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A Qualitative Study of Agricultural Literacy in Urban Youth: Understanding for Democratic Participation in Renewing the Agri–food System

Alexander J. Hess, Career–Technical Education Teacher
Davis High School, California
Cary J. Trexler, Associate Professor
University of California, Davis

Modern agriculture poses ecological problems and opportunities, which defy simple democratic reform without an educated citizenry. Developing an educated citizenry can be accomplished by further developing agricultural literacy in elementary education. While benchmarks for agricultural literacy have been produced, relatively little attention has been focused on how students conceptualize the food system. Using Piaget's theories of schemata development, this study compared students' understanding of agriculture to grade–specific benchmarks for agricultural literacy to uncover relationships between students' backgrounds, experiences, and understandings of the agri–food system. The population consisted of 18 elementary students from Long Beach, California. Data was collected via 45–minute semi–structured interviews. While almost half had been on field trips to a farm or visited a garden, none had ever grown a plant or raised an animal. Students' ideas about agriculture were often guesses, underdeveloped, or contradictory to expert conceptions. Students failed to convey an understanding of the types and variety of farms, the purpose of farms, or the cultural practices dominating conventional farming. Results suggest that educators should focus on existing underdeveloped schemata to help learners construct viable ideas about modern agriculture supported by contextually rich formal and informal agricultural experiences.

Keywords: agricultural literacy, elementary students, constructivism, schema, food systems

Introduction and Theoretical Framework

Humans are dependent on agriculture to meet many of their basic needs. Inherent to agriculture is its conflict with nature. Agriculture uses habitat, soil, and water and often creates externalities of production (e.g., excess nitrogen, siltation, and aquifer depletion). Additionally, agricultural productivity relies heavily on practices (e.g., selective breeding, cultivation, and genetic engineering) to control nature's diversity and variation (Batie, 1990). Agriculture can also be harmonious with natural systems and even act as a technology to improve environmental quality (Hrubovcak, Vasavada, & Aldy, 1999; Robertson & Swinton, 2005). Past agricultural practices, however, have not always been environmentally friendly, and in recent years, the general public has voiced greater concern about agri–food system impacts and sustainability (Berry, 1990, Pollen, 2006). As public discourse focuses on agri–food system reform, it becomes increasingly important for citizens to understand this complex system to engage in democratic decision–making processes. Formal education, beginning in elementary and through high school, seems to be a logical means by which to help people develop agri–food system understandings that would be a foundation for well–reasoned debate.

As citizens debate the trade–offs inherent to the agri–food system, an increasingly deeper understanding is required. In discussing societal renewal, John Dewey (1916) argued for formal education to diffuse acquired knowledge: "As societies become more complex in structure and resources, the need for formal or intentional teaching and learning increases" (p. 9). Aligned with Dewey, agricultural educators have recognized the need for education to prepare citizens to make sense of agri–food system complexities. Agricultural educators' thinking about knowledge and understandings needed to understand the agri–food system has evolved over time. In the early 1990s, agricultural education researchers sought to define agricultural literacy and ferret out key agricultural concepts underpinning the definition. Frick, Kahler, and Miller (1991) suggested that agricultural literacy entailed "the understanding and knowledge necessary to synthesize, analyze, and communicate basic information about agriculture" (p. 52). In 1999, the National Council for Agricultural Education (1999) defined goals for literacy in terms of a person becoming "conversationally" literate about agriculture, while Meischen and Trexler (2003) broadened the definition of *agricultural literacy* to include science– and technology–related concepts "required for personal decision making, participation in civic and cultural affairs, and economic productivity" (p. 44) manifested through public debate. As the definition of *agricultural literacy* continues to evolve, so shall its content and concepts.

Calls for agri–food system literacy have come primarily from two disciplines: science and agriculture education. In science education, the American Association for the Advancement of Science published *Benchmarks for Science Literacy* (1993, 2007) that defined content necessary for K–12 children to understand the scientific and technological underpinnings of the agri–food system. Similarly, agricultural educators published *A Guide to Food and Fiber Systems Literacy* (Leising, 1998) and defined what K–12 children should know about agri–food systems. Both documents promote the integration of multiple disciplines and a softening of barriers across domains to help students gain the requisite knowledge and understanding needed for democratic participation within the agri–food system. To understand how conceptual frameworks underpinning the agri–food system are acquired requires one to look at learning from a constructivist theoretical perspective.

Cognitive psychologists Piaget (1950) and Ausubel, Novak, and Hanesian (1978) theorized that learning is based on the integration of new perceptions and ideas into existing conceptual frameworks called *schemata*, while Bereiter (1994) suggested that learning occurs when individuals reconstruct their schemata. Schemata represent the mental patterns of interconnected information people hold about a topic. Schemata are constructed, deconstructed, and reconstructed to form new schemata. In other words, ideas or concept construction rely on the integration of new knowledge with existing knowledge structures. Constructivists view learning as a continually active process that occurs through interpretation of experience (or information) against the backdrop of past experience and existing knowledge (Bransford, Brown, & Cocking, 1999).

Integration of new knowledge and understanding requires challenges to existing knowledge structures, which allow for new ideas to be incorporated into preexisting schemata through a process of accommodation or assimilation (Piaget, 1973). From a constructivist perspective, educators promoting conceptual change seek to create disequilibrium in a learner's existing schema to force construction of new, more sophisticated understandings. In formal education, learning can be thought of as the alignment of a learner's schema to a specific goal conception. For this to happen efficiently, educators must gain insight into what learners already understand to help learners develop new or modified conceptions more closely aligned with the goal (Bransford et al., 1999).

In this study, constructivist theoretical perspectives and concomitant research methods are used to delve deeply into what elementary students understand about agriculture. Science and agriculture educational benchmarks (goal conceptions) provide a framework for the exploration of foundational knowledge and understanding that scaffold the construction of schema needed for democratic participation within the agri–food system.

Purpose and Objectives

This study sought to determine elementary students' understandings of agri–food system concepts. The study's objectives were to (a) determine informants' backgrounds and agriculture experiences, (b) compare informant understandings of agriculture to expert conceptions of grade–specific benchmarks and benchmark sub–concepts for agriculture literacy from science and agriculture frameworks, and

(c) ascertain if themes or commonalties exist among informants with regard to their backgrounds, experiences, and understandings of the agri–food system.

Methods and Procedures

Population

The study included 18 informants from Long Beach, California. Upper elementary (grades 4 through 6) students were selected because they had reasonably well–developed language skills and were the same age as informants in similar studies on this topic. Individual students were selected based on gender, ethnicity, location, and type of residence to complement previous studies and reflect demographics of this study's local urban schools. This was accomplished by working with the Boys and Girls Club of Long Beach, California. The program's director recruited 10– and 11–year–old volunteers from the club's summer program. Compensation of $300 was provided to the Boys and Girls Club for the benefit of all members. No participant received any direct compensation. Letters explaining the study's purpose and parental consent forms were sent home by the summer program director. All participants came to the interviews with signed parental consent forms and were read an age appropriate explanation of the interview protocol. The University of California, Davis Institutional Review Board, approved all procedures followed in this study.

Interview Protocol

Semi–structured interviews were used to elicit informant agri–food system understandings and identify states of cognitive development (Trexler & Roeder, 2003). Interviews were 45 minutes in length and were audio and videotaped. Audiotapes were transcribed, serving as the primary data source. Videotapes were used to determine nuances in the informants' speech. In addition, field notes were analyzed as secondary data and participants were asked to confirm responses for triangulation purposes. Confirmation came at the conclusion of the interview as the researchers re–read interview field notes and asked the informants' if the researchers' interpretations of their responses were accurate.

The interview protocol was developed based on Trexler's (2000) synthesis of AAAS's (1993, 2007) *Project 2061 Benchmarks for Science Literacy* and *A Guide to Food and Fiber Systems Literacy Framework* (Leising, 1998). Relevant K–5 grade–level benchmarks guided questioning and were the basis for analysis.

Analysis of Data

To promote trustworthiness of results, researchers employed established qualitative methods. First, to bring forth potential biases, the authors were both high school agriculture teachers and are now currently agriculture teacher educators with particular interest in agricultural literacy. Second, during each phase of study, methods were employed to minimize potential biases by use of independent review and peer verification procedures.

Analysis of data involved four phases and was modeled after Hogan and Fisherkeller's (1996) study that explored elementary students' understanding of a complex scientific concept: *Nutrient Cycling in Ecosystems*. In the first phase, expert propositions for the agri–food system and related sub–concepts were developed and were validated by experts from science and agricultural education. Expert propositions, based on Trexler's (2000) benchmark synthesis, were used as goal statements for comparative analysis.

In the second phase, interview responses were translated into representational propositions. Interview transcripts and investigator notes were used to write representations of informant propositions. Drafts were compared to recordings to refine propositions and confirm interpretations. Peer review processes were used to confirm the accuracy and trustworthiness of informant propositional statements. An expert was asked to randomly select any two propositional statements, listen to recorded interviews, and read propositional statements prepared from the interviews. Validation of propositional statements required 100% agreement of codings between the researchers and the external expert. If 100% agreement was not met, data were reviewed again, revisions made, and the processes repeated.

The third phase focused on coding informant responses. Sophistication of informant thinking about a given goal's conception was judged for each benchmark along two dimensions: quality (compatibility) and depth (elaboration of response) in comparison to the expert proposition. Informant understandings were assigned codes based on this bimodal coding scheme (Hogan & Fisherkeller, 1996). Table 1 presents the bimodal coding scheme used to determine the compatibility of informants' responses with the expert propositions.

Table 1
Coding Scheme for Comparing Informant Propositions to the Expert's

Code	Description
Compatible elaborate (CE)	Statement concurs with the expert's proposition and has sufficient detail to show the thinking behind the concepts articulated
Compatible sketchy (CS)	Statement concurs with expert proposition, but essential details are missing; bits and pieces of facts are articulated but are not synthesized into a coherent whole
Compatible/incompatible (CI)	Sketchy statements are made that concur with the proposition but are not elaborated on; at times, statements contradict proposition
Incompatible sketchy (IS)	Statements disagree with the proposition but provide few details and are not reoccurring; responses appear to be simply guesses
Incompatible elaborate (IE)	Statements disagree with proposition and informants provide details or coherent, personal logic supporting them; same or similar statements/explanations recur throughout the conversation
Nonexistent (N)	Informant responds "I don't know" or does not mention the topic when asked a question calling for its use
No evidence (Ø)	Topic was not directly addressed by a question and the informant did not mention it within the context of a response to any question

Informant responses were also coded numerically based on a comparison of responses to underlying benchmark sub–concepts. To ensure trustworthiness and credibility of coding, another researcher coded the sub–concepts independently. Prior to coding, intercoder reliability was set at a correlation coefficient of (r = .90) and actual correlation coefficients were above (r = .93).

The final phase of analysis sought confirming and disconfirming evidence of patterns among individuals (Huberman & Miles, 1994). First, benchmarks were analyzed across individuals. Second, portraits of informant thinking were analyzed to ascertain how understandings influenced understanding of another benchmark and, ultimately, the goal conception. The last step used the constant comparative method to analyze patterns developed across and between participants' responses to flesh out specific commonalities (Glaser & Strauss, 1967).

Findings

Research Objective One: Informants' Backgrounds and Experiences

Background. Race, gender, age, and grade–level demographics were collected. Gender and race were determined by the investigator's visual observation. Ten informants were girls, and eight were boys. Of the ten female informants, nine were African American and one was Hispanic. Seven male informants were African American, and one male informant was Caucasian. Ages ranged from 9–11 years of age. At the time of the interviews, informants were enrolled in public schools with traditional academic year schedules. Nine informants were entering the sixth grade. Eight informants were entering the fifth grade. The last informant was entering the fourth grade. All informants were raised in a major urban metropolitan area.

Agricultural experiences. During interviews, informants described the origin of cheeseburger components and if they had been to a place similar to what they described. For example, some informants said tomatoes came from gardens. As a result, conversations turned to gardens. This information was used to determine informants' agricultural experiences.

A school–based field trip and visiting a relative's garden were mentioned most frequently as an agriculturally related experience. Of the group, eight informants had gone on a field trip to a farm, and seven had had an experience in a garden. Three informants discussed a visit to their grandparents' family farm. One noted a visit to a "dirt farm," where her aunt kept a horse. One informant discussed a school–site presentation by a Mobile Dairy Education Unit. Three informants had no agricultural experiences, and no informant grew plants or raised animals.

Research Objective Two: Comparison of Informant Understandings to Expert Conceptions, Grade–Specific Benchmarks, and Benchmark Sub–concepts

The concept "what is agriculture?" framed the study. The three agriculture benchmarks included in this concept were to (a) identify a variety of farms and their products, (b) describe basic needs farms provide, and (c) describe local agriculture. Initial questions for informants were based on what they understood about the components of a cheeseburger. The informants' prior knowledge of the cheeseburger served as a basis for initial conversations, which then led to more a deeper exploration of what informants understood about the agri–food system.

Benchmark 1: Identify a variety of farms and their products. Informant responses were analyzed for benchmark sub–concept language and were compared to the expert's goal conception for bimodal coding. A superscript number represented the total number of sub–concepts addressed. Sub–concepts for this benchmark were (a) animal–based production operations, (b) plant–based production operations, (c) animal and plant production combinations, (d) size or variety in scale of operations, and (e) ownership type. Table 2 presents informant codings for identifying a variety of farms and their products.

Table 2
Informant Coding for Benchmark 1 and Benchmark 1 Sub–concepts

	Informants						
Sub–concept	Alicia, Sandi, Delaine, Lynn, Logan	Lilly, Montie, Art, LeMarr	Parker	Denise, Nancy, Suzanne, Paul, Greg	Trisha	Victor	Virginia
Animal crop	X		X	X			X
Plant crop			X		X		X
Ani & plant		X	X			X	
Size or scale							
Ownership							
Codings[a]	CS^1	CS^1	CS^3	CI^1	CI^1	CI^1	CI^2

Note. A "X" indicates that the sub–concept was addressed.
[a.] The superscript represents the total number of sub–concepts addressed by the informant

In terms of sub–concepts, 12 informants (67%) used language related to animal–based farming operations. Six informants (33%) addressed diversified plant and animal farming operations, and three (17%) described plant–based farming. No informant used language congruent with describing variations in farm size or ownership.

Relative to the holistic bimodal coding, eight informants (44%) described farms in a *compatible incompatible* (CI) manner when compared to the goal conception. CI descriptions used words that were congruent with elements of the expert proposition but were not elaborated on. Further, CI informants expressed concepts that contradicted or opposed the goal conception. Virginia, an example of a CI code, discussed plant and animal products coming from a variety of farms that raised both plants and animals. At times, Virginia's descriptions were aligned with the goal conception, but incompatible concepts surfaced when she was asked to expand on her description. For example, Virginia described both plant and animal farms that were overly diversified and not aligned with most modern agricultural practices. Virginia's transcript is provided as an example of discourse from a typical CI informant:

INTERVIEWER (I): So [you mentioned earlier] there are animal farms and plant farms.
VIRGINIA (V): Mm hmm [yes].

I: OK, can you describe the plant farm for me?
V: Well, the farmer has seeds and he builds a whole row of dirt and he plants the seeds in a row, in each row and they come in separately so they won't get mixed up. They have each of the vegetables come in a different row.
I: OK, and can you describe the animal farm?
V: Well they also separate the animals too 'cause they don't want anything bad happening to them.
I: And what animals do they separate at an animal farm?
V: Chickens, roosters, sheep, pigs, cows, yeah.
I: Are there any plants on an animal farm?
V: Yeah, there's some like hay they buy for them to eat.
I: How about the plant farms? Are there any animals at the plant farms?
V: No.

Most informants (56%) described farms in a *compatible sketchy* (CS) manner when compared to the goal conception. CS descriptions were congruent with elements of the goal conception, but essential components were missing. Parker, coded CS, was asked follow–up questions after he described a historic farm he toured while in kindergarten. An excerpt from Parker's transcript is detailed below:

INTERVIEWER (I): OK. And so what kind of things do we get from a farm?
PARKER (P): We get eggs from chickens. We get milk and meat and cheese from cows. We get vegetables, and we get wheat and grains.

I: OK. And what was "tending the field"? What was he doing in the field?
P: At the farm, he was like plowing and the plowing is like . . . he attaches this thing to the back of his horse, and the horse pulls it and he was plowing the grain, harvesting the wheat, and picking vegetables.
I: OK. What else do we get from farms?
P: We get fruit. We get like apples, bananas—I don't know about grapes—oranges and pears.
I: And pears? Were these at the farm you toured?
P: Some, yeah.
I: Some of them were? OK. And do all farms have them?
P: No.
I: No. So there are different farms?
P: Yeah.
I: Why are they different?
P: They're different farms because usually like farms, they just specialize in one special thing.
I: Why do you think they do that?
P: Because they know that they . . . that's what they're better at, and they know that they're used to that so they can make more money doing just that.

Parker's descriptions of farms and farming operations were congruent with the goal conception, but did not address variation in farm size, ownership, nor modern mechanized production.

Benchmark 2: Describe basic needs farms provide. Informants were asked about biological and physiological needs of plants, animals, and humans and to describe the basic needs farms provided. Informant responses were analyzed for benchmark sub–concept language and compared to the expert's goal conception for coding. There were five sub–concepts for this benchmark: (a) food for people, (b) food for animals, (c) shelter for people, (d) shelter for animals, and (c) clothing (fiber, fur, or leather) used for human protection. Table 3 presents informant codings for describing the basic needs that farms provide.

Table 3
Informant Coding for Benchmark 2 and Benchmark 2 Sub–concepts

	Informants					
Sub–concept	Alicia and Sandi	Trisha, Montie, and Logan	Art and LeMarr	Nine (9) Informants	Virginia	Lynn
Food– people		X	X	X	X	X
Food– animals						
Shelter– people						
Shelter–animal					X	
Clothing			X			X
Codings[a]	N^0	CS^1	CS^2	CI^1	CI^2	CI^2

[a.] The superscript numeral equals the total number of sub–concepts addressed by the informant.

In terms of sub–concepts, analysis revealed that all but two informants, Alicia and Sandi, described farms as providing humans with food. Although several informants mentioned animals being fed by a farmer, no informant described farms as locations that produced food eaten by animals. With respect to *shelter* sub–concepts, only Virginia described farms as providing products used for shelter by humans *or* animals. For the last sub–concept related to clothing, three informants provided superficial descriptions that included the terms wool and fur.

Relative to the holistic bimodal coding, 2 of 18 informants (11%), Alicia and Sandi, were *nonexistent* (N) when propositional statements were compared to the goal conception. Alicia and Sandi failed to address any sub–concept, even in an incompatible manner. Five or 28% of informants were coded CS because their responses concurred with the expert proposition, but essential detail and key sub–concepts were missing (e.g., discussion of timber products for shelter or plant fibers for clothing). LeMarr, a CS informant, spoke of a specific animal–based textile, wool, but did not mention plant–based textiles, fur, or leather. LeMarr's transcript is provided as an example of a CS–coded informant:

INTERVIEWER (I): You were in the third grade and you got to milk a cow. And what else did you get to do?
LEMARR (L): They brought out some baby chicks, and we were able to hold them. And then we got to see some goats and sheep. Oh yeah, we saw sheep's wool, get worn into yarn.
I: And, and so what'd you learn about the farm by going there?
L: I learned that it takes a big responsibility to keep it moving and shipping products. And it's pretty hard to make wool into yarn, plus you have to dye it after.
I: What are the products they were talking about? Do you remember?
L: They were talking about like jackets and wool collars and I think that's it.

The remaining 11 (61%) informants were coded CI because their descriptions included both compatible and incompatible statements when compared to the goal conception. Lynn, for example, first stated farms produce food but did not communicate anything broader (e.g., food is a basic human necessity or farms were essential to human existence). Most CI informants made sketchy statements that lacked support or provided contradictions that went unresolved.

Benchmark 3: Describe local agriculture. Informants were asked to describe where production agriculture occurred and the reasons why these locations were chosen. Additional questions were also asked about production agriculture in the informant's city, county, region, and state. Codes were assigned based on responses for benchmark sub–concept language and goal conception comparisons. Because the informants lived in California, known for diverse growing conditions and a variety of crops produced, sub–concepts for this benchmark were labeled by geographic area (city, county, region, and state) to provide a frame of reference for analysis.

Table 4 presents informant codings form describing local agriculture.

Table 4
Informant Coding for Benchmark 3 and Benchmark 3 Sub–concept

	Informants								
Sub–concept	Victor Logan	Virginia	Denise, Nancy, Lilly, Paul, LeMarr	Suzanne Greg	Alicia	Sandi, Delaine, Montie, Parker	Trisha	Lynn	Art
City				X			X		X
County		X			X			X	X
Region									
State		X				X	X	X	X
Codings[a]	N^0	CI^2	IS^0	IS^1	IS^1	IS^1	IS^1	IS^2	IS^3

[a.] The superscript numeral equals the total number of sub–concepts addressed by the informant

With respect to sub–concepts, informants' descriptions were analyzed for references to production agriculture within the specific sub–concept geographic areas. Four informants (22%) described production agriculture in Long Beach, while the same number described production agriculture in Los Angeles County. No informant described production agriculture on a regional basis. The remaining eight informants (44%) described agriculture that occurred in California.

Relative to the holistic bimodal coding, comparative analysis was completed for each informant. Analysis showed benchmark understandings to be largely incompatible with the expert's goal conception. Two informants (11%) were coded as (N) because they were unable to describe where agriculture production occurred. Virginia alone, or 6% of informants, was coded CI because her response included both compatible and incompatible statements. Most informants (83%) were coded incompatible sketchy (IS) because their descriptions appeared to be guesses. Art's transcript exemplifies IS–coded responses:

INTERVIEWER (I): Are there any other farms close by?
ART (A): I think so.

I: You think so?
A: Yes.
I: OK. How about farther away?
A: Yeah.
I: Yes?
A: Like other countries have farms, I guess.
I: Other countries, too?
A: Yes.
I: OK. Where do you think most farms are located?
A: California.
I: California. How come?
A: I guess, I just guessed.

Research Objective Three: Ascertain If Themes or Commonalties Exist Among Informants With Regard to Backgrounds, Experiences, and Understandings of the Agri–food System

Research Objective Three was met by analyzing data across and between the informant group and the benchmarks. Common patterns among informants were their (a) African American origins (only one informant was Caucasian and one Latino), (b) age (approximately 10–11 years), and (c) lack of agricultural background or experiences. Patterns and commonalities found in understandings of benchmarks and sub–concepts are presented by benchmark below.

Benchmark One: Identify a variety of farms and their products. Common patterns in understandings emerged across the informant group. First, all but one informant described farms using terms that weighed heavily on animal production or animal production activities. All informants described farms in a generic manner with a large variety of products. While it was common for farms to have generic descriptions and a variety of crops, patterns also emerged in benchmark goal conception comparisons. Every informant provided partially compatible descriptions but also included inaccurate statements or, more frequently, left out essential details.

Benchmark Two: Describe basic needs farms provide. The informants' benchmark–related discourse revealed four commonalities within Benchmark Two: (a) farms were perceived to provide people with the basic necessity of food, (b) animals were excluded (domesticated or wild) as benefactors of farms, (c) neither shelter nor clothing (except for three informants) were described as farm products, and (d) no informant met the benchmark goal conception because they left out essential details or, more frequently, included inaccurate statements.

Benchmark Three: Describe local agriculture production. Informants' descriptions of local agricultural production were analyzed for patterns and commonalities; three commonalities were revealed: (a) farms or farm production were not described on a *regional* basis, (b) fewer than half of informants described farms or farm production on a *state* basis, (c) *county*– or *city*–based farms and farm production descriptions did not accurately reflect agricultural production for these locations, and (d) understandings of the benchmark goal conception were incompatible and, in two instances, nonexistent. Ultimately, informants' descriptions revealed a pattern of what appeared to be guesses as to what local agricultural production looked like. Generally, then, descriptions overwhelmingly did not convey an understanding of California's agriculture production, local or otherwise.

Conclusions/ Recommendations/ Implications

Because this is a qualitative study, conclusions cannot be generalized to larger populations, but add to a growing body of similar research focused on advancing agricultural literacy. The study revealed informants lacked background that supported the construction of agricultural knowledge and understanding. When compared to grade–specific benchmarks, few areas of compatibility existed. In general, patterns surfaced that pointed to the informants' lack of schemata needed to articulate an understanding of the goal conception "what is agriculture?" Informants appeared to be missing essential sub–concepts preventing them from developing schema needed for understanding agricultural and science educational benchmarks.

To help learners align their thinking with desired goal conceptions, educators can focus curriculum development and teaching on the existing underdeveloped schemata held by learners. In this study, elementary school informants shared common ideas about farm structure and farm diversification, similar to the findings of other studies that focused on unearthing students' ideas about the agri–food system (Meischen & Trexler, 2003; Trexler, 2000). On the basis of this line of research, educational approaches can be developed to help learners build schemata that are more compatible with modern agricultural production systems. Similarly, because most informants understood that farms provide food for people, this accurate but limited schema can be used to build more complex ideas about the basic necessities farms provide both humans and animals (e.g., shelter, clothing, and animal feed). Informants' ill–conceived understandings of local agriculture can be challenged to help learners construct accurate conceptions. By challenging and building on existing schema, connections across multiple domains (e.g., economics, geography, environmental science) can be leveraged to help learners construct compatible and robust schemata on which to build more complex understandings.

Constructivist–based approaches for teaching agricultural literacy require experiential learning elements. Experiential education, a philosophical approach to teaching aligned with constructivism, underpins agricultural education philosophy (Roberts, 2006). Formal and informal contexts contribute to a learner's construction of knowledge. Informants in this study lacked the background and agricultural experiences needed to support schema development.

Educating young people to become informed decision makers requires intentional teaching and learning. Based on constructivist learning theory, which views learning as the interpretation of experience, direct involvement in agricultural endeavors can provide a foundation on which learners construct new schema. Educators, therefore, should provide learners with opportunities to engage in agricultural experiences (e.g., school gardens, animal care, cooking, etc.) as a way to develop missing schemata. With these informal experiences, along with content provided in classrooms, young learners can develop schemata on which to build more complex understandings required for democratic reform of the agri–food system.

Some researchers might ask, "What is new here?" and "What are the implications of this research?" They might say, "the Agricultural Education field has proven time and again that elementary students do not understand agricultural concepts. What does this study add to the field?" The authors reply, first, most elementary students do appear to understand where their food comes from – farms; however, they do not understand details about the agri–food system and oftentimes hold misconceptions that may hinder their acquisition of new schema. Second, few Agricultural Education researchers have used schema theory as a basis for analysis of student conceptions, although science education has been using this frame for over 25 years. This study shows that these methods are applicable to Agricultural Education research. Third, constructivist theory is one of the leading frames guiding the education field writ large. This theory, however, is rarely used by Agricultural Education researchers. Why does the Agricultural Education discipline nearly ignore this foundational theory that most other educational disciplines employ? Therefore, a major implication of this research study is found in the theoretical framework and attendant methodologies used to ferret out agri–food system understandings of elementary aged informants.

The next steps in this line of research are along these lines. In this study, a detailed examination of findings shows that a few students did possess compatible, but somewhat sketchy understandings of agri–food system concepts, but not the majority. Based on what is known about how people learn (Bransford et al., 1999) and science education research (Driver & Easely, 1978; Driver, Guesne, & Tiberghien,1985; Brook & Driver, 1989), which points out that students in different countries and across socio–economic divides typically hold similar conceptions about natural occurring phenomena, the following questions arise: (a) Why is it that some students with the same formal education and similar backgrounds and experiences as their peers possess more complex and accurate schema? and (b) What helped the more sophisticated informants construct nearly compatible schema (with experts), which was called upon to provide a foundation for elaborate and detailed conversations about the agri–food system?

In terms of intentional teaching, the following questions arise: (a) What would a teacher need to do to help bring the majority of students in this study to the same level as their more sophisticated peers? and (b) What specific subject matter, teaching methods, experiences, etc. would be most efficacious to help all students construct an understanding of agri–food system concepts? and (c) What type of training would be needed to prepare teachers help students construct more accurate schema?

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ALEXANDER J. HESS is a teacher of Agricultural Education at Davis High School, 315 W. 14th Street Davis, CA 95616, alxhess@gmail.com

CARY J. TREXLER is an Associate Professor of Agricultural and Environmental Education in the School of Education at the University of California, Davis, One Shields Avenue, Davis, CA 95616, cjtrexler@ucdavis.edu