 or less, indicating a strong consensus for inclusion among peers. Exceptions were made for items that met the mean threshold but failed the standard deviation criterion if the distribution of scores for that given item held 51% or greater within the 4 and/or 5, "very important" and/or "extremely important" values.

In the third round, participants were asked if they still agreed with their initial ratings and, if not, to adjust their initial ratings. To do this, they were provided with both Group Mean ratings of statements and their own ratings from the second round. All data were collected and analyzed in FileMaker Pro and Microsoft Excel. Results from the final round are represented as group mean scores and standard deviations.

Findings

As noted in Table 1, practitioners believed that *Internships and Apprenticeships* were an extremely important experience for sustainable agriculture undergraduate students—rating this item with a mean of 4.50. Practitioners identified three primary internship areas, with a mean range of 4.37 to 3.59. These areas were on-farm and on-ranch, on a variety of farms, and with an agricultural organization or company.

Table 1
Delphi Round Three: Types of Experiences-Internships/Apprenticeships, On-Farm Experiences, and Field Trips (n = 27)

Experiences	*M*	*SD*
Internships/Apprenticeships		
Internships	4.50	0.79
On-farm and on-ranch	4.37	0.79
On a variety of farms	4.04	0.85
Agricultural organization or company, co-ops, wineries, etc.	3.59	0.89
On-Farm Experience		
Field experience as a complement to classroom learning	4.35	0.69
Field identification of problems including pests, soil, water issues	4.33	0.82
Field practices	4.04	0.91
Experience with a variety of agricultural enterprises, including conventional, "sustainable", large, and small	3.88	0.99
Field experience to evaluate what will work under what conditions	3.82	0.90
Field experience to evaluate the impacts of new processes or equipment	3.68	0.98
Visits and Field trips		
Exposure to the overall complexity of an agricultural system	4.33	0.68
Seeing differences in farm management with respect to pest management, soil and water	4.22	0.85
Visits and field trips	4.07	1.05
Working farm tours	4.04	1.10
Visits to conventional and organic farms to compare	4.04	1.14
Biologically Integrated Farming Systems and other projects on-farm	3.93	1.02
See and experience the diversity of agriculture in California	3.64	1.06

Note. Very Important = 3.50 – 4.49, Extremely Important = 4.50 – 5.00

Closely following *Internships/ Apprenticeships*, practitioners expressed the importance of *On-Farm Experiences* to complement classroom learning. The respondents underscored the need for skill-building experiences in areas such as identification of field problems and field practices. They noted the need for experience with a variety of agricultural enterprises, including conventional and sustainable practices, and large and small-scale farms. Finally, they saw field experiences as a means to evaluate innovations and practices in various conditions.

In conjunction with the aforementioned practical experiences, *Visits and Field Trips* were identified as important experiences for undergraduates in sustainable agriculture, with a mean range of 4.33 to 3.64. The responses emphasized the need to explore the complexity of several different farming systems and to understand the diversity of California agriculture.

In Table 2, practitioners highlighted the need for unconventional *Teaching Approaches*. The approaches advocated ranged in mean score from 4.32 and 3.54. Practitioners saw greatest need in providing

a systems approach to learning and interdisciplinary classroom discussion. Also emphasized was the need to couple practical experience with theory and subject curriculum. Additionally, useful learning practices identified were guest lectures, senior projects that use community resources, and group projects.

Table 2
Delphi Round Three: Teaching Approaches, Research, and Technology Use (n = 27)

Experiences	*M*	*SD*
Teaching Approaches		
Systems approach	4.32	0.80
Practical experience that is augmented with theory and subject curriculum	4.16	0.62
Guest lectures	3.67	0.92
Interdisciplinary classroom discussion that challenges single subject system	3.65	1.09
Senior project that utilizes community resources	3.58	1.21
Class project done in a team with student team leader	3.54	1.14
Research		
On-farm research	4.00	1.02
Senior project investigating and reporting novel practices that address agriculture and environmental sustainability	3.88	0.99
Experience with scientific methodology	3.57	0.96
Production plot trials to evaluate alternative management methods	3.57	1.07
Technology		
Computer use	3.93	0.96

Note. Very Important = 3.50 – 4.49

Practitioners also emphasized a need for *Research* experiences, with means ranging from 4.00 to 3.57. Specific research agendas involved on-farm research investigations that introduced students to scientific methodology while giving them an opportunity to evaluate alternative agricultural practices.

Finally, Table 2 also shows that stakeholders identified *Computer Use* as a very important skill-building experience for students, scoring this at 3.93.

Data represented in Table 3 indicates that practitioners thought various *Networking and Community Building* tactics in real-world contexts were essential for students. Means ranged from 3.86 to 3.71. Respondents emphasized a need for students to interact and converse with a range of people with divergent perspectives and experiences within various segments of agriculture. Stakeholders specifically mentioned a need for students to talk with farmers.

Table 3
Delphi Round Three: Experiences Related to Networking/Community Building, Practical Experience, Planning, Business, and Marketing (n = 27)

Experiences	*M*	*SD*
Networking/Community Building		
Interaction with a variety of growers and others in the agriculture sector	3.86	1.08
Debates and discussions among a diversity of people with divergent opinions about agriculture and sustainability issues	3.82	1.06
Talk to farmers and consultants	3.71	1.08
Practical experience		
Practical project that emphasizes long-term implications of an agricultural system along with short-term production/profit goals	3.72	0.79
Hands on experience on student farm	3.68	1.02
Mentoring/job shadowing	3.68	1.12
Learning from those who are successful and are still struggling	3.64	0.91
Planning, Business, and Marketing		
Analysis of agricultural systems and farm planning	3.82	0.72
Marketing basics	3.70	0.95
Development of production budgets for potential crops	3.59	0.93

Note. Very Important = 3.50 – 4.49

Practitioners also determined that *Practical* experience was very important for undergraduates, with means ranging from 3.72 to 3.64. Practitioners underscored the need for students to understand the implications of various practices through hands-on learning at the student farm and through job shadowing and practitioner-student mentorship experiences.

Planning, Business, and Marketing were also considered very important experiences for students, with means ranging from 3.82 to 3.59. Practitioners noted a need for students to understand marketing basics and to have an opportunity to plan and budget farms, and design cropping systems.

Conclusions

The following conclusions are drawn from the study's findings and fall into two general categories. Initial conclusions are suggestions of *topics* for student experiences. The latter category suggests *how* experiences might be approached *pedagogically*.

Practitioners thought an undergraduate sustainable agriculture major should include the following three topics:

First, on-farm and in-field experiences are critically important for undergraduates in sustainable agriculture. This could be contrasted with the absence of practitioners' recommendations for on-campus experiences in conventional lecture, reading assignments or in-lab exercises. Practitioners suggested that on-farm internships, visits, and field trips are very-to-extremely important and that research experiences be situated on-farm.

Second, students need to engage in dynamic relationships between diverse components of the entire agri-food system. Practitioners emphasized a need for student exposure to the overall complexity of the agri-food system and included experiences with a variety of conventional and organic

management settings, as well as differing scales of operation.

Third, agricultural experiences are necessary, but need to extend well beyond agronomic production disciplines into environmental and social sciences. Suggested experiences included investigations and reporting of novel practices that address agricultural and environmental sustainability. Ideas for practical projects emphasized long-term implications of practices as well as short-term production and profit goals. Economics and management were also very important considerations. Networking with stakeholders with divergent viewpoints was also highlighted.

The next set of conclusions builds on the first in important ways. The inclusion of practical experiences that engage the complexity of the entire agri-food system—inclusive of agronomic, environmental and social components—presents challenging pedagogical requirements. Practitioners' proposed teaching approaches to address many of these challenges:

First, practitioners proposed many on-farm production experiences, but emphasized comparing and evaluating the impacts of management practices to determine differences under variable conditions. Further, they suggested these field experiences complement classroom learning and that this experiential learning be approached on many levels, from on-campus experiences on the student farm, to off-campus shadowing of mentors and real-world internship experience.

Second, undergraduates need to be involved with agricultural communities of practice. This points to the practitioners' conception of agriculture as a complex system of social relationships. Practitioners suggested interactions between student learners and non-faculty teachers and guest lecturers in various settings. These settings provide for networking with people in the agricultural labor, processing, distribution, marketing, retail, consultation, and advocacy sub-sectors. Suggested pedagogical strategies also included debates and discussions among a diversity of people with divergent opinions about agriculture and sustainability issues. Other pedagogical innovations emphasized the use of community resources and class projects conducted in teams, sometimes with student leaders.

Third, and perhaps most significant in terms of pedagogical design, practitioners thought a systems approach to teaching was very-to-extremely important. They suggested that practical experience should be augmented with theory and curriculum content, and emphasized that classroom discussion needed to be interdisciplinary.

Recommendations/Implications

Recommendations are offered that can be implemented primarily within the UC Davis context. Practitioners articulated well-defined types of experiences and pedagogical strategies to provide students with ways to construct an understanding of the complexities of sustainable agriculture. Designers of this new major need to seriously consider the advice of this constituent group and infuse student farm experiences, job shadowing, internships, and apprenticeships throughout the curriculum that broach all aspects of the agri-food system. They also need to consider how the curriculum will be designed to expose students to and connect them with people actively engaged along the continuum of sustainable agriculture professions. An interdisciplinary, experiential, and systems teaching approach, at the heart of many practitioner suggestions, requires a reconceptualization of student learning. Faculty and staff designing curriculum based on this approach would benefit from visiting the work of seminal scholars in this field (Allen, Dusen, Lundy, and Gliessman, 1991; Altieri, 1998; Bawden, 1990; Francis et al., 2001; Francis et al. 2003; Gliessmann, 1998;). These considerations are of particular importance because the committee has asked for input and now these engaged stakeholders will be looking to see how their advice is incorporated. As graduates of this major enter the field, the informants will be their employers and colleagues.

Implementing a curriculum with these experiential components will require not only planning, but leadership to make

contacts within the local sustainable agriculture community. Once contacts are made and agreements established, successful off-campus learning experiences will require attention to individual counseling and follow up and assessment of student progress and learning. These experiences will require additional resources from the UC Davis CA&ES administration, or other provisions must be made within existing structures to support the program. At least equally important is the need for a support and mentorship program for professors and lecturers who may be unaccustomed to teaching in the innovative ways suggested by the practitioners. Particular concern will need to be given to helping faculty and staff bring balance to the integration of theory and research in a curriculum that is more practical, contextual, and applied.

The implications drawn from this study are not meant to be prescriptive to other institutions. They may, however, offer plausible methods for engaging agricultural stakeholders in guiding curriculum development. As found in this study, practitioners believe experiences to be credible learning environments and very important vehicles for building undergraduate capacity in becoming agricultural professionals. How often are applied learning experiences infused seamlessly into modern agricultural education curriculum outside of laboratory activities? As noted in the introduction to this paper, as the population base becomes even more urban, undergraduates will need greater exposure to and more experience within all sectors of the agri-food system as a foundation for future learning. The practitioner suggestions in this study may be of use to others designing sustainable agricultural education programs.

This study also raises important questions about facilitating administrator, faculty, and student internal engagement, while directly bringing more external stakeholders into the work of land-grant universities. By incorporating stakeholder input into the design process, land-grant universities may not only better prepare students for the future, but also, more fully meet the spirit of the Morrill Act.

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