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<https://doi.org/10.5191/jiaee.2021.28449>

Cultural Differences in Critical Thinking Style: A Comparison of U. S. and Chinese Undergraduate Agricultural Students

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Abstract

This study aimed to compare critical thinking styles between students studying agriculture in the U.S. and China. A survey of critical thinking styles was administered to two groups of students in U.S. (n = 104) and China (n = 103). Multivariate analysis of variance (MANOVA) was applied to determine if there were significant differences in critical thinking styles between the two groups. Results indicate that U.S. students tended to prefer an engaging critical thinking style, whereas Chinese students tended to prefer an information seeking critical thinking style. These differences between critical thinking style preferences may be explained by students' cultural backgrounds. This study can help agricultural educators understand the differences in critical thinking style preferences among culturally-diverse students. Further, it provides empirical evidence to guide agricultural educators seeking to adopt effective pedagogical approaches to cultivate critical thinking among students from diverse cultural backgrounds. This study provides fresh insight into the individualism and collectivism theory by explaining the cross-cultural differences in critical thinking style between U.S. and Chinese agricultural students.

Keywords: agricultural education, critical thinking style, international agricultural student, cross-cultural

Acknowledgement: This study was supported by the Texas Tech University Graduate School Student Research Support Awards.

Introduction

Critical thinking has been identified as one of the most important attributes of students' success in an era of globalization (Dwyer et al., 2014; Jackson, 2010). Previous research has presented evidence of the crucial role of critical thinking and its contribution to the quality of the education system in many disciplines (Halpern, 2014; Paul & Binker, 1990). Agriculture is a discipline with specific and unique challenges arising from many complicated and controversial issues with global impact, such as food insecurity, water conservation, biotechnology and climate change (United States Department of Agriculture – National Institute of Food and Agriculture, 2014). Considering the significance of the issues pertaining to global sustainable agricultural development, agricultural students around the world should learn to think critically to weigh evidence, make sound decisions, and solve real-world issues (Berkley, 1995; Egege & Kutieleh, 2004; Perry et al., 2014; Telg & Irani, 2005).

Countries worldwide emphasize the need to improve the quality of their education systems to prepare their citizens for the rapidly changing society (Ennis, 2018; Kitot et al., 2010; Pithers & Soden, 2000). The U.S. has been attracting many international students to pursue higher education (Institute of International Education, 2019). Chinese students constitute a great portion, accounting for 33% of all international students in the U.S. (Institute of International Education, 2019). However, cultural differences between the U.S. and China create challenges for Chinese international students' academic adjustments (Andrade, 2006; Senyshyn et al., 2000). One of the difficulties that Chinese students have encountered stems from different cognitive styles (Han, 2007; Jin & Cortazzi, 2006). Previous researchers argued that cultural differences could explain Chinese international students' relatively lower levels of engagement in higher-order cognitive styles (Chue & Nie, 2016; Purdie & Hattie, 1996).

The different cultures also proposed challenges for higher educational professionals to cultivate critical thinking in students with different cultural backgrounds (Lee & Rice, 2007; Lun et al., 2010; Tan, 2017). For example, a study conducted by Biemans and Van Mil (2008) at a Dutch agricultural university concluded that the learning strategies Chinese students developed in their home country did not fit the Dutch educational system and caused Chinese students to struggle academically. Biemans and Van Mil (2008) emphasized the importance of understanding students' culture to help them enhance their learning performance in the classroom. In addition, the Chronicle of Higher Education and the New York Times have been urging higher education institutions to address the academic difficulties faced by Chinese international students studying in the U.S. (Bartlett & Fischer, 2011). Thus, a deeper understanding of how individuals from different cultural backgrounds think could help educators develop appropriate teaching strategies that may correspond better to students' thinking styles, and then to improve their higher-level cognitive engagement (Biemans & Van Mil, 2008). The present study aims to identify to what extent the critical thinking styles of U.S. agricultural students differ from the critical thinking styles of Chinese agricultural students.

Conceptual Framework

Culture Differences

Hofstede and Bond (1988) describe culture as 'the collective programming of the mind that distinguishes the members of one category of people from those of another (p. 6)'. According to Hofstede's (2001) cultural dimension theory, people from different countries and

groups have different cultures, which is developed during early childhood and shaped in schools and organizations. The collective programming of the mind consists of individuals' basic psychological processes reflect their cultures or country of origin, such as antecedents to behaviors (Segall, 1986; Hofstede, 1984, 1990, 2001). The internationalization of higher education in the U.S. has increased cultural diversity in U.S. colleges and universities (Nieto, 2015; Wang & Machado, 2015). However, the paradigm shift from the Chinese educational system to the U.S. educational system generates academic challenges for Chinese international students (Wan, 2001; Zhang & Xu, 2007a, Zhang & Xu, 2007b).

Analytic cognitive style vs Holistic cognitive style

Western cultures, shared by European countries and Americans, and East Asian cultures (e.g., China, Japan, Korea) are two of the most contrasting cultures in the world (Mote, 2003). Previous cross-cultural psychological research indicated that the two contrasting cultures lead to different cognitive styles (Nisbett & Masuda, 2003; Nisbett et al., 2001). Western cultures emphasize analytic cognitive style, whereas East Asian cultures emphasize holistic cognitive styles (Choi et al., 1999; Peng & Nisbett, 1999). People possessing an analytic cognitive style are concerned with the validity and soundness of an argument. They tend to use logical evaluation or rules to detect or reject invalid arguments (Nisbett et al., 2001). An analytic cognitive style also focuses on breaking ideas down and evaluating the components individually to simplify problem solving (de Oliveira & Nisbett, 2017). People with a holistic cognitive style, on the other hand, focus on broader background and contextual information while they go through the problem-solving process. A holistic cognitive style integrates of multiple perspectives to generate an individuals' own perceptions (Peng & Nisbett, 1999). In addition, people with a holistic cognitive style are more likely to accept the coexistence of opposites, and they are much more open to the values and perspectives held by others (Littlewood, 2000; Liu, 2001; Peng & Nisbett, 1999; Nisbett et al., 2001).

Individualism vs collectivism

Cross-culture psychological researchers explained the different cognitive styles through the constructs of individualism and collectivism (Hofstede, 1984; Wang & Machado, 2015). Hofsted (1980) found that people raised in Western developed countries (e.g., the U.S., Canada) have high levels of individualism, whereas people from East Asian countries (e.g., China, Thailand) have high levels of collectivism. Individualism values self-expression and freedom. In contrast, collectivism values harmony and relationships. People seek to maintain group harmony to avoid contradictions (Wang & Machado, 2015). Results from studies pertaining to the Chinese educational system indicated that Chinese students were less encouraged to question teachers' authority (Coleman, 1996; Li, 2012; Zhou, 2018). Also, Chinese students perceive the critique of peers' ideas or scholarly articles as disruptions of group relationship and harmony (Carson & Nelson, 1996). In addition, Chinese students have been described as being quiet in classroom (Olaussen, 1999; Paton, 2005), and class debates in Chinese classroom environments might be viewed as hurtful to others (Durkin, 2008; Tan, 2017). Furthermore, researchers reported that Chinese students generally lack critical thinking skills compared to students from Western countries (Ip et al., 2000; McBride et al., 2002; Salsali et al., 2013; Tiwari et al., 2003).

In contrast, the classroom environment in the U.S. encourages critical thinking, arguments, and debates (Hamp-Lyons, 1991; Eckstein, et al. 2003; Li, 2012; Nisbett et al., 2011). Researchers also found that people in individualistic cultures exhibited greater self-assurance than those in collectivistic cultures (Markus & Kitayama, 1991; Tafarodi & Swann, 1996; Triandis, 1994). For example, Duncan et al. (2016) found that U.S. students actively engaged in

classroom activities, expressed their opinions, and exchanged ideas freely. Similarly, Wan (2001) found U.S. students were able to confidently communicate their thoughts and ideas by interacting with instructors and peers.

Critical Thinking Style Inventory

Critical thinking style ‘describes the way an individual goes about thinking and reaching solutions to a problem (Lamm, 2015a, p. 1)’. Lamm and Irani (2001) developed University of Florida Critical Thinking Inventory (UFCTI) that measures critical thinking styles (Lamm, 2015b). The critical thinking style inventory distinguishes the approach that an individual uses to gather or process information through a continuum between engagement and seeking information (Lamm & Irani, 2011). Each critical thinker has an individual style of processing information regarding a specific issue (Lamm & Irani, 2011). Individuals who have the engaging critical thinking style are called engagers, and individuals who have the seeking information critical thinking style are called seekers. There is no right or wrong critical thinking style. An ideal critical thinker would be able to utilize both critical thinking styles when appropriate instead of operating only in one specific style (Lamm & Irani, 2011).

Engagers confidently communicate their thinking processes with others, or actively show their ability to use reasoning to solve problems when making decisions (e.g., I am confident that I can reach a reasonable conclusion; I present issues in a clear and precise manner) (Lamm, 2015b). Engagers are also aware of their surroundings and anticipate situations to use reasoning skills and research solutions (Lamm, 2015b). Verbal communications and conversations are the preferred approach to gain information for engagers (Lamm, 2015b). Seekers, on the other hand, are open to others’ opinions, even if the opinions contradict their own opinions or beliefs (e.g., I can get along with people who do not share my opinions) (Lamm, 2015b). Seekers actively seek out information or sources by reading and research. They also consistently look for information to improve their knowledge level (e.g., I will go out of way to find the right answers to a problem) (Lamm & Irani, 2011; Lamm, 2015b).

Purpose and Objectives

The purpose of this study was to explore to what extent do the critical thinking styles of U.S. students differ from the critical thinking styles of the Chinese students. The research question of this study was to determine if critical thinking style significantly differed between U.S. and Chinese agricultural students. The hypotheses were:

H₀: Students from the U.S. and China have the same critical thinking style (information seeking, engagement).

H_a: Students from the U.S. and China do not have the same critical thinking style (information seeking, engagement).

Methods

Population and sample

The population of this study was undergraduate students majoring in agriculture in the U.S. and China. Two convenience samples of undergraduate students from Hebei Agricultural University in China and Texas Tech University in the U.S. were included. The data was collected through an online administration method. To recruit participants in the U.S., the lead researcher attended five face-to-face courses and explained the purpose of the study to students in person. Once students agreed to take the survey, the researcher distributed a QR code, which directed them to the Qualtrics survey containing the UFCTI. To recruit participants in China, an email

containing a link to the Qualtrics survey was sent to one instructor who explained the purpose of the research to students enrolled in face-to-face courses. Once students agreed to take the survey, the instructor forwarded them the email containing the link to the Qualtrics survey. The UFCTI is accessed through access codes purchased by the researcher. Each access code allows a participant one-time access to the UFCTI. Therefore, the researcher stopped collecting data when all the access codes were used. As a result, the target sample size was reached.

The Chinese sample included Chinese citizens who have been studying in China to ensure their critical thinking styles have not been changed significantly by exposure to other cultures. A total of 207 ($N = 207$) students completed the questionnaire. The U.S. sample consisted of 104 ($n = 104$) students and the Chinese sample included 103 students ($n = 103$). The U.S. students were 64.4% female ($n = 67$) and 35.6% male ($n = 37$). The majority of the U.S. students were between 20 and 25 years old ($n = 73, 70.2\%$). The majority of Chinese students were male ($n = 69, 67\%$) and between 20-25 years old ($n = 85, 82.5\%$).

Instrument

The UFCTI was used to measure participants' critical thinking style. The UFCTI has been established for 10 years, and it has sound psychometric properties (Lamm & Irani, 2011). Previous studies been applied UFCTI in the context of integrating critical thinking into agricultural education and extension programs, such as assessing the critical thinking styles of greenhouse growers (Lamm et al., 2019), opinion leaders (Putnam et al., 2017), and international faculties (Barrick & DiBenedetto, 2019). The UFCTI consists of 20 statements assessing individuals' preferences for critical thinking styles on a five-point Likert-type scale, with 1 representing "strongly disagree" and 5 representing "strongly agree".

Two constructs (seeking information, engagement) were underlying the UFCTI to measure critical thinking style. Thirteen questions were designed to measure the construct of seeking information, and seven items were used to measure engagement (Lamm & Irani, 2011). Seeking information score was created by summing 13 items, and engagement score was created by summing 7 items. The engagement score was transposed and multiplied by 1.866 to balance the amount between the two constructs (Leal et al., 2017; Putnam et al., 2017). The UFCTI overall score was calculated by seeker score and transposed engagement score. Students with scores 79 or higher were identified as seekers, and those with 78 or lower were identified as engagers (Lamm & Irani, 2011).

To accommodate the Chinese students who may have a lower proficiency in English, the UFCTI was translated from English to Chinese by six Chinese bilingual educators. A two-factor confirmatory factor analysis provided an adequate model fit for the Chinese version UFCTI (comparative fit index (CFI) = .95, Tucker–Lewis index (TLI) = .94, Root Mean Square Error of Approximation ($RMSEA$) = .05) (Baker et al., 2021). In this study, the two constructs indicated good internal consistency for both the English version and Chinese version. The Cronbach's alpha for the engagement construct in the Chinese version was .84, the Cronbach's alpha for the seeking information construct was .92, and the overall reliability of the UFCTI Chinese version was .92. The Cronbach's alpha for the engagement construct in the English version was .76, the Cronbach's alpha for the seeking construct was .84, and the Cronbach's alpha for the overall UFCTI English version was .89 (Baker et al., 2021).

Data analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics was used to describe the demographic characteristics of the two groups of students. A multivariate analysis of variance (MANOVA) can be used to test the

significance of group differences with more than one dependent variable (Field, 2018; Mertler & Reinhart, 2016; Tabachnick & Fidell, 2019). In this study, MANOVA was used to determine the significant differences in critical thinking styles between students from the U.S and China. The independent variables were the students' country of origin (coded as 0 = U.S. and 1 = China). The dependent variables were the two constructs (engagement and seeking information) of critical thinking style measured by the UFCTI.

Results

Each student was assigned an overall score after completing the UFCTI inventory. The overall critical thinking style scores of the U.S. students ranged from 64.71 to 89.57 with a mean score of 77.87 ($SD = 5.05$), indicating that U.S. students tended to be engagers. The mean score of the engagement style construct was 52.26 ($SD = 6.25$), and the mean score of the seeking information construct was 28.21 ($SD = 3.55$). The overall critical thinking style scores of the Chinese students ranged from 68.43 to 93.14 with a mean score of 80.86 ($SD = 4.96$), indicating the Chinese students tended to be seekers. The mean score of the engagement style construct was 45.97 ($SD = 10.19$), and the mean score of the seeking information construct was 23.31 ($SD = 5.30$). Table 1 displays the critical thinking style scores for the U.S. and Chinese students.

Table 1

The U.S. and Chinese agriculture undergraduate students' critical thinking style (N = 207)

Variables	<i>n</i>	<i>M</i>	<i>SD</i>
U.S. student			
Seeking information	104	28.21	3.55
Engagement	104	52.26	6.25
Overall score	104	77.87	5.05
Chinese student			
Seeking information	103	23.31	5.30
Engagement	103	45.97	10.19
Overall score	103	80.67	4.96

MANOVA was used to test the null hypothesis. Prior to conducting the analysis, data were screened for missing data and outliers. The assumptions of normality, homogeneity, and multicollinearity were also evaluated before analysis. Skewness and kurtosis were used to assess the normality. Box's M test was used to examine the assumption of homogeneity of covariance matrices. An insignificant Box's M value meets the assumption (Field, 2018; Mertler & Reinhart, 2016; Tabachnick & Fidell, 2019). In this study, the Box's M test, $p = 0.11$, revealed no statistically significant violation of the assumption.

Four statistical tests are generated from MANOVA to evaluate group differences on the dependent variable: Pillai's Trace, Wilks's λ , Hotelling's Trace and Roy's Largest Root (Table 2) (Field, 2018; Mertler & Reinhart, 2016; Tabachnick & Fidell, 2019). Wilks's λ is the most commonly reported statistic if the assumption of homogeneity of covariance matrices is met (Mertler & Reinhart, 2016). A significance level of $p \leq .05$ was established *a priori* for MANOVA. Cohen's (2013) criteria was used to interpret the effect size (partial eta squared). The Wilks's λ statistics test revealed a significant difference of the mean scores in critical thinking style between the U.S. and the Chinese students (Wilks's $\lambda = .83$, $F(2, 204) = 20.64$, $p < .001$).

Therefore, the null hypothesis was untenable. The partial eta squared ($\eta^2 = .17$) indicated a large effect (Cohen, 2013).

Table 2

Multivariate Tests for Critical Thinking Style^a Between the U.S. and Chinese Students^b

Test	<i>V</i>	<i>F</i>	<i>Hypothesis df</i>	<i>Error df</i>	<i>p</i>	η^2
Pillai's Trace	.17	20.64	2.00	204.00	< .05	.17
Wilks' Lambda	.83	20.64	2.00	204.00	< .05	.17
Hotelling's Trace	.20	20.64	2.00	204.00	< .05	.17
Roy's Largest Root	.20	20.64	2.00	204.00	< .05	.17

Note. ^a 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree, ^b 0 = U.S. students, 1 = Chinese students

Conclusion, Implications and Recommendations

Global agricultural development requires agricultural educators to prepare students as critical thinkers to solve the real-world issues across the world (Quinn et al., 2009). This study investigated the differences in critical thinking styles between U.S. and Chinese agricultural students. We argued the differences in critical thinking style may be explained by students' different cultural backgrounds. For example, U.S. students in this study tended to be more engaged while thinking critically to process information. The characteristics of engagers (e.g., looking for opportunities to use a more collaborative approach to solve problems, preferring verbal communications) could be the result of an individualistic culture as exhibited in Western countries. As mentioned above, individualistic cultures value self-assurance and self-expression (Wang, 2011). Additionally, people from Western countries often exhibit an analytic cognition mode (Nisbett et al., 2001). Individualistic cultures often influence people within them to depend on logical evaluation to investigate the validity of arguments. This could explain why most of the U.S. students in this study agreed with the statements in the UFCTI inventory representing engagement construct, such as 'I enjoy finding answers to challenging questions.'

In addition, this study found that Chinese students tended to be seekers while thinking critically. China is a collectivist society, which values group relationships and harmony. Individuals within a collectivist society would accept the coexistence of opposites and seek to remain moderate in disputes (Liu et al., 2015; Nisbett et al., 2001; Peng & Nisbett, 1999). This collectivist culture could explain why most of the Chinese students agreed with the statements representing information seeking construct, such as 'I can get along with people who do not share my opinions' or 'I listen carefully to the opinions of others even when they disagree with me'. Moreover, it has been known that the holistic cognition that China has been fostering focuses on integrating multiple sources of information to generate individuals' own perceptions (Peng & Nisbett, 1999). Thus, a possible explanation for the characteristic of seekers (e.g., preferring generating arguments by combining multiple perspectives) might be the result of a holistic cognition culture.

Previous literature found that Chinese students showed lower level critical thinking skills compared to students from Western countries. This study argues that the observed lower level of engagement behaviors in critical thinking, such as keeping silent during classroom discussion or rarely asking questions, may not simply explain Chinese students' lower level of critical thinking performance. The 'quiet' or 'passive' critical thinking behaviors may be attributed to the Chinese students' critical thinking style influenced by their culture. As noted by Cheng et al (2011), the relatively 'quiet' classroom behaviors observed from Chinese students might be due to their

holistic thinking style, which focuses on constructing connections with information. The holistic cognitive thinking style may lead them to wait for instructors to present knowledge as a big picture.

This comparison of critical thinking styles between U.S. and Chinese students provided further insight into how to incorporate useful pedagogical approaches into international or multicultural agricultural educational programs. By understanding students' critical thinking styles from different cultural backgrounds, educators will be able to effectively support students' learning based on their critical thinking style preferences. In other words, educators might create better practical opportunities to develop curriculum and teaching strategies for the purpose of fostering students' critical thinking. Specifically, a better understanding of Chinese students' critical thinking style may help educators diminish intercultural educational challenges faced when cultivating critical thinking.

Since engagers and seekers have different ways of processing or gaining information, a match between teaching strategies and learners' critical thinking styles can encourage classroom engagement and improve learners' performance. For instance, the U.S. students who identified as engagers prefer to acquire information by communicating or interacting with others. Educators should develop an array of activities to conduct active learning, such as incorporating group discussions or class debate. Chinese students who are identified seekers have a different way of processing information. Therefore, different teaching strategies should be utilized with those who prefer to acquire information by themselves from reading materials. Educators could provide information from different perspectives that can appeal to seekers' motivation to investigate new information from different points of view to generate arguments. For example, in an agricultural context, educators should provide seekers information about differing viewpoints as they related to controversial agricultural issues (e.g., biotechnology concepts, the role of genetically modified organisms) to improve seekers' critical thinking.

The internationalization in higher education nurtures cultural diversity, which requires students to have broader cultural knowledge (Pandit, 2007). Lamm and Irani (2001) stated that both critical thinking styles are important in order to enhance critical thinking skills. Each student, to some degree, should possess multiple cognitive thinking styles to adapt to increasing globalization. For this reason, developing different programs and activities to cultivate both types of critical thinking styles should be encouraged in the context of agricultural education. For instance, to help engagers seek broader information and integrate multiple perspectives, educators should demonstrate the process of seeking comprehensive information from different perspectives. It is important to encourage engagers to be attuned to their biases and to explore all angles of a subject. On the other hand, if students are seekers, educators should help them develop their engagement style. For instance, creating opportunities for seekers to interact with others, such as opening group discussion or class debate, would be effective teaching strategies to encourage seekers' classroom engagement.

As teaching critical thinking is a long-term educational goal for educators around the world, educators should continue to apply different teaching strategies to cultivate students' critical thinking skills. This is especially important for international students who are educated in a culture where critical thinking is barely encouraged or even discouraged. In order to gain in-depth information about critical thinking from international Chinese students' perspectives, qualitative research should be conducted to explore how to help them think critically. For example, researchers could interview Chinese international students about how they view critical

thinking in different cultures as well as their educational experiences with critical thinking development during studying abroad.

The Chinese students in this study were recruited from China instead of the U.S. There are a few implications for this. First, it is important to investigate Chinese students' critical thinking style before they are exposed to other cultures. Research indicates that insufficient awareness of the U.S. culture and a lack of knowledge regarding the U.S. educational system result in academic difficulties for Chinese international students studying in U.S. (Wu, et al. 2015). This study suggests that the educational institutions in China should be aware of improving cultural knowledge and perspectives to better prepare their students for adapting to the U.S. academic environment. Secondly, international student recruitment has been a high priority for many educational institutions because of the financial benefits (Chue & Nie, 2016). According to Association of International Educator (NAFSA) (2019), international students contributed \$39 billion to the U.S. economy during the 2017-2018 academic year. However, some international students reported that they do not experience the same benefits as their domestic peers, which raises questions for attracting more international students studying in U.S. (Kim et al., 2017). Because the largest group of international students studying in the U.S. are Chinese, this study encourages future research be conducted to investigate the influences of culture on Chinese students' cognitive style. The goal should be to develop a cultural bridge to connect educational programs with diverse thinking or learning styles to improve Chinese international students' educational experiences (Moon et al., 2020).

This study has several limitations. First, this study used a convenience sample to explore the differences between U.S. and Chinese agricultural students, and they were recruited from only one university in each country. Thus, these findings cannot be generalized to the population. Future studies should use a larger sample from multiple universities to generalize the results. Second, this study only investigated two constructs associated with critical thinking-engaging and seeking information. Critical thinking is a complex and multi-dimensional concept involving a set of cognitive skills (Ennis, 1991; Facione, 1990). Future studies should include other thinking styles to provide a comprehensive understanding of cultural differences. Third, the cultural differences in this study were measured by the country of origin. It would be ideal to include other cultural dimension values to further analyze the relationship between culture and critical thinking styles.

Despite the limitations of this study, the results indicate that the critical thinking styles between U.S. and Chinese agricultural students are different, and those differences may be explained by cultural backgrounds. This study suggests that future international educational interventions aiming to improve critical thinking should be developed based on that population of international students' critical thinking style. Specifically, discovering the critical thinking style within the context of Chinese culture could facilitate Chinese international students' cross-cultural acculturation process. Providing educational programs by including Chinese international students could be a critical source of synergy beneficial for international agricultural development.

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