

Critical thinking perspectives of undergraduate students: How they think about climate change impacts on global food security and hunger

N. Stedman¹, A. Brown²

Abstract

Today's learners need support in not only developing capacity for a global mindset, but also for thinking critically about the world. Employers are seeking graduates who can enter the workforce prepared to work within agriculture with the ability to understand its complexities. Higher education institutions have been called upon to provide this to students and faculty are often charged with this responsibility. However, faculty are often unprepared to provide this level of instruction and need support in order to foster this in the classroom. Student participants in this study were exposed to scenarios, which are a tool used to provide multiple perspectives and outcomes to real-life scenarios. Faculty used the scenarios to complement course instruction with respect to the impacts of climate change on food security and hunger. Using Facione's (1990) framework for critical thinking skill, statements submitted by students both prior to the scenario and post were analyzed. It was found that while students demonstrated critical thinking in both the pre and post, the post statements were much richer, in-depth, and thoughtful in how critical thinking was demonstrated. This showed that faculty support, combined with innovative teaching methods, like scenarios, will encourage students' building of capacity for critical thinking.

Keywords

Critical Thinking, Higher Education, Scenarios, Faculty Development, Undergraduate Education

1. Nicole Stedman, Professor, University of Florida
PO Box 110540, Gainesville, FL 32611-0540
nstedman@ufl.edu, <https://orcid.org/0000-0001-7970-1798>
2. Amy Brown, Graduate Assistant, University of Florida
PO Box 110540, Gainesville, FL 32611-0540
amybrown@ufl.edu, <https://orcid.org/0000-0001-6378-025X>

Introduction and Problem Statement

The world is rapidly changing and “employers look to colleges and universities to produce employment-ready graduates” to solve tomorrow’s problems (National Research Council, 2009, p. 18). In order to solve complex problems of a global nature, students must be able to think critically about them. Thinking is a natural process and can often be biased, distorted, partial, uninformed and potentially prejudiced; excellence in thought must be cultivated (Duron, Limbach, & Waugh, 2006).

In today’s university climate, it is becoming a necessity to provide the world with informed, productive, and internationally minded citizens. According to the American Association of Colleges and Universities (AAC&U, 2007), “it is clear that the United States-and individual Americans-will be challenged to engage in unprecedented ways with the global community, collaboratively and competitively” (p. 2). Internationalization of curriculum is becoming a priority for most universities. Although this problem was noted a decade ago, The National Association of State Universities and Land-Grant Colleges (NASULGC, 2004) concluded the internationalization of curriculum “helps [students] to develop the global critical thinking essential to contributing as citizens of the world and competing in the international marketplace” (p. viii).

In 2004, higher education associations and leaders of institutional accrediting bodies decided critical thinking was one of the six major intellectual and practical skills with which students should leave their undergraduate time (AAC&U, 2004). “If critical thinking skills are not well-developed through the educational system, there are ramifications to our ability to make meaning in the workforce. If our ability to make meaning is limited by deficient critical thinking, it will have an impact on our ability to lead” (Flores, Matkin, Burbach, Quinn, & Harding, 2013, p. 213).

Reinforcing this idea, the National Research Council (2009) challenged faculty to realign their focus on ‘transferable competencies’ in order for graduates in FANH to stay competitive. Specifically, the NRC recognizes the importance of critical thinking development in students (2009). Recent college graduates have been unsuccessful in the workplace at jobs any higher than entry level. This has been attributed to the students’ inadequate and poorly developed critical thinking skills. Colleges must meet the demand of the industry by finding a solution to developing better critical thinking skills in undergraduate student before entering the workforce (Bascuas, 2013).

Stedman and Adams (2012) found faculty are not generally knowledgeable about critical thinking. When asked to answer questions related to critical thinking basic concepts and understanding, faculty often answered these questions incorrectly indicating a lack of knowledge about the concepts of critical thinking. A gap exists in how they are able to teach for critical thinking when they are not knowledgeable about those basic concepts. Teaching critical thinking skills explicitly is possibly the most effective way to foster critical thinking skills in students. Multiple studies have supported students’ general problem solving, critical thinking

abilities, language comprehension, inventive thinking, and even IQ have had significant improvements when students are provided explicit instruction (Abrami, Bernard, Borokhovski, Michael, Surkes, Tamim, & Zhang, 2008; Hernnstein, Nickerson, de Sánchez, & Swets, 1986; Zohar, Weinberger, & Tamir, 1994).

Context is a large component of one's ability to think critically. For the purposes of this project, a global perspective will be emphasized. In our increasingly global society, there is a need to provide today's students and future employees with global perspectives and competencies (Ricketts & Morgan, 2009).

Theoretical and Conceptual Framework

For the purposes of this study, Facione's (1990) Delphi study provided the framework for defining critical thinking and skills. Facione (1990) defined critical thinking as, "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations..." (pg. 2). The Delphi panel of experts consensually agreed on descriptions of the following critical thinking cognitive skills:

- (1) Interpretation, "to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria" (p. 6),
- (2) Analysis," to identify the intended and actual inferential relationships among statements, questions, concepts, descriptions or other forms of representation intended to express beliefs, judgments, experiences, reasons, information, or opinions" (p. 7),
- (3) Evaluation, "to assess the credibility of statements or other representations which are accounts or descriptions of a person's perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intend inferential relationships among statements, descriptions, questions or other forms of representation" (p. 8),
- (4) Inference, "to identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to educe the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation (p. 9),
- (5) Explanation, "to state the results of one's reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological and contextual considerations upon which one's results were based; and to present one's reasoning in the form of cogent arguments" (p. 10), and
- (6) Self-Regulation, "self-consciously to monitor one's cognitive activities, the elements used in those activities, and the results educed, particularly by applying skills in analysis and evaluation to one's own inferential judgments with a view toward questioning, confirming, validating, or correcting either one's reasoning or one's results" (p. 10).

Each of these skills are then broken down into subskills further refining their application. The manner in which skills are used has been applied to specific contexts, Facione confirming that the context determines the successful application. However, "while CT skills themselves transcend specific subjects or disciplines, exercising them successfully in certain contexts demands domain-specific knowledge, some of which may concern specific methods and techniques used to make reasonable judgments in those specific contexts" (Facione, 1990, p. 5).

Tomorrow's graduates in FANH will face challenges on a global scale. Preparing them to solve these problems must be a primary goal for colleges of agriculture. To do so, teaching faculty must be able to teach in a way that encourages and fosters critical thinking. As Terenzini, Springer, Pascarella, and Nora (1995) noted, critical thinking is an "enduring skill, that it is a central element in lifelong learning, and that it is an appropriate skill for colleges and universities to develop among students" (p. 24).

In order to accomplish the transfer of critical thinking skill. Instructors created scenarios, which are similar to case studies. This provides a much more fertile foundation for developing and using critical thinking skills. Wilson and Ralston (2006) developed a process for the creation of scenarios, which was adapted for the purposes of this project. Each step in this process is a critical point of adding value and exposing mental models and assumptions during the scenario project. These 18 steps are also in four general phases of scenario planning, namely, (a) "getting started, (b) laying the environmental analysis foundation, (c) creating the scenarios, and (d) moving from scenarios to a decision" (Wilson & Ralston, 2006, p. 25).

Purpose

The purpose of this study was to identify changes in undergraduate students' use of critical thinking skills when thinking about the impacts of climate change on global food security and hunger. The study was guided by a single objective, to identify students use of critical thinking skills prior to instruction compared to post instruction.

Methods

This qualitative study was designed to assess the impact of critical thinking instruction on undergraduates thinking about climate change and global food security and hunger. Faculty instructors were recruited to participate in an academy on critical thinking in efforts to promote capacity building of critical thinking of undergraduate students in colleges of agriculture across the southeastern United States. Faculty participated in a three-month online academy that included specific modules on critical thinking, critical thinking pedagogy, climate change, food security and hunger, scenario and scenario development, instructional design, and teaching contentious topics. Thirteen faculty created scenarios which were used as instructional resources in their classrooms. The courses included non-profit leadership, family sciences, food sciences, contemporary agricultural issues, environmental health, and agricultural communication. This is important aspect, as according to Facione (1990) the value of critical thinking in context contributes to the development of capacity. Scenarios were used in the

classes from fall to spring 2018. Faculty implemented the scenarios as part of existing course lesson. Each scenario was 10-15 minutes in length and included: an introduction to Belize, video content related to the topic, additional support resources, and specific elements of the scenario (objectives, knowledge/data/expert insight, future scenarios, and plan(s) of action. Faculty invited students to participate in the study and as a result 142 pre-test and 243 post-test statements were collected via Qualtrics. This qualitative portion was part of a larger mix-methods study, which included a cultural questionnaire developed during a previous research project, as well as a demographic portion.

Using a qualitative design, both pre and post-tests were analyzed using structural coding based on Facione's (1990) critical thinking skills. Students were asked to respond to one question for both pre and post-test, "what is your current understanding of the impacts of climate change on global food security and hunger?" Two researchers worked independently to code student statements for critical thinking. The two sets were then compared to codify the identified skills.

Findings

Participants of the study included students enrolled in courses across a range of disciplines. Participants self-reported demographic data. Of the participants responding their reported classifications included freshmen ($n=3$), sophomore ($n=18$), junior ($n=41$), and senior ($n=57$). Ninety-two reported female as their gender with 27 reporting male. Ethnicities included American Indian or Alaskan Native ($n=1$), Asian ($n=4$), Black or African American ($n=19$), Hispanic or Latino ($n=16$), and White Caucasian ($n=79$).

To further understand the participants, they were asked if they had traveled to Latin America, and if so where. Of those who responded, 41 indicated that they had traveled to Latin America with countries visited including Costa Rica, Mexico, Brazil, Guatemala, Colombia, Dominican Republic, Puerto Rico, El Salvador, Haiti, Chili, Honduras, and Belize.

The following provides examples collected from the students' and post-tests. Of the six skills, the following were most frequently demonstrated in the pre-test, explanation (16), interpretation (25), self-regulation (29), and inference (38). In the post-test statements, students demonstrated four of the six skills including explanation (12), interpretation (28), self-regulation (29), and inference (30). While the statements were not identified in a manner to compare individual student responses, findings were determined by aggregate, comparing the total pool of statements provided by students across all the courses included in the sample. For the pre-test, table 1 illustrates statements, which demonstrated critical thinking skill.

Table 1

Examples of student statements illustrating critical thinking skill (n=119)

Critical Thinking Skill	Quote 1 Pre	Quote 2 Post
Interpretation	<p>“Food security and climate change are the result of larger systemic issues in global society. I believe both are issues that stem from the current economic issues on the global market. The profit of using fossil fuels and other environmental hazards outweighs the future damages. And food security is a result of resources not being utilized properly or given generously because of the greater appeal of capital gain.”</p>	<p>“This study has made me aware that many factors come into play when considering a "solution." By solution I mean this is a big problem that can't be fixed with a single solution but a set of solutions that highlight a part of the bigger problem.”</p>
	<p>“I currently believe that climate change is a prominent issue in the world today and it has a major effect on our environment. I believe that if we don't change the way we are using nonrenewable resources and other things that are polluting the air, we can damage Earth in a permanent and irreversible. In terms of food security, it is definitely an important issue all across our country and around the globe. People have problems getting access to the proper food they need to survive.”</p>	<p>“I knew that food insecurity was a wicked problem, but adding the unknown caused by climate change just adds a whole other wicked problem that would have to be addressed. I feel due to the environment that I have grown up, prior to this activity, I was unable to really think critically or understand a problem like this and how there is more than just food insecurity to address. Definitely a complex problem that doesn't have just one, or even 5 answers.”</p>
Inference	<p>“Despite what many say, the climate is changing. Global temperature is rising, our polar caps are melting, and from my understanding, we are headed down a dangerous path. Food security is asterisk as well, however, genetic modification is</p>	<p>“Now, I understand the urgency behind climate change and how intrinsically it is linked to food security. For many countries, especially in the Caribbean and South America, food security will</p>

	<p>helping us create disease and pest resistant crops that allow us to advance crop production.”</p>	<p>be drastically affected by climate change and rising sea levels. Not only, do temperature changes affect the growth of different produce, but if sea levels were to rise drastically, it would decrease the land area many of nations require.”</p>
	<p>“I believe that the climate change and particularly the precipitation patterns are affecting the Mississippi Delta crops in regard to less rainfall in the summertime. Less rainfall means pumping excess water from the ground. Therefore, depleting the aquifers. As a result of this, food security could be a problem if one day we are not able to water our crops.”</p>	<p>“I still believe that climate change is caused by global warming as I have observed. For food security, it is still a problem in contemporary times. In the US, there are food deserts still. There are also places that people do not have access to fresh foods and only have fast food restaurants. In that regard, its kind of increases the obesity rates.”</p>
<p>Explanation</p>	<p>“My understanding is that they both are largely affected by increase in population. With an increase in population we are putting a strain on our environment, which then has adverse effects on our climate. Food security is challenged when our climate becomes so volatile, which is not helped by increasing demand due to current population levels.”</p>	<p>“My beliefs and understanding of climate change and food security are largely unchanged. I believe climate change is an issue humans have helped create due to negligence. I am concerned about the effects of climate change on the environment, quality of air and water, and availability of food. I think as climate change becomes worse, there will be many more who are food insecure due to potential increased prices of food. I think we will also need to be more creative in how food is grown, and what we</p>

		do with food waste after it has been consumed.”
	<p>“Climate change is a real issue that should be addressed and taken seriously by all global citizens. Climate change is connected to food security as it produces unpredictable weather, natural disasters (such as droughts, tsunamis, and hurricanes), etc. that kill entire harvests and food supplies. Therefore, people who are solely dependent on agriculture for their income and live in agricultural societies (like Sub-Saharan Africa) face higher food insecurities and are heavily affected by climate change.”</p>	<p>“Following my participation in the scenario, I learned that climate change and food security go hand in hand. Climate change includes things like hurricanes, droughts, and rain patterns which all affect the production of food. Many third world countries are affected greatly because of this. They do not have the resources and technology to preserve their food and they have to find alternate ways to earn money to buy food or ways to grow food during these changing weather patterns.”</p>
Self-Regulation	<p>“I personally have not done much research into the matter and cannot give a solid opinion on whether it is happening or if it is not.”</p>	<p>“I was unaware of the large correlation between climate change and food security, also my idea of what food security is has changed. I did not know it meant the ability to foresee where your food is coming from in the future.”</p>
	<p>“I know there is an underlying issue with the two topics, but I'm not exactly sure how to fix the problem of climate change and food security.”</p>	<p>“My current beliefs are even more so in support of developing ways which can have a significant positive impact on countries which are threatened by climate change and food insecurity. It is especially necessary to analyze the evidence we already have to ensure that we are considering all potential impacts to a community, its people and</p>

		<p>their families. Evidence-supported legislation which can promote resilience in communities as well as increase the ability for residents to recovery quickly is important to determine because without it climate change and food insecurity could lead to serious trauma for millions of individuals.”</p>
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Conclusions, Discussion, and Recommendations

It is clear that post instruction students were more likely to use a breadth of critical thinking skills, demonstrating a higher capacity for critical thinking. Students were also able to more accurately describe the impacts, so while they may have used inference in the pre-test, how inference was used and depth of thought in demonstrating inference was greater after use of the scenario. This supports Terenzini, Springer, Pascarella, and Nora (1995) in that students need support on how to apply the skills. The transferability of critical thinking skill is evident and the clarity in which they are demonstrated by the student further impacts the ways in which students can transfer that skill set. It is important for faculty to continue to encourage students to not just thinking broadly, but deeply about climate change and its impacts on global food security and hunger.

The application of context is supported by Facione (1990) and showcases that teaching critical thinking in a context promotes its use and application. Faculty need to be encouraged to promote critical thinking in their instructional activities, as showcased in the scenarios created and implemented in this study. Stedman and Adams (2012) recognized that faculty need support and resources in order to better facilitate the teaching of critical thinking skill. Faculty who participated in this study were provided ample instruction on critical thinking, scenario development, and climate change/food security. With those instructional aids in place, faculty and students demonstrated higher levels of a capacity for teaching and learning. Further, Wilson and Ralston (2006) model for developing scenario-based learning objects showed to be beneficial in its application to student learning, especially in the context of critical thinking.

While the results of this study are not broadly transferable, it is clear that specific support for faculty related to critical thinking facilitates the building of capacity for students. Further, explicit instruction, clarity in delivery and expectation were also provided to student participants. This enabled the learners to fully understand and appreciate that demonstrating critical thinking as an outcome of the lesson was important. The lessons were more than just

learning about the impacts of climate change on food security, it was being able to demonstrate critical thinking in that context.

This study provided a baseline of data related to how students can build capacity for critical thinking. However, further information is needed with respect to understanding how discipline or context-specific teaching influences this. Student participants represented a wide range of disciplines and pinpointing how and when critical thinking is taught and promoted across curriculum is another important consideration.

Overall this study sought to identify the impact that context-specific scenarios emphasizing critical thinking had on students' ability to demonstrate critical thinking skill. In this study, students were able to demonstrate critical thinking prior to the implementation of the scenario; however, the manner and depth in which they applied the skills increased greatly after the scenario use. Students learning of critical thinking must be context-specific, continuous, and supported across their curriculum. Faculty also need to be supported in their instruction of critical thinking, whereby helping to teach students who not only have a global perspective but can truly think about what is happening in the world around them.

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