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Teaching Critical Thinking via the "Wicked Problem" of Food Insecurity

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abstract: This article describes a project to engage sociology students in real-world research designed to foster critical thinking about food security. Faculty-librarian collaboration was an essential component. An open-ended questionnaire was administered to three classes at the end of the semester. Assessed were students' experiences gathering data and applying abstract concepts and theories to the case study. Students characterized their skill development, identified missing project components, and suggested improvements. These responses were assessed via a rubric to document three types of thinking: dualistic thinking, the belief that the problem has a right and wrong answer; multiplistic thinking, which recognizes uncertainty and multiple viewpoints to the problem; and systemic thinking, which understands the complexity of the problem and how interrelated factors cause it. Results show that the project helped students identify the complex processes and relationships that contribute to food insecurity.

Introduction

Educators are increasingly aware of their responsibility to prepare college students to function and succeed as citizens of a complex global society.[1] Teachers face the challenge of how to foster critical thinking skills—that is, the abilities to analyze, synthesize, and evaluate information to reach a sound conclusion—which are necessary for students to appreciate and understand the complexity of social problems.[2] Interest in critical thinking is evident in both information literacy instruction and in the sociological literature, which considers a host of social problems,

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known as "wicked problems," that are difficult or impossible to solve.[3] For example, a wicked problem that has garnered media attention is the rural health crisis,[4] exemplified by inadequate access to medical care due to hospital closures and lack of providers.[5] Insufficient health care results in widespread disparities, such as higher rates of diabetes and heart disease and shortened life expectancy among rural populations, to name a few.[6] Embedded are issues associated with both income inequality and social and geographic isolation.

Of concern to both sociology and information literacy educators is to identify and describe a type of scholarly engagement that contributes to students' intellectual development such that they become well-informed citizens who recognize social justice issues and are empowered to lead and serve as agents of change.[7] We contend that the study of any wicked problem requires specific subject knowledge, as well as collaborative critical thinking and problem-solving skills. The interlinking of substantive, disciplinary-based knowledge with information literacy and soft skills—that is, personality traits and behaviors—is essential for identifying, managing, analyzing, and using information sources in creative ways to unpack complex issues.[8] Thus, the authors designed a project for an upper-level rural sociology course to introduce students to a wicked problem that intersects directly with health outcomes: the limited availability of fresh, culturally appropriate, and nutritious food. In terms of Benjamin Bloom's taxonomy, which classifies learning objectives by levels of complexity,[9] the goal was to move students beyond basic memorization and regurgitation of information and past the one-dimensional explanations typically associated with lower-level cognitive processes. The aim of the rural sociology course, Food, Agriculture, and Society (RSOC 3190), was to challenge students to engage instead in the higher-level cognitive processes necessary to synthesize the course materials—including readings, lectures, and data—with varied discipline-specific information sources to evaluate food security.

The interlinking of substantive, disciplinary-based knowledge with information literacy and soft skills—that is, personality traits and behaviors—is essential for identifying, managing, analyzing, and using information sources in creative ways to unpack complex issues.

Well-established pedagogical theories provided the disciplinary foundation for both the course design and the teaching strategies. Traditional lectures were long favored as an opportunity for students to hone valuable skills, especially listening.[10] However, many educators see the lecture-only format as less effective than active learning, in which students actively engage with the material instead of passively absorbing it.[11] Paulo Freire referred to the traditional approach as the "banking model of education," a view that regards learners as empty vessels into which instructors must deposit information.[12] RSOC 3190 draws on both lines of thought to deliver content in a semi-flipped style: that is, it provides students the opportunity to develop broad knowledge of issues relating to food insecurity through lectures and readings, as well as through a series of activities in the form of an in-depth research project.

Second, the curriculum plan integrated a real-world case study into the course to challenge students' viewpoints. More specifically, in this project, students were required to engage with complex, often uncomfortable, historic class- and race-based roots of food insecurity in rural Alabama. The approach drew on Lev Vygotsky's notion of assisted discovery, in which learners gain new insights with the aid of both teacher guidance and peer collaboration.[13] The instructors led students through a series of interconnected, scaffolded assignments aimed at progressively building complex knowledge, skills, and aptitudes.[14] This process offered students a means of assimilating unfamiliar concepts and theories, as well as new types of information sources, and then applying the newly acquired understanding to their case study. Jean Piaget's constructivist theory suggests that students can best learn ideas contrary to what they believe by encountering them in real-world examples.[15] These encounters, it is argued, will motivate students to reflect on their previously held ideas and beliefs.[16] Thus, educators hope that exposure to new information sources will play a critical role in triggering a reflective feedback process that will challenge students' strongly held beliefs on a topic and lead to the reorganization of their mental schema. These changes will, in turn, facilitate new understandings and knowledge growth.

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This article provides a description of the course and project background, as well as an introduction to the region known as Alabama's Black Belt, before proceeding to a review of the literature on wicked problems and critical thinking. Also detailed are the project design and a series of interwoven library sessions, including links to the information literacy objectives of the Association of College and Research Libraries (ACRL) Framework for Information Literacy for Higher Education (known hereafter as Framework) and the development of critical thinking skills. Finally, the authors describe their assessment process before recommending further areas of research and improvement.

Course and Project Background

To foster students' critical thinking about the "wickedness" of food insecurity and the information necessary to explore its complexities, a semester-long research project was designed for a three-credit, junior-level course in rural sociology, RSOC 3190 at Auburn University in Auburn, Alabama. There is no undergraduate major in the discipline and, in fact, most students come from outside the College of Agriculture. Instead, students typically seek credit toward minors in sustainability studies, hunger studies, rural and community development, community and civic engagement, agricultural leadership, or stewardship-based agriculture. The instructor has offered RSOC 3190 each fall since 2009. The class meets twice a week for 1 hour 15 minutes. Typically, one day per week is a traditional lecture with some intertwined activities, and the second weekly meeting is dedicated to the students' semester-long research project. The course includes two midterm examinations, but the research project, in its entirety, substitutes for a final exam because it requires integration and application of all the course material.

Through the years, several research projects and activities, including a state-wide agrifood system assessment and a local foods feasibility study, were used to engage students in their learning. Although the projects appeared structurally sound and offered rich subject content, the execution was flawed. Few students had any background in sociology, and even fewer had formal training in research methods, even in their own discipline. As a result, they lacked familiarity with the basic concepts (for example, race, class, and gender) and underlying theories (for example, political economy) that underpinned the projects. They were deficient both in the basic mindset of rigor and comprehensiveness and in an understanding of the how and why of scientific practice. The students lacked familiarity with how to find, evaluate, and use important information sources that provide a wide range of empirical data underlying food and agricultural policy. In other words, they typically came to the class with an interest in agriculture, food, or both (agrifood), but they lacked the breadth of knowledge necessary to appreciate its complexity.

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These key factors led to a redesign of the course and to the introduction of a real-world, semester-long case study called the Community Food Security Assessment of Alabama's Black Belt (known hereafter as the project). This project was tested in 2014 and officially integrated into the course in fall 2015. From the beginning, a team of research librarians were formally embedded in the course. Class readings, lectures, and discussion spanned three core areas. The first area was the historical development of the agrifood system in the United States, including its influence on Southern agriculture and the intersection of race and class. The second part of the course focused on the outcomes and impacts of the current structure of the agrifood system. This section covered the disinvestment in rural communities and the increasing consolidation in agricultural production and food manufacturing that are thought to contribute to food deserts, areas where residents lack access to affordable, nutritious food. It also described changes in food consumption patterns and declines in household food provisioning—including decreased participation in gardening, meal preparation, and cooking. The last segment presented several trends as they relate to nutrition and health, the role of federal nutritional assistance programs, and the relationship between communities and alternative agrifood systems (for example, the local food movement, which seeks to reduce the distance between food production and consumption). The thread tying these areas together was the concept of sustainability, particularly the sub-issue of social justice. Drawing upon these foci, the food security project centered on Alabama's Black Belt.

The Alabama Black Belt is comprised of 17 counties that span the middle and lower half of the state, named for both its rich soil and its historical, political, and economic history.[17] The counties in this area have a high percentage of racial minorities (23.4 percent to 82.6 percent Black).[18] They also tend to be rural, varying from 45.6 percent to entirely rural.[19] Between 20.9 and 46.9 percent of Alabama's Black Belt residents live at or below the poverty level, exceeding the national rate of 15.5 percent.[20] The United Nations Special

Rapporteur on extreme poverty and human rights, an independent expert appointed by the Human Rights Council, stated that the region has some of the worst poverty he has seen in the developed world.[21] A consequence of these interconnected factors is that a third of the population, and nearly two-fifths of the children, suffer from food insecurity. Moreover, Alabama's Black Belt residents have some of the highest levels of negative health indicators in the United States: between 16 percent and 24 percent have diabetes and from 36 percent to 46 percent are obese.[22]

Literature Review

The underlying goals of the course were to improve students' ability to identify and describe the complex, multifactor dynamics of food insecurity and to develop the skills necessary to comprehensively assess and make evidence-based claims about the "wickedness" of the problem by utilizing key, publicly available information sources.[23] Toward this goal, the authors define what is meant by "wicked problems" and how such matters have been discussed in both the sociology and the library and information science (LIS) literatures. Finally, the literature on critical thinking is reviewed in relation to evaluating and contextualizing wicked problems and to understanding the information literacy concepts and skills necessary to explore them.

Wicked Problems

Food insecurity is a prime example of what is called a "wicked problem."[24] Wicked problems are harmful social or cultural situations that are difficult or impossible to solve and have complex interactions influenced by a range of values and changing conditions. As Tom Ritchey states, there are several key characteristics to wicked problems.[25] They lack a clear definition because many stakeholders have different ideas about them. Such problems are typically symptoms of other wicked problems, and they are often explained in numerous ways. Assessing an intervention or solution is complicated because a range of stakeholders, political forces, and available resources affect the outcome. Thus, it may be difficult to determine if there has been positive change, and it may be unclear when an intervention should stop. In fact, Ritchey indicates that a solution to a wicked problem is "not true or false, but better or worse."[26]

Scholars argue that the very nature of sociology is to grapple with wicked problems. However, the concept receives relatively little attention in the discipline's pedagogical literature. Exceptions include calls for teaching via scenario analysis, which studies issues by considering alternative potential outcomes,[27] and the concept of sustainability, which seeks to avoid the depletion of natural resources while also maintaining economic profitability, fairness across social organizations and institutions, and individual well-being.[28] Discussion of wicked problems in the LIS literature is even more limited. Focusing on utilitarian issues, some studies claim that the processes, functions, programs, and services utilized in libraries are wicked problems.[29] Examples identified include the creation of data management plans,[30] the development of metadata standards,[31] electronic records systems and management,[32] and the use of e-books.[33] One article calls for a renewed emphasis on preparing future LIS leaders to tackle wicked problems in the profession, citing the importance of transformational learning, overcoming resistance to change,

and the role of threshold or gateway concepts, transformative ideas that lead to new levels of understanding.[34] Anne-Marie Deitering and Sara Jameson provide one of the few LIS pedagogical articles that discusses the concept of wicked problems in library instruction.[35] These authors point to the frequency with which students choose wicked problems—such as gun control, homelessness, global warming, poverty, and inequality—for their course research papers, yet they approach these issues expecting that the problems have a single cause and a single solution.[36]

Critical Thinking

To tackle a wicked problem, students must think critically about the situation, its components, and possible solutions. Successful performance requires the ability to objectively analyze and evaluate an issue; to conceptualize, select, and gather information from multiple sources; to question assumptions about the information and sources; to synthesize and assess facts; to review a range of outcomes and possible solutions; and to remain reflective throughout the process. Thus, a number of underlying competencies are necessary,[37] as well as a set of attitudes and habits that make it possible to logically apply information to an issue.[38] In sociology, critical thinking requires not only an understanding of complex issues and problems[39] but also an ability to identify social patterns and understand the role of social forces,[40] and to comprehend reality using social facts embedded in context and history.[41] Thus, sociology as a discipline is "critical"[42] and rooted in concerns of equity and justice.[43] These underlying attributes also mean that a sociology course, with an emphasis on developing information literacy skills, is a natural place to instill and teach critical thinking.

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Studies show that college professors widely acknowledge the importance of critical thinking but can neither describe nor teach it.[44] This failure is due to confusion about the meaning of critical thinking and associated concepts, including higher-level and reflective thinking. Higher-level thinking differs from everyday thought in that it is disciplined, systemic, and able to manage varying degrees of abstraction and ambiguity.[45] It also requires the right attitude, a combination of open-mindedness, concern for evidence, and persistence. In other words, thinkers need to reserve judgment until they have sufficient information and to keep going in the face of roadblocks.[46] In reflective thinking, judgments are made from assessment of "a broad range of possibilities."[47] According to Keith Roberts, critical thinking develops via a predictable pattern. It starts with basic dualism, the idea that every problem has two main aspects, particularly a right and a wrong. It moves toward multiplicity, which recognizes many perspectives that may create a gray area in which right and wrong cannot be discerned. Then, it progresses to relativism, the belief that there is no absolute truth, only what an individual or social group happens to

believe. Finally, the thinking advances to complex analysis.[48] When assignments foster this transition, learners start to develop the skills necessary to see beyond their own cultural context. Students begin to understand that causality is complex and typically involves multiple variables and that "truths" are socially constructed, at least in part. They should also grasp the importance of rigorous and systematic study and the need to support a thesis with evidence.

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Don Weast points to the challenge of teaching the cognitive processes of critical thinking.[49] Other experts, however, claim that several assignment types can be effective, namely writing,[50] observation,[51] use of census data,[52] and case studies.[53] The relationship between writing and higher-level thinking is well established; writing requires students to make their own arguments and to root their assertions in the literature and appropriate theory.[54] Developing a thesis statement, for example, demands that learners reconcile their evidence, reasoning, and conclusions.[55] Critical observation, it is argued, helps students move from individual to structural explanations of social phenomena. The practice of such observation facilitates the development of three skills: the abilities to distinguish the social constructedness of behavior, to recognize existing assumptions and stereotypes, and to understand the context in which an observation takes place.[56] Like critical observation, case studies provide a context for enhancing analytical and evaluation skills.[57] Several authors claim that U.S. Census data can be helpful in this regard.[58] Working with noteworthy data sources, students engage in active and inquiry-based learning and become more thoughtful about the information they collect, its usefulness, and its connection to abstract concepts.[59] They also become more skillful in data interpretation and increase their knowledge and awareness of contributing social factors.[60]

Perhaps most important are calls for serious and sustained intervention,[61] particularly substantive context and content,[62] as student skills may otherwise erode over the course of a semester. Research suggests one way to enhance and retain student competency is through student-led research. The Council on Undergraduate Research, which promotes high-quality collaborative research among students and faculty, recommends research assignments as a means of developing more sophisticated critical thinking skills.[63] For instance, as part of a social problems course, Weast incorporated a semester-long library project in which students learned to collect and review different types of literature, from mass media to scholarly works.[64] He found that while students needed a sufficient knowledge base to challenge an argument's validity and soundness, analytical thought could, in fact, be taught. The value of embedding information literacy instruction to instill critical thinking skills in students is vitally relevant to the RSOC 3190 project discussed here. Through the duration of this course, students engaged with several information sources, providing the opportunity to develop critical thinking through the evaluation and synthesis of census data, encyclopedia entries, and observation, and to connect the sources to the course readings and lecture.

The ACRL Framework[65] expands the definition of information literacy to include reflexive discovery of information production, including its use and value in creating new knowledge.[66] This new definition strongly emphasizes critical thinking. Library instruction, however, is typically arranged on an ad hoc basis, by requests from course instructors, for a predetermined assignment. These sessions usually center on technical training, such as keyword searching or database selection, offered for a limited time.[67] Content and time restrictions prevent the implementation of in-depth instruction and the interaction necessary to truly develop critical thinking about information. Consequently, librarians tend to encounter students who "seek paths of least resistance," relying on the most effortlessly obtained information, which they assume to be "good enough."[68] Several LIS studies argue the merits of carefully integrating critical thinking skills into courses as a conduit for imparting higher-order information literacy competencies.[69] However, as Pamela Kessinger found, this integration necessitates that librarians work in a partnership with faculty to scaffold material over the duration of a course.[70]

Description and Design of the Project

Food, Agriculture, and Society (RSOC 3190) is taught in-person with assignments and associated written instructions disseminated via Canvas, the learning management system at Auburn. The research librarians are enrolled in Canvas, which permits direct access to both the instructor's directions and student contact information. Individual assignments are scaffolded to provide foundational knowledge about factors contributing to food insecurity. These tasks draw, in part, on the U.S. Department of Agriculture (USDA) "Community Food Security Assessment Toolkit," which emphasizes both food access and food availability.[71]

Students work in three- or four-person teams, each assigned to a Black Belt county. They explore the intersections of social phenomena critical to the county, including its economics and sociodemographics; farming and agricultural production trends; food consumption patterns; and public health indicators. The project is broken into four sections that correspond to the course lectures and assigned readings. Most sections include scaffolded mini-assignments due approximately every two weeks throughout the semester (see Table 1).[72] These assignments require students to submit the data collected and to write a short (250-word) summary directed toward a professional audience (for example, government officials, public health and food security advocates, or leaders of civic organizations). The summary must be connected to and supported by the assigned readings. Most assignments require students to develop a graphic representation of their data (that is, a chart or figure), with a number and title, in-text discussion, and appropriate references. All assignments require the use of standard Microsoft Office™ software (that is, Word and Excel) and American Sociological Association style guidelines.[73] While students coordinate work with their team, they turn in the setting (section I), fieldwork (section II), and consumption (section III) assignments individually. Assignments associated with analysis (section IV) are submitted as a group. All sections are graded according to a rubric that is provided with the assignment instructions, and all receive written feedback from the instructor.

Table 1.
Community Food Security Project assignments

Assignment	Objective(s)	Resource(s) used	Data collection	Submission
Section I: Setting				
Background	To explore the historical and contemporary characteristics of the county, including its economy and primary industries; its location, geography, and key cities (library session 1, week 2); and its contemporary sociodemographics (library session 2, week 3).	• Alabama Department of Archives and History database. • *Encyclopedia of Alabama.* • *Bibliography of the County Histories of Alabama.* • U.S. Census Bureau's "American Fact Finder" database. • University of Alabama's "Alabama Maps" website.	• Historical narratives about the county and prominent current events. • Current and historical economic and population data recorded in a Microsoft Word table. • County map.	• A Word document that describes the county and includes both a table of key socioeconomic data, explained in the text, and a county map.
Structure of agriculture	To determine the type and trajectory of county-level agriculture production as it relates to U.S. production (library session 3, week 5).	• U.S. Department of Agriculture (USDA) "Census of Agriculture" database.	• Six specific years of numerical data between 1850 and 2012 that represent trends (e.g., numbers of farms, farmers, and farm	• An Excel file, with a complete data set, and all variables and units identified. • A Word document that describes county trends;

Table 1, cont.

Assignment	Objective(s)	Resource(s) used	Data collection	Submission
			laborers; crop types and production volume; use of government subsidy programs) recorded on an Excel spreadsheet.*	at least two figures of trend data that were created from the data set; and an explanation of the relationship between county and national trends.
Section II: Fieldwork				
Personal consumption	To examine personal food buying and consumption patterns, and to explore the role of both industry concentration and lifestyle on these choices (library session 4, week 7).	• Hoover's online database of business information. • Company websites.	• Name each food source and description of quality, numerical data (e.g., quantity purchased, calories consumed), and reason for both purchase and consumption recorded on a preexisting Excel spreadsheet.* • Name of parent company and brand of each food item.	• A completed Excel spreadsheet.* • A Word document that describes personal dietary intake and food sources with at least one relevant figure of consumption data.
Food availability	To survey food outlets (e.g., supermarket, convenience store) and to document options for transportation to these outlets.	• USDA Food and Nutrition Service Thrifty Food Plan Market Basket list.	• Presence of each Market Basket item, including quality and price, recorded on a preexisting Excel spreadsheet.*	• A completed Excel spreadsheet of data collected.* • A Word document that describes the food

			• Appearance and condition of the food retailer recorded on a preexisting Excel spreadsheet.* • Availability and type of public transportation.	available in the store surveyed, the store itself, the distribution of stores across the county, and the transportation available; as well as photographs inside and outside the retailer.
Section III: Consumption				
Food access	To quantify food access at both the county and state level, such as proximity, household use of food assistance programs, county-level health indicators, and nutritional outcomes from food choices and dietary patterns (library session 5, week 10).	• USDA Economic Research Service "Food Environment Atlas."	• Numerical data about access (e.g., farmers markets, total food outlets, distance to grocery store, and access to transportation), use of nutrition programs (e.g., Supplemental Nutrition Assistance Program [SNAP], school lunch), and health statistics (e.g., diabetes, obesity) gathered from a preexisting data set.†	• An Excel file with a cleaned data set.† • A Word document that describes food access in the county with at least two embedded figures representing county food access.
Section IV: Analysis				
Concept practice	To identify and to use key concepts from the assigned readings to explain the collated	• All resources used in Sections I to III.	• All data collected by group members throughout the project.	• A list of six to eight concepts, identified from assigned readings, with bulleted statements that

Table 1, cont.

Assignment	Objective(s)	Resource(s) used	Data collection	Submission
	group findings (library session 6, week 14).			define, explain, and use the concept in an example; and application of the concept using collated data.‡ • An evidence-based statement about food security in the county.
Presentation of data	To present each group's findings, to discuss the findings across all groups, and to consider all findings in the larger context of Alabama's Black Belt region.	• All resources used in Sections I to III.	• All data collected by group members throughout the project.	• A collated "master" data set in Excel. • A 10-minute, substantive PowerPoint presentation that makes specific comparisons between the findings and the assigned reading; and includes a series of graphs, tables, and figures to illustrate data.
Final report	To develop an evidence-based community food security assessment for the group's county.	• All resources used in Sections I to III.	• All data collected by group members throughout the project.	• A formal Word document (i.e., cover page, table of contents, lists of tables and figures) that defines and describes food security at societal and community levels; evidence-based

descriptions of the county's background, structure of agriculture, and food access and availability; tables and figures of supporting data; and a contextualized discussion of the findings.

* For two assignments, food availability and personal consumption, students are provided with an Excel spreadsheet that has all the variables and units indicated. Students fill in the numerical data that is requested.

† In the food access assignment, students download an Excel file of national, state, and county-level data from the USDA Economic Research Service website, as well as the codebook. Students identify the data they wish to use and "clean" the file by eliminating extraneous material and changing the variable codes to usable names.

‡ The concept practice is completed as a group during a class period. Responses are submitted on large poster paper or written on whiteboards. This format enables the instructor and librarians to interact with the groups as they collate findings and to answer questions as needed.

Throughout the course, students meet with librarians for six instruction sessions that instill information literacy concepts relating to the ACRL Framework, including the frames "Searching as Strategic Exploration," "Research as Inquiry," "Information Creation as Process," "Authority Is Constructed and Contextual," and "Information Has Value." Each class is team-taught by two research librarians with subject knowledge of agriculture, natural resources, and business. The number of sessions allow for librarians to build relationships with students and to introduce them to a variety of information sources, including data, at pivotal points during the project.

The library sessions typically begin with the instructor introducing the goals and objectives for that period. Next, reinforcing and expanding on the course concepts, librarians lead students in a period of "inquiry," in which students, in their county groups, free-associate the information needed to complete the mini-assignment in question.[74] This librarian-led brainstorming gives students time to reflect on the information they need; it is a vitally important exercise that offers students the opportunity to tie course readings and lectures to the data they will find during the session. Students are then queried where they might find their desired information. Based on the responses, librarians introduce them to a relevant data source; its background, history, or role; and examples of how it is organized and how it functions. Open search time is provided to experiment with the new data source and to practice source-specific search techniques. Since students work in groups to find their county-level information, librarians help to foster communication between the individual group members and to guide them as they ask questions. Students often revisit and reassess what information they can collect based on the restrictions of the source they use. At the end of the class period, each group is asked to share with the class what they learned about their county throughout the search process, as well as any challenges they might have encountered. This provides an opportunity for groups to learn from one another.

Students often revisit and reassess what information they can collect based on the restrictions of the source they use.

In section I, students attend three library instruction periods to collect data and information for two interrelated assignments (see Table 1). These assignments establish the county's setting—its background and the structure of its agriculture—and require the reading and creation of tables, which are foundational research skills.[75] This section also provides the students with their first chance to get to know their county; in most cases, students are completely unfamiliar with the setting. Thus, these initial sessions provide vital context and information that will allow students to get their first "look" at their assigned counties.

Rather than simply showing students how to find the numerous sources of information, librarians ask them to think critically about what they need to understand . . .

During session 1, in week 2, students consider the types of historical and contemporary information needed, then librarians guide them through several options (for example, *Bibliography of the County Histories of Alabama* and Alabama maps).[76] Rather than

simply showing students how to find the numerous sources of information, librarians ask them to think critically about what they need to understand—what might they need to know to appreciate the county history and milieu. As the students' information needs change and become more refined, librarians reassure them that this is a normal part of the research process. Thus, students learn that research may, at times, be a nonlinear process.

The county's socioeconomic and demographic data—age, race, income, and educational attainment—are collected during session 2, in week 3. Students are introduced to the "American Fact Finder," learn how U.S. Census data are collected, and then create a Word table to record these data.[77] This session serves as a transition point from week 2, when students used more familiar sources such as articles or books. The census data provide another way to view county information that is out of students' comfort zone because it offers data without the analysis that articles or books provide to give meaning to the numbers. Students consider the data they might need to find about their county, given what the census collects. This brainstorming is perhaps more important than week 2, as it leads students down the path of thinking critically about how the data can be used to tell a story about the sociodemographic factors of their county.

The next assignment takes place during week 5 (session 3) and introduces learners to the U.S. Department of Agriculture (USDA) Census of Agriculture.[78] Students are instructed to focus their data collection on six specific years between 1850 and 2012, each representing an epoch in the development of the U.S. agrifood system, and to create an Excel spreadsheet to record the variable names, units of measurement, and numerical data. While nearly every agricultural census is available online, navigational instructions are especially important because there are relatively few search functions for the older data and most data are presented in pdf tables that require deciphering. The librarians emphasize links to the course lectures and readings to determine which data to gather and to gauge the significance of the data collection periods. Most importantly, they probe students' choices to help identify data collection gaps. For instance, students may record the number of farmers and farmworkers per year but neglect to follow race and class trends, which are vital to understanding the region. This content, and the resources explored in this session, can sometimes be frustrating for students as they grapple with limitations of secondary data sources, while simultaneously valuing what they offer. The students learn some of the processes behind the collection and sharing of agricultural census data—how and why data points are not always consistent over time and the inherent difficulty of comparing historical and contemporary data. As in week 2, they must consider how these data fit into a bigger, longitudinal "story" of food production—collecting data with a purpose rather than simply filling a spreadsheet.

Section II is comprised of two interrelated assignments that require the collection of primary field data—personal consumption and food availability (see Table 1). Together, they provide an opportunity for role-taking, in which the students put themselves into others' circumstances and see alternative views, independent of their own.[79] A food diary is used to illustrate why economically challenged people may make seemingly poor food choices and have what appear to be unhealthful eating habits (for example, eating fast food regularly due to time and cost constraints). Using a predesigned Excel spreadsheet, students record when, where, and why a food or beverage was purchased over two two-day periods; the company and brand; and the nutritional composition, such as number of calories. Thus, students are provided the means to both reflect on their

own circumstances and habits and to create their own data set that they must analyze in week 7's library session.

In session 4 (week 7), students explore food industry consolidation and how it relates to their consumption choices. A librarian begins a dialog with the class to identify food supply chain stakeholders (for example, farmers, retailers, and consumers) and to consider the relationships among food production, processing, and manufacturing. A relatable item, a microbrewed beer, is used as an example to show students how to differentiate between brands and companies, particularly corporate subsidiaries. To further reduce confusion, a librarian leads students in a short game, "Name That Company," where a trademark or a brand is displayed on a slide and students are asked to identify the parent company. Students are then asked to identify the names and locations of the companies that own the brands of the foods listed in their food diaries. The librarian instructs them to use Hoover's database of business information, as well as company websites, to track down profiles including company name(s), location(s), parent and subsidiaries, size (for example, financial data, top officers, and total employees), leading competitors, and industry sector. Students discover the inherent challenge in locating this information, especially for private companies, and learn how many of the brands that they regularly consume, like the microbrewed beer example, are owned by huge transnational corporations.

A county store inventory is the second field study. This assignment requires each group member to visit the assigned country and to survey a different type of food retailer (for example, supercenter, small grocer, discount, or convenience store) using the list of foods in the United States Department of Agriculture (USDA) Food and Nutrition Service Thrifty Food Plan Market Basket.[80] Students assess the quality and cost of each item, including the ways in which community members might travel to the store. There is no specific library session for this assignment, but it is a regular topic during the library sessions. It serves as a point of comparison or "benign disruption" in terms of expected findings.[81] For nearly all students, this field trip is the first time they have ever visited their county, or any county in Alabama's Black Belt. Thus, the on-site visit serves as an eye-opening experience that brings to life both the data and the other resources used throughout the semester.

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Students consider consumption, broadly, in section III (see Table 1). During session 5, week 10, librarians introduce the "Food Environment Atlas"[82] and describe how these data are compiled and how they differ from the previous information sources.[83] Students learn that the atlas is a "living" data set that the USDA Economic Research Service updates regularly from multiple sources. Recorded are data relevant to consumption, such as numbers of food outlets; distance to food stores and vehicle access; and use of nutrition programs, for example, the Supplemental Nutrition Assistance Program (SNAP) and school lunch and breakfast programs. This data set also includes several relevant health statistics, including percentage of the population with diabetes, rate of obesity, and levels of physical activity. Key aspects of this assignment include learning how to

download raw online data; to identify relevant variables using the data documentation and codebook; and to "clean" the data for analysis, which includes renaming the respective variables and determining variable units. Librarians ask students to reflect on the data they gathered in previous weeks, including what they uncovered during the county field trip. They also question students on their data collection choices and gaps in logic, reminding students that the various data collected must work together to tell the story of food security in their county.

During the final phase of the project, section IV, group members collate their individually collected data to consider, develop, and provide support for conclusions about food insecurity in their county.[84] This analysis involves a multistep process that begins with a final visit to the library. During week 14 (session 6), students work in their groups to identify six to eight course concepts and theories that help to explain their case study. The groups are required to justify their choices and to provide specific examples that illustrate the links between each chosen concept and their findings. They record the information on large poster paper or whiteboards to enable the instructor and the librarians to more easily see the teams' ideas and the connections they have made; to interact with each group member and to query their choices; and to assist when there are uncertainties. Drawing on this work session, the groups present their findings in two ways: a short presentation and discussion of their data and an expanded research paper. Presentations take place before an audience of faculty, staff, and students knowledgeable about food insecurity who can challenge the students on their findings and underlying assumptions. The class and the audience discuss and compare the findings across all counties analyzed.[85] This discussion is used to inform the final paper, which is written in the style of a Cooperative Extension Service or Agricultural Experiment Station report[86] and appropriate for county-level decision-makers.

Critical Thinking Skills Assessment

Across the 2014 and 2015 classes, nearly half (48 percent) of the students responded to the course evaluation prompt "The instructor(s) encouraged me to think critically," to which all respondents agreed or strongly agreed. Yet, only 36 percent of these students identified a specific strength or improvement in the open-ended comment section. Even fewer remarked on the project itself; all of them indicated that they had learned more about the agrifood system than expected. For instance, respondents stated, "The sessions at the library were a great way to introduce new methods of demographic analysis" and that they "appreciated the semester-long project tying all of the concepts together." To obtain more in-depth reflections, the instructor and librarians developed a series of eight open-ended questions. Students were asked to identify the most important theories, concepts, and data for understanding the wicked problem of food insecurity and to identify data limitations, missing elements, and skills that might be used in another context. Substantive responses of approximately 50 words were requested. Data were collected in 2016 (N = 15), 2017 (N = 11), and 2018 (N = 14), at the end of the semester, as an extra-credit assignment.[87] To assure uniformity, the authors coded the first year of responses separately, met to discuss differences and reach consensus, and then recoded all data.

Table 2.
Critical thinking rubric

	Dualistic/ monosolutional thinking	Multiplistic/ relativistic thinking	Systemic thinking/ contextual thinking
Problem identification	• Little recognition of context beyond the self.* • Viewed with concrete operational lens.* • Lacks description and/or clarity, and does not acknowledge abstract circumstances.‡	• Accepts that context matters.† • Some complexity recognized, and identifies some factors.‡ • Some uncertainties about the circumstances, but the factors may be undefined and/or unexplored.‡	• Expresses views beyond own context.* • Understands complexity and the intersection of multiple factors.*‡ • Describes circumstances using "social facts" that are embedded in a context and a history.#
Data	• Information is received from an authority and goes unquestioned.*† • Simple to obtain using one method. • Rejects ambiguity.* • Assumptions about "facts" and "truth" not recognized.‡	• Information is received from multiple sources, including opinion-based ones, and acknowledges exceptions.*† • May require multiple methods to obtain. • Accepts some ambiguity.* • Aware of some assumptions and may question some "facts."‡§	• Information is contextual, and there are multiple ways of knowing.* • May be difficult to obtain, thus requires multiple methods. • Tolerates ambiguity.* • Questions data selection and assumptions about the data.*‡ • Acknowledges social influences on "facts" and shows awareness of reasoning errors—generalizations, reductionism, and ecological fallacies.§

Synthesis and analysis	• Lacks knowledge of contributing and multifactor causality.* • Uses single factor or source to specify one correct answer.*†	• Recognizes some multifactor connections to abstract concepts.§ • Uses multiple factors and sources for some logical interpretation.‡	• Makes multifactor connections between a range of abstract concepts.§ • Uses multiple factors and sources to develop a logical set of possible explanations.*
Discussion and conclusions	• Simplistic and obvious, and/or based on anecdotal evidence.*‡ • "Truth" seen as an absolute.*† • Judgment based on pre-reflexive reasoning and may be inconsistent with findings.*‡ • Oversimplified views solved with a single solution.‡	• Some gaps due to data selection bias or use of unconnected evidence.*‡ • "Truth" seen as undeterminable.*† • Judgment responsive to some assumptions, bias, and/or aspects.*‡ • Finds more than one solution, or no solution, to a problem.†	• Identifies patterns in data and understands the role of social forces in producing patterns.# • "Truth" is seen, at least partly, as a social construction.* • Judgment based on reflexive reasoning and acknowledges probability and limitations.*‡ • Considers multiple possible solutions that are logical and based on an informed evaluation.‡

*Adapted from Keith A. Roberts, "Ironies of Effective Teaching: Deep Structure Learning and Constructions of the Classroom," *Teaching Sociology* 30, 1 (2002): 1–25.

†Adapted from William S. Moore, "Understanding Learning in a Postmodern World: Reconsidering the [William] Perry Scheme of Intellectual and Ethical Development," in Barbara K. Hofer and Paul R. Pintrich, eds., *Personal Epistemology: The Psychology of Beliefs about Knowledge and Knowing* (Mahwah, NJ: Lawrence Erlbaum, 2002), 17–36.

‡Adapted from Association of American College & Universities' Critical Thinking VALUE (Valid Assessment of Learning in Undergraduate Education) Rubric, https://www.aacu.org/value/rubrics/critical-thinking.

§Adapted from Christine L. Himes and Christine Caffery, "Linking Social Gerontology with Quantitative Skills: A Class Project Using U.S. Census Data," *Teaching Sociology* 31, 1 (2003): 85–94.

#Adapted from Amy M. Burdette and Kerry McLoughlin, "Using Census Data in the Classroom to Increase Quantitative Literacy and Promote Critical Sociological Thinking," *Teaching Sociology* 38, 3 (2010): 247–57.

Drawing on the Perry Scheme, a continuum of stages of intellectual development devised by the educational theorist William Perry;[88] on the Association of American College & Universities' "Critical Thinking VALUE (Valid Assessment of Learning in Undergraduate Education) Rubric";[89] and on the literature more broadly, the authors developed a rubric identifying three levels of critical thinking. As seen in Table 2, "dualistic/monosolutional" responses are the least critical and included those presenting a single factor as a cause or solution. Responses that showed multiple points of view or a range of factors, causes, or solutions were coded as "multiplistic/relativistic." Responses coded as the highest level of critical thinking were those that displayed both an awareness of "complex systems and dynamics" and ability to apply the concepts.

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Analysis and Findings

Nearly all (n = 39, 97.5 percent) students chose to answer at least some of the open-ended, extra-credit questions. Most respondents were female (n = 28, 71.8 percent). Student standing was evenly split between juniors (n = 17, 43.6 percent) and seniors (n = 18, 46.2 percent); the remaining were sophomores (n = 5, 12.8 percent). While students came from a broad range of majors, more than a third (n = 14, 35.9 percent) pursued a minor in sustainability studies.

Responding to a question about the social factors most important to understanding the wickedness of food insecurity, approximately half (n = 20, 51.2 percent) provided a single answer or an oversimplified list of variables. Yet, close to a third (n = 12, 30.8 percent) acknowledged the complexity of food insecurity by stating, for instance, that it is difficult to understand complicated social factors such as persistent poverty, how these factors are influenced by the historical context, and how they intersect with the structure of agriculture and the broader economy. Another 17.9 percent (n = 7) of students articulated the importance of systems thinking, focusing on the influence of global supply chains, agricultural markets, distribution of wealth, and federal policy. As one student stated, it "is a systemic problem and it's every issue put together." Only two students (5.1 percent) continued to blame residents and their reliance on government assistance as reasons for food insecurity.

When asked what idea, concept, or theory helped them think more deeply about food insecurity and contextualize the problem, over 20 percent (n = 7) of responses were reductive, focusing solely on such topics as transportation or obesity. Moreover, two responses were culturally based; in referencing Southern tradition and identity, they alluded to issues of race and class that are embedded in the region. Nearly two-thirds (n = 22, 59.5 percent) of students provided a more sophisticated, multifactor response. They often drew on the experiential field trip and the use of an evaluation tool (that is, the USDA Thrifty Food Plan Market Basket list); the connections between food deserts, food quality, and obesity; or the relationship among supply chains, marketing, and food

Table 3.
Coded responses

Question	Dualistic/ monosolutional responses (%)	Multiplistic/ relativistic responses (%)	Systemic thinking/ contextual thinking responses (%)	n
1. Most important factors for understanding food security.	20 (51.2)	12 (30.8)	7 (17.9)	39
2. Most helpful idea, concept, and/or theory for explaining food security.	7 (18.9)	22 (59.5)	8 (21.6)	37
3. Most helpful data collection method and/or library resource.	21 (55.2)	17 (44.7)	0 (00.0)	38
4. What was learned about the power and limitations of data.	8 (21.0)	18 (47.4)	12 (31.6)	38
5. Element(s) that should be added to the project.	23 (62.2)	12 (32.4)	2 (5.4)	37
6. How/what would be done differently next time.	11 (29.7)	22 (59.5)	4 (10.8)	37
7. Skills that will be used outside class.	21 (56.8)	10 (27.0)	6 (16.2)	37
8. Lessons or surprises about food security.	14 (36.8)	8 (21.1)	16 (42.1)	38
Total	**125 (40.3)**	**121 (39.0)**	**55 (17.7)**	**310**

availability. Moreover, another 21.6 percent (n = 8) focused, as one student put it, on a larger "complex web of interactions" and questions of fairness that emerge from the processes of capitalization, agroindustrialization, and globalization.

The next question invited respondents to reflect on the information-gathering process, which is central to the critical thinking necessary to formulate a position. More than half (n = 21, 55.3 percent) of respondents were monosolutional, indicating that only one of the data collection methods or library resources was most helpful in learning about food insecurity, namely the USDA "Food Environment Atlas." This tool was perceived as the easiest to use, a source of one-stop information shopping, and valuable for its visualization platform. The remaining students (n = 17, 44.7 percent) were multiplistic in their responses, but several (n = 5, 29.4 percent) also shared this preference for the "Atlas," acknowledging, for instance, that it "introduced more social issues contributing to food security." Over half (n = 9, 52.9 percent) of the students in the multiplistic group focused on the information generated from the Thrifty Food Plan Market Basket, calling it "more tangible" and "more real-time." Essentially, they gravitated toward the hands-on experience of primary data collection because it provided a means of seeing "data as more than just numbers."

The fourth question asked, "What do you feel you've learned about the power and limitations of data to define a complex problem like food access and availability?" Monosolutional responses (n = 8, 21.0 percent) focused on the existing data, describing the collection process as "grueling." These responses tended to illustrate a dislike for variable ambiguity and focused on the idea that data could or ought to be "perfect." A student who captured this sentiment stated that the U.S. Census of Agriculture was difficult to use because "the items that were studied changed from 1850 to 2012." Another student admitted to simply ignoring any variable that was not consistent across the years. A more nuanced, multiplistic response acknowledged important reasons for variable definitions, such as "our concept of race has changed." Close to half (n = 18, 47.4 percent) of respondents fell into this latter group, and most focused on the necessity of multiple data sources, as well as on an effort to collect primary data. One stated, "You can't really understand . . . until you actually go to the county." Nevertheless, almost a third of participants (n = 12, 31.6 percent) were critical of the data overall. While acknowledging the power and importance of the information, they also recognized that quantification of system complexity and context (for example, the power of the agrifood industry or influences on food buying behavior) would always be partial.

Many students (n = 23, 62.2 percent) offered a limited response to a question about what might be "missing and ought to be added to the project." More than half (n = 12, 52.2 percent) appeared uncomfortable with ambiguity and desired not just an easier project but also more instructions and guidelines, as well as more explicit connections between assignments. Some students appeared uncertain about their ability to work with "just data." However, a recommendation from the multiplistic group suggested that the problem lies in the limited opportunities for in-class presentation. These students indicated that additional question and answer sessions "would give students the ability to present their findings to their peers and get feedback that would strengthen their final report." Further differentiating, the multiplistic group (n = 12, 32.4 percent) was predominantly interested in additional survey and data collection (n = 9, 75 percent),

especially from on-site visits, tours, and formal meetings "with members of the county municipality." Only two students (5.4 percent) provided systems-based responses, both wishing to expand their broader contextual knowledge of the setting.

Nearly 30 percent (n = 11) offered a dualistic response to the question asking, "If you were to do this specific food security project again, from the beginning, how and/or what would you do differently?" Of these responses, most gave a utilitarian reply (n = 8, 72.7 percent) that focused on time management, but five (45.5 percent) wanted more data, stating, "You can never have too much." Twice as many students (n = 22, 59.5 percent) provided a multiplistic response, most (n = 17, 77.3 percent) driven by a desire for more quantitative or qualitative data or both. However, this wish for additional data was coupled with a desire to improve their ability to make comparisons. In fact, students in this group tended to focus on the importance of "connecting the readings with data," making such statements as "I would give more attention to understanding the entanglement of the assignments with the books we were supposed to read." This latter group seemed to have moved toward, but not quite achieved, systemic ways of thinking. Only a few students (n = 4, 10.8 percent) exhibited systemic thinking, but they each recognized, on reflection, that the information garnered throughout the project illustrated the complexity of the Black Belt.

Next, students were asked to identify specific skills from this class that they will use in their studies now or after they graduate. A variety of technical competencies and soft skills were identified. However, more than half (n = 21, 56.8 percent) of the responses were dualistic answers that focused on utilitarian aspects, such as general research skills for obtaining more data, organizational abilities for "sifting through large amounts of data," and communication skills for presenting data. More nuanced responses came from the multiplistic group (n = 10, 27.0 percent). They, too, focused on data collection but also identified problem-solving and analysis skills that will be "helpful in high-level classes where independent learning is favored." Only 16.2 percent (n = 6) of students exhibited systemic thinking, yet they all articulated the critical nature of context and the use of multiple data sources to develop an informed opinion. An example of the latter indicated that an important skill learned was "to make connections, understanding that everything influences something and dissecting how, where, and why are very important." Another focused on inquiry and evidence-based learning, stating, "I thought this class being sociology type would encourage more opinions however I quickly learned that it still must be professional especially when discussing serious social issues."

Lastly, students were asked to share "lessons or surprises about food access and availability." More than a third (n = 14; 36.8 percent) provided a one-dimensional response; 57.1 percent (n = 8) of this monosolutional group identified gaps in knowledge about food insecurity, specifically lack of education. While a couple of students maintained a narrow focus on the residents and their "poor" food choices, most respondents reflected on themselves, stating that they "never thought such an issue would be so close to home." Others focused on the public more broadly, calling it "a far larger problem than most Americans realize with millions struggling to get nutritious meals." Approximately a fifth (n = 8, 21.1 percent) of responses were classified as multiplistic. These students made connections to a specific dimension or type of data, particularly transportation and the overall scarcity of food retailers. The largest group of responses (n = 16, 42.1 percent)

were contextual. This latter group indicated that "food insecurity doesn't look a certain way" and that the issue is more complicated than simply hunger and scarcity. For instance, participants indicated that "food insecurity in rural Alabama" is embedded in a "vast network" of "cultutral [*sic*], economic, environmental, and historical currents that have been driving and creating the events" and are "beyond the control of individuals in certain communities and geographic areas." Others went further, taking the "Southern context" to task, stating, "In nearly 150 years, we've never truly corrected the wrongs of institutionalized slavery."

Discussion

Rebekah Massengill argues that students tend to start college as "dualistic thinkers," unable to evaluate perspectives outside their own or to understand other perspectives as legitimate.[90] This thought pattern is the result of cognitive gaps that make it difficult to link personal troubles to larger public issues or to manage a high degree of abstraction. After completing the Community Food Security Assessment of Alabama's Black Belt, only one student (n = 39) failed to make any connections between food and social structure. The student expressed disdain for "poor" food and dietary choices, as well as dependency on the nutritional programs (that is, SNAP) found most likely to improve both the economic and health outcomes of the poor. Moreover, the student's commentary displayed little understanding of food insecurity, asserting that consumers "don't need super healthy food to stay healthy"; therefore, they ought to buy what is necessary and "eat enough to survive." No other student echoed this sentiment, even among those (n = 10, 26.3 percent) who were predominately dualistic in their thinking. Overall, the large number of multiplistic or systemic responses (n = 181, 59.5 percent) suggest that the course participants used a range of information sources to gain an understanding of the wickedness of food insecurity.

Acknowledging the varied dimensions and complexities of food insecurity was seen most clearly in students' interest in the data collection process generally and in acquiring additional data specifically, as well as their concern for creating meaning from their data. "Critical sociological thinking," Patti Caravello and her coauthors argue, requires discipline-specific reference and database literacy.[91] While some preference for simplicity remains (that is, secondary data aggregated in the "Food Environment Atlas"), 78 percent (n = 30) of students surveyed, none of them rural sociology majors, favored the data sources, tools, and analysis introduced during the project. Some learners conveyed concern about floundering through the material and uncertainty about the procedures used,[92] but they also recognized their own growth in understanding the research process, including the use of varied information sources. Respondents stated that they learned no one source could be perfect, necessitating a need "to take a holistic approach to research and [to] be willing to add external data and sources." Moreover, previous struggles "conducting quality research from sound sources" were acknowledged, indicating that "this project really helped . . . assess and internalize data." Others claimed that the material and the techniques learned would be applicable to future courses or work in their respective fields of study because they learned to find "the best quality data" and to "think deeper."

Interacting with the real world, especially with people in the county itself, had the greatest appeal in terms of data collection. In fact, almost 65 percent (n = 24) of students requested supplemental trips to their assigned county or to another county for comparison. Speaking for many, a student claimed, "You can't really understand this project until you actually go to the county." It might be argued that on-site observation is simply a dualistic approach,[93] but it is certainly not the "path of least resistance."[94] Primary data collection is time-consuming and energy-intensive. As another student stated, "By the time i [*sic*] got to the store, i [*sic*] was in the car for ~2.5 hours and worn out, but I wish I had done more exploring." More importantly, the fieldwork provided a tangible way for students to see beyond their own cultural context,[95] to look outside themselves, and to grasp other than individual explanations for food insecurity.[96] This sentiment was captured by students stating that "the concept of having to drive long distances to get below standard grocery store quality was eyeopening." Several others focused on the root causes of food insecurity by questioning those who profited, such as organizations that dominate the supply chains.[97] Students indicated, for instance, their surprise to see firsthand the "marketing and lobbying practices of mega food companies and their effect on people." Visiting their counties gave a real-world context to students' secondary data and helped them construct the story of what was happening.

Several students admitted that they wanted, at least initially, data to confirm an opinion,[98] but most sought additional insight or reflected on the experience of generating new knowledge. An example of the latter was a student who learned to "be careful not to generalize concepts such as poverty and food security and [to] make sure to understand that those concepts are different for every community I do research in." The preference for "social facts" is an important step toward not only an appreciation of context but also an understanding that context is a product of history and a means for comparison.[99] Students sought data beyond the project—the content of school lunches, the numbers of food banks, descriptions of living conditions, and the status of the judicial system. Moreover, their attention to data was an important part of critical sociological thinking about county-level phenomena. These data were necessary to understand the economic, political, and other institutions and the social forces, such as race, class, and gender, that shape the circumstances, choices, and troubles of the community.[100] Developing an awareness of the complex systems and dynamics at play, and the revelation that there is a need for outside sources to grasp an understanding of these complex systems, display the highest order of critical thinking skills. While less than 18 percent (n = 55) of all responses were classified as systems or contextual thinking, several students reflected on their shortcomings, noting, in particular, their weaknesses in processing abstract ideas and wishing to "better connect data and concepts."

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Conclusion

Numerous pedagogical papers espouse the importance of teaching critical thinking. But, as Roberts states, this learning ought to "go *well beyond* content" (emphasis in original) to include "deep structure objectives."[101] These deeper aims are to facilitate an understanding of the importance of rigorous and systemic study, including the use of multiple variables and a thesis supported with evidence; an appreciation of the complexity of causality; and insight into the social constructedness of "truth."[102] However, several questions about the teaching of critical thinking skills have been raised. For example, there are concerns that these skills are taught outside content-specific areas.[103] Assessment raises another concern. Beyond appraisal of general skills via experimental design, the teaching of critical thinking has not been fully evaluated.[104] There is little evidence that learners truly receive the training they need. One way to guide students is to embed active learning and application of knowledge into the structure of a course.[105]

Rather than assign a standard term paper, typically completed outside of class on an individual basis, Food, Agriculture, and Society (RSOC 3190) was designed in a semi-flipped format to make possible the integration of a guided, semester-long, group research project. The project included scaffolded assignments that provided successive levels of support and were linked conceptually to the course readings and lectures.[106] Students practiced rigorous data collection by gathering qualitative (for example, history, location, and geographic features) and quantitative (for example, socioeconomics, agricultural production, food environment, and health indicators) information about their assigned county. Participants practiced data analysis when they conducted a systematic assessment of their information to identify key factors that cast most light on the county food environment. Learners grappled with complexity as they practiced data interpretation and connected their findings to the course material, such as lectures and assigned readings, and to the findings of other county groups to explain the possible causes of food insecurity. At each step, students confronted their assumptions about the information that they used, the "facts" about who will most likely be food insecure, and the challenges faced by those who live in Alabama's Black Belt, especially poor and minority populations. Leading students through this complicated case study provided an opportunity to expose students to the types of information sources that can bring broader social structures to light and to use the data from these sources to highlight issues of equity and justice, which are core values of the discipline of sociology.[107]

At each step, students confronted their assumptions about the information that they used . . .

The role of both librarians and faculty is to facilitate students' transition away from dualistic and monosolutional thinking about complex issues, and to help them move instead toward more sophisticated, thoughtful consideration of wicked problems using outside evidence and sources.

The role of both librarians and faculty is to facilitate students' transition away from dualistic and monosolutional thinking about complex issues, and to help them move instead toward more sophisticated, thoughtful consideration of wicked problems using outside evidence and sources.[108] To gauge the success of this shift, students were asked to respond to a series of open-ended questions about the project. These reactions were analyzed using a range of definitions from the LIS and sociology literatures (see Table 2). Nearly 60 percent of responses, overall, were multiplistic or systemic (see Table 3). These results suggest that many students acquired at least some of the information literacy and critical thinking skills necessary to assess the data, such as to consider the possible influence of data collection practices, to understand the usefulness of the information assembled, and to recognize gaps in the data available. Some students even showed an appreciation for the social constructedness of various data categories and acknowledged the limits of data in understanding the context and complexity of food insecurity.[109] Perhaps more important, at the conclusion of the project, learners were more inquisitive and evidence-minded. They were more willing to work through the inherent ambiguities of the research process, including the information sources that were used, and more persistent in problem-solving.[110]

Faculty-Librarian Collaboration

This project was possible because of sustained collaboration between research librarians and research faculty and because of a high ratio of faculty and librarians to students. The instructor and librarians meet regularly to discuss problems, successes, alternative approaches, and future improvements, and to make project adjustments accordingly. However, the sustained contact with students throughout the project had the greatest influence and was most vital to its successful completion. As Brendan Howley suggests, the role of libraries in their communities makes them ideal candidates for bringing data and stakeholders together to explore critical problems that shape society.[111] Librarians are uniquely situated to introduce students to multiple data sources, to explain the nuances of the resources, and to highlight issues that ought to be considered when using them. Thus, the library sessions facilitated students' own discovery of the dimensions of food security, as well as their grasp of the underlying dynamics associated with the "wickedness" of food insecurity. An unintended consequence, not considered in the original course design, was that students saw, firsthand, librarian-faculty collaboration. This teamwork provided a model for students' behavior, as well as a point of reference that illustrated the value of soliciting multiple viewpoints via brainstorming and discussion, leveraging multidisciplinary backgrounds, and drawing on collective intelligence.

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Limitations and Recommendations

While a goal of the project was to transition all students into "systems thinkers," several intervening and interrelated characteristics limited this transformation. First, methods need to be considered. The coding may have been overly conservative. A student's response had to fit clearly within a multiplistic or systemic category to be coded as such; questionable responses were ranked lower. In contrast, administration of formalized pretests and posttests may aid in tracking and attributing improvements in critical thinking skills.

Second, the respondents' background may influence the ranking. Each student started from a different place: few had any training in the discipline, and none majored in rural sociology. Thus, RSOC 3190 is taken strictly as an elective. As most instructors recognize, students tend to pay more attention to courses in their major and to avoid electives that seem difficult or time-consuming. Results could differ in a traditional setting, especially in cases where the skills can be codified in student learning objectives that reach across the major. Another consideration is that some students may need more time and experience to develop and demonstrate critical thinking skills. Thus, a longitudinal assessment would be better positioned to track whether students have learned to think more abstractly[112] and to transfer their newly acquired information literacy skills to assignments and real-world situations beyond the course.

Lastly, the relatively small course sizes also meant that the surveyed population was small. To generalize more broadly beyond this course and this project will require investigation of similar projects, including those at other institutions in similar settings. In most cases, especially in colleges of liberal arts, faculty tend to have a larger number of students per class, more sections of a course per year, or both, even among some upper-division curricula. Increasing the course size will decrease the ability of faculty to provide extensive written feedback on each assignment and reduce librarians' ability to provide individualized attention. Nevertheless, to gain a better understanding of the role of this project, as well as that of similar projects, future studies ought to assess the development of critical thinking skills in larger, advanced courses over longer periods.

Acknowledgments

We thank the courageous students in RSOC 3190 who contributed to this study not only as participants but also as junior researchers who generated new knowledge in the process of conducting their assigned individual and group research projects.

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