

Using Environmental and Ethical Issues for Debate in an Introductory Agronomy Course

Gina M. McAndrews¹, Jean Goodwin², and Russell E. Mullen
Department of Agronomy
Iowa State University
Ames, IA 50011



Abstract

As modern societies place greater demand on natural resources, professionals working in areas impacting natural resources will increasingly have to work with others to address contentious issues. Students studying agriculture and natural resource related fields would benefit from improved professional skills in debate and discussion of complex issues. In this study, we investigated student perspectives on debate in an introductory agronomy course using the following questions: 1) What are student perceptions of debate as a pedagogical method in an agricultural classroom? and 2) Do the students find that debate improves their content learning and communication skills? In 2005, 106 students completed surveys with agree/disagree statements, and short answer questions regarding debate. When participating students were asked why they had chosen to participate in the class debate part of the course, 85% listed "intrinsic" or learning goals, and 83% of the participants listed extra credit points as one of their motivations. Eighty-seven percent of the participants expressed that debate contributed to their learning of course material. Students appreciated the way the debates encouraged them to go from passive knowledge of course content to active application of the material, and helped them improve their communication skills and learn about different points of view. Students' overall evaluation of the debate experience was positive, with only two negative responses. This study suggests that incorporating debate in the agricultural classroom was an effective pedagogical method for improving content learning and strengthening student skills in professional discourse on controversial societal issues.

Introduction

Greater demand for natural resources, combined with advances in technology, communication and travel have made people more interdependent worldwide. As competition for natural resources increases, representatives of corporations, governments, environmental groups, non-governmental organizations and others are more frequently working together to discuss complex societal issues and possible solutions. Consequently, the challenges and resulting solutions of societal issues involving natural resources require input from a wide stakeholder group. In this

new environment, agriculture professionals will increasingly have to go beyond providing expert knowledge to also discussing contentious issues (Singletary et al., 2004). These authors concluded that it is vital to train students on how to "deal coincidentally with technical complexity, human diversity and political sensitivity in a dynamic moment" (Singletary et al., 2004).

Current curricula in agricultural fields may not be meeting this emerging need. In a survey of alumni and employers, Karsten and Risius (2004) stated that both groups identified a need for more education in oral and written communication. In particular, Karsten and Risius (2004) found that employers think agriculture graduates lack awareness of important environmental issues and of different cultures and attitudes. Even graduate agronomy students have trouble with argumentative communication, according to one recent study (Lindner et al., 2004). An examination of their written work showed weaknesses in developing well-supported and logical arguments.

One classroom exercise that may help enrich agricultural curricula is the debate. Debate in other classroom contexts has had several beneficial results. First and most importantly, debate exercises have increased content learning and critical thinking. As Bellon (2000) and Goodwin (2003) have shown, the challenging, realistic issues raised in a debate motivate students to think critically about information, and encourage them to engage the course material broadly, deeply and personally. As Bellon (2000) states, "debate is a complex, interactive experience that presents students with personally meaningful challenges and encourages intensive analysis". A meta-analysis of 19 studies demonstrated that any form of communication instruction improved critical thinking, but that the most significant improvements were found when students participated in competitive forensic activities, such as debates (Allen et al., 1999).

Participation in debate activities has also been shown to improve oral communication skills interpersonal as well as public speaking (Bellon, 2000). In particular, debate activities increase both self-confidence in stating one's view and open-mindedness towards the views of others. In Bellon's summary of the scholarly consensus, participants in debate learn how to become more flexible in debate, and to more effectively listen to and understand other people's viewpoints, which in

¹126 Agronomy Hall, Phone: 515.294.7832; Email: gina@iastate.edu

²Department of English, 223 Ross Hall

Table 1. Shortened Version of One of the Environmental and Ethical Issue Components of CIMPLE that is used in Class for a Topic of THINKER (debate) Activity in Agronomy 114 at Iowa State University Spring 2005

Issues: Wetlands
Your Role: You are a farmer in southern Minnesota
Your Mission: To make your farm as profitable as possible
Background Info: Southern Minnesota is part of the prairie pothole region. When the last glacier receded, it left large chunks of ice in depressions where it melted slowly. At the time of European contact, this region was covered with wetlands.
Crops: You generally grow annual crops in a three-year rotation of maize, soybeans and oats.
Soils: On your farm, the upland soil is sandy. The soil in the lowlands is poorly drained but is high in organic matter.
Water: The pothole areas often have standing water part of the year.
Potential Problem: Choice A: Too much water to allow planting. Choice B: Water logged soils are poor in nutrients.
Possible Solution: Choice A: Tile and drain the wetland. Choice B: Dig a drainage ditch from the wetland to the road.
Related Issues: City council members of your local town, which is downstream from your farm with the prairie wetlands, come to visit you to try and convince you and other farmers in your area to leave some wetlands on your farms to help protect the local town from flooding and reduce the amount of erosion and nutrients in the local river.
Question to discuss: Do you think the farmers should drain their prairie pothole and wetland areas?

“Principles of Agronomy” serves as a foundation course for undergraduate students in several agriculture-related majors, including Agronomy, Horticulture, Animal Science, Ag. Business, and Ag. Education. Generally 250 students annually enroll in this three-credit 15-week agronomy course (Agron 114). The primary focus of the course is to introduce material that will help students understand the science and strategies underlying crop production and soil management.

Covering a chapter a week from the Agron 114 course text (Mullen, 2005), the course consists of 13 chapters: 1) crop plant anatomy, 2) crop plant classification and identification, 3) crop physiology, 4) climate, 5) soils, 6) soil water, 7) tillage and seeding, 8) plant breeding, 9) seed and grain quality, 10) weed management, 11)

insect management, 12) crop disease management, and 13) crop harvesting and storage. Educational institutions worldwide often include a similar introductory plant-related course as part of their undergraduate agriculture curricula.

Students use different learning styles in their learning process (Kolb, 1981, 1984). In an effort to meet the needs of students with different learning styles, a combination of hands-on laboratory materials, live plants and experiments in the greenhouse, class discussions, and demonstrations to teach the subject matter have been incorporated into the course. Moreover, the instructors developed an interactive multi-media computer program called CIMPLE, which includes learner objectives, subject relevance, digitized tutorial video, key concepts of material, practice exercises, self diagnostic quizzes, problem-solving scenarios, and environmental / ethical problems for each of the 13 chapter units of the text (McAndrews et al., 2004).

One component of the Agron 114 course uses the environmental / ethical problems part of CIMPLE and class debate to challenge students to address environmental or ethical issues associated with the technical material covered in a chapter. This component is

Table 2. Majors of Students Enrolled in Agronomy 114 during Spring 2005

Major	Attended THINKER		Did NOT Attend THINKER	
	Number	Percent	Number	Percent
Agronomy	6	12.8	21	35.6
Animal Science	8	17	6	10.2
Agricultural Studies	8	17	8	13.6
Agricultural Education	5	10.6	6	10.2
Agricultural Business	14	29.8	2	3.4
Other	7	14.9	17	28.8

turn helps the individual to debate the issue in a richer context. As Goodwin (2003) has documented, students themselves appreciate the opportunity debate offers them and learn how to recognize and manage difference of opinions.

While previous studies have examined the written communication skills of agronomy students (Lindner et al., 2004) and activities to improve oral group communication skills (Sammis et al., 2003), little attention has yet been given to public speaking and debate activities or their related skills. In this study, we investigated student perceptions of the benefits of debate in the agronomy classroom using the following questions: 1) Can agronomy students be motivated to actively participate in classroom debates? 2) What, if any, are the main barriers to student participation? 3) What are student perceptions of debate as a pedagogical method in an agricultural classroom? and 4) Do the students find that debate improves their content learning and communication skills they will need to function as professionals in an increasingly complex and contentious world?

Agronomy 114

At Iowa State University, the introductory course

Table 3. Academic Classification of Students Enrolled in Agronomy 114 during Spring 2005

Academic Classification	Attended THINKER		Did NOT Attend THINKER	
	Number	Percent	Number	Percent
Freshman	28	59.6	37	62.7
Sophomore	15	31.9	10	16.9
Junior	4	8.5	6	10.2
Senior	0	0	6	10.2
Other	0	0	0	0

Table 4. Amount of Farm Experience of Students Enrolled in Agronomy 114 during Spring 2005

Farm Experience	Attended THINKER		Did NOT Attend THINKER	
	Number	Percent	Number	Percent
Farm reared with extensive field and farm-work experience	28	59.6	35	59.3
Farm reared with little field and farm-work experience	8	17.0	8	13.6
Not farm reared but have extensive field or farm experience (6 months or more)	4	8.5	9	15.3
Not farm reared but some degree of field or farm-work experience (2-5 months)	2	4.3	3	5.1
Little field or farm-work experience (less than 1 month)	5	10.6	1	1.7
No field or farm-work experience	0	0	3	5.1

designed to increase student awareness and knowledge of the broader ethical, environmental and social issues that can be associated with technical solutions within their disciplines, and to help students embrace efforts to minimize negative environmental impacts of crop production practices. In this component, we emphasize real life situations that can affect agriculture and society on a broad level, and gives students the opportunity to practice higher learning skills, including analyzing, evaluating, synthesizing, and applying information, as well as improving their communication and persuasive skills in a safe environment. Participating in this component of the course requires students to think about the presented issue, analyzing, synthesizing and applying information, and therefore we nicknamed this component of the course THINKER. Students participate in THINKER for extra credit, receiving two extra credit points for each five THINKER units completed. There are 13 total THINKER units, one for each of the chapter topics of the course.

For each of the 13 chapter units of CIRCLE, there is one environmental / ethical issue. In the first part of the environmental/ethical problem component, the student is presented with a technical problem that can be answered using past experience and material covered in the course (Table 1). Once a technical solution is reached, the program places the student in a new problem-solving role, in which he or she is asked to address the environmental and ethical issues associated with the technical problems/solutions. After making a decision and writing a statement justifying the reasoning of the decision, the student attends class to submit the decision statement, and to

discuss and defend and their decision with other students in a class setting where the instructor serves as an objective facilitator.

Methods

During the spring 2005 course, students were allowed the choice to participate or not in THINKER. Only those students who wanted to participate, had read the environmental / ethical issue and submitted a written decision statement were in the classroom during the fifty-minute class debate activity.

In the classroom, the instructor collects papers and gives an overview of the technical problem and the environmental and/or

ethical issues associated with the problem. To maintain a positive environment for debate, at the beginning of class the instructor reminds students to respect and listen to each person's opinions, and to not interrupt when others are speaking. After the technical issue and solutions are briefly discussed, the instructor randomly assigns students into groups of two or three to discuss their views of the topic with each other. After 10 to 15 minutes, the students gather into a circle with their chairs and the instructor facilitates the debate. Each student has two to three minutes to present his or her point of view on the issue. After each student states their side of the issue, the instructor facilitates students debate and discussion of the topic. In some instances where the instructor reviews the papers and finds that a considerable majority of the students have the same view on an issue, the instructor may randomly assign groups of two to three students a specific side of the issue so that all sides of an issue are represented. At the end of class, students vote on the technical decision in view of the "larger" issues discussed.

At the end of the course, 106 students completed surveys asking demographic information, statements to agree/disagree, and short answer questions regarding argument and debate. There were two surveys with the only difference being the wording of the short-answer questions, depending on whether students participated in THINKER during the course. For the numerical data, an analysis of variance (ANOVA) was conducted using SAS (SAS Institute, 1999). A thematic content analysis was used for the qualitative data.

Table 5. Survey Statement Response of Students Who Participated in the THINKER Debate Exercises in Agronomy 114 at Iowa State University During Spring 2005

Participated in THINKER (Debate) Statement	Answered 1 Strongly Agree		Answered 2 Somewhat Agree		Answered 3 Neither Agree or Disagree
	Number	Percent	Number	Percent	Number
1. I can learn things even from someone who is wrong.	6	12.8	8	17.0	5
2. Arguing often leads to fighting.	5	10.6	15	31.9	16
3. Arguing rarely accomplishes anything.	6	12.8	23	48.9	10
4. Most people who argue are just trying to show how smart they are.	5	10.6	21	44.7	13
5. It's better not to speak out, but to avoid conflict with people.	12	25.5	27	57.4	5
6. I have things to say that are worth hearing.	1	2.1	4	8.5	2
7. I feel uncertain when I argue, because most people argue better than me.	6	12.8	25	53.2	9
8. I find it threatening when people disagree with me.	11	23.4	17	36.2	15

Table 6. Survey Statement Response of Students Who Did Not Participate in the THINKER Debate Exercises in Agronomy 114 at Iowa State University During Spring 2005

Did not do THINKER (Debate) Statement	Answered 1 Strongly Agree		Answered 2 Somewhat Agree		Answered 3 Neither Agree or Disagree
	Number	Percent	Number	Percent	Number
1. I can learn things even from someone who is wrong.	6	10.2	8	13.6	13
2. Arguing often leads to fighting.	5	8.5	16	27.1	20
3. Arguing rarely accomplishes anything.	8	13.6	26	44.1	17
4. Most people who argue are just trying to show how smart they are.	5	8.5	25	42.4	16
5. It's better not to speak out, but to avoid conflict with people.	9	15.3	24	40.7	16
6. I have things to say that are worth hearing.	1	1.7	3	5.1	10
7. I feel uncertain when I argue, because most people argue better than me.	6	10.2	18	30.5	16
8. I find it threatening when people disagree with me.	10	16.9	28	47.5	13

Results and Discussion

Demographics

The 106 students who participated in the study came from a variety of majors: 27 (25%) agronomy, 14 (13%) animal science, 16 (15%) agricultural studies, 11 (10%) agricultural education, 16 (15%) agricultural business, and 24 (22%) other (Table 2). Sixty-five (61%) students were freshmen, 25 (24%) were sophomores, and 16 (15%) were juniors or seniors. Sixty percent (n = 63) were farm reared with extensive field and farm-work experience, 15% (n = 16) were farm reared with little field and farm-work experience, 23% (n = 24) were not reared on a farm but had some field or farm-work experience, and 3% (n=3) had no field or farm work experience.

Motivation to Participate

When participating students were asked why they had chosen to participate in THINKER, 39 of 47 participants (83%) listed extra credit points as one of their motivations. A closer examination of their responses, however, reveals that their reasons for participating went deeper than this sort of "extrinsic motivation." Eighty-five percent of the students listed "intrinsic" or learning goals in response to questions about their motivation or their expectations of THINKER.

When asked why they participated in the THINKER debate sessions and what they expected to get out of the THINKER sessions, 23 of these students

(49%) expected the THINKER debates to extend their course learning. One student, for example, stated that THINKER would "help me to understand that section better," another looked forward to "a better basic understanding of what we learned about in class," or simply "extra knowledge for exams." Forty-three percent of the students expressed learning goals of a broader sort, wanting to find out how the topics of a basic agronomy course related to practical problems in the world beyond the university. One student said, "I thought it would help connect what we learned to a real world event." Others likewise spoke of the "broader view," "wider spectrum," "broader perspective" or "wider viewpoint" that they hoped to gain through THINKER, and especially through gaining "applied knowledge about that area, real life situations." Finally, a substantial minority were simply curious to hear from their fellow students, or to find out what the debates would be like, stating that THINKER "sounded interesting," while others stated they "wanted to see what other people my age thought about agricultural issues."

Barriers

Though Agron 114 is a required course for the agronomy major, a large percentage of the agronomy majors in the study did not attend THINKER (Table 2). In contrast, a majority of the Agricultural Business majors did choose to attend THINKER. All of the

Using Environmental

seniors and those students who had no field or farm-work experience chose not to participate in THINKER (Tables 3 and 4). If the participating students found THINKER sessions attractive as both "interesting" ways of learning and as a source of extra points, what barriers, if any, prevented the non-participating students from engaging the debate activity?

From the student surveys, some factors can be eliminated. Both participating and non-participating students shared a largely positive evaluation of debate as an activity. Both groups largely considered debates to be "fun" and "a good learning tool," especially since it allows "everyone to voice their opinions" and "to see how different people think and believe" (64% of 47 participants and 63% of 59 non-participants). Slightly more non-participants than participants expressed any negative views. A minority in both groups gave only a conditional approval to debating, believing that the activity was good if: if it was done "correctly" and "under control," not leading "to name-calling, etc." (24% of the 59 non-participating students, 26% of 47 participating students). Only six other non-participating students (10%) stated unconditional negative attitudes towards debating itself, compared with only two students among the participating students (4%). And when asked what "negative aspects" the THINKER debates had/might have, seven (12%) non-participating students, and four participat-

ing students (9%), thought that debates lead/could lead to "frustration" or getting "heated."

Evidently students may have elected not to participate in THINKER not because of a low opinion of debate, but instead from uncertainty about their skills as a debater. When given a list of eight statements with which to agree or disagree, only two statements (numbers 5 and 7) showed significant differences ($P < 0.05$) between the two study groups; the group that participated in THINKER and the group that did not (Tables 5 and 6). In response to the statement "It's better not to speak out, but to avoid conflict with people," a greater percent of those who participated in THINKER stated they strongly or somewhat disagreed with this statement than those who chose not to attend THINKER. A significantly higher percent of those who did not participate in THINKER also agreed with the statement "I feel uncertain when I argue, because most people argue better than me" than those who attended THINKER, indicating a lower confidence level in argumentation and debate in those who did not participate (Tables 5 and 6).

On the other hand, about half of students in both groups (47% of participants, 61% of non-participants) reported prior experience with debating, either formally (classroom, FFA, debate team) or informally (among friends or family). When asked whether they

were "comfortable discussing issues with people who may have a different view, an overwhelming majority of both groups answered with a strong "yes," "absolutely" or "most definitely" or "very much so." Only 7 of the participating students (15%) and 14 of the non-participants (24%) expressed any reservations about their own ability to debate. And only three of the non-participating students (5%) listed an aversion to speaking or writing as a reason why they decided not to participate in THINKER.

The barriers to participation in THINKER appear to have been largely mechanical. Twenty-seven of the non-participants (46%) mentioned lack of time or scheduling conflicts as the main constraint preventing them from attending the debates; as one student candidly stated, "to be perfectly honest, I was too lazy." And the extra credit

Agronomy 114 Survey

1. What is your major?
a. Agronomy b. Animal Science c. Ag. Studies d. Ag. Education e. Ag. Business f. Other
2. Your academic classification is:
a. Freshmen b. Sophomore c. Junior d. Senior e. Other
3. Why are you taking this course?
a. it is specifically required for my major
b. I can use the course to meet a general requirement for my major
c. I thought it would be an interesting class to use as a free elective
d. I wanted to learn about agronomy
e. my advisor or friend suggested the course
4. Your current GPA at ISU is:
a. greater than 3.49
b. 3.0 - 3.49
c. 2.5 - 2.99
d. 2.0 - 2.49
e. less than 2.0
f. no grade point established yet (first semester)
4. Which of the following explains your field or farm experience?
a. farm reared with extensive field and farm-work experience
b. farm reared with little field and farm-work experience
c. not farm reared but have extensive field or farm experience (6 months or more)
d. not farm reared but some degree of field or farm-work experience (2-5 months)
e. little field or farm-work experience (less than 1 month)
f. no field or farm-work experience
5. I would characterize my interest level in this agronomy course as
a) very interesting to me and self motivated to study
b) interesting to me but not necessarily self motivated to study
c) indifferent and little self motivation
d) uninterested and little self motivation
e) uninterested and not motivated

points themselves ended up to be a barrier to participation by some students: 13 (22%) decided not to attend THINKER sessions because they didn't "need" the extra credit. As one student wrote, "I felt I could get by just fine without the points," or in another's view, "I was happy enough with the grade I was getting in here already."

Outcomes

THINKER participants gave the debate activities a strong endorsement as a learning activity. When asked whether "THINKER contributed to your learning in the course," 41 (87%) expressed a positive view. According to students, the debates contributed in several ways. Some students focused on the way the debates helped them master course content. For example, one mentioned that the sessions "reviewed course material one more time;" another, that "we used the course content to do our assignments." THINKER was thus a good opportunity to "practice my agronomy language," as one student said.

Other students appreciated the way the debates encouraged them to go from passive knowledge of course content to active application of the material. Along these lines, several mentioned the importance of the "real life situations" that the debates provided: "we were able to relate topics to real life situations," or "apply what we were learning to real life situations." THINKER thus encouraged critical thinking, or as one student stated, "it taught me to think outside the box."

Finally, some students valued the communication skills, or what might better be called the "social learning" they gained from the debates—an understanding of, and indeed "citizenship" in, the community of agronomists—evidence that students went beyond the passive knowledge of the course content. This view was evident when students commented how they enjoyed learning about others' thoughts in the debates. As

one student wrote: "I learned how other farmers think, and what they would do in different situations." Several students agreed that the experience had "opened" them: THINKER had "opened me up to a lot of interesting topics and [I] learn[ed] about a lot of different people's beliefs," or "it opened my eyes to different views." This learning was important both to a novice agronomist, who said, "I'm not from a farm background... I think I learned about as much from THINKER as I did from reading the book and CIMPLE," but it was also useful to the students with more agronomic experience; one student reported how "THINKER helped open my eyes to farming practices not commonly used in my area." The interaction between expert and novice views—"the variation in thought processes in different people, farmers and non-farmers"—was also important. In several cases,

I. Circle how much you agree with the following statements

1=strongly disagree 2=somewhat disagree 3=neither agree nor disagree 4=somewhat agree 5=strongly agree

- 1. I can learn things even from someone who is wrong. 1---2---3---4---5
- 2. Arguing often leads to fighting. 1---2---3---4---5
- 3. My family argues together a lot, and we enjoy it. 1---2---3---4---5
- 4. Sometimes, even people in authority like government officials and teachers are wrong. 1---2---3---4---5
- 5. My opinions about political issues don't really make a difference. 1---2---3---4---5
- 6. Arguing rarely accomplishes anything. 1---2---3---4---5
- 7. At one point, everyone disagreed with me, but I was sure I was right. 1---2---3---4---5
- 8. I want to become more self-confident. 1---2---3---4---5
- 9. Most people who argue are just trying to show how smart they are. 1---2---3---4---5
- 10. It's better not to speak out, but to avoid conflict with people. 1---2---3---4---5
- 11. I have things to say that are worth hearing. 1---2---3---4---5
- 12. I feel uncertain when I argue, because most people argue better than me. 1---2---3---4---5
- 13. People generally pay attention to what I have to say. 1---2---3---4---5
- 14. Men are better at arguing, women at making friends. 1---2---3---4---5
- 15. I readily understand what other people mean. 1---2---3---4---5
- 16. I find it threatening when people disagree with me. 1---2---3---4---5

NOTE: The following two sections differ on whether the student chose to participate in THINKER.

- 1. Why did you participate in the THINKER debate sessions?
- 2. What did you expect to get out of the THINKER session(s)?
- 3. Do you think THINKER contributed to your learning in the course? Why or why not?
- 4. Have you had prior experience in debate? If so, please explain.
- 5. What do you think of debate as an activity?
- 6. Are you comfortable discussing issues with people who may have a different point of view?
- 7. Do you think that the THINKER experience changed your comfort level for debate? If so, how?
- 8. Has THINKER helped you to learn to express and defend your views? If so, how?
- 9. Did the debate(s) you attended go well or successfully? Why or why not?
- 10. Do you think there were positive aspects of participating in THINKER and the debates? If so, what?
- 11. Do you think there were negative aspects of participating in THINKER and the debates? If so, what?

- 1. In the Agronomy 114 course, did you understand what THINKER is? Please describe.
- 2. Have you participated in the THINKER debate sessions? Besides time constraints, why not?
- 3. Do you think THINKER would have contributed to your learning in the course? Why or why not?
- 4. What do you think of debate as an activity?
- 5. Have you had experience in debate? If so what type?
- 6. Are you comfortable discussing issues with people who may have a different point of view?
- 7. Do you think THINKER would have helped you learn to better express and defend your views? Why or why not?
- 8. Do you think there would have been positive aspects of participating in THINKER and the debates? If so, what?
- 9. Do you think there would have been negative aspects of participating in THINKER and the debates? If so, what?

Using Environmental

this exposure to the diversity of the agronomy community significantly changed students' views. As one student stated, "I went in with maximizing profits attitude and came out on the environment end." Finally, one student said that it was simply "fun to discuss the different views people had."

The importance of such "social learning" was also evident in students' responses to questions asking about whether THINKER helped them improve their ability to debate, and to express and defend their views. Twelve students (26%) reported no improvement, while nine others (19%) said that they were already good at these activities. A majority of students, however, reported that they had made gains in these skills. Some students focused on their improvements in specific debating skills, such as "convey[ing] my ideas in a manner that was easily understood by others" and "us[ing] backup info." Others, however, expressed more significant changes in their conceptions of the community they participated in—changes in conceptions of themselves and others. Several students spoke of increases in self-confidence in debate, such as one who thought that THINKER "made me more confident in stating my point of view." Another spoke of how the debates had "made my opinion worth something." Students also mentioned improving their tolerance of others who disagree. For example, one person reported learning that "it's okay to disagree and sometimes people have ideas that I never thought of." And another said, "I learned that people are entitled to their own opinions even if I may not agree with what they had to say."

Not surprisingly, students' overall evaluation of the THINKER experience was positive. Forty-five of the 47 participants (96%) responded positively when asked, "Did the debate(s) you attended go well or successfully?", and 44 (94%) expressed approval when asked "Do you think there were positive aspects of participating in THINKER and the debates?" Students mentioned several positive features of the debates, mainly the debates' civility and organization, and the debates' productiveness: either they had ended with a resolution of the issue, or at least with "good arguments and new ideas." Finally, students appreciated the way the debates promoted "social learning" by involving all or almost all the students in attendance. In the debates, the students thought, "everyone seemed to get some educated thoughts in" and "everyone contributed."

By contrast, when asked about the negative features of THINKER, less than half the students (47%) mentioned any. In their responses, participating students primarily expressed a view that a poor debate was not frustrating or angry, as some non-participating students mentioned, but was "boring" because of a lack of full involvement. Either "it was the same people who talked every time" or some were

"talking amongst themselves" as opposed to participating in the debate, points reflecting the facilitator's skills during the THINKER activities.

Conclusions

In this study, student response data suggested that students perceived that the debate exercises enhanced content learning as well as their ability to use critical thinking in applying course knowledge to complex, real-world problems. Work by Mankin et al. (2004) revealed that many agriculture students are motivated by information that they perceive has realistic applications and relevance to their professional goals. As these authors stated, "students preferred assignments that provided real-life experiences. Instruction that clearly related the work to realistic situations was valued by the students" (Mankin et al., 2004 p.9). Fieldwork, laboratories, internships and service learning are all methods of achieving such "realistic situations" outside of the classroom; debate exercises provide another way to bring realistic experiences into the classroom. A study investigating how students studied and used CIMPLE in Agron 114 showed that students who used the Environmental and Ethical Issues component showed a positive correlation with end of semester grades (McAndrews et al., 2005).

Furthermore, students thought the debate exercises helped them strengthen skills that they will use in their profession. Debating gave students an opportunity to better understand how Agronomists approach problem analysis and decision-making. Through the debating exercise, students encountered a diversity of opinion that existed on controversial topics in the professional community, enhanced their ability to listen and respond to the views of others, and built self-confidence in communicating their opinions.

Through the instructor's informal questioning at the end of class, over half of the students frequently commented that the debate exercise broadened their perspective of the issues and that they learned new information that they "hadn't thought of." Roughly 10% of the students stated that they had changed their viewpoint regarding the topic after the debate.

Previous studies indicate that many students with majors relating to agriculture and natural resources should and/or could improve their abilities to communicate and discuss controversial or career related issues, and our data show that many students understand the benefits and endorse the practice of debate. Furthermore, most students have at least some intrinsic interest in debate as a learning activity. It would likely prove beneficial if more instructors included debate activities in courses, and it should be possible to reinforce that interest with an "extrinsic" reward system that also communicates the activity's importance to all students, helping them want to invest their time. Extra credit points for the course provide incen-

tive for some students to participate in a course debate. Requiring participation could increase participation, however, for large classes, having debate may require more structure, time, facilitation and planning.

To incorporate debate into a class, the instructor should first develop a debatable issue: a real or realistic story that raises a question of judgment that will require course knowledge to answer. In our course, we start with a technical problem that connects course material to a real scenario, and the technical issue leads into the larger context and components of an issue. Initiating debate with a broad complex issue, the students could miss the connection to the course material. News reports, local events and typical professional situations are all good sources of issues. After laying out the issue and challenges, the instructor may have students research and debate as individuals or assign two to eight person student groups to play specific roles in the issue, being responsible for advocating specific points-of-view.

At the same time, this study suggested some areas of possible difficulty that instructors may encounter using debates in the agricultural classroom. First, some students are concerned about keeping debates civil (not angry or heated) and productive (not frustrating). These concerns should be met early, for example by laying ground rules for listening and speaking, and having some conspicuously orderly debates. Students should be required to respect and listen to others opinions, and respond in a respectful manner. The instructor should provide acceptable and unacceptable examples. The instructor should facilitate the debate in an orderly manner, should encourage all students to share their views, and each student should have a set limited time to speak. It may also be necessary for instructors to encourage broad participation in the debates, for example, by calling on silent students. The results of this study reinforce the importance of instructors' efforts to create and maintain a safe, supporting atmosphere for classroom debate.

In summary, debate exercises work well and are a beneficial part of effective instruction even at a beginning, foundation course in agronomy. Debate exercises, as used in this study, do not have to be elaborate case studies or extensive problems to provide the beneficial effects of using debate in the agricultural classroom. Providing a safe, supporting environment for classroom debate with guided facilitation by the instructor will help students strengthen their professional skills for debate and complex issue analysis to a level they will need as professionals. Debating is thus not only training in content knowledge and oral communication, but also training for fuller participation in increasingly more interrelated and complex issues of society.

Literature Cited

- Allen, M., S. Berkowitz, S. Hunt and A. Loudon. 1999. A meta-analysis of the impact of forensics and communication education on critical thinking. *Communication Education*. 48:18-30.
- Bellon, J. 2000. A research-based justification for debate across the curriculum. *Argumentation and Advocacy*. 36:161-175.
- Goodwin, J. 2003. Students' perspectives on debate exercises in content area classes. *Communication Education* 52:157-163.
- Karsten, H.D, M.L. Risius. 2004. Development of an interdisciplinary agroecology major with input from surveys of students, graduates, and employers. *NACTA Jour.* Mar., v. 48, no. 1 p. 58-64.
- Kolb, D. A. 1981. Learning styles and disciplinary differences. In A. W. Chickering (Ed.), *The Modern College*. San Francisco: Jossey-Bass.
- Kolb, D. A. 1984. *Experiential learning: Experience as a source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall
- Lindner, J.R., T.H. Murphy, G.J. Wingenbach, K.D. Kelsey. 2004. Written communication competencies: Strengths and weaknesses of agricultural education graduate students. *NACTA Jour.* Dec., v. 48, no. 4 p. 31-38.
- Mankin, K.R., K.M. Boone, S. Flores, M.R. Willyard. 2004. What agriculture students say motivates them to learn. *NACTA Jour.* Dec., v. 48, no. 4 p. 6-11.
- McAndrews, G.M., R.E. Mullen, K.L. Taylor, D. Dobill, and D. Green. 2004. Developing an interactive multimedia computer program for learning agronomic principles. *NACTA Jour.* December Vol. 48 4:57-62.
- McAndrews, G.M., R.E. Mullen and S.A. Chadwick, 2005. Relationships among learning styles and motivation with computer-aided instruction use and grades in an introductory agronomy course. *Jour. of Natural Resources and Life Sciences Education*. Vol. 34:13-16.
- Mullen, R.E. 2005. *Crop science: Principles and practice*. 5th Ed. Boston: Pearson Custom Publishing.
- Sammis, T., J. Mexal, M. O'Connell, V. Gutschick. 2003. Instrumentation class develops interdisciplinary skills. *NACTA Jour.* Dec., v. 47, no. 4 p. 56-60.
- Singletary, L., G. Hill, M. Smith, P. Corcoran. 2004. An emerging arena: Preparing agricultural and natural resource outreach professionals to conduct public issues education programs. *NACTA Jour.* Sept., v. 48, no. 3 p. 41-46.
- SAS Institute. 1999. *The SAS system for Windows*. Released 8.0. SAS Institute, Cary, NC.