Enhancing Experiential Learning through a Hands-on Crop Production and Marketing Contest[1]

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Abstract

In an age when many college agriculture students come from non-farm backgrounds, knowledge of and experience in farming operations is still required or desired for many careers in the agricultural industry. In response to this dilemma, the Department of Agriculture at Illinois State University has designed and implemented a contest that provides students an opportunity to gain hands-on experience with crop production and marketing. The contest was based upon pedagogical research that supports the theory that student comprehension is increased through critical thinking exercises and application of course concepts to real-world situations. The contest was designed to enhance learning by requiring students to develop and implement crop production and marketing strategies on a two-hectare plot of University farmland, which encouraged critical evaluation of classroom instruction. The objective of this study was to determine if participation in the contest enhances student knowledge of crop production and marketing. Four teams that represented student organizations designed and implemented their own crop production and marketing strategies with the goal of obtaining the highest return to management from a *Zea mays* – *Glycine max* (corn-soybean) rotation. The impact of the contest was qualitatively evaluated by having the students reflect upon what they had learned. This reflection occurred during focus group discussions and sessions in which students wrote responses to open-ended questions. Students indicated that participation in the contest had positively impacted their knowledge of agricultural practices, increased their self-confidence when interacting with farmers and agribusiness personnel, and improved their leadership skills.

Introduction

The most cited educational need in agricultural curricula is the development of student problem-solving and critical thinking skills (Bentley et al., 1992; Coulter, 1992; Goodman, 1992; Foster and Pikkert, 1991). These skills may be acquired through participation in experiential learning activities. Experiential learning is a process that links the student's education, work, and experience. Kolb (1984) stated that education is becoming more accessible to all people and there has been a corresponding need for curricula to translate abstract ideas into concrete practical realities in peoples' lives. The experiential learning theory combines experience, perception, cognition, and behavior (Kolb, 1984). Experiential learning revolves around any experience that can be incorporated into the curriculum or program, which is complemented by a debriefing or reflection component. The latter application of experiential learning should take place in a structured environment and it becomes critical if the experience is to be transferred into higher order cognitive levels (Joplin, 1981; Leske, 1994; Stone, 1994). Halpern (2003) stated that experiential teaching and increased usage of critical thinking skills may increase the cognitive ability and retention of information of these students. The increase of these critical thinking skills allows the student to obtain, retain, and process information more efficiently (Ngeow and Kong, 2001).

John Dewey (1938) has been regarded as the most influential 20th century educational theorist (Kolb, 1984) to emphasize the importance of experiential learning. Since the writings of Dewey, numerous models of experiential learning have been described. David Kolb (1984), devised a model with four modes: abstract conceptualization, active experimentation,

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concrete experience, and reflective observation. These four modes deal with the processes whereby knowledge is gained through experience.

Kolb and Fry (1975) argued that the learning cycle may begin at any one of the four modes, but it should remain a continuous cycle. The concrete experience results in the creation of concepts that integrate the learner's observations into logically sound theories. The learner uses these theories to make decisions and solve problems. After decisions are made and problems are solved, the learner utilizes the hands-on component of learning and applies his/her experiences. Kolb (1984) argued the first three modes of the model could culminate in a true experiential learning experience only when a reflection component was present. This would allow the learner to apply the experiences to real-world situations and contexts.

Numerous research projects have supported the theory that there is a link between cognitive learning and skills needed for future employment (Kraft, 1986). For example Kyle et al., (1988) compared students in a traditional textbook science program with students in an experiential, inquiry-oriented program and found that those in the experiential group had considerably improved attitudes toward learning. Additionally, Michaelson et.al., (2004) found that the use of team situations for teaching has become more prevalent in the curriculum. In a study conducted by Light (2001), it was found that students, who study outside of class in the form of small teams, even just once a week, benefited greatly and became more cognitive of the subject matter.

The use of simulations, games, and contests to provide experiential learning activities in agricultural curricula has been shown to enhance student learning. Interactive simulations, such as simulated farming systems, allow students to become more competent in understanding and applying the management decision-making process (Stewart et al., 2000). Additionally, simulation games enhance students' interpersonal and communication skills, improve their ability to recognize and apply principles, and improve their ability to analyze situations (Dobbins et al., 1995). Submersing students in natural learning environments allows students to share and gain knowledge through research, trial and error, networking, and intuitive forces (Webb, 2000). Koontz et al., (1995) believed that teaching agricultural economics is often difficult due to the abstract nature of the topics presented; therefore they devised and implemented the “Packer-Feeder Game” at Oklahoma State University. The educators developed the game to allow students to experience the principles and concepts of beef production and marketing first-hand. Koontz et al., (1995) found that with participation in the game, students assimilated classroom curricula using analysis and communication, which allowed for greater concept understanding.

Because Illinois ranked first in *Glycine max* (soybean) production and second in *Zea mays* (corn) production in 2003 (Illinois Agricultural Statistics Service, 2004), enhancing Illinois college students' understanding of corn and soybean production and marketing is important to Illinois' economy. Corn, which accounted for 39.3 % of Illinois crop receipts, and soybeans, which accounted for 30.9% of Illinois crop receipts, contributed $6.49 billion to the Illinois economy in 2003 (Illinois Agricultural Statistics Service, 2004). Additionally, Illinois was ranked third in the country in total agricultural exports for 2003 (United States Department of Agriculture Economic Research Service, 2005).

With corn and soybean production accounting for billions of dollars towards Illinois' gross domestic product, there is a need to have well-trained individuals prepared to work within this industry. However, in Illinois, the majority of college students enrolled in agriculture classes come from non-farm backgrounds. Demographics of students enrolled in agriculture classes reveal that 55% are from urban areas, 27% are from rural non-farm areas, and only 18% are from farms (2000 Illinois Agricultural Education Report, 2000). First-hand knowledge and experiences of farming practices, particularly crop production planning and crop marketing, is fundamental to many career paths in agriculture.

The objectives of this study were to qualitatively evaluate the impact of participation in the Illinois State University (ISU) Crop Production and Marketing Contest on student learning of agronomic principles and marketing practices and to evaluate the impact of participation on student social skills and leadership competencies.

Materials and Methods

A crop production and marketing contest was designed and implemented for two years to provide students with an experiential learning opportunity. The contest was designed to include all four components of the Kolb model of experiential learning: a concrete example, formation of abstract concepts, testing in new situations, and observation and reflection (Kolb, 1984). First, the concrete example was provided by the hands-on experience of planting and harvesting a crop. Second, the students were required to form abstract concepts as they formulated their production and marketing plans. Third, testing in new situations occurred as unexpected events arose during the growing season, and fourth, observation and reflection were required when students participated in focus groups and wrote about their experiences.

The contest challenged four undergraduate student organizations at ISU: Alpha Gamma Rho Fraternity, Alpha Zeta Honorary Fraternity, FarmHouse Fraternity, and the Student Agriculture Association to grow soybeans and corn, respectively, during the 2003 and 2004 growing seasons with the objective of generating the largest return to management while being environmentally responsible. Each team consisted of at least five undergraduate students, and each team was provided with a two-hectare plot at the ISU Farm near Lexington, IL. To protect the identity of the individuals that participated in the contest and the organizations, we randomly assigned the student organizations to teams A to D for purposes of reporting their decisions and results.

A spreadsheet was designed to track production costs, marketing activities, and cash receipts, and to identify the winning team. The marketing activities section of the spreadsheet included information about cash sales, cash forward contracts, and futures and options transactions. Five copies of the spreadsheet were created, and one copy was allocated to each of the four teams that competed in the contest. Teams were given a blank version of the file so that they could conduct "what if" analysis and then develop production and marketing plans. A copy that contained all of the data entered during the contest and the outcomes of the contest was distributed to each team after the contest was completed and results were announced. Because students were physically operating two-hectare plots, but theoretically managing 400 hectares, the spreadsheet was designed to convert data from a two-hectare basis to a 400 hectare basis. Output cells included variable costs and fixed costs per kg and per hectare, return to management per kg and per hectare, and net price received per kg after adjusting for hedging gains and losses.

Teams selected and implemented their own crop production and marketing strategies, including seed variety selection, method of planting, fertility, tillage, pest management programs, and marketing strategies. Teams selected all of their seed from Mycogen Seeds Inc., the donor of seed for the contest, and they selected all agricultural chemicals (including fertilizers and pesticides) from Sun Ag of Hudson, IL, the donor of those materials. Each team was required to submit a written production plan prior to planting, and each plan was reviewed by a committee of agricultural faculty to ensure that field operations did not threaten environmental quality. Teams were further encourage to incorporate land stewardship by being instructed that their team would farm the same ground in consecutive years. Students were responsible for performing all farm operations. Farming equipment owned by the ISU Department of Agriculture was made available to the teams, and ISU Farm employees provided necessary training and supervision for all field operations. Costs of all inputs, including the fair market price of all donated materials, were recorded on the previously described spreadsheet. Yield was determined by weighing the grain harvested from each two-ha plot and correcting for moisture. The contest objective was to obtain the highest return to management before government program payments. The top three teams were provided cash awards of $300 for first place, $200 for second place, and $100 for third place. Cash awards were donated by the ISU Agricultural Alumni Association. Additionally, the first place team was recognized by having their team name engraved on a trophy that is displayed by the ISU Department of Agriculture.

This contest was unique in that it provided an opportunity to apply the principles and theories of several production and marketing courses in a hands-on, problem based learning situation. While crop production and marketing skills are taught in courses offered by the ISU Department of Agriculture, no single course provides a holistic approach that includes the cycle of planning, planting, harvesting, marketing and re-planning.

During the contest, students were required to integrate knowledge from many fields within agriculture, and teams were encouraged to include students with expertise in such diverse areas as crop science, soil science, weed science, entomology, agricultural engineering technology, and agribusiness. Additionally, students had to utilize written and oral communication skills when they interacted with fellow team members, faculty, and members of the local agricultural industry who were involved with the contest.

The impact of participation in the contest was qualitatively evaluated after students participated in focus group discussions and provided written responses to open-ended questions. The focus groups were led by local agribusiness professionals. The open-ended questions were administered to team members following their respective focus-group sessions.

Results and Discussion

Selected agronomic decisions made by the contest teams are shown in Tables 1 and 2 for years one and two respectively. Because of the nature of the contest, team decisions were somewhat restricted. For example, teams had to select their seed from Mycogen Seeds Inc., but they were allowed to select from any of the Mycogen varieties that were available to producers in central Illinois. During year 1 of the contest, the four teams chose three different soybean varieties, all of which were genetically modified to be Roundup Ready®.

Requiring students to plan and perform all aspects of growing corn and soybeans enhanced knowledge of the agronomic aspects of crop production. As part of the process, teams met with professional experts from the agricultural industry to solicit advice. For example, all teams met with the Mycogen Seeds District

Table 1. Selected Management Decisions for Teams during Year 1 of the Crop Production and Marketing Contest (soybeans)[z]

	Team A	Team B	Team C	Team D
Tillage	No-tillage	No-tillage	No-tillage	No-tillage
Row spacing (m)	0.38	0.76	0.38	0.38
Seed variety[y]	5B381RR	5B381RR	5B283RR	5B311RR
Seeding rate (# ha^{-1})	543,000	457,000	395,000	444,444
Planting date	May 19	May 19	May 21	May 21
Harvest date	October 13	October 14	October 17	October 13

[z] The mention of a commercial company or product does not imply endorsement, but is for educational use and information.
[y] Donated by Mycogen Seed Inc.

Table 2. Selected Management Decision for Teams during Year 2 of the Crop Production and Marketing Contest (corn)[z]

	Team A	Team B	Team C	Team D
Tillage	Conventional	Conventional	Conventional	Conventional
Nitrogen[y] ($kg\ ha^{-1}$)	224 from NH_3[x] 40 from DAP[v]	224 from NH_3[x] 40 from DAP[v]	224 from UAN[w] 40 from DAP[v]	224 from UAN[w] 40 from DAP[v]
Phosphorous[y] ($kg\ ha^{-1}$)	224 from DAP[v]	224 from DAP[v]	224 from DAP[v]	224 from DAP[v]
Potassium[y, u] ($kg\ ha^{-1}$)	224	224	224	224
Seed variety[t]	2784	2784	2E689[s]	2E689[s]
GMO	No	No	Yes	Yes
Seeds (# ha^{-1})	77,000	74,000	72,000	72,000
Herbicide[y]	Keystone®	Keystone®	Keystone®	Keystone®
Insecticide[y]	Aztec®	Aztec®	---	---
Planting date	April 28	April 28	April 28	April 28
Harvest date	September 28	September 30	September 28	September 29

[z] The mention of a commercial company or product does not imply endorsement, but is for educational use and information.
[y] Donated by Sun Ag of Hudson, IL
[x] Annhydrous ammonia, 82% N
[w] Liquid urea-ammonium nitrate, 28% N
[v] Diammonium phosphate
[u] Potash (0-0-60)
[t] Donated by Mycogen Seed
[s] Yieldguard® Rootworm protection

Agronomist to discuss the advantages and disadvantages of available seed varieties. Teams had to evaluate the pros and cons of using genetically modified crops and determine if the increased cost of seed would be offset by decreased non-seed input costs or increased yield. Teams also made certain that if they grew a genetically modified crop, they would be able to sell their grain to a local elevator or find an outlet for this crop. Additionally, teams paid close attention to details of field operations to help optimize production. For example, the Student Agriculture Association evaluated threshing losses (Figure 1) and made adjustments to the combine (Figure 2) to maximize yield.

As students applied agronomic concepts from the curriculum, they began to realize how making one decision has a ripple effect on other decisions. For example, students discovered the advantages of specific seed varieties in relation to the available tillage practices. If they decided to use no-tillage, which all the teams chose for soybeans, the number of suitable varieties was reduced. Therefore, teams learned that they had to carefully consider all agronomic inputs to insure they were compatible, environmentally responsible, and would not limit yield potential. While making these decisions, teams also had to consider the economic and environmental implications of their decisions.

Table 3 shows production budgets, including production costs, selling prices, yields, and return to management for both years of the contest. During the first year, three teams netted a positive return to management, and the winning team generated a return to management of $104,071.97. During the second year, all of the teams posted negative returns to management. The contest did not allow government program payments in either year.

Major changes in marketing strategies utilized by the teams were observed from the first year of the contest to the second as teams became more aware of marketing tools and strategies aimed at managing risk. During the first year of the contest, all of the teams simply sold their grain for cash at the nearest elevator following harvest. However, during the second year of the contest, every team adopted a more sophisticated marketing strategy and incorporated either cash forward contracts, futures contracts, option on futures contract, or some combination of these strategies. Additionally, one team solicited the advice of a commodities broker to educate them on how to incorporate these tools. Feedback from the focus group discussions and written comments clearly showed that students gained a much better understanding of marketing strategies as risk management tools as a result of using them. Because of the experiential learning activity, participants were much more confident in their marketing skills.

Figure 1. Members of the Student Agriculture Association Team evaluate threshing losses after harvesting the edge of their plot. Threshing losses were determined by measuring the number of seeds in a specific area in the field following harvest. Adjustments were then made to the distance between the concave and cylinder to minimize grain loss.

Figure 2. A member of the Student Agriculture Association Team adjusts the concave and cylinder distance on an Allis Chalmers Gleaner model F3 plot combine to minimize grain loss during harvest.

met regularly to discuss production and marketing strategies and relied on one another's expertise to help the group make the best possible decisions. Students perceived that they learned from each other through these discussions and gained confidence in their own knowledge when they advised the group regarding information from their own discipline. Comments from focus group discussions and written responses to questions (Table 4) indicated that these interactions were one of the most enjoyable aspects of the contest.

Comments from focus group discussions and written comments also indicated that students believed that contest participation had enhanced their social and leadership skills. All teams recognized the importance of leadership to successful project completion. In fact, two of the organizations, created an elected office for an individual who would be responsible for organizing a crops contest committee and reporting back to the organization at scheduled meetings. The other two organizations organized committees that completed the above tasks. Because the contest extended through the summer months, all of the organizations thoughtfully encouraged freshmen, sophomores, and juniors to participate in order to provide team continuity from one academic year to the next.

Table 3. Results from the Illinois State University Student Crop Production and Marketing Contest

Team	Production Cost ($ kg^{-1})	Selling Price ($ kg^{-1})	Yield (kg ha^{-1})	Return to Management^{z} (400 hectare basis) ($)
Year 1 (soybean)				
Team A	0.220	0.324	2508	104,071.97
Team B	0.227	0.315	2326	81,885.44
Team C	0.253	0.299	2137	38,630.80
Team D	0.302	0.300	1817	(999.36)
Year 2 (corn)				
Team A	0.088	0.071	11,424	(75,398.23)
Team B	0.101	0.071	10,248	(124,003.88)
Team C	0.087	0.073	11,424	(66,422.25)
Team D	0.103	0.071	10,060	(129,625.60)

^{z} Return to management does not include government program payments

The crop production and marketing contest encouraged experiential learning by requiring students to make real farming decisions, and then act upon their decisions by performing field operations and marketing their crops. This contest provided all four components of the Kolb model of experiential learning: a concrete example, observation and reflection, forming abstract concepts, and testing

This contest provided a medium for inductive learning, which is the synthesis of the whole from parts (Koontz et al., 1995). The contest generated financial outcomes that were dependent upon agronomic production, environmental concerns, and the marketing decisions made by the teams. The personal experience and knowledge gained through these decisions provided students with a deeper understanding than would have been possible in a classroom setting, where concepts are easily dismissed or forgotten (Ladd, 1987).

Students seemed to appreciate the fact that the contest promoted interdisciplinary learning. Organizations were careful to select group members from diverse complimentary backgrounds. Team members

Table 4. Selected Written Responses (direct quotes) Describing the Most Beneficial Aspects of the Contest

This contest gives an opportunity to make your own decisions and see what impact your decisions have.
Making puts and calls.
The marketing aspect due to the depth and involvement involved.
As an agriculture student we have the privilege of a hands-on experience to work with the production and marketing.
Discussing with teammates the best way to go about raising the crops.
Paying attention all year long to markets.
The decision making experience.
Putting all aspects of farming together.
It gave me a reason to watch the markets so we could buy and sell at the right time.
Real-life applications.
Developing leadership skills.
Learning how to set up the combine for harvest. I have watched this, but never done this by myself before.
I am more familiar with pesticide use, seed selection, and genetically modified crops.
I learned that using insecticide is very important.
I learned about the use of different corn varieties.
I learned how to run a farm.

in new situations (Kolb, 1984). Student comments from focus group discussions and written responses to open-ended questions confirmed that participation enhanced their understanding of agronomy and marketing as well as fostering social and leadership competencies.

Summary

This study describes a crop production and marketing contest that was designed to enhance student learning by providing undergraduate students in agriculture with an opportunity to acquire production and marketing skills in a team-oriented, problem-based setting. Qualitative analysis of student participation shows the contest had a positive impact on their knowledge of agronomic and marketing aspects of corn and soybean production. This contest may serve as a model for other universities with agriculture programs that wish to enhance their students' understanding of crop production, environmental concerns, and marketing. The contest could easily be modified to adjust for regional differences in climate and geography.

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