

Teaching Methods

Relationship between High School Student Participation in State-level Future Farmers of America Career Development Events and Matriculation at the Host University: A Case Study in Horticulture at Kansas State University

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ADDITIONAL INDEX WORDS. baccalaureate degree, FFA, floriculture, nursery, student recruitment, undergraduate enrollment

SUMMARY. In recent years, many horticulture departments around the United States have been concerned with recruiting and retaining an adequate number of students. One potential recruitment opportunity is the horticulture Future Farmers of America (FFA) Career Development Events (CDEs). For the time period of 1999 to 2012 (14 years), 1462 students participated in the annual state-level horticulture contests, comprising floriculture and nursery/landscape CDEs, held at Kansas State University (KSU). Using the rosters from these two CDEs, we referenced the university's student information database to determine whether the high school students who participated as FFA horticulture CDE contestants ultimately matriculated to KSU. Fifty-two percent of former FFA horticulture CDE participants were accepted to KSU and 32% matriculated. Of these, 58% enrolled in the College of Agriculture and 19% majored in horticulture. Therefore, 3.5% of total horticulture CDE participants majored in horticulture at KSU. Students who participated in more than one horticulture CDE over time were more likely to major in horticulture at KSU compared with students who competed only once. Thirty-nine percent of students who participated in both horticulture CDEs pursued a baccalaureate program in horticulture. These two student characteristics could be used as indicator data points to target recruitment of future horticulture students. Data about the high school programs that generated contest participants were also summarized. Excelling in the CDE contests was not an indicator CDE participants would pursue a baccalaureate degree in horticulture. These analyses suggest FFA CDEs have some potential to optimize student recruitment efforts.

The FFA, now known as the National FFA Organization, was founded in 1928 to promote and support agricultural education. It is one of the largest student-led organizations in the world whose mission is to “make a positive difference” in the lives of students by developing

their potential for “premier leadership, personal growth and career success through agricultural education” (National FFA Organization, 2016a). High school instructors of agricultural education programs, which often include greenhouse production, floriculture, and landscape management

coursework, prepare selected students from their programs to compete in regional, state, and national horticulture FFA CDEs (National FFA Organization, 2016b; Petrovic, 2015; Zurko, 2016). In some states, as in Kansas, hundreds of high school students travel each year to a state's land-grant university to compete in state-level CDEs that are often coordinated by faculty with teaching and extension appointments in horticultural disciplines. State-level CDEs typically serve as qualifying events for selection of the team to represent its state at the national CDE competition held at the National FFA Convention each year. The national floriculture (FLOR) CDE requires students to work individually and in teams to identify plants, solve industry problems, and demonstrate skills in flower arranging and plant growing procedures (National FFA Organization, 2016c). The national nursery (NURS) CDE tests student skills in aspects of maintaining landscape plants and related products, evaluating equipment and services, and landscape design (National FFA Organization, 2016d). The horticulture CDEs evaluate student knowledge on discipline topics through several testing components (National FFA Organization, 2016b, 2016c, 2016d). At the state level, these components typically include a written exam, plant identification, and laboratory practicum tests; this is the procedure for the Kansas state FLOR and NURS CDEs.

Horticulture and some other agricultural disciplines in the United States have struggled with recruiting and retaining an adequate number of student majors in recent years (Dole, 2015; Reed, 2014). Moreover, horticulture departments are disappearing as stand-alone units as they are merged and integrated with other plant-related departments, contributing to concern that horticulture may be lost as a major and career track (Pritts and Park, 2013). Although the enrollment in horticulture baccalaureate programs across the United States has declined, the need for graduates of these programs is higher than ever (Seed Your Future, 2016). It is estimated there are 59,700 agriculture sector job openings available annually, but only 35,400 U.S. students graduating with a bachelor's degree or higher to fill them [U.S. Department of Agriculture (USDA), 2015].

At the intersections of art and science, and basic and applied plant

sciences, horticulture is a dynamic field that marries plant biology with practical applications in fields including floriculture, ornamentals, fruits, nuts, vegetables, turf, landscape, and public horticulture. Research has shown that high school students participate in FFA CDEs because the event relates to their career choice (Croom et al., 2009) and serves as a means for students to learn industry-specific skills (Jones, 2013; Petrovic, 2015). Jones (2013) adapted the Academic Motivation Scale to assess CDE participants' level of intrinsic motivation, extrinsic motivation, and amotivation with regard to CDE participation in the southeast FFA region of North Carolina. He found students strongly agreed with statements about CDE participation being helpful in finding a future job, improving one's chances of entering the job market in a desired field, having a more prestigious job later on, and having a higher paying job. Our experience suggests some students participate in CDEs because of their interest, but other reasons, such as high school instructor curriculum preferences and high school curriculum structure, also often impact whether a student may participate in a specific CDE. Jones' (2013) results supported these observations as he reported that students indicated the FFA advisor plays a key role in

recruiting students to participate in CDEs. Jones (2011) findings were similar: advisors serve an important role in student motivation and content competency-building. Harris (2008) concluded high school agricultural education teachers participate in CDEs with which they feel comfortable and are less likely to participate in CDEs with which they feel less familiar.

The first objective of this research was to evaluate previous participants in Kansas' state-level FLOR and NURS CDEs to determine whether participation resulted in future matriculation at KSU, the host institution. The second objective was to quantify and summarize data about performance of high school FFA programs that generated CDE participants and future horticulture majors. The knowledge from this case study can serve as a foundation to understand how to optimize the potential for horticulture FFA CDEs to be used as a recruitment tool to attract students into undergraduate programs in horticulture.

Materials and methods

Lists of Kansas high school student FLOR and NURS CDE participants were obtained for each year from 1999 to 2012 for a combined data set of 14 years. Each list provided participants' names as entered by their FFA adviser, high school, and the contests (FLOR and/or NURS) in which the students participated. As the first step, these 14 lists were merged into one data file (Microsoft Excel 2010; Microsoft Corp., Redmond, WA), alphabetically by last name (row) and contest/year (column). When a student participant appeared on more than one list (either contest or year), this was captured in the compiled list. The merged lists yielded 1462 total unique participants.

As the second step, each CDE participant was manually queried in KSU's student information system, kSIS, by last name. First name and possible nicknames (e.g., "Sam" used as a nickname for "Samuel" or "Samantha") were used to narrow the list of possible matches. Occasionally, multiple records were possible matches. Data collected from kSIS for each potentially matched CDE participant record was birthdate, town or city of permanent address, and high school from which they graduated.

As a third step, a range of possible birthdates for participants was generated based on CDE participant age at the year of the CDE contest(s). Name and birthdate were evaluated against the participant list to determine which, if any, of the KSU records matched a former CDE participant. Results from this comparison were triangulated with record of the high school at which the student participated in the CDE compared with the high school from which they graduated. Rarely, to confirm or deny a match between CDE participant and KSU kSIS records, the distance between a student's permanent address and the high school from which the student participated in a CDE and he or she graduated were compared. In cases in which the distance between permanent address and high school graduated from was greater than 60 miles, the participant was not considered a match.

Additional data collected were: ACT score; acceptance to KSU (yes/no); enrollment at KSU (yes/no); college enrolled in upon entering and exiting; degree program enrolled in; minor program(s) enrolled in; and student degree status (did not complete, in progress, or graduated).

The high schools that sponsored teams in the state-level horticulture CDEs were also sorted. The number of participants from the high school, number of horticulture majors from the high school, and which CDEs students from a given high school participated in were tallied. In addition, the top five placing teams in each of the 28 CDE contests (14 years \times 2 contests per year) were reverse coded with 5, 4, 3, 2, and 1 award points assigned to the teams finishing first, second, third, fourth, and fifth place, respectively. Then, cumulative award points were tallied for each high school. Finally, a count of the number of CDE contests in which a high school placed in the top five was determined.

STATISTICS. Descriptive statistics were determined for many aspects of the data set. An unequal paired *t* test was conducted to compare the number of times a student participated in either FLOR and/or NURS CDEs who eventually majored in horticulture to the number of times a student participated in either CDE who did not major in horticulture. The paired *t* test was performed after conducting

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Table 1. Colleges and majors within the College of Agriculture selected by former state-level horticulture Future Farmers of America Career Development Event participants from 1999 to 2012 who enrolled at Kansas State University [KSU (n = 469)].

College major	Students (no.)	Students who enrolled at KSU (%)	Students who enrolled in CoA (%)
College of Agriculture (CoA)	271	57.8	
Animal Science	53	11.3	19.6
Agricultural Education	29	6.2	10.7
Agricultural Communications and Journalism	28	6.0	10.3
Agronomy	24	5.1	8.9
Agricultural Economics	24	5.1	8.9
Agricultural Business	22	4.7	8.1
Agriculture Technology Management	5	1.1	1.8
Bakery Science	4	0.9	1.5
Feed Science	5	1.1	1.8
Food Science	12	2.6	4.4
Horticulture	51	10.9	18.8
Milling Science	5	1.1	1.8
Park Management and Conservation	2	0.4	0.7
Veterinary Medicine	2	0.4	0.7
Undeclared	5	1.1	1.8
College of Architecture, Planning and Design	4	0.9	
College of Arts and Sciences	75 ^z	16.0	
College of Business Administration	29 ^z	6.2	
College of Education	22	4.7	
College of Engineering	26 ^z	5.5	
College of Human Ecology	36	7.7	
College of Technology and Aviation	8	1.7	

^zOne student double-majored in the College of Arts and Sciences and the College of Business Administration, so is counted in each; another student double-majored in the College of Arts and Sciences and the College of Engineering, so is counted in each.

an F-test to evaluate whether variance of the unequally sized samples was not different; it was not. A Pearson's chi-square contingency analysis was used to compare the students who participated in both FLOR and NURS CDEs to those who only participated in one of the CDEs. Data were analyzed using JMP (version 10; SAS Institute, Cary, NC).

Results and discussion

Of the 1462 FFA horticulture CDE participants, 51.7% applied to and were accepted at KSU (n = 756). Of those participants who were accepted, 62.0% matriculated at KSU (n = 469). Of those who matriculated, 57.8% selected a major in the College of Agriculture [CoA (n = 271, Table 1)]. Of those who matriculated, 10.9% majored in horticulture (n = 51). Therefore, of the total number of students who participated in the FFA CDEs, 3.5% majored in horticulture.

Of the 57.8% (n = 271) who enrolled in the CoA, 18.8% majored in horticulture (n = 51), 19.6% in animal science (n = 53), 10.7% in agricultural education (n = 29), 10.3% in agricultural communications and

journalism (n = 28), 8.9% in agronomy (n = 24), 8.1% in agricultural business (n = 22), and 12.9% in other CoA majors or undeclared (n = 35).

The average ACT score for students who matriculated at KSU, chose a major in the CoA, or majored in horticulture was 23.5, 23.3, and 22.5, respectively. As of 2016, of the horticulture majors, 72.5% (n = 37) had graduated from the program, 7.8% (n = 4) were in progress of degree completion, and 19.6% (n = 10) did not complete their degrees. Eighty percent of KSU horticulture majors connected to horticulture CDE participation over 18 years were successful in KSU's baccalaureate horticulture program; this observation provides evidence high school preparation and student abilities did not hinder successful degree completion.

The data set indicates nearly 60% of the former FFA CDE participants who did matriculate at KSU selected a major within the CoA and nearly 20% of these CoA students selected horticulture as their major. These data represent students who had

self-selected to be active in FFA and participate in the horticulture CDEs during high school, so it may not be surprising a healthy number of students pursued baccalaureate degrees in Agriculture. But, could the connection between FFA horticulture CDEs and student recruitment into horticulture majors be stronger? Note that while 18.8% of former horticulture CDE participants majored in horticulture at KSU, about the same percentage—19.6%—majored in animal science (Table 1). And ultimately, only 3.5% of all horticulture CDE participants majored in horticulture at KSU.

HORTICULTURE MINORS. Only six of the horticulture CDE participants over 14 years chose to minor in horticulture at KSU, and all were also pursuing CoA majors, as follows: three agricultural education, one agricultural economics, one agribusiness, and one agricultural technology and management. This means that of the total number of students who participated in the FFA horticulture CDEs, only 0.4% minored in horticulture, and only 2.2% of former participants who pursued

CoA majors chose to minor in horticulture. An opportunity exists to increase the number of students who pursue a horticulture minor in CoA majors by marketing the horticulture program and making the minor relevant to student career aspirations. Moreover, an overlooked opportunity is the marketing and promotion of the horticulture minor to students pursuing majors in other colleges: students majoring in the College of Human Ecology's interior design curriculum would benefit from knowledge of interiorscaping and people-plant interactions; students majoring in event planning would benefit from knowledge of floral design and interior plant use as well as public gardens. Students majoring in some architecture and engineering disciplines would benefit from knowledge of greenhouse construction, sustainable design, and/or runoff mitigation through green roofs and rain gardens. Students in the College of Arts and Sciences majoring in sociology may be interested in urban agriculture and its interplay with social constructs. Students in the College of Business Administration who plan to be business owners may minor in horticulture to pursue business opportunities in the horticulture sectors. However, the vast majority of students are unaware horticulture as a discipline exists. Marketing the field during FFA horticulture CDEs is one strategy to increase student exposure to aspirational career opportunities in the discipline.

INDICATORS OF FUTURE PURSUIT OF A BACCALAUREATE DEGREE IN HORTICULTURE. The total number of times a participant competed in FLOR and NURS CDEs over years was tallied. Range per individual participant was one to eight times. The average number of times eventual horticulture majors ($n = 51$) participated in an FFA CDE was 2.47, significantly higher than for all other eventual majors ($n = 418$), with an average of 1.96 ($P = 0.013$). Students who participated in more FLOR and/or NURS CDEs over time were more inclined to major in horticulture at KSU. This data characteristic could be used as an indicator to target recruitment of future students into a baccalaureate horticulture program.

Twenty of the 51 students who became horticulture majors, or 39.2%,

had participated in both of the horticulture CDEs (FLOR and NURS), as opposed to just one or the other. Of the students who did not major in horticulture ($n = 418$), a significantly lower percentage, 22.2%, had participated in both of the horticulture CDEs [Pearson chi-square ($P = 0.0075$)]. It is interesting that students who participated in both of the horticulture CDEs were more inclined to major in Horticulture at KSU compared with students who only competed in either of the horticulture CDEs. Although this result may not seem surprising because it is founded on demonstrated student interest in the subject matter, it is not necessarily the norm for a high school agricultural education program to support preparation for both FLOR and NURS CDEs. Many agricultural education programs support only one or the other of the horticulture CDEs, or neither, which is often a function of the comfort level of high school agriculture instructors with CDE disciplinary content (Boone and Boone, 2007). Only 13 of the 34 high school FFA programs that produced KSU horticulture majors had students compete in both FLOR and NURS CDE contests (data not shown) over the 14 years of this study. Nevertheless, if a CDE participant did attempt both horticulture CDE events, it was an indication he or she was more likely to matriculate in a baccalaureate horticulture program. Therefore, this data point could be used as an indicator to target recruitment of future students.

IMPACT OF FFA ADVISOR/AGRICULTURE INSTRUCTOR. In recognizing the importance of the agriculture instructor in exposing students to horticulture content, the individual high school programs that generated horticulture majors were studied in more detail. Of the 81 high schools that contributed participants to the horticulture CDEs, horticulture majors came from only 34 high schools (Table 2). Of the 47 schools that contributed horticulture CDE participants but did not generate horticulture majors, 11, 19, and 11 of these schools sponsored one, two to five, or six to nine CDE participants over the 14 years of this study (data not shown). Six schools sponsored 10 or more horticulture CDE participants during this time (Table 2). Fifty-two of the high

schools that contributed CDE participants (64.2%) did not finish in the top five teams over 14 years (data not shown). At the same time, only six schools (7.4%) finished in the top five schools for 10 or more times over 14 years (Table 2). These data indicate individual high schools dominate the contests, and often, domination of an event can be associated with a specific FFA adviser/agriculture instructor.

An interesting comparison emerged between two high school programs that were both successful at finishing CDE contests in the top five schools over the 14 years of this study. The high school "LSOI" sponsored 15 CDE participants that garnered 60 cumulative award points (the highest) and 21 team finishes in the top five (the highest); yet, it contributed zero students who became horticulture majors. The high school "WHAS" sponsored 22 CDE participants (the highest) that garnered 54 cumulative award points (the second highest) and 12 team finishes in the top five (the third highest); this program contributed four students who became horticulture majors. Only one other school, "BLUH," contributed four students who became horticulture majors, and this program had only two cumulative award points and one finish in the top five. This data suggests horticulture CDE contest success is not a criterion that determines whether a student will pursue a baccalaureate degree in horticulture. Future qualitative research to evaluate the mindsets and strategies of the FFA advisors/agriculture instructors at these three schools may yield useful insights about how CDEs may best contribute to the vocational training that is their calling card. Using the regional and state-level CDEs only as a means to obtain a "ticket to the National FFA Convention" undercuts their potential value.

It is also important to point out that seven schools (Table 2) contributed three or fewer horticulture CDE participants over the 14 years of this study, but each still generated a horticulture major. This group accounted for 8.6% of all the schools who sponsored participants and 20.6% of the 34 schools that contributed horticulture majors. These

Table 2. Partial list of the 81 high schools that supported horticulture Career Development Event (CDE) teams at the Kansas state-level floriculture (FLOR) and nursery/landscape (NURS) CDEs at Kansas State University (KSU). The schools listed either generated horticulture majors or sponsored 10 or more horticulture CDE participants over the 14 years of this study (1999–2012).

High school code ^z	CDE participants (no.)	KSU horticulture majors (no.)	Cumulative award points ^y	Top five finishes by school team (no.)
High schools that generated horticulture majors				
ACRK	15	1	40	11
BLUH^x	9	4	2	1
<i>CCON^w</i>	<i>3</i>	<i>1</i>	<i>0</i>	<i>0</i>
CPHA	12	2	9	2
CRNG	8	1	6	2
<i>CVAN</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>0</i>
CYLA	9	3	11	6
DPON	7	1	1	1
HCOL	5	1	0	0
HHIG	7	1	0	0
HLIL	5	1	0	0
HSAY	11	1	19	8
HTOL	19	2	48	16
HVAN	7	1	9	2
HWIA	6	1	0	0
JNLI	11	1	2	1
MIAR	4	1	0	0
MKAN	5	1	0	0
MMAR	5	2	0	0
<i>MNOU</i>	<i>3</i>	<i>1</i>	<i>0</i>	<i>0</i>
MSIS	4	2	0	0
MYAR	10	1	1	1
OGNA	6	1	0	0
ONLA	4	3	0	0
<i>QVUI</i>	<i>2</i>	<i>1</i>	<i>0</i>	<i>0</i>
OWTT	7	1	2	1
<i>SNAL</i>	<i>1</i>	<i>1</i>	<i>0</i>	<i>0</i>
WAAB	5	1	0	0
WEAM	6	1	1	1
WFIN	11	3	29	10
WHAS	22	4	54	12
WHAT	4	2	4	3
<i>WHIC</i>	<i>3</i>	<i>1</i>	<i>0</i>	<i>0</i>
<i>WLEL</i>	<i>2</i>	<i>1</i>	<i>0</i>	<i>0</i>
Programs that contributed 10 or more horticulture CDE participants				
ALBI	10	0	23	6
HTOR	11	0	1	1
INNM	14	0	4	2
LNIN	12	0	35	10
LSOI	15	0	60	21
STAB	13	0	0	0

^zHigh schools are identified by code to maintain anonymity.

^yCumulative award points were derived by reverse-coding; 5, 4, 3, 2, and 1 award points were assigned to the teams finishing first, second, third, fourth, and fifth place, respectively, for the top five placing teams in each of the 28 CDE contests (14 years × 2 contests per year).

^xBolded data rows are high schools that were most successful based on generation of horticulture majors and/or placing in the top five teams during the 14 years of the study.

^wItalicized data rows are high schools that sponsored three or fewer horticulture CDE participants but still generated a horticulture major during the 14 years of the study.

students likely had a high level of interest in horticulture before taking part in the CDEs as there were not enough participants over the 14 years of this study to even generate one team of three. Yet, these students benefited from an FFA advisor/agriculture instructor who was

willing to support their interest in horticulture and sponsor their participation in the state-level CDE events.

A number of factors may impact the effectiveness of CDE events in their function as vocational training. First, for CDEs to be a most useful

effort in generating future horticulture practitioners, we do not believe that having a handful of dominant teams is helpful. Second, many agriculture instructors struggle with preparedness to teach horticulture subject matter. Two problem areas have been identified by agriculture teachers,

especially beginning teachers, with regard to their challenges. First was their self-confidence in their ability to teach different content areas and second was their access to curricular materials (Boone and Boone, 2007). These problems may be addressed with development of curricular content for high school FFA advisers/agriculture instructors focused around CDEs and by supporting their efforts to sponsor horticulture CDE teams with in-service training events. Harris (2008) found most teachers use Internet resources to help prepare students for CDEs, so developing these materials at the state and national levels will be useful to enhance horticulture CDE impact on developing vocational skills. We have been told by FFA advisers/agriculture instructors that the plant identification component of the CDE contests is one of the most daunting for those who are approaching the content anew (R. Caviness, personal communication). This subject matter would be relatively easy to develop as an internet resource that could be widely distributed and accessed.

Conclusions

A need exists to increase student exposure to and understanding of horticulture, and participation in horticulture CDEs may be one of many ways to contribute to this goal. An online survey of horticulture stakeholders ($n = 487$) found that 54% of the respondents consider horticulture education and awareness as the biggest challenge facing the horticulture industry (Meyer et al., 2016). One way to facilitate and encourage high school students to consider horticulture as a career would be to focus on and increase student exposure to horticulture knowledge and career opportunities at the middle and high school levels, as talent recruitment begins before college admission (President's Council of Advisors in Science and Technology, 2012). Thus, the ability of FFA CDE organizers to create horticulture activities that expand participants' understanding of the cutting-edge and diverse career opportunities associated with floriculture and nursery/landscape disciplines, along with recognition of the strong demand for future employees (USDA, 2015), may be one way to fill this gap. But the challenge in recruitment is greater than

simply increasing exposure to content. Ultimately, students must believe their vocational choices will lead to a fulfilling and respected career (Thielen, 2012).

In particular, it is critical to develop agriculture instructors who are comfortable with horticulture curricula and will be willing to support horticulture CDE participation. This begins in the college classrooms of these instructors when they are agricultural education students and continues with in-service training and internet-based curricular content to support horticulture disciplines.

Our findings suggest that FFA CDE participants already enroll in significant numbers into agriculture majors. But, there is a greater opportunity to use state-level FFA HORT and NURS CDE events as a recruiting tool to attract more students to major and minor in horticulture. In particular, developing a "targeted recruiting program" (Bradley et al., 2000) would be beneficial for a horticulture department to target a high school student if he or she has participated in both FLOR and NURS CDEs, or has participated in either of the horticulture CDEs for more than 2 years. In addition, increasing the number of participants in horticulture CDEs in general may lead to an increase in student exposure to careers in horticulture. The challenge in supporting this goal is to increase preparation of high school agriculture instructors who are not currently offering horticulture curricula or sponsoring student preparation to participate in FLOR and NURS CDEs. By proffering widely accessible preparatory content to large numbers of FFA advisers, the domination of individual programs may be stifled and a wider array of high schools may be willing to sponsor teams. This is dually important because students who were previously involved in FFA reported the most influential factor to attend college was the influence of their agriculture teacher (Duncan et al., 2015).

These efforts have the potential to assist in meeting the challenges of the 21st century by providing "sufficient scientific and professional workforce" who in return can "drive sustainable growth, scientific discovery, and innovation in public, private, and academic settings" (American

Association for Agricultural Education, 2011) and fill the nearly 60,000 anticipated jobs in agriculture (USDA, 2015), of which horticulture is an important component.

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