Undergraduate Students' Knowledge of International Agricultural Issues by Academic Standing

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Abstract

Future agricultural professionals and scientists will be required to have broader perspectives and apply their technical knowledge to keep pace with global trends. The purpose of this study was to assess and compare United States (U.S.) and Latin American (L.A.) students' knowledge of international agricultural issues. A modified version of the International Agricultural Awareness and Understanding instrument by Wingenbach et al. (2003) and Hurst (2013) was used. Findings in this study were similar to previous studies indicating a continuing lack of knowledge regarding international agricultural issues among undergraduate students. Despite an overall increase in students' scores by their academic standing, from freshmen to seniors, only 3.5% of the population obtained a passing score. Findings from the ANOVA suggest scores from freshmen and sophomores are significantly different than the scores from juniors and seniors. Overall, accurate knowledge of international agricultural issues from Zamorano University students was significantly different than the scores from Texas Tech University students. The significant differences found in this study have small to medium Cohen's effect sizes (Kotrlik, Williams, & Jabor, 2011). It is recommended for future research to explore actions that may provide students with a global perspective and identify mechanisms that may reinforce students' knowledge of agriculture in an international context.

Introduction/Theoretical Framework

Globalization is a multi-faceted term used to describe the complex dynamics between countries or regions, which are shaped by the interaction of their economics, politics, culture, labor force, technology, and communications. Continuing globalization has increased competition between nations and enhanced their abilities to respond rapidly to the world's demands (Stromquist & Monkman, 2014).

Trends in globalization, along with global issues such as food security, sustainability, and sociopolitical stability have intertwined, becoming solutions and problems simultaneously (Whigham & Acker, 2003). Agriculture may be considered one of the biggest contributors to these challenges, yet agriculturalists can play an important role in the development of agricultural solutions to problems worldwide and contribute significantly to the improvement of global food security, environmental sustainability, and poverty reduction (Acker, 1999; Christiaensen, Demery, & Kuh, 2011; McIntyre, Herren, Wakhungu, & Watson, 2009). The 2016 -2020 National Research Agenda of the American Association for Agricultural Education (AAAE) suggested future agriculturists should be able to perform in a global setting as needed. For that reason, academic institutions should be able to provide students with an internationally infused curriculum to enhance their college preparation (Stripling & Ricketts, 2016). These perspectives are highlighted in the AAAE's third research priority "the demand for a sufficient scientific and professional workforce to address the challenges of the 21st century" (Stripling & Ricketts, 2016, p. 29).

In this context, formal education has become an important symbol of a nation's ability to compete. Formal education has transformed from child-centered to work skills preparation and ultimately is becoming the pathway to competitiveness (Stromquist & Monkman, 2014). Formal education, along with current pressing world issues, have led countries, business leaders, and educators to discuss the need for schools to prepare students for international work. In addition, there is a need to include students' abilities to address diversity and agriculture-related issues (Spring, 2008; Olson, Evans, & Shoenberg, 2007; Whigham & Acker, 2003), as students may potentially fill work positions worldwide that require international knowledge and awareness (Anthony, Bederman, & Yarrish, 2013). The terms of internationalization and globalization of education tend to be used interchangeably (Altbach, 2004); however, globalization of education refers to the global trends influencing educational programs worldwide, while internationalization of education refers to countries' educational policies designed to keep pace with other countries (Altbach, 2015). Internationalization of higher education became prominent after World War II (Olson et al., 2007) and has continued to evolve ever since (Bonfiglio, 1999; Olson et al., 2007).

The U.S. hosts the majority of international students and in doing so, fosters a cross-cultural education for their students. Yet, there is a nationwide lack of consistency of actions by institutions to intentionally internationalize U.S. students (Altbach, 2015). The Latin American (L.A.) educational system faces similar challenges when it comes to preparing students for a global context (Torres & Schugurensky, 2002). However, L.A. countries face the additional challenge of access to resources used to conduct research coupled with abilities to provide job opportunities (De Wit, 2005). Agricultural departments in L.A. universities started in the mid-1850s similar to the U.S., yet have not seen equivalent growth when compared to their U.S. counterparts. Initially, this discrepancy was assumed to be the result of the separation of higher education and extension programs, social unrest at national and local levels, lack of availability of funds, and insufficient faculty (Rio, 1964). Currently, a greater emphasis is being placed on higher education in L.A., but the region continues to lag behind developed countries. Challenges in the region continue to be similar as in 1964, focusing on the out-of-date curriculum, teaching materials, insufficient faculty, and how to introduce graduates into the professional market (Holm-Nielsen, Thorn, Brunner, & Balán, 2005).

Over the years, efforts have been made to infuse international dimensions into the students' curriculum. These efforts include firsthand international experiences, which have been considered an important element in the students' education (Coers, Rodriguez, Roberts, Emerson, & Barrick, 2012). However, only one percent of students majoring in agricultural sciences participated in study abroad programs during the 2011-2012 academic year (Institute of International Education, 2014); therefore, other ways to internationalize students' agricultural sciences curriculum should be explored (Wingham, Acker, 2003). Olson et al. (2007) suggested academic institutions should employ educators who understand current global trends and world implications to effectively teach students the complex interactions of globalization and its impacts. Over the past 15 years, researchers have assessed college students' knowledge of international agricultural issues and their awareness. Results have consistently found a lack of knowledge among students (Hurst & Roberts, 2013; Radhakrishna & Dominguez, 1999; Wingenbach et al., 2003).

This study was based on the Theory of Planned Behavior (Ajzen, 1985) and supported by the Human Capital Theory, initially developed by Adam Smith in his book *The Wealth of Nations* in 1776. It was later applied to education by Schultz in 1961 and Becker in 1962 (Sweetland, 1996). The Theory of Planned Behavior explains "individuals' intention to perform a given behavior; intentions are assumed to capture the motivational factors that influence behavior" (Ajzen, 1985, p. 181). According to Ajzen (2006), behavior is guided by three considerations: behavioral beliefs, normative beliefs, and control beliefs. In this study, we focused on the students' knowledge of international agricultural issues as part of their control beliefs, which refers to the "beliefs about the presence of factors that may facilitate or impede performance of the behavior and the perceived power of these factors" (Ajzen, 2006, p. 1). The application of the Theory of Human Capital lies in the hypothesis that "[the] pursuit of education leads to individual and national economic growth" (Sweetland, 1996, p. 356). Moriba (2011) proposed, if investments in education are done for the purpose of advancing a nation's economy, then we might assume investments in internationalized education are done with the purpose of helping a nation keep up with a globalized world.

Purpose and Objectives

The purpose of this research study was to assess and compare U.S. and L.A. students' knowledge of international agricultural issues. The following objectives guided this study:

1. Describe students enrolled in agricultural sciences at TTU and ZU.
2. Assess students' knowledge of international agricultural issues at TTU and ZU.
3. Determine if there is a significant difference in students' overall knowledge of international agricultural issues by academic institution.
4. Determine if there is a significant difference in students' knowledge of international agricultural issues by academic standing.

Methods/Procedures

The study design was causal-comparative, which is used to identify cause and effect relationships with the critical feature of an independent categorical variable (Gall, Gall, & Borg, 2007). The target populations were undergraduate students enrolled in agricultural sciences at TTU and ZU. A non-probabilistic convenience oversample of students in classes with large numbers of enrollment was taken at both academic institutions. We used this procedure to minimize sampling error by maximizing participant response rate. Findings by Sax, Gilmartin, and Bryant (2003) highlighted low response rates among college students in paper-only instruments and web surveys. Therefore, we oversampled the population following the guidelines by Bartlett, Kotrlik, and Higgins (2001). General data collection procedures were established to maintain consistency between groups. A total of 1,300 students volunteered to complete the instrument. Instruments with less than 90% completion were considered invalid and were eliminated. Students who opted not to participate in this research study were considered non-respondents, based on enrollment records at both academic institutions. Students in more than one class were considered duplicates and were asked not to complete the instrument more than a single time. An overall response rate of 90% was obtained. No control for non-response error was followed in this study, as participants were part of a convenience sample with

no way to contact the non-respondents given IRB constraints and lack of identifiers on the instrument.

In order to evaluate students' knowledge of international agricultural issues, the researcher used a modified version of the International Agricultural Awareness and Understanding instrument by Wingenbach et al. (2003) and Hurst (2013). The original instrument consisted of three sections assessing knowledge, attitudes and beliefs of international agricultural issues. The knowledge section of the instrument consisted of "20 multiple-choice, knowledge questions related to international agricultural policies, products, peoples, and culture" (Wingenbach, 2003, p. 27). Questions which were determined to be no longer relevant were replaced with others addressing issues highlighted by the Food and Agriculture Organization of the United Nations (FAO) in 2014, in the post-2015 development agenda and the Millennium Development Goals (MDG). A comprehensive literature review was conducted to find the most accurate and current information per question selected. A panel of experts from TTU and Texas A&M evaluated the final instrument for face and content validity. A demographic section was included consisting of students' gender, academic standing, major, ethnic background, international experiences and language proficiency. The final instrument was originally developed in English and translated into Spanish by a Spanish-speaking student with a background in agriculture.

The descriptive statistics of central tendency and variability were used to describe and assess students in terms of their demographic characteristics and knowledge of international agricultural issues. An independent t-test was used to determine if there was a significant difference between students' overall knowledge scores based on their institution of enrollment. The null hypothesis stated there would be no difference in the participants' knowledge scores relating to international agricultural issues (H_o: $\mu_1 = \mu_2$). An ANOVA was conducted to evaluate mean differences between students' knowledge scores by academic standings. The null hypothesis stated there would be no significant difference in the participants' knowledge of international agricultural issues based on their academic standing (H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). An alpha level of .05 was established *a priori* for significance.

Results/Findings

Research objective one sought to describe students' demographic characteristics. A total of 1,218 students completed the instrument, 612 (50.2%) from TTU and 606 (49.8%) from ZU. Overall, the majority of the participants were males (53.8%). At TTU the majority were females (56.8%) and at ZU the majority were male (64.6%).

In terms of academic standing, the largest group of respondents classified themselves as freshman (n = 356), followed by sophomores (n = 324), juniors (n = 261), and seniors (n = 255). Freshman students were the majority at TTU (n = 214), but at ZU seniors were the majority (n = 195). Twenty-two of the participants did not specify their academic standing. Table 1 summarizes students' academic standing by academic institution.

Table 1
Summary of Students' Academic Standing

Characteristic	Total (n = 1196)		TTU (n^a =604)		ZU (n^b = 592)	
	f	%	*f*	%	*f*	%
Freshman	356	29.8	214	35.4	142	24.0
Sophomore	324	27.1	180	29.8	144	24.0
Junior	261	21.8	150	24.8	111	18.8
Senior	255	21.3	60	9.9	195	32.9

Note. [a] sample of participating students at TTU. [b] sample of participating students at ZU.

Research objective two assessed the students' knowledge of international agricultural issues. Students answered 20 multiple-choice items. Results were coded as correct and incorrect with a binary code of 1 and 0, respectively. Therefore, the sum of correct answers resulted in the overall knowledge of international agricultural issues score based on 20 possible points.

Overall, the majority of the students (90.4%) responded correctly to the item "the _____ desert is the world's largest hot desert". While, the question receiving the most incorrect answers was: "Although large areas of land are brought into cultivation throughout the world each year, large amounts are also rendered useless or are reduced in productive capacity because of the following reason". Only 5% answered this question correctly. These two questions were the most correct and incorrect answered items at both academic institutions. See Table 2 for a summary of students' knowledge of international agricultural issues per question.

Table 2

Summary of Students' Knowledge of International Agricultural Issues

Question	Correct Answer	Total (n = 1218) %	TTU (n^a = 612) %	ZU (n^b = 606) %
11. The ___ desert is the world's largest hot desert.	Sahara	90.4	86.9	93.9
2. What is the primary household fuel in lower income groups in Latin America?	Wood	72.2	58.8	85.6
6. Which of the following languages are the four most spoken languages worldwide?	Chinese, English, Hindi, Spanish	56.4	64.1	48.7
8. These countries are part of the European Union?	France, Ireland, Italy, Sweden	47.0	42.2	52.0
19. Worldwide population will be approximately ____ billions by 2050	9	46.9	45.3	48.5
12. What country produces the largest volume of swine?	China	46.2	40.7	51.8
20. Which of the following food nutrients is most lacking in the diets of the world's population?	Proteins	41.9	43.1	40.6
7. In what part of the world are you most likely to find a hand-dug underground irrigation system called a ghanat (quanat) that may extend for many miles from the mountains to fields out to the plains?	Middle East	39.9	26.5	53.5
14. Considering developing and developed countries, the projection of the world population for the year 2050 shows that the largest segment will be in:	Asia and Oceania	38.1	46.1	30.0
18. Worldwide food production need to increase at least___% to meet global food demand in 2050	60	36.7	37.7	35.6
15. Which country is the largest producer of tea?	China	36.5	29.2	43.7
17. The economic strength of a country can be measured by	Gross national product (GNP)	35.1	24.5	45.9

Table 2 continued

Question	Correct Answer	Total (n = 1218) %	TTU (n^a = 612) %	ZU (n^b= 606) %
13. Which cereal grain is the basic food for more than half of the world's population?	Rice	34.7	45.3	24.1
5. Which means of communication currently reaches the largest number of people throughout the world?	Radio	32.6	38.7	26.4
1. Who carries out most of the field work on an African farm?	Women	30.9	37.1	24.6
16. In East Africa, it is expected that everyone will____ upon greeting each other at a meeting, and upon departure from meetings.	shake hands	19.5	13.2	25.9
3. As of 2013, what percentage of the world population suffers from chronic hunger?	12%	18.4	14.9	21.9
4. Which of the following is the major reason why more countries in Asia, Africa, and Latin America have become net food importers in the last 50 years?	A production shift from food to cash crops earns money to offset trade imbalances	14.4	12.3	16.5
10. Which food sector uses a greater variety of biological diversity?	Capture fisheries	13.5	10.3	16.7
9. Although large areas of land are brought into cultivation throughout the world each year, large amounts are also rendered useless or are reduced in productive capacity because of the following reasons:	lack of sufficient farm labor	5.0	6.7	3.3

Note. [a] sample of participating students at TTU. [b] sample of participating students at ZU.

Overall, students' mean score of correct answers was 7.6 (*SD* = 2.1) with a median and mode score of 7 (*Mdn* = 7, Mode = 7). ZU students' knowledge mean score was higher (*M* = 7.9; *SD* = 2.0) than TTU students' score (*M* = 7.2; *SD* = 2.2). See Table 3.

Table 3
*Summary of Students' Knowledge of International Agricultural Issues Scores (*N *= 1218)*

Population	*n*	*M*[a]	*Mdn*[a]	*SD*	*Range*
Overall Knowledge Score		7.6	7	2.1	14
TTU	612	7.2	7	2.2	14
ZU	606	7.9	8	2.0	12

Note. [a] total knowledge score on a scale of 0 to 20

Overall, senior students' obtained the highest mean score (*M* = 7.95, *SD* = 2.11), followed by juniors (*M* = 7.93, *SD* = 2.19), sophomores (*M* = 7.48, *SD* = 2.14), and freshmen (*M* = 7.10, *SD* = 2.03). Similar to the overall results, TTU students' highest mean score was obtained by seniors (*M* = 7.58, *SD* = 2.20), whereas junior students at ZU gained the highest mean score (*M* = 8.77, *SD* = 2.07). See Table 4.

Table 4
Summary of Students' Knowledge of International Agricultural Issues by Academic Standing

Characteristic	Total (*n* = 1196)		TTU (n^a =593)		ZU (n^b = 586)	
	M[c]	*SD*	*M*[c]	*SD*	*M*[c]	*SD*
Freshman	7.10	2.03	7.12	2.24	7.06	1.69
Sophomore	7.48	2.14	7.18	2.15	7.85	2.08
Junior	7.93	2.19	7.32	2.25	8.77	2.07
Senior	7.95	2.10	7.58	2.20	8.06	2.02

Note. [a] sample of participating students at TTU. [b] sample of participating students at ZU. [c] total knowledge score on a scale of 0 to 20.

Research objective three focused on determining if there was a significant difference in students' overall knowledge of international agricultural issues by academic institution. An independent *t*-test was used to assess the statistical significance in the students' knowledge of international agricultural issues scores based on their academic institution of enrollment. The null hypothesis stated there would be no difference in the students' knowledge of international agricultural issues (H_o: $\mu_1 = \mu_2$). The alpha level was set at .05 *a priori.* Levene's test for equality of variances was significant (*p* = .03), therefore, the corrected *t*-test was used. This corrected independent *t*-test reported a *t*-value of -5.46 (*p* = .01), therefore the null hypothesis was rejected in favor of the research hypothesis stating that, in the population, there was a significant difference in the participants' knowledge of international agricultural issues depending on where they were enrolled (H_o:$\mu_1 \neq \mu_2$). Cohen's *d* effect size value (*d* = .33) suggest a medium effect size (Kotrlik, Williams, & Jabor, 2011). Table 5 displays the obtained results.

Table 5

*Independent t-test for Students' Knowledge of International Agricultural Issues (*n = *1196)*

Characteristic	*t*	*df*	*p*	*d*
Knowledge	-5.46	1207.62	.01*	.33

* $p < .05$

Research objective four sought to determine if there was a significant difference in the students' overall knowledge of international agricultural issues by academic standing. A one-way ANOVA was conducted to compare the mean scores of students' knowledge based on their academic standing. The independent variable had four levels based on the students' academic standing: freshman, sophomore, junior, and senior. The dependent variable was the students' knowledge score. The null hypothesis stated there would be no significant difference in the students' knowledge of international agricultural issues by academic standing (H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). The alpha level was set at .05 *a priori*. Based on the findings, the null hypothesis was rejected in favor of the research hypothesis, suggesting there was a significant difference in students' knowledge by academic standing, $F_{(3, 1192)} = 11.49$, $p < .05$. Cohen's *d* effect size value ($d = .17$) suggest a small effect size (Kotrlik et al., 2011). See Table 6. A post hoc analysis was conducted to evaluate differences among the means. The assumption of homogeneity of variance was met $F_{(3, 1192)} = 1.32$, $p = .27$. A Tukey HSD test indicated that freshmen and sophomores are significantly different ($p < .05$) than juniors and seniors.

Table 6

*One-way Analysis of Variance of Students' Knowledge Scores by Academic Standing (*n = *1196)*

Source	*df*	*SS*	*MS*	*F*	*p*	*d*
Between groups	3	154.04	51.35	11.49	.01*	.17
Within groups	1192	5325.87	4.47			
Total	1195	5479.91				

* $p < .05$

An ANOVA was conducted to assess if there was a significant difference in the students' academic standing by academic institution. In the case of TTU, no significant difference was found among the students' academic standing (H_o: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). In the case of ZU, the results indicate there was a significant difference between students' academic standing, $F_{(3, 588)} = 16.80$, $p < .05$). Cohen's *d* effect size value ($f = .29$) suggest a small to medium effect size (Kotrlik et al., 2011). The Levene's test for homogeneity of variance indicated a significant difference, therefore, based upon the recommendations by Field (2005), the Dunnett's T3 test was used due to its tight control over Type I error. The results confirmed freshmen, juniors and seniors were similar, and significantly different than juniors (H_o: $(\mu_1 = \mu_2 = \mu_4) \neq \mu_3$). See Table 7.

Table 7
One-way Analysis of Variance of ZU Students' Knowledge Scores by Academic Standing (n^a = *592)*

Source	*df*	*SS*	*MS*	*F*	*p*	*d*
Between groups	3	189.66	63.22	16.80	.01*	.29
Within groups	588	2212.66	3.76			
Total	591	2402.32				

Note. [a] sample of participating students at ZU. * $p < .05$

Conclusions/Recommendations/Implications

The results obtained in this study should be taken with caution and should not be generalized to other populations as non-random assignment procedures were used. In addition, data fell outside the bounds of normality, appearing to be positively skewed; the researchers considered this within the parameters of the study design and results were acceptable. These results describe well TTU and ZU students.

Knowledge of international agricultural issues continues to be deficient among students. Only 3.6% of the total population obtained a passing score above 60% as was identified by Wingenbach et al. (2003), 3.5% at TTU and 3.7% at ZU. The overall mean score was 7.6, indicating the average number of correctly answered questions out of the 20 knowledge items on the instrument. These low scores on knowledge items are consistent with previous studies. Hurst (2013) found low mean scores in her study; on average 8 items were correctly answered out of 20, and only 6.5% of her participants obtained a passing score. While, Wingenbach et al. (2003) found only 5% of the students obtained a passing score after taking an international agriculture course.

Freshman students' knowledge mean score at both academic intuitions were fairly similar (TTU = 7.12; ZU = 7.06). A statistically significantly increase in correct answers was observed at both academic institutions, based on the students' academic standing. Overall, these results suggests freshmen and sophomore students are similar, while junior and seniors are similar. Junior and Senior students have been in school for a longer period time, expose to more coursework and international infusion compared to freshman and sophomore students. These two groups were significantly different but still, a low proportion of students' obtained a passing score. Students' means scores by academic standing were between 7 and 8 points out of 20 in both academic institutions. These are below the passing score and imply a lack of understanding of international agricultural issues. In addition, due to nature of this study – convenience sample – the proportion of students at each academic institution and at each grade level was not equivalent, therefore differences in knowledge observed may have been influenced by the proportion of students.

Wingenbach et al. (2003) suggested students may not be able to connect the course information and media to the instrument, consequently accounting for the obtained results. This can possibly be the case in this study as well. The lack of knowledge may be disadvantageous for students entering a labor force that demands skillful employees, able to apply their technical

knowledge and to be internationally proficient. Olson et al. (2007) suggested that "students' should be able to think, work, and operate across boundaries" (2007, p. 14). Students' lacking knowledge may interfere with their ability to engage in a global context if entering the professional world immediately. This lack of knowledge, specifically in terms of international agriculture, is not uncommon among U.S. students as was concluded by Wingenbach et al. (2003).

Both academic institutions should provide students with the needed knowledge of international agricultural issues by further internationalizing their curriculums to effectively engage students in an understanding of global issues and their implications to the world. The internationalization of the higher education curriculum goes beyond the commercialization of education as a commodity and beyond the curriculum (Olson et al., 2007). It involves faculty engaging with the world (Whigham & Ackers, 2003), developing partnerships to conduct research and encourage educational opportunities for students and faculty, as well as the potential recruitment of international students and faculty to foster a multicultural environment on campuses around the globe (Altbach & Knight, 2007; Olson et al., 2007; Whigham & Ackers, 2003). The internationalization and globalization of education will remain as a central force in future years and will most likely be affected by multiple factors such as, the global political realities, policy, cost of study, domestic capacity, expansion of the English language, e-learning initiatives, private sector, quality assurance, and the internationalization of curriculum itself (Altbach, 2015; Altbach & Knight, 2007). It is recommended to further explore students' knowledge of international agricultural issues by identifying courses with international dimensions that may expand students' knowledge to an international context, as well as other factors that may potentially influence their understanding, such as study abroad programs. This can potentially position graduates as skillful and competitive employees in a constantly evolving world.

In addition, further research is needed to identify the most appropriate instrumentation to measure accurate knowledge of international agricultural issues held by students. The reliability analyses conducted to assess the instrument internal consistency in the pilot test and at post-hoc found were negligible (KR-20 = .23; KR-20 = .14). Frisbie (1988) indicates low reliability coefficients found in knowledge instruments can be attributed to the independence of items explored in the instrumentation. Furthermore, he suggested to researchers obtaining low reliability coefficients to not use results with confidence to make conclusions. However, it is important to highlight findings by previous researchers whom have also analyzed reliability, finding low coefficients on knowledge tests (Hurst, 2013), as well as others that have opted not to reported reliability analyses (Wingenbach et al., 2003).

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