

# Change in Students' Self-reported Learning Gains and Worldviews in a Discussion-Driven International Livestock Agriculture Classroom<sup>1,2</sup>

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## Abstract

This article outlined the design of a small-enrollment, non-lecture course on international livestock agriculture and documented self-reported learning gains and changes in worldviews of 66 students captured with a 14-item survey administered the first and the last day of class in four consecutive years (i.e., student cohorts). Measured as change in self-reported level of knowledge, learning gains averaged 64%, but ranged from 24 to 157% across course topics. The course changed students' worldviews on food security, livestock agriculture as a means to reduce poverty in rural Mexico and the relative benefits for Mexico and the U.S. to engage in dairy trade, but not on immigration and environmental issues. At the beginning of the semester, self-reported level of knowledge varied between majors (dairy science vs. non-dairy science) and among standings (freshman, sophomore, junior or senior), but worldviews varied between majors only. By the end of the semester these relationships had subsided, but cohort had risen in influence. More than the major, the cohort shaped a student's self-reported learning gains and changes in worldviews during the semester. These outcomes may reflect the impact of an instructional design aimed at engaging students from diverse backgrounds in a discussion-driven classroom throughout the semester.

## Introduction

Some educators have long insisted that learning about the world and about the interrelationship of national, international and global issues is indispensable to a high quality education (Green, 2002). Similarly, the American

Association of Colleges and Universities (AAC&U) have echoed these views. For example one of the AAC&U's principle of excellence for 21st century suggested to engage students in "Big Questions" of contemporary and enduring significance, addressed with a "*far-reaching curriculum in science and society, cultures and values, global interdependencies the changing economy and human dignity and freedom*" (AAC&U, 2013a). Intercultural knowledge and competence and engagement in local and global issues provide opportunities for gains in personal and social responsibility, which is one of the essential learning outcomes of a four-year degree (AAC&U, 2013b). In addition to training students for so-called "engaged citizenship" into their adulthood, there are pragmatic and practical economic and market-based reasons to expand the worldviews of the next generation of agriculturalists and employees of agricultural firms. With the productivity of U.S. agriculture growing faster than domestic food and fiber demand, policy makers, farmers and agricultural firms have increasingly relied on export markets to sustain prices and revenues. For example in 2012, 13.2% of US milk production was exported and international agreements such as NAFTA (North American Free Trade Agreement) has made it possible for Mexico to become the first billion dollar dairy export market from the U.S. in 2011 (USDEC, 2013)

Canadian and U.S. administrators of animal sciences-related departments indicated a strong belief in the value of internationalization initiatives, but implementation remained limited (Forsberg et al. 2003;

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Lesch and Wachenheim, 2004). In spite of practical and philosophical importance, there are many barriers to internationalizing the science curriculum (Wattiaux et al., 2001; Van Eyck et al, 2012) and educating students in international and global agriculture has remained a relatively neglected part of animal sciences curriculum (Acker and Taylor, 2000). Thus the first objective was to outline the design of a course aimed at: (a) increasing students' awareness of the multi-dimensionality and multi-functionality of livestock agriculture in a global context and (b) increasing students' critical thinking skills by exploring inter-dependencies between the U.S. and Mexico using the dairy industry as a case-study. The second objective was to determine retrospectively the influence of student's major, standing, cohort and mid-semester decision to participate in a subsequent study abroad (two-week summer field program in Mexico) on their self-reported level of knowledge and worldviews at the beginning of the semester, the end of the semester and the change in these variables as a result of participating in the course.

## Materials and Methods

### Course Description and Design

The course titled "Agriculture in Emerging Economies: Dairying in Mexico" has been taught for the last 10 years as a one-credit elective open to all undergraduates at the University of Wisconsin-Madison. Annual enrollment for the four years (2009 to 2012) of this study is presented in Table 1. Enrollment over the life-span of the course was  $15.8 \pm 4.6$  (means  $\pm$  standard deviation), but was  $19.2 \pm 2.6$  in the last four years. The course does not have a prerequisite but serves as a prerequisite for a two-week faculty-led summer field program in Central Mexico that students elect to enroll for in mid semester.

The syllabus describes the learning objectives as follows: Students who actively participate in this seminar will gain knowledge and understanding of a few important global agricultural issues, including: a) The diversity of agricultural systems around the world; b) The historical, social, economic and political forces that shape rapid changes in agriculture around both the "developed" nations and the "developing" nations; c) The increased interdependence of agricultural industries around the world; d) The people of Central Mexico, its history, economic and social structure; e) Mexico-U.S. relations regarding immigration issues, trade of dairy products and the tension between the two countries because of cultural differences and f) The diversity of the Mexican dairy industry, which spans from subsistence farming (resource-poor farmers) to industrial-scale operations. An additional objective is listed as helping

Table 1. Class and Study Enrollment

Cohort/ Year	Class Enrollment Total	Study Enrollment							Data Excluded <sup>x</sup>	
		Total	Major <sup>z</sup>		Standing <sup>y</sup>			IC	NE	
			ND	D	Fr	So	Ju			Se
2009	23	17	4	13	1	11	1	4	1	5
2010	20	19	12	7	5	3	4	7	0	1
2011	18	14	7	7	0	1	4	9	2	2
2012	16	16	9	7	4	4	1	7	0	0
Total	77	66	32	34	10	19	10	27	3	8

<sup>z</sup>Major: ND = Non-Dairy Science, D = Dairy Science.

<sup>y</sup>Standing: Fr = Freshman, So = Sophomore, Ju = Junior, and Se = Senior.

<sup>x</sup>Data excluded: IC = Incomplete data, NE = Not eligible (graduate or guest students).

students gain competence in discussing international agricultural issues. Consequently, selection of course material, website features ( <https://dairynutrient.wisc.edu/375/> ) and classroom activities have been designed to engage students in higher-order of thinking and to create an inclusive in-class and out-of-class learning community (Figure 1).

The first section of the course introduces big-picture topics related to population change, food demand and supply, livestock agriculture and trade at the global scale. Regional or national examples are used to illustrate global trends and interdependencies among nations. The so-called "Livestock Revolution" (Delgado and Narrod, 2002; Delgado et al., 2003) is a central theme of recurrent class discussions. The second section of the course focuses on the overall U.S. – Mexico agricultural relations with a specific emphasis on immigration and trade issues. Finally, the third part of the course focuses on a description and analysis of the Mexican dairy industry: a) from the United States' exporting firms perspective, b) from the Mexican farmers' perspectives and c) from the perspective of the sustainability challenges associated with specific dairy production systems in Mexico in relation to equivalent systems in the United States.

Figure 1:

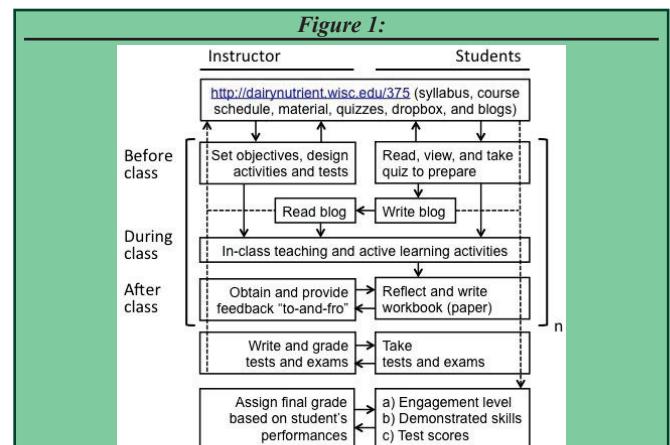


Figure 1 illustrates the multiple functions of the course website and the roles and responsibilities of the instructor and the students in the class. In essence, students demonstrate their engagement with course material prior to class meeting with on-line quizzes and blog entries. Typically, each class starts with a graded group quiz that has three pedagogical functions. It rewards students for having interacted with the pre-assigned material, it is a simple way to take attendance, but more importantly it makes students talk to one another about course content from the very beginning of class. Learning activities during the remaining time in class varies weekly, but are designed according to a template, first to bring everyone “on the same page” in regards to important facts and figures of the pre-assigned material and then to engage students in individual, small group and large group activities culminating with a whole class discussion and wrap-up. Grades for the course are assigned based on six items including: (1) students’ test scores, level of engagement measured with weekly in-class quizzes (2) before-class blog entries (3) and after-class reflections entries (4) and demonstration of ability to integrate content and analyze it critically in a two-part creative story writing/telling (5; written an oral midterm) and through a final take-home exam (6).

**Survey Instrument and Administration**

The survey instrument used in this study comprised two parts (Table 2). The first part was developed to measure students’ perceptions of their level of knowledge of core topics of the course (item 1.1 to 1.7). In the second part, students’ worldviews were measured as level of agreement with items worded as broad integrative statements addressing a particular aspect of the same core topics (items 2.1 to 2.7). Possible numerical scores for each item in the scale ranged from 1 to 10, with descriptive qualifiers describing scores 1 and 2 as “Not at all,” scores 3 and 4 as “A little,” scores 5 and 6 as “Somewhat,” scores 7 and 8 as “A lot” and scores 9 and 10 as “A great deal.” The survey was administered, with the consent of every participant, as

one of the first class activities conducted on the first day of class and a second time, as one of the last activities of the last day of class. Students were requested to provide the first two letters of the first names of their mother and father as a way to anonymously match early and late semester surveys. Student demographics data collected included major, standing and (on the last day of class only) whether in mid-semester the student had decided to enroll in the subsequent study abroad program in Mexico. The analysis reported here included data collected in four consecutive years (2009 to 2012), construed thereafter as student cohorts.

**Statistical Analysis**

The PROC ANOVA of SAS (SAS Institute, 2008) was used to determine the significance of the difference in items scores between the first and the last day of class. The differences for items 1.1 to 1.7 and for items 2.1 to 2.7 quantified the self-reported learning gains and the change in worldviews, respectively during the semester. In a second analysis, the dependent variables of interest included: a) item scores on the first day of class, b) item scores on the last day of class and c) the difference in item scores between the last and first day of class. Our interest was to determine whether a student’s major (dairy science vs. non-dairy science), standing (freshman, sophomore, junior or senior), cohort (2009, 2010, 2011, or 2012) and the mid-semester decision to enroll in study abroad (yes or no) had an ex post facto influence on the aforementioned dependent variables. Given prior experience (Wattiaux and Crump 2006), data were analyzed as ranked values using a nonparametric procedure (PROC NPAR1WAY,

**Table 2. Instrument Used to Determine Students’ Self-Assessment of Knowledge (items 1.1 to 1.7) and to Capture Students’ Worldviews (items 2.1 to 2.7) on Course Topics**

Items	Not at all	A little	Some what	A lot	A great deal					
1. How much knowledge do you have on the following topics:										
1.1. Agriculture in developing countries	1	2	3	4	5	6	7	8	9	10
1.2. Agriculture in general in Mexico	1	2	3	4	5	6	7	8	9	10
1.3. U.S. – Mexico agriculture relations	1	2	3	4	5	6	7	8	9	10
1.4. Structure and diversity of the Mexican dairy industry	1	2	3	4	5	6	7	8	9	10
1.5. Structure and diversity of the U.S dairy industry	1	2	3	4	5	6	7	8	9	10
1.6. Mexico, its people and its cultures	1	2	3	4	5	6	7	8	9	10
1.7. Issues related to poverty in Mexico	1	2	3	4	5	6	7	8	9	10
2. To what extent do you agree with the following statements:										
2.1. The increase in world population will create a worldwide food crisis in my lifetime	1	2	3	4	5	6	7	8	9	10
2.2. Livestock (dairy) agriculture is more environmentally friendly in Mexico (developing countries in general) than in Wisconsin (the U.S. in general)	1	2	3	4	5	6	7	8	9	10
2.3. Illegal (Mexican) immigrants are taking away jobs from U.S. Citizens	1	2	3	4	5	6	7	8	9	10
2.4. Livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico	1	2	3	4	5	6	7	8	9	10
2.5. Expanding agricultural (dairy) trade with Mexico is good for the U.S.	1	2	3	4	5	6	7	8	9	10
2.6. Expanding agricultural (dairy) trade with the U.S. is good for Mexico	1	2	3	4	5	6	7	8	9	10
2.7. The Mexican and the U.S. Dairy industry will look more alike in the next 20 years?	1	2	3	4	5	6	7	8	9	10



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SAS Institute, 2008) and the Kruskal-Wallis test, which do not rely on assumption of normal distribution of the data and residual errors (Conover, 1999). Means values were reported on the original scale for convenience of interpretation. Differences were considered significant for  $P \leq 0.05$  and tendencies were reported in tabular results for  $0.06 \leq P \leq 0.15$ .

## Results

### Enrollment

All students enrolled in the course over the four years of the study consented to participate in the study. However, eight of the 77 students were graduate or guest students and were not eligible to be enrolled in the study. Among the 69 eligible students three were excluded from the analysis because of the inability to pair unequivocally a beginning-of-semester survey with end-of-semester survey (Table 1). Almost half of study participants were dairy science major. Non-dairy science majors included primarily Animal Sciences, Agricultural and Applied Economics and Agronomy. Students in the study were primarily seniors and sophomores followed by freshmen and juniors. This pattern may reflect in part the curricular flexibility for elective courses throughout the 4-year program. However, Table 1 showed also a highly variable pattern of majors and standing across cohorts (i.e., years) reflecting most likely the absence of prerequisite for the seminar. In addition, 29 students among the eligible study participants elected in mid-semester to attend the subsequent study abroad program.

### Students' Gain in Knowledge and Change in Worldviews

The self-reported level of knowledge measured on a scale of 1 (not at all) to 10 (a great deal) and captured with survey items 1.1 to 1.7, was  $4.5 \pm 1.0$  and  $7.4 \pm 0.3$  (means  $\pm$  standard deviation) on the first day of class and at the last day of class, respectively. Learning gains measured by the changes in scores during the semester were significant for all seven topical areas (items 1.1 to 1.7, Table 3) and averaged  $2.9 \pm 1.2$  overall. Thus the increase in self-reported level of knowledge averaged 64.4%, but the gains were not uniform across items. Interestingly, the two largest increases (111% and 157%) were observed for the two items that had the lowest score the first day of class (item 1.2: Agriculture in general in Mexico and item 1.4: Structure and diversity of the Mexican dairy industry). Con-

versely, the two lowest increases (24% and 31%) were observed for the two items that had the highest scores the first day of class (item 1.6: Mexico, its people and its cultures and item 1.5: Structure and diversity of the U.S. dairy industry).

The average level of agreement with the 7 items used to measure students' worldviews on course topics (items 2.1 to 2.7) was  $5.4 \pm 1.2$  and  $5.3 \pm 1.7$  the first and last day of class, respectively. There was no change in students' worldviews for three items, but significant changes occurred for four items (Table 3). The three items that remained unchanged were those that students scored numerically lowest the first day of class and included item 2.3 addressing illegal immigration, item 2.2 addressing the relative environmental impact of livestock and item 2.7 addressing the convergence of the Mexican and U.S. dairy industries in the future. Overall, the course decreased students' belief that the increase in world population will create a worldwide food crisis in their lifetime (item 1.1), but increased their belief that livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico (item 2.4). Expanding agricultural trade between the U.S. and Mexico was perceived as equally good for both nations the first day of class (item 2.5 score = 6.15 and item 2.6 score = 6.54, Table 3). However, on the last day of class the belief that it was good for the U.S. to expand its trade with Mexico increased by 1.74 units (item 2.5, Table 3), but the belief that it was good for Mexico to expand its trade with the U.S. decreased by 2.30 units (item 2.6, Table 3).

**Table 3. Students' Self-Reported Level of Knowledge (items 1.1 to 1.7), Worldviews (items 2.1 to 2.7) and Change (Chg.) in These Variables during the Semester Measured by Difference between Item-Scores the First Day of Class (Pre) and the Last Day of Class (Post)**

Items and Statement	Pre	Post	Chg.	P <sup>2</sup>
1. How much knowledge do you have on the following topics:				
1.1 Agriculture in developing countries	4.28	7.40	3.09	<0.001
1.2 Agriculture in general in Mexico	3.65	7.73	4.04	<0.001
1.3 U.S. – Mexico agriculture relations	3.97	7.49	3.45	<0.001
1.4 Structure and diversity of the Mexican dairy industry	2.99	7.80	4.70	<0.001
1.5 Structure and diversity of the U.S dairy industry	5.70	7.64	1.76	<0.001
1.6 Mexico, its people and its cultures	5.55	6.87	1.33	<0.001
1.7 Issues related to poverty in Mexico	5.04	7.19	2.20	<0.001
2. To what extent do you agree with the following statements:				
2.1 The increase in world population will create a worldwide food crisis in my lifetime	5.97	4.88	-1.06	<0.001
2.2 Livestock (dairy) agriculture is more environmentally friendly in Mexico (developing countries in general) than in Wisconsin (the U.S. in general)	3.98	4.07	0.16	0.618
2.3 Illegal (Mexican) immigrants are taking away jobs from U.S. Citizens	3.35	2.96	-0.33	0.220
2.4 Livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico	6.37	7.03	0.80	0.022
2.5 Expanding agricultural (dairy) trade with Mexico is good for the U.S.	6.15	7.91	1.74	<0.001
2.6 Expanding agricultural (dairy) trade with the U.S. is good for Mexico	6.54	4.48	-2.30	<0.001
2.7 The Mexican and the U.S. Dairy industry will look more alike in the next 20 years?	5.56	5.83	0.35	0.189

<sup>2</sup>Two sided t-test for the significance of Chg.

### Impact of a Student's Major, Standing, Cohort and Commitment to Study Abroad

A student's mid-semester decision to participate or not in the subsequent faculty-led study abroad in Mexico for which the course is a prerequisite had no impact on scores of any items on the last day of class, the change in score during the semester, or the first day of class (data not shown). Table 4 summarized the influence of a student's major, standing and cohort on all items on the first day of class, the last day of class, as well as the learning gains (item 1.1 to 1.7) and change in worldviews (items 2.1 to 2.7) that occurred during the semester.

**Student's Major.** On the first day of class, scores for self-reported level of knowledge in agriculture in developing countries (item 1.1), structure and diversity of the Mexican dairy industry (item 1.4) and structure and diversity of the U.S. dairy industry (item 1.5) were higher for dairy science majors compared with non-dairy science majors (4.75 vs. 3.81, 3.56 vs. 2.42 and 6.88 vs. 4.50, respectively). However on the last day of class, only item 1.5 tended to remain higher for dairy science majors compared with non-dairy science majors (7.96

vs. 7.25). Self-reported learning gains were higher for non-dairy science majors than for dairy sciences majors for items 1.4 (structure and diversity of the Mexican dairy industry; 5.50 vs. 4.04, respectively) and items 1.5 (structure and diversity of the U.S. dairy industry 2.54 vs. 1.12, respectively) and tended to be higher also for items 1.1 and 1.2 (Table 4). Furthermore, on the first day of class dairy science and non-dairy science majors differed substantially in their worldviews as revealed by a tendency or a significant difference for six of the seven items in the instrument (item 2.1 to 2.7, Table 4). Dairy science majors scored higher for item 2.1 (the increase in world population will create a worldwide food crisis in my lifetime; 6.46 vs. 5.47), item 2.4 (Livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico; 6.91 vs. 5.83) and item 2.6 (expanding agricultural (dairy) trade with the U.S. is good for Mexico, 7.01 vs. 6.08).

In contrast non-dairy science majors scored higher for item 2.2 (Livestock (dairy) agriculture is more environmentally friendly in Mexico (developing countries in general) than in Wisconsin (the U.S. in general), 4.58 vs. 3.38). Interestingly, on the last day of class, a student's major impacted only one of the worldview items. Dairy science majors believed that illegal (Mexican) immigrants are taking away jobs from U.S. Citizen (item 2.3) to a greater extent than non-dairy science majors (3.40 vs. 2.43). Also on the last day of class the effect of a student's major persisted as a tendency for item 2.1 (the increase in world population will create a worldwide food crisis in my lifetime; 5.43 vs. 4.21 for dairy science and non-dairy science major, respectively). A student's major influenced the change in worldview during the semester for only one of the seven items. The change in belief that livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico (item 2.4) was endorsed to a higher degree among non-dairy science majors than for dairy science majors (1.77 vs. -0.33).

**Student's Standing.** Student's standing influenced items 1.1, 1.4 and 1.5 the first day of class. For each of these three items, the two highest numerical scores were observed consistently for seniors and sophomores whereas the two lowest numerical scores were recorded for freshman and juniors (data not shown). However, the effect of student standing did not reach significance for any of the items the last day of class, for the learning gains or the change in worldviews during the semester (Table 4).

**Table 4. Significance<sup>c</sup> of Students' Major, Standing and Cohort on the First Day of Class (Pre), the Last Day of Class (Post), and for the Change (Chg.) during the Semester in Item Scores Quantifying Self-Reported Learning Gains (item 1.1 to 1.7) and Worldviews (items 2.1 to 2.7)**

Items	Students' major <sup>e</sup>			Student's standing <sup>x</sup>			Student's cohort <sup>w</sup>		
	Pre	Post	Chg.	Pre	Post	Chg.	Pre	Post	Chg.
1. Level of knowledge and learning gains <sup>v</sup>									
1.1	0.03	--	0.10	0.01	--	0.07	--	0.03	0.08
1.2	0.09	--	0.12	--	--	--	0.12	--	0.03
1.3	--	--	--	--	--	--	--	0.04	0.04
1.4	0.01	--	0.01	0.03	--	--	--	0.13	0.05
1.5	<0.01	0.06	<0.01	0.04	--	0.08	--	--	--
1.6	--	--	--	--	--	--	--	0.14	0.09
1.7	--	--	--	--	0.11	--	--	0.03	0.05
2. Level of agreement and change in worldviews <sup>u</sup>									
2.1	0.05	0.06	--	--	--	--	--	--	--
2.2	0.01	--	--	--	--	--	0.06	--	0.03
2.3	--	0.01	--	--	--	--	--	--	--
2.4	0.01	--	0.01	--	--	0.15	--	0.03	0.03
2.5	0.13	--	0.10	--	--	--	--	0.06	--
2.6	0.03	--	--	--	--	--	--	--	--
2.7	0.10	--	--	--	--	--	--	<0.01	<0.01

<sup>a</sup>All P values noted for significance ( $P \leq 0.05$ ) and tendencies ( $0.06 \leq P \leq 0.15$ ), whereas non-significance ( $P > 0.15$ ) was denoted as "--".

<sup>b</sup>Student's major: Dairy science versus non-dairy science.

<sup>c</sup>Student's standing: Freshman, sophomore, junior or senior.

<sup>d</sup>Student's cohort: 2009, 2010, 2011, or 2012.

<sup>e</sup>How much knowledge do you have on the following topics: 1.1. Agriculture in developing Countries; 1.2. Agriculture in general in Mexico; 1.3. U.S. – Mexico Agriculture relations; 1.4. Structure and diversity of the Mexican Dairy industry; 1.5. Structure and diversity of U.S. Dairy Industry; 1.6. Mexico, its people and its cultures, 1.7. Issues related to poverty in Mexico.

<sup>u</sup>To what extent do you agree with the following statements: 2.1. The increase in world population will create a worldwide food crisis in my lifetime; 2.2. Livestock (dairy) agriculture is more environmentally friendly in Mexico (developing countries in general) than in Wisconsin (the U.S. in general); 2.3. Illegal (Mexican) immigrants are taking away jobs from U.S. Citizens; 2.4. Livestock (dairy) production should be promoted as a way to alleviate poverty and develop a strong rural economy in Mexico; 2.5. Expanding agricultural (dairy) trade with Mexico is good for the U.S.; 2.6. Expanding agricultural (dairy) trade with the U.S. is good for Mexico; 2.7. The Mexican and the U.S. Dairy industry will look more alike in the next 20 years.

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**Student's Cohort.** Student's cohort had minimal effects on the first day of class but influenced or tended to influence numerous items the last day of class (Table 4). Specifically, items 1.1, 1.3 and 1.7 varied among cohorts, but in no clearly discernable patterns (data not shown). Similarly cohort influenced worldviews on the last day of class for item 2.4 addressing livestock as a means to alleviate rural poverty in Mexico and item 2.7 addressing the possible convergence of the Mexican and the U.S. Dairy industries in the future, for which scores were 1.2 and 1.5 units lower in the 2009 cohort than the next lowest cohorts (5.73, 7.25, 7.61, 8.00 for item 2.4 and 4.73, 6.33, 6.00, 6.69 for items 2.7 in 2009, 2010, 2011 and 2012, respectively). In addition, a students' cohort influenced learning gains during the semester for four of the seven items 1.1 to 1.7. Scores increased from year to year for item 1.2 (agriculture in general in Mexico; 2.87, 4.25, 4.64 and 4.81 for 2009, 2010, 2011 and 2012, respectively) and item 1.4 (structure and diversity of the Mexican dairy industry; 3.70, 4.83, 4.96 and 5.63 for 2009, 2010, 2011 and 2012, respectively). Year-to-year differences were significant also for items 1.3 and 1.7, with lowest value observed for 2009 and varying patterns for the remaining three years (data not shown). Furthermore, there was a student cohort effect in the change in worldviews during the semester for items 2.2, 2.4 and 2.7. The patterns of change were distinct for item 2.2 and 2.4 (0.73, 1.50, -0.46, -1.00 for item 2.2 and -0.38, 0.83, 1.77, 1.44 for item 2.4 in 2009, 2010, 2011 and 2012, respectively) but increased from year to year for item 2.7 (-0.83, 0.33, 0.57 and 1.63 for 2009, 2010, 2011 and 2012, respectively).

## Discussion

### Designing an Elective Course in International Agriculture for Diverse Students

Except for the recent work of Murphrey et al., (2013) that focused on best practices to share international experiences, there are few studies addressing the design and assessment of an elective international agriculture classroom that enroll diverse students ranging from freshman to seniors and coming from a variety of majors. Active student engagement (Dancy and Beichner, 2002; Haak et al., 2011) and a proper alignment among the intended learning outcomes, the teaching and learning activities and the learning assessment (i.e., the grading scheme; Biggs, 1996) are common challenges that are inherently associated with course design. At least three features of our international agriculture course contributed to addressing these challenges. First, the course website was designed to provide students with a platform to engage with media-rich content before class, to

guide their preparation for in-class interactions and to demonstrate their continued engagement with post-class postings of reflection entries. Second, the complexity of the grading scale signaled to the students the importance of demonstrating their engagement with the material (in and out of class) and an emphasis on higher thinking skills rather than memorization. Third, active engagement in the classroom was addressed with individuals and group activities as preludes for classroom discussion, which can be a powerful mode of teaching and learning (Brookfield and Preskill, 2005).

The intensity of student-to-student interaction may have contributed to the important cohort effect observed in this study for the self-reported level of knowledge and worldviews on the last day of class as well as the learning gains and change in worldviews that occurred during the semester. As found here and elsewhere (Wattiaux and Crump, 2006), there are evidences for the importance of designing undergraduate classroom discussion relying in part on students' questions or thoughts on pre-assigned course material.

### Measuring Students' Gain in International Agriculture

Changes observed with a pretest and posttest administered 15 weeks apart should not be attributed solely to the course. For example, serendipitous changes in the views of some students may have occurred because of news events, personal experiences or other courses taken during the same semester. However, in this study the breakdown of the survey tool in two categories of items, one to measure self-reported level of knowledge and the other to measure students' worldviews was a critical step of this study. Data of Table 3 suggested that it is easier to bring about changes in students' perception of their learning gains (items 1.1 to 1.7) than to change in their worldviews (items 2.1 to 2.7). Coers et al. (2012) reported similar findings while evaluating the impact of three short-term international field programs. Another critical step of this study was the proper wording of each item such that applying the survey instrument as a pre-test the first day of class and a post-test the last day of class enabled us to capture any cumulative effects and the relative impact of each section of the course holistically. Also, this study offered a rare opportunity to explore the relative importance of a student's major, standing and cohort. Notwithstanding a certain degree of confounding among these factors, the relatively low impact of student standing in this study may be related to the novelty of the content and the absence of prerequisite. The frequency of significances and tendencies presented in Table 4 suggested also that the substantial influence of a student's major at the beginning of the



semester subsided as the semester progress. In contrast the cohort effect was a process that built over time as it had barely any impact at the beginning of the semester, but emerged as an importance influence on students' perception of their level of knowledge and worldviews at the end of the semester and their perceived learning gains and change in worldviews during the semester.

## **Summary**

This study provided a student-centered model of an elective course designed to engage students in understanding and evaluating critically livestock agriculture globally and the relationship between the dairy industries of the U.S. and Mexico. As shown in other studies our results suggested that a student's self-reported level of knowledge was more easily altered than their worldviews. A student's decision mid semester to attend a subsequent study abroad field program in Mexico had no effects on measured responses. At the beginning of the semester, dairy science and non-dairy science students had different worldviews, but these differences subsided over the course of the semester. In contrast differences among cohorts were not significant at the beginning of the semester, but grew significantly during the semester. Cohort became an important factor associated with students' self-reported level of learning and worldviews at the end of the semester as well as their perceived learning gains and changes in worldviews during the semester. Results of this study suggested that in a discussion-based classroom designed to engage diverse students in high-order thinking levels about international agricultural issues they initially know little about one should expect substantial year-to-year variation (i.e., cohort effect) in students' perception of their learning gains and change in worldviews.

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