The Evaluation of Critical Thinking Dispositions in High School Agriculture Teachers

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Abstract

Teachers are continually asked to develop students who are critical thinkers. Gaining an understanding of critical thinking and the capacity to think critically is essential for educators in agriculture. While critical thinking of secondary and postsecondary students has been widely studied, there is limited research that examines teachers' critical thinking and its influence on students' critical thinking. The purpose of this study was to develop a critical thinking disposition profile of high school agriculture teachers in [state], and examine their Engagement, Cognitive Maturity, and Innovativeness (EMI). In further pursuit of the following the conceptual model, agriculture teachers' demographic information was collected to determine if relationships existed between age, gender, level of education, years of teaching experience, route to certification/licensure, and critical thinking dispositions. The results revealed that majority of the teachers had moderate critical thinking dispositions, and that no substantial relationships existed between critical thinking dispositions and independent demographic variables investigated.

Introduction/Conceptual Framework

For agricultural education, the National Research Agenda (NRA) emphasizes the need for a sufficient scientific and professional workforce that addresses the challenges of the 21st Century (Roberts, Harder, & Brashears, 2016). Challenges such as food safety and insecurity, climate change and water limits, appropriate technology adoption, and keeping agricultural education relevant require one being able to analyze, reason, be open-minded, and innovative. As the world's population will reach 8.5 billion by 2050 (UN, Department of Economic and Social Affairs, 2015), agriculturists, more than ever, are being expected to meet the increasing need for food, fiber and shelter while maintaining appropriate quality, quantity and availability of resources (Roberts, et al., 2016; Burbach, Matkin, Quinn, & Seale, 2012). To meet these needs and others, students, teachers, and general members of society must become critical thinkers.

Educators have been encouraged to focus on enabling their students to think critically for many years (Shaughnessy & Seevers, 2002). Through state standards and national goals, critical thinking objectives span the education field from elementary schools to universities (Crane, 2003; Soule, 2006). Agricultural education is not excluded from these mandates. Therefore, agriculture instructors need to provide students with opportunities to practice critical thinking skills and develop critical thinking dispositions (Burbach, et al., 2012).

Agriculture teachers are in position to teach relevant, integrative lessons that increase students' critical thinking development. Even though teachers have numerous opportunities to teach critical thinking, they are not necessarily developing students who are critical thinkers (Pithers, 2000). Could the problem be that educators have trouble teaching critical thinking because they are not naturally inclined to think critically themselves?

In this study, we attempt to develop a critical thinking disposition profile of teachers to determine whether they are naturally inclined to demonstrate critical thinking. A report of this type contributes to current knowledge of teaching and learning for critical thinking in significant ways. The report establishes a true baseline of critical thinking dispositions among agricultural educators. From this baseline, we can improve scholarly pursuits seeking to determine the impact of covariates like teacher preparation, leadership education, or professional development.

Critical thinkers are in demand, whether students are entering the workforce or continuing in their education (McMillan, 1987; Robinson, Garton, & Vaughn, 2007). This is especially the case for agriculture graduates starting their careers. Employers of college graduates in agriculture, natural resources, and related careers increasingly search for and vet applicants who are critical thinkers and problem solvers (i.e. Crawford, Lang, Fink, Dalton, & Fielitz, 2011; Robinson, et al., 2007; Stauffer & McMullin, 2009).

This study asked, "What are the critical thinking disposition scores of high school agriculture teachers in [State]," and "Are there relationships between age, gender, level of education, years of teaching experience, and route to certification/licensure and teachers' critical thinking dispositions?" These are important questions, because agriculture teachers, unlike other disciplinary educators, spend a great deal of time with their students through the various phases of a total program of agricultural education – classroom and laboratory learning, Future Farmers of America (FFA) activities, and Supervised Agricultural Experience (SAE) (Phipps & Osborne, 1988). Park and Rudd (2005) determined that secondary agriscience teachers influence their students through teacher actions, comments, and instruction in each of the aforementioned environments. However, are teachers conscious of the critical thinking they model for their students? Results from this study will help teachers understand their own critical thinking behaviors. How can teachers be expected to develop critical thinking in their students if they are unaware of their own dispositions in this area?

This study also assessed whether there is a relationship between critical thinking dispositions of agriculture educators and their age, gender, level of education, years of teaching experience, and route to certification/licensure that can assist with encouraging and preparing future teachers in critical thinking development. This information has been compiled with the hope that such knowledge will guide research and professional development in the context of critical thinking dispositions of agriculture teachers.

Figure 1 provides a framework, as theorized by Perkins, Jay & Tishman (1993), for developing good critical thinking. This study equates dispositions and inclinations. Perkins, et al. (1993) found that teachers model thinking behaviors that are consistent with their dispositions, and that students are influenced by their teachers' weak or strong thinking dispositions. If a teacher has a weak critical thinking disposition, their students risk learning undesirable critical thinking behaviors. Contrarily, if a teacher has a strong critical thinking disposition, students are more readily able to learn, especially through enculturation.

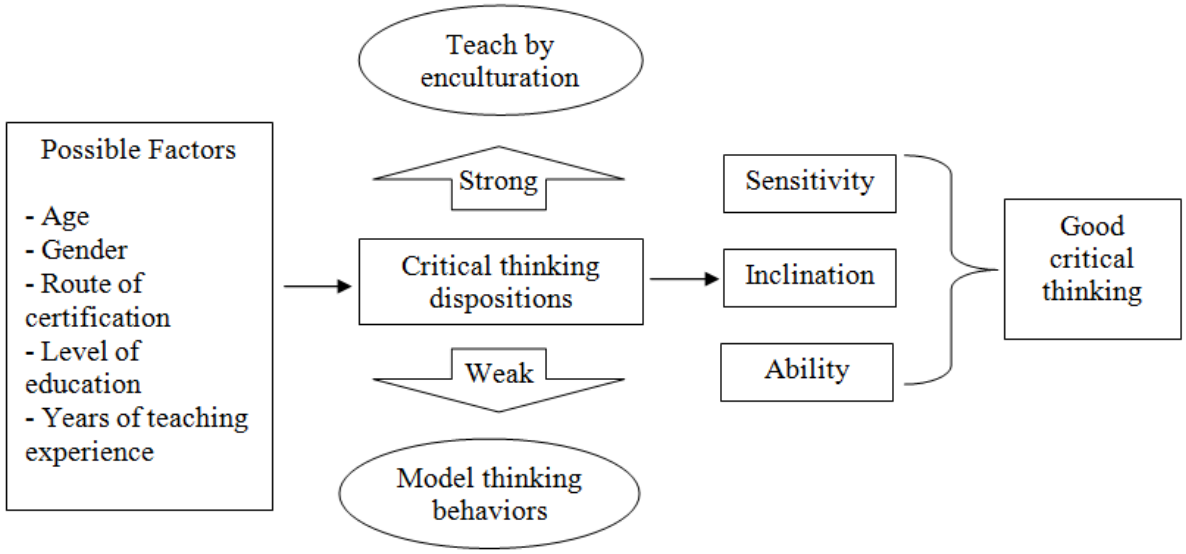

Figure 1. Conceptual model of factors affecting good critical thinking (Tishman, Jay, & Perkins, 1993).

This study relied on the Triadic Dispositional Theory offered by Perkins, Jay, and Tishman (1993) indicating that an individual should notice when a situation calls for critical thinking skills, know which skills to use, and possess the ability to use those skills. The theory states that to be an effective critical thinker an individual must be *sensitive* to situations calling for critical thought, have the *ability* to think critically, and be *inclined* to use the critical thinking skills they possess. Other researchers affirm that critical thinking *skills* are just as important as *disposition* - inclination, or willingness - to use those skills (Dewey, 1930; Ennis, 1996; Facione & Facione, 1992; Nieto & Saiz, 2011). Additionally, Perkins, et al. provide a model of enculturation which states that the most effective way to teach critical thinking dispositions is for teachers to demonstrate positive critical thinking habits, provide examples, and create teacher-student interactions involving the disposition (Tishman, et al., 1993).

Perkins used cognitive science to understand, teach, and assess thinking dispositions (Perkins, et al., 1993). They proposed that a triad of dispositions lead to behaviors. The researchers declared that good thinking dispositions consist of seven intellectual tendencies which need to be cultivated by educators: 1-broad and adventurous; 2-intellectual curiosity; 3-clarifying and seeking understanding; 4-being planful and strategic; 5- begin intellectually careful; 6-seeking and evaluating reasons; and 7-being metacognitively inclined. The authors did not disregard the idea that other dispositional characteristics play a role in good thinking; however, they found that these are the central dispositions (Tishman, et al., 1993).

The behavioral tendencies outlined by the Tishman, et al.'s (1993) triadic model align with the California Critical Thinking Disposition Inventory (CCTDI), which was the genesis of the EMI instrument too (Ricketts, 2003). According to Ricketts (2003), researchers from the University of Florida performed a factor analysis on the CCTDI and discovered that it did not accurately measure the intended constructs. As a result, a team of researchers from UF created the EMI, which used Facione's 1990 Delphi study and a literature review, to identify three

dispositions necessary to determine whether an individual had a high or low critical thinking disposition (Ricketts, 2003). These three dispositions included: engagement, cognitive maturity, and innovativeness.

Individuals strong in the *engagement* disposition are able to tell when good reasoning is needed, can look for times when the need to reason arises, and are confident in their ability to reason, solve problems, and make decisions. Those strong in the *cognitive maturity* disposition are cognizant of the idea that the beliefs held, opinions formed, and positions taken are influenced by personal upbringings, surroundings, and experiences. Individuals with a high disposition in cognitive maturity are also aware of their personal biases and realize their ideals may not hold true for others. Their open-mindedness allows them to be objective, and to consider others' points of view when making decisions and solving problems. People with the *innovativeness* disposition long for new knowledge and actively try to fulfill that longing. Individuals with a high disposition in innovativeness desire to know more about the world, their careers, the people around them, and themselves. They are intellectually curious and seek to fulfill that curiosity through research, questioning, reading, and daily interactions.

According to Perkins, et al. (1993), if teachers are to teach dispositions to students, they should utilize an enculturation model of teaching that develops positive critical thinking dispositions by focusing on exemplars, interactions, and direct instruction. Consider an agriculture teacher attempting to promote students' intellectual curiosity. To develop the students' ability to be intellectually curious, the teacher has to directly teach thinking skills that will allow students to make observations, challenge assumptions, and investigate questions. Teaching students the basic scientific method could satisfy the requirement of developing their ability to be intellectually curious. However, in addition to the ability, the student must be sensitive to situations that would require intellectual curiosity. The teacher would then aim to make students alert to unasked questions and compensate for gaps in knowledge. The teacher would model his or her personal sensitivities by stating aloud their own thought processes, such as, "I don't feel like enough information is presented here. What else do I need to know?" Finally, the teacher will cultivate the students' inclination to be intellectually curious by encouraging and rewarding indicative behaviors in the classroom.

Tishman et al. (1993) suggests that the importance of teaching, as a form of transmission, be maintained while teaching through enculturation. The authors stress that the effectiveness of different models is dependent upon the educational outcome. For instance, when a teacher's goal is to teach students how to identify different plant species, this can be achieved using a model of transmission. By using text, pictures, live specimens, and providing students the opportunity to practice, teacher's can effectively "prepare and transmit information to their learners," who will "receive, store and act upon this information" (p.149). The transmission model is effective for retrieving facts and following procedures, which tailors best to one's teaching abilities. However, the model fails to teach "commitment to principles and conducts (inclination) and alertness to appropriate occasions for their deployment (sensitivity)" (p. 149). If the teacher's goal is to foster a specific disposition in their students, then a different approach is required. Teachers must encourage sensitivities to critical thinking dispositions because a student simply knowing how to use a skill will not make them aware of when to apply the skill (Ernst & Monroe, 2004). For each disposition a teacher wants to enculturate, they should provide

examples of the disposition, encourage and orchestrate student-student and teacher-student interactions involving the disposition, and directly teach the disposition.

Other researchers support the benefit of use of the enculturation model. McBride and Knight stated, "Teachers must consciously plan and structure both their teaching behaviors and their environment for critical thinking," by providing opportunities for inquiry, promoting cooperation and group work among students, and modeling critical thinking dispositions (1993, p. 377). Facione, Facione, and Giancarlo offered, "one powerful tool for nurturing the disposition [critical thinking] in students…is by modeling it" (2000, p. 81). According to Esterle and Clurman (1993), the primary deficit in teachers attempting to teach critical thinking is their failure to model it. Facione (2000) posed the question, "If we are not truth-seeking, open-minded, and the rest [all critical thinking dispositions], in our thinking with students…is it not unreasonable of us to expect more of them (p.35)?" The Delphi study conducted by Facione (1990), suggested that teachers should model appropriate critical thinking skills and dispositions, justify why critical thinking is important, and teach students the specific skills, along with when and how to use them. Facione, et al. (1995) contributed that as part of modeling and teaching critical thinking, teachers should admit their own biases and encourage students to become aware of the viewpoints they possess.

The primary purpose was to develop a critical thinking disposition profile for agricultural educators, linking participants' EMI (engagement, cognitive maturity, and innovativeness) dispositions and demographic factors addressed in the literature. However, as this was one of the first studies seeking to identify the critical thinking of teachers rather than students of higher education, it was important to investigate all the variables the literature suggested might be related.

Age

In 1991, Kennedy, Fisher, and Ennis surveyed the research literature and concluded that critical thinking appears to improve with age**.** Since Facione, Facione, & Giancarlo (1997) theorized that, as an individual gets older, they would have higher critical thinking dispositions than a younger person; age has been a frequently investigated variable related to critical thinking dispositions. In Facione and Facione's (1992) study of 826 students, a positive correlation between age and critical thinking disposition resulted. Wangensteen, Johansson, Bjorkstrom and Nordstrom (2010) and Kelly (2003) also found that older individuals were more likely to be critical thinkers.

The age factor needs more clarification, however, because some researchers have found that age, as a predictor of critical thinking dispositions, had no relationships to critical thinking (Facione 1990; Jenkins, 1998; Ricketts, 2003; Rodriquez, 2000; Rudd, Baker, & Hoover, 2000). Because of these discrepancies and again, limited studies related to teachers and critical thinking, the age piece of Tishman's, et al., (1993) model of factors contributing to good critical thinking was included as part of this study.

Gender

In a study using the UF-EMI, Merrikhi (2011) found that males achieved higher critical thinking disposition scores than females; yet, many studies have reported a lack of differences between genders when considering total critical thinking disposition scores. In a similar study, using the UF-EMI to quantify the critical thinking dispositions of meat evaluation students, no statistical differences were found relating gender to critical thinking disposition scores (Miller, et al., 2011). Cohen (2010) also reported no statistically significant differences between gender and critical thinking dispositions. Chan, Ho, and Ku (2011) found that gender was not a predictor of thinking behaviors in their study of undergraduate students' critical thinking behaviors, and Bisdorf-Rhoades, Ricketts, Irani, Lundy, & Telg (2005) failed to find a significant difference between males and females in terms of their critical thinking dispositions.

As with age, there are contradictions, concerning the influence of gender in critical thinking disposition, as the literature also sometimes indicates that gender can be predictive of critical thinking disposition scores (Hofreiter, 2005). Although no studies were found suggesting an overall higher critical thinking disposition score for a specific gender, there have been studies which report a statistically significant higher scores for males than females in the CCTDI subscale of analysis (Facione, et al., 1995; Giancarlo & Facione 2001; Wangensteen, et al., 2010). It is also commonly reported that females have higher dispositions, particularly with regards to cognitive maturity (Facione, et al., 1997; Facione, Sanchez, Facione, & Gainen, 1995; Giancarlo & Facione, 2001; Rudd, et al., 2000; Walsh & Hardy, 1999).

Level of Education

Additionally, literature on the correlation between the level of education and thinking disposition of students is conflicting. Begbie (2007) and Bisdorf-Rhoades, et al. (2005) found no difference based on level of education, but Wangensteen, et al. (2010) and Yingshan & Ying (2011) examined prior education, and they discovered that university-educated participants scored higher on total critical thinking dispositions than those who had not earned a college degree. Although no studies were found that specifically examined the level of education of teachers in terms of critical thinking disposition, Kelly (2003) came close with an investigation of the critical thinking dispositions of pre-service teachers, determining that undergraduate students had lower critical thinking dispositions than graduate students. However, Bisdorf-Rhoades, et al. (2005) concluded their study by calling for future researchers to explore the influence of gender and level of education on critical thinking dispositions.

Years of Teaching Experience

After an extensive review of literature, very limited studies were found that focused on teaching experience as related to critical thinking dispositions. For instance, in similar studies in nursing, an association between critical thinking dispositions and years of experience in certain nursing jobs was found (Feng, Chen, Chen & Pai, 2010; Huang & Yeh, 2010). In McEwen's (1994) study of business teachers, the conclusion was made that teachers, regardless of the years of teaching experience, are capable of encouraging critical thinking in students. However, as researchers have already determined, the ability to do so in contrast to the willingness to do so, are not the same. This study of the critical thinking dispositions of high school agriculture teachers, examines whether the number of years of teaching experience is an indicator of the willingness a teacher possesses to use the critical thinking skills they have.

Route to Certification/Licensure

According to Roberts and Dyer (2004), a traditionally certified teacher is one who earned an undergraduate degree in agricultural education, thereby qualifying for certification. An alternatively certified teacher is one who earned their certification by other means and applied directly for certification. Unexpectedly, Roberts and Dyer (2004) discovered that certified teachers indicated a greater need than the alternatively certified teachers for instruction in students' critical thinking development.

Purpose and Objectives

The literature review identified little understanding of the factors that may or may not contribute to this study's purpose to develop a critical thinking disposition (EMI) profile for agriculture educators. In fact, no studies looking at the critical thinking dispositions of agriculture teachers were identified. The following research questions were developed to guide this study:

1. What are the critical thinking disposition scores (CTDS) of high school agriculture teachers in [state], as measured by the UF-EMI?
2. What was the high school agriculture teachers' age, gender, level of education, years of teaching experience, and route to certification/licensure?
3. Do relationships exist between the critical thinking disposition scores and demographic variables?

Methods

To limit costs and to collect data as efficiently as possible, a random sample (n = 252) out of a population frame of N=339 agriculture teachers in [state] was selected. The sample was selected based on the conventions of Krejcie and Morgan (1970). The design was descriptive and correlational survey research. Following approval from the university's Institutional Review Board (IRB), instruments were administered using the Tailored Design Method (Dillman, Smyth, & Christian, 2014). After initial contact, the use of inaccurate email addresses and teachers choosing to opt out resulted in a final 249 teachers being emailed a link to the survey. A response rate of 70% (n =175) was achieved. Inferential statistics [independent samples t-tests, one-way Analysis of Variance (ANOVA), and Pearson's product moment correlation procedures] were used to analyze the data.

Survey Instrument

We administered the UF-EMI to analyze critical thinking dispositions. The EMI utilizes a 5-point Likert-type summated rating scale, ranging from 1 (strongly disagree) to 5 (strongly agree) (Irani, et al., 2007). The 26 items on the questionnaire represent three different constructs. The Maturity construct consist of eight items, Engagement is made up of 11 items, and Innovativeness is a six-item construct. EMI scores were calculated by adding the point value for each answer per construct. The total possible score for Engagement ranged from 11 to 55, for Cognitive Maturity it ranged from 8 to 40, and for Innovativeness the score ranged from 7 to 35. The total EMI score ranged from 26 to 130. Instrument developers at UF reported a Cronbach's

alpha coefficient of $\alpha = 0.94$ for the whole instrument (Irani, et al., 2007). For each individual construct, the coefficients as reported by Irani, et al. were Engagement, $\alpha = 0.91$; Cognitive maturity, $\alpha = 0.79$; and Innovativeness, $\alpha = 0.80$.

Our research team here at [university] developed the demographic section to collect age, gender, level of education, years of teaching experience, and route to certification/licensure data. The levels of education included the following six categories: less than a high school degree, high school degree or equivalent (e.g. GED), some college but no degree, associate's degree, bachelor's degree and graduate's degree. The gender and route to certification/licensure variables were bivariate: male or female, and traditionally or alternatively certified, respectively. For number of years teaching and age, teachers simply wrote in their response.

Frequencies, means and standard deviations were calculated for overall critical thinking dispositions and for each construct. Means were compared and correlated with demographic variables using inferential statistics using SPSS (Independent samples *t*-test, Analysis of Variance, Pearson's *r*). Data was reported using descriptive and inferential statistics including frequencies, means, independent samples t-tests and analysis of variance. An analysis of variance also determined there were no statistically significant differences between early and late respondents as a way of addressing non-response.

Results

Description of the Critical Thinking Dispositions of Agriculture Teachers

Scores for each construct cannot be directly compared because each construct has a different number of items. Therefore, to determine which construct teachers scored highest, percentage of possible points for each subscale is reported (See Table 1). Teachers scored about the same for Engagement and Innovativeness. Cognitive Maturity was slightly lower.

Table 1
Critical Thinking Disposition Scores of Agriculture Teachers

	f	*M*	*SD*	*%*
Engagement	175	43.21	4.12	78.56
Innovativeness	175	27.48	3.42	78.51
Cognitive maturity	175	30.45	3.48	76.13
Total critical thinking disposition	175	101.14*	9.15	77.80

Note: *Teachers in this study would be considered moderate critical thinkers.

For the total critical thinking disposition scale, a score of 106.7 and above indicates a strong critical thinking disposition; 85.9 to 106.6 indicates a moderate disposition; and 85.8 and below indicates a weak disposition (Bisdorf-Rhoades, et al., 2005). Seventy-four percent (n = 130) of high school agricultural education teachers in this study could be classified as moderate critical thinkers with a score of 101.14 for overall critical thinking disposition (See Table 2). Twenty-two percent of teachers (n = 39) were strong critical thinkers overall, and 3.4% (n =6) were categorized as weak critical thinkers.

Agriculture Teachers' Demographic Variables

Table 2 provides Agriculture teachers' demographic variables.

Age. Agricultural education teachers' ages ranged from 22 to 66 years old. The average age was *M* = 40 years old (*SD* = 11.8). There were 51 (29%) teachers between 31 and 40 years; 45 (26%) between the ages of 21 and 30; 37 (21%) between 41 and 50 years; 37 (21%) between 51 and 60 years; and 4 (3%) teachers were 61 years old and above.

Gender. There were 130 (75%) male respondents and 44 (25%) females.

Level of education. Ninety-five (54%) participants reported earning a graduate degree; seventy-eight (45%) reported earning a bachelor's degree as their highest degree and one (1%) reported attending college, but did not earning a degree.

Years of teaching experience. There were 79 (47%) teachers who reported 0-10 years of teaching experience; 46 (27%) with 11-20 years; 28 (17%) with 21-30 years, 14 (8%) with 31-40 years, and 1 (1%) with more than 41 years of experience.

Route to certification/licensure. Of the 175 respondents, 146 (84%) were certified traditionally through a 4-year degree program and 27 (16%) were certified through alternative methods.

Table 2
Agriculture Teachers' Demographic Information

Demographic	Item	*f*	%
Age	21-30	45	26
	31-40	51	29
	41-50	37	21
	51-60	37	21
	61 and older	4	3
Gender	Male	130	74
	Female	44	25
	Not reported	1	1
Level of Education	Bachelors	78	45
	Graduate	95	54
	Attended college w/o earning a degree	1	1
Years Teaching Experience	0-10	79	47
	11-20	46	27
	21-30	28	17
	31-40	14	8
	41 or more	1	1
Route to Certification/Licensure	Tradionally	146	84
	Alternative methods	27	16

Relationships between Critical Thinking Dispositions and Demographics

Table 3 displays Agriculture teachers' demographic variables as listed below.

Age. Pearson product moment correlation coefficients (*r*), exploring relationships between age and critical thinking, disposition scores were between 0.01 and 0.09 for each subscale and total EMI, indicating a negligible relationship (Miller, 1998).

Gender. Male and female teachers in this study scored very similarly, overall. Gender was not related to critical thinking dispositions, as evidenced by results of t-tests: Engagement, $t(172) = -.25$, $p > 0.05$, Innovativeness, $t(172) = -.56$, $p > 0.05$, Cognitive Maturity, $t(172) = .76$, $p > 0.05$, or Total EMI, $t(172) = -.04$, $p > 0.05$.

Level of education. Teachers scored similarly despite their level of education. One-way analysis of variances procedures determined that critical thinking dispositions were not dependent on level of education: Engagement, $F(2, 171) = .47$, $p > 0.05$, Cognitive Maturity, $F(2, 171) = .20$, $p > 0.05$, Innovativeness $F(2, 171) = .52$, $p > 0.05$, or Total EMI scores $F(2, 171) = .18$, $p > 0.05$.

Years of teaching experience. Pearson product moment correlation coefficient (*r*) was calculated to determine if a relationship existed between number of years teaching and critical thinking disposition scores; Pearson's *r* was between 0.01 and 0.09 and not significant for each subscale and total EMI, indicating no relationship (Miller, 1998).

Route to certification/licensure. Traditionally certified and alternatively certified teachers scored similarly, also. There was no critical thinking disposition difference between the two routes to certification for Engagement, $t(171) = .48$, $p > 0.05$, Innovativeness, $t(171) = .56$, $p > 0.05$, Cognitive Maturity, $t(171) = -.30$, $p > 0.05$, or Total EMI, $t(171) = .32$, $p > 0.05$.

Conclusions/Recommendations/Implications

Agriculture teachers are asked to develop critical thinking in students, but little is known about the critical thinking capacity or abilities of the teachers themselves. This study is important because agriculture teachers spend a significant amount of time with students and thus, have ~~so~~ many opportunities to influence them (Park & Rudd, 2005). In fact, Perkins, et al. (1993) and Tishman, et al. (2003) explained that teachers demonstrate critical thinking if they possess the discussed dispositions, and they noted that students are positively or negatively influenced by strong or weak critical thinking dispositions, respectively.

In this study, we determined that the critical thinking disposition profile of a [state] agriculture teacher is that of a moderate critical thinker. [State] agriculture teachers have room for improvement in Engagement, Innovativeness, and especially Cognitive Maturity. Since teachers model critical thinking behaviors consistent with their disposition (Tishman, et al., 2003), and since [state] teachers are moderate critical thinkers, it can be reasoned that when presented with the opportunity to use critical thinking skills, or when provided an opportunity to teach the skills, they are capable of doing so.

Agriculture teachers, specifically, have moderate capacity to defend decisions they make based on logic (Engagement); they have a desire to know more about the world and seek to fulfill their curiosity (Innovativeness); and they are open-minded, aware of their personal biases, and realize that there may be multiple solutions to a problem (Maturity). Recall that to truly foster critical thinking dispositions in students, teachers must teach by enculturation (Perkins, et al., 1993) or by demonstrating critical thinking and creating a culture of critical thinking.

To teach by enculturation, teachers can provide examples of the disposition, model personal sensitivities by stating thought processes aloud, encourage and reward behaviors that indicate critical thinking dispositions, and make students alert to unasked questions and gaps in knowledge. Teachers can encourage and create student-student and teacher-student interactions involving the dispositions, and they can directly teach the dispositions.

Even though moderate dispositions indicate that the teachers are likely to use their critical thinking skills, they can only use the skills they possess. According to the conceptual model, outlined in Figure 1, teachers must be sensitive to situations calling for critical thinking and be able to apply critical thinking. This study did not examine the sensitivities or abilities of teachers, only their dispositions.

As teachers become consciously aware of their critical thinking dispositions, in efforts to model them for students to observe, it is hoped that they will develop their own dispositions over time. Therefore, the teachers who have moderate critical thinking dispositions can progress towards strong dispositions. Current teachers need to attend professional development trainings in critical thinking so that they can get their students to become problem solvers. In fact, professional development in critical thinking is an identified need area, as determined by secondary agriculture teachers themselves (Sanok, et al., 2015).

While a single study cannot provide a sound basis for encouraging changes in teaching behaviors, this study and several others have demonstrated that teachers of higher education can positively influence student's critical thinking skills, particularly when purposively and explicitly teaching critical thinking (e.g., Abrami et al., 2008; Bensley, Crowe, Bernhardt, Buckner, & Allman, 2010; Miri, Ben–Chaim, & Zoller, 2007). Based on these studies and recommendations, it is suggested that [State] agriculture teachers model their thinking behaviors for their students and teach by enculturation. By creating an awareness of critical thinking dispositions, teachers may begin to strive for personal improvement, thereby enhancing their ability to teach by enculturation.

None of the studied factors that impacted critical thinking in students had any influence on teachers' critical thinking development, but we recommend that future studies examine other possible factors. Does the way in which a teacher teaches impact critical thinking? Do certain topics or pathways that teachers focus on develop their capacity for critical thinking? Improving the profile is important, because we want to be able to ultimately develop students' critical thinking. Therefore, future studies should also test the enculturation theory in agricultural education. In other words, we need to understand the impact a teacher's critical thinking has on

their students, and understand how the methods they employ specifically develop critical thinking in their students.

References

Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M. A., Tamim, R., & Zhaing, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A Stage 1 meta–analysis. *Review of Educational Research*, *78*(4), 1102–1134. doi: 10.3102/0034654308326084

Begbie, F. (2007). Critical thinking disposition – counts and matters in post-registration SCPH nurse education. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.543.268&rep=rep1&type=pdf

Bensley, D. A., Crowe, D. S., Bernhardt, P., Buckner, C., & Allman, A.L. (2010). Teaching and assessing critical thinking skills for argument analysis in psychology. *Teaching of Psychology*, *37*(2), 91-96.

Bisdorf-Rhoades, E., Ricketts, J., Irani, T., Lundy, L., & Telg, R. (2005). Critical thinking dispositions of agricultural communications students. *Journal of Applied Communications*, *89*(1), 25-34.

Burbach, M., Matkin, G., Quinn, C., & Searle, T. (2012). The impact of preparing agriculture faculty to influence student critical thinking disposition. *Journal of Agricultural Education*, *53*(2), 1-14. doi:10.5032/jae.2012.02001

Chan, N., Ho, I. T., & Ku, K. Y. L. (2009). Epistemic beliefs and critical thinking of Chinese students. *Learning and Individual Differences*, 21, 67-77. Retrieved from http://dx.doi.org/10.1016/j.paid.2009.08.015

Cohen, J. (2010). *Critical-thinking disposition and profile of critical-thinking disposition for post-professional graduate athletic training students*. (Doctoral Dissertation). Capella University, Minneapolis, MN.

Crane, T. (2003). Learning for the 21st century. Retrieved from http://www.p21.org/storage/documents/P21_Report.pdf

Crawford, P., Lang, S., Fink, W., Dalton, R., & Fielitz, L. (2011). *Comparative analysis of soft skills: What is important for new graduates?* Washington, DC: Association of Public and Land–grant Universities.

Dewey, J. (1930). *Human nature and conduct.* New York, NY: The Modern Library.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. Hoboken, NJ: Wiley.

Ennis, R. H. (1996). Critical thinking dispositions: Their nature and accessibility. *Informal Logic*, *18*(2), 165-182.

Ernst, J., & Monroe, M. (2004). The effects of environment-based education on students' critical thinking skills and disposition toward critical thinking. *Environmental Education Research, 10*(4), 507-522. doi: 10.1080/1350462042000291038

Esterle, J., & Clurman, D. (1993). *Conversations with critical thinkers.* San Francisco, CA: The Whitman Institute.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for the purposes of educational assessment and instruction.* Milbrae, CA: The California Academic Press.

Facione, P.A., Facione, N.C., & Giancarlo, G. (2000). The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skill. *Informal Logic, 20*(1), 61-84. Retrieved from http://hrgpapers.uwindsor.ca/ojs/leddy/index.php/informal_logic/article/view/225 4/1698

Facione, P.A., & Facione, N.C. (1992). *The California critical thinking dispositions inventory.* Millbrae, CA: California Academic Press.

Facione, P. A., Facione, N., & Giancarlo, C. (1997). The motivation to think in working and learning. In E. Jones (Ed.), *Preparing Competent College Graduates: Setting Newer and Higher Expectations for Student Learning*. (pp. 67-79). San Francisco, CA: Jossey-Bass Publishers.

Facione, P.A., Sanchez, C.A., Facione, N.C., & Gainen, J. (1995). The disposition toward critical thinking. *Journal of General Education, 44*(1), 1-25.

Feng, R., Chen, M., Chen, M., & Pai, Y. (2010). Critical thinking competence and disposition of clinical nurses in a medical center. *Journal of Nursing Research, 18*(2), 77-87. doi: 10.1097/JNR.0b013e3181dda6f6

Giancarlo, C.A., & Facione, P.A. (2001). A look across four years at the disposition toward critical-thinking among undergraduate students. *The Journal of General Education, 50*(1), 29-55.

Huang, Y., & Yeh, M. (2010). Exploring critical thinking in clinical nurses. Retrieved from http://hdl.handle.net/10755/152910

Irani, T., Rudd, R., Gallo, M., Ricketts, J., Friedel, C., & Rhoades, E. (2007). *Critical thinking instrumentation manual*. Retrieved from http://step.ufl.edu/resources/critical_thinking/ctmanual.pdf

Kelly, M. (2003). *An examination of the critical and creative thinking dispositions of teacher education students at the practicum point* (Doctoral dissertation). University of Massachusetts, Boston, Massachusetts.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

Jenkins, E.K. (1998). The significant role of critical thinking in predicting auditing students' performance. *Journal of Education for Business, 73*(5), 274-279.

McBride, R., & Knight, S. (1993). Identifying teacher behaviors during critical-thinking tasks. *The Clearing House, 66*(6). 374-378.
Retrieved from http://www.jstor.org/stable/30188927

McEwen, B.C. (1994). Teaching critical thinking skills in business education. *Journal of Education for Business, 70*(2), 99-103. doi: 10.1080/08832323.1994.10117733

McMillan, J. H. (1987). Enhancing college students' critical thinking: A review of studies. *Research in Higher Education, 26*(1), 3-29. doi: 10.1007/BF00991931

Merrikhi, P. (2011). The effect of bilingualism on Iranian ELT student's critical thinking ability (CT). *Theory and Practice in Language Studies, 1*(10), 1424-1431.
doi: 10.4304/tpls.1.10.1424-1431

Miller, L. E. (1998). Appropriate analysis. *Journal of Agricultural Education, 39*(2), 1-10.
doi:10.5032/jae.1998.02001

Miller, C. C., Carr, C. C., Brendemuhl, J. H., Ricketts, J. C., Myers, B. E., & Roberts, T. G. (2011). Quantifying the critical thinking skills of students who receive instruction in meat-animal or meat product evaluation. *NACTA Journal, March 2011*, 50-54.

Miri, B., Ben-Chaim, D., & Zoller, U. (2007). Purposely teaching for the promotion of higher-order thinking: A case of critical thinking. *Res Sci Educ*, 37, 353-369,
doi: 10.1007/s11165-006-9029-2

Nieto, A. M., & Saiz, C. (2011). Skills and dispositions of critical thinking: are they sufficient? *Anales de Psicologia*, *27*(1), 202-209. Retrieved from
http://redalyc.uaemex.mx/src/inicio/ArtPdfRed.jsp?iCve=16717018024

Park, T.D., & Rudd, R. (2005). A description of the characteristics attributed to students' decisions to teach agriscience. *Journal of Agricultural Education, 46*(3), 82-94.

Perkins, D. N., Jay, E., & Tishman, S. (1993). Beyond abilities: A dispositional theory of thinking. *The Merrill-Palmer Quarterly, 39*(1), 1-21.

Phipps, L. J., & Osborne, E. W. (1988). *Handbook on agricultural education in public schools*. Danville, IL: The Interstate Printers & Publishers, Inc.

Pithers, R.T. (2000). Critical thinking in education: A review. *Educational Research, 42*(3), 237-249.

Ricketts, J. C. (2003). Critical thinking skills of selected youth leaders: The efficacy of leadership development, critical thinking dispositions, and student academic performance (Doctoral dissertation). University of Florida, Gainesville, FL.

Roberts, T. G., Harder, A., & Brashears, M. T. (2016). American Association for Agricultural Education National Research Agenda: 2016-2020. Gainesville, FL, Department of Agricultural Education and Communication.

Roberts, T.G., & Dyer, J.E. (2004). Inservice needs of traditionally and alternatively certified agriculture teachers. *Journal of Agricultural Education, 45*(4) 57-70. Retrieved from http://pubs.aged.tamu.edu/jae/pdf/vol45/45-04-057.pdf

Robinson, J. S., Garton, B. L., & Vaughn, P. R. (2007). Becoming employable: A look at graduates' and supervisors' perceptions of the skills needed for employability. *NACTA Journal, 51*(2), 19-26.

Rodriguez, G. (2000). Demographics and disposition as predictors of the application of critical thinking skills in nursing practice. *Dissertation Abstracts International, 62(1)*, (UMI No. AAT3002095).

Rudd, R., Baker, M., & Hoover, T. (2000). Undergraduate agriculture students learning styles and critical thinking abilities: Is there a relationship? *Journal of Agricultural Education, 41*(3), 2-12. doi: 10.5032/jae.2000.03002

Sanok, D., Stripling, C. T., Stephens, C. A., Ricketts, J. C., Estepp, C. M., & Conner, M. W. (2015). Professional development needs of Tennessee school-based agricultural education teachers. *Journal of Southern Agricultural Education Research, 65*(1), 69-82.

Shaughnessy, M.F., & Seevers, R. (2002). An interview with Linda Elder: About critical thinking and gifted education. Available at: http://www.criticalthinking.org/pages/an-interview-with-linda-elder-about-critical-thinking-and-gifted-education/476

Soule, H. (2006). State standards for the 21st century. Retrieved from http://www.p21.org/storage/documents/StateStandards.

Stauffer, D. F., & McMullin, S. I. (2009). Desired competencies and perceived proficiencies of entry–level fishers and wildlife professionals: A survey of employers and educators. *Transactions of the North American Wildlife and Natural Resources Conference, 74*, 62–68.

Tishman, S., Jay, E., & Perkins, D. S. (1993). Teaching thinking dispositions: From transmission to enculturation. *Theory into Practice, 32*(3), 147-153.

Retrieved from http://www.jstor.org/stable/1476695

UN, Department of Economic and Social Affairs. (2015). World population projected to reach 9.7 billion by 2050. Available at: http://www.un.org/en/development/desa/news/population/2015-report.html

Walsh, C.M. & Hardy, R.C. (1997). Factor structure stability of the California critical thinking disposition inventory across sex and various students' majors. *Perception and Motor Skills, 85*(3), 1211-1228. doi:10.2466/pms.1997.85.3f.1211

Wangensteen, S., Johansson, I.S., Bjorkstrom, M.E., & Nordstrom, G. (2010). Critical thinking dispositions among newly graduated nurses. *J Adv Nurs, 66*(10), 2170-2181. doi: 10.1111/j.1365-2648.2010.05282