Rural Elementary Students' Understandings Of Agricultural And Science Education Benchmarks Related To Meat And Livestock

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Abstract

Agricultural educators and agricultural industry leaders call for a basic level of agricultural literacy for all ages of Americans. Benchmarks were developed by science and agricultural educators for students in grades K-12 regarding an understanding of meat and livestock concepts. The purpose of this qualitative study was to ascertain rural fifth grade students' understandings about these concepts. Through interviews and concept mapping, student cognitive structures were unearthed. Students in this study were aware that food products come from animals, but were not as aware of other products that animals produce for human use. The students held inaccurate understandings about the size and scope of modern agriculture. Most, however, had a very basic understanding of meats journey from farm to consumer. Although the students could describe the journey's steps, their discourse did not include "scientifically" acceptable terminology educators prescribed in national benchmarks.

Introduction

Literacy involves the mastery of language in both oral and written forms (Gee, 1990). Language, however, is more than simply vocabulary; it also embodies culturally based beliefs, values, and attitudes. As one becomes literate, he or she masters the ability to make judgments based on culturally based norms that reify or reshape the culture and its institutions. Agriculture is a culture unto itself.

In 1988 the term "agriculture literacy" was coined in the National Research Council's report *Understanding Agriculture: New Directions for Education*. The report contended that an agriculturally literate person should understand many aspects of the food and fiber system, including "its history and current economic, social, and environmental significance" (National Research Council, 1988, p. 1). To further clarify the definition, Frick, Kahler, and Miller (1991), and Russell, McCracken, and Miller (1990) also included an understanding of the production, processing, and marketing of agriculture products as components of agricultural literacy.

The early definitions of agricultural literacy focused on identifying salient content but did not include an explanation of what literacy was and how agricultural literacy levels could be determined through discourse. The definition of literacy is constantly evolving as changes in society and cultures occur (Trexler, 2000a). The National Council for Agricultural Education's 1999 report *Reinventing Agricultural Education for the Year 2020* began to expand the definition of agricultural literacy by adding conversational literacy about agriculture as a goal. This was a laudable beginning; however, the new definition of literacy needs to include discourse and understanding within the culture of agriculture.

From the definition of science literacy in National Science Standards (National Research Council, 1996) and Gee's (1990) definition of literacy, an updated definition of agricultural literacy is offered. This new definition merges both agriculture content and linguists' definition of literacy relative to culture. The following is suggested as an updated definition:

> Agricultural literacy entails knowledge and understanding of agriculturally related scientific and technologically based concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. At a minimum, if a person were literate about agriculture, food, fiber, and natural resource systems, he or she would be able to a) engage in social conversation, b) evaluate the validity of media, c) identify local, national, and international issues, and d) pose and evaluate arguments based on scientific evidence. Because people involved in agriculture form a unique culture, an understanding of their beliefs and values should also be included in a definition of agriculture literacy so people outside the culture can become engaged in the system.

In 1988, the NRC report argued that "beginning in kindergarten and continuing through twelfth grade, all students should receive some systematic instruction about agriculture" (p. 2). Agricultural producers also agreed that because "students are the consumers of tomorrow" it is important to educate them early (Messenger, 2001, p. 34). Currently most Americans, and particularly youth, have little understanding about agriculture and its significance in their lives and to the environment (Leising, 1998). Although there have been studies on adults' understandings and perceptions, few studies have measured the level of agriculture literacy in

elementary students. The American Association for the Advancement of Science (AAAS, 1993) acknowledged that its agriculture concepts were based on recommendations from technology teachers, not research. In research based on the AAAS benchmarks, Trexler (2000b) found that elementary students had little understanding of the scope of agriculture in today's society and of how new technologies affect agriculture and the environment. Roper Starch Worldwide (2000) found similar findings in a study commissioned by Philip Morris and the American Farm Bureau Federation that found those directly involved with agriculture had miscalculated consumers' concerns about agriculture issues. These agriculturalists became concerned about a lack of public education about agricultural topics and believed gaps in understanding needed to be identified.

Typically agriculture literacy efforts focus on urban and suburban people. In a study that compared rural and urban adults, urban citizens lacked the most knowledge of agriculture, however, rural non-farm citizens also lagged behind their on-farm peers (Frick, Birkenholz, & Machtmes, 1995). Children living and going to school in rural areas (characterized by the U.S. Census Bureau as locations with a population of less than 2,500) may have no more ties to agriculture than urban youth. This was supported by Messenger's (2001) study that found there were no significant differences in perceptions of the pork industry between people living close to livestock areas and those in more urban environments. In 1990, only seven percent of the rural population lived on farms (Albrecht & Albrecht, 1996), meaning "rural" can no longer be directly associated with "farm."

This study's theoretical framework is based on Piaget's research on developmental psychology, which is considered a basis of constructivism. Piaget posited that children's ideas are based on pre-conceived thoughts about how or why things are in a certain state (Gardner, 1991). Only when these knowledge structures, or schemas, are challenged does a child's understanding of the new information begin to occur (Piaget, 1975/1985). Changes in schema occur through a process called conceptual change (Posner, Strike, Hewson, & Gertzog, 1982). This process involves dissatisfaction, intelligibility, plausibility, and fruitfulness with alternative schema (Dole & Sinatra, 1998; Posner et al., 1982; Thorley & Stofflett, 1996).

Based on constructivist theory, the initial role of the researcher or teacher is to assess students' prior knowledge structures so as to link new concepts to previous ones or to cause students' dissatisfaction with their current schema and begin the conceptual change process. If a constructivist learning theory is to be followed in agricultural education, then uncovering students' prior knowledge structures through a process of discourse analysis is the first step in the development of curriculum. Agricultural educators (Trexler, 2000b; Trexler & Heinze, 2001) have begun to investigate student understanding. This study was designed to add to that body of knowledge in terms of livestock and meat concepts.

Purpose/Objectives

The purpose of this qualitative study was to determine rural elementary students' understandings of science and agricultural education benchmarks related to meat and livestock concepts. The objectives were: 1) to determine students' backgrounds and experience with meat and livestock, 2) to compare students' understandings of science and agricultural education benchmarks related to meat and livestock with expert understandings, and 3) to conclude if relationships existed between objective one and the students' understanding of the benchmarks.

Methods

Agricultural education researchers often rely on surveys to determine what people understand. There is, however, some question as to whether these types of quantitative measurements are truly indicative of what people understand (Lincoln, 1998). Lincoln (1998) has argued that because "knowledge cannot be separated wholly from the context in which it was generated" (p. 17) alternative methods of research are needed. In addition, because each person has his/her own unique understanding, qualitative research and in-depth inquiry are essential in grasping insight into an individual's cognitive structure. The use of the qualitative paradigm in agricultural education is sometimes suspect. Therefore, we paid particular attention to assuring trustworthiness (akin to validity in the quantitative paradigm) by explaining how we assured credibility, transferability, dependability, and confirmability of the research.

Seven students were selected for interviews from a rural Midwestern consolidated school. Of the purposefully selected students, four were girls and three were boys. Fifth grade students were selected because it was believed that they possessed a large enough vocabulary to converse clearly, and fell within the grade level range of the benchmarks. Students attending the school lived in several small towns that were separated by less than 15 miles of farmland. A larger city was located approximately 35 miles from the school building. In reporting data, pseudonyms masked the identities of students.

Clinical interviews allowed the researchers to ascertain in-depth understandings and were conversational rather than scripted. Students were interviewed twice. The goal of the two interviews was to determine the nature and extent of an individual's knowledge by identifying the relevant conceptions held and the perceived relationships among those conceptions (Posner & Gertzog, 1982).

During the first interview a hamburger from a nationally known food chain was used to initiate conversation (Anderson & Demetrius, 1993; Trexler & Heinze, 2001). Students were asked to draw and explain a concept map of their understandings regarding the journey meat takes from farm to consumer. Students were presented a short lesson on concept mapping to insure they understood how to construct one. Interviews were audio taped and transcribed. After the first interview, we coded the transcripts and then expanded the students' concept map by adding additional information from the interview. A second interview served as a member check and established credibility of the research findings (Guba & Lincoln, 1989; Taylor & Bogdan, 1998).

Interview questions were based on benchmarks developed by Trexler (1999) from a synthesis of the Benchmarks for Science Literacy (AAAS, 1993) and the Food and Fiber System Literacy Framework (Leising, 1998). The benchmarks were designed for students from kindergarten to fifth grade with the exception of the by-products benchmark. The by-product benchmark was designed for ninth through twelfth grade, but because many state beef councils use this concept for educational programs, it was also chosen for study. Table 1 contains the benchmarks and the language necessary for demonstrating understanding of these concepts.

Table 1.

Concepts, Benchmarks, and Language

Concept	Benchmark	Language
What is Agriculture?	1. Identify food products that come from animals. (K-1 FFSL[a] & K-2 AAAS[b])	1. meat, milk
	2. Describe by-products that come from animals. (9-12 FFSL)	2. clothing, sporting equipment, medicine, cosmetics, gelatin, plastic
	3. Describe farms and their products. (K-1 FFSL & K-2 AAAS)	3. small, large
	4. Describe how animals provide for people's basic needs. (4-5 FFSL)	1. grow, food, clothing
	5. Describe the journey a meat product travels through from farm to consumer. (2-3 FFSL)	2. production, transportation, processing, distribution, consumption

Note. Benchmarks were derived from [a]Food and Fiber Systems Literacy Framework (Leising, 1998) and [b]American Association for the Advancement of Science 2061 Benchmarks (1993).

Analysis began with identifying the background and experiences of the students, which was then reported descriptively. Next, goal conceptions and an expert concept map were developed by the researchers and were reviewed by experts in science and agricultural education, animal science, and the beef industry. To analyze student understandings of the benchmarks, Hogan and Fisherkeller's (1996) bidimensional coding system was used to judge participants' compatibility with experts and elaboration on each benchmark. Participants' conceptions were coded based on the language they used. The transcribed interviews served as the data.

The students' concept maps were a secondary data source. To ensure confirmability and dependability of the findings, excerpts of interview transcripts that supported codings are included (Guba & Lincoln, 1989). In addition, credibility of findings was further assured because another researcher also independently coded the data with 96% agreement with the primary researcher. Table 2 describes the coding scheme used.

Table 2.
Coding scheme for comparing student responses to expert conceptions.

Code	Definition
Compatible elaborate	Statements concur with the expert proposition and have sufficient detail to show the thinking behind them and/or recur throughout the transcript in the same form.
Compatible sketchy	Statements concur with expert proposition, but essential details are missing. Often represent a correct guess among choices provided, but no ability to explain why choice was made.
Compatible/ incompatible	Makes sketchy statements that concur with proposition, but which are not elaborated, and also makes sketchy statements that disagree. Contradictory statements are often found in two parts of the transcript in response to different questions or tasks on the same topic.
Incompatible sketchy	Statements disagree with proposition, but very few details or logic given, and do not recur throughout transcript. Often seem to be responses given just to say something, a guess.
Incompatible elaborate	Statements disagree with proposition and students provide details or coherent, personal logic backing them up. Same or similar statements/explanations recur throughout transcript.
Nonexistent	Used when students respond "I don't know" or do not mention the topic when asked a question calling for its use.
No evidence	Used when a topic was not directly addressed by a question and students did not mention it within the context of response to any question.

Finally, to ascertain if relationships existed between students' backgrounds and experiences and compatibility and depth of responses, we inductively and intuitively searched for patterns that developed from the data (Taylor & Bogdan, 1998).

Findings

By questioning students about their personal experience with livestock, the researchers ascertained research objective one. All students were Caucasian. Three students lived on farms while the other four lived in small towns. Two students' families raised steers and one student raised lambs for 4-H projects. One student had an uncle who raised cattle. None of the other three students had direct experience with livestock. Most students' parents worked in a near by city. Table 3 lists the students along with their background and experiences.

Table 3.
Student background and experience.

Name	Gender	Home Location	Parent(s) occupation	Livestock Experience
Greg	Male	Farm	Father: Food production company Mother: in city (unknown)	Family raises steers
David	Male	In Town	Father: Label company Mother: Cook	None
Heidi	Female	In Town	Father: Train driver Mother: College Student	None
Jim	Male	In Town	Father: Miner Mother: Department store salesperson	Uncle raises cattle
Jessica	Female	Farm	Father: Firefighter/ Carpenter/ Farmer Mother: Nursing home employee	Family raises steers
Lynn	Female	In Town	Father: Filter company Mother: Stays at home	None
Melissa	Female	Farm	Father: Department of Transportation Mother: College student	Shows lambs in 4-H

We asked students to describe their understanding of the nature of agriculture in research objective two. The first benchmark identified food products that came from animals. Codings assigned to students based on an interpretation of language are found in Table 4. Dots indicate students' understandings of the subconcepts necessary to understand the benchmark. A superscript further clarifies the depth of understanding for each student.

Table 4.
Student understanding of identification of food products from animals.

Benchmark	Greg	David	Heidi	Jim	Jessica	Lynn	Melissa
1. Identify food products from animals							
a. meat	•	•	•	•	•	•	•
b. milk	•	•	•	•	•	•	•
Coding	CE^2	CE^2	CE^2	CE^2	CE^2	CE^2	CE^2

ø--No evidence; N--Nonexistent; IE--Incompatible Elaborate; IS--Incompatible Sketchy; CI--Compatible/Incompatible; CS--Compatible Sketchy; CE--Compatible Elaborate
Superscript indicates depth of understanding of the benchmark and was determined based on how many subconcepts the student identified.

All students were coded Compatible Elaborate because they could effectively articulate an understanding that cattle produce meat and milk for human consumption. Some students said that different types of cattle were used for different types of production. Greg, Jessica, and Melissa all noted that dairy cows were used mainly for the production of milk and dairy products and that these cows were different than cattle primarily used for meat production. Heidi felt that only the "boys" were used for meat production and the "girls" give the milk. Although her understanding was partially correct, she did not seem to understand that different types of cattle produce different products. Lynn's understanding of different types of cows was linked to what she saw in the store. She thought some cows produced two percent milk and some whole.

The second benchmark required that students describe cattle by-products. Table 5 lists the codings assigned to each student.

Table 5.
Student understanding of by-products from animals.

Benchmark	Greg	David	Heidi	Jim	Jessica	Lynn	Melissa
1. Describe by-products that come from animals							
a. leather -clothing -sporting equipment		• •	• •	• •			•
b. medicine							
c. cosmetics							
d. other		•					
Coding	N	CS^2	CS^2	CS^2	N	N	CI^1

ø--No evidence; N--Nonexistent; IE--Incompatible Elaborate; IS--Incompatible Sketchy; CI--Compatible/Incompatible; CS--Compatible Sketchy; CE--Compatible Elaborate
Superscript indicates depth of understanding of the benchmark and was determined based on how many subconcepts the student identified.

Three students understood how by-products from cattle are used in products they encounter daily and were coded Compatible Sketchy. Heidi and Jim were the only students who mentioned leather as a product from cattle. David and Melissa both knew that some clothing comes from animals, but Melissa's conception was linked to her background with sheep. She thought that cattle were shaved and their "fur" was used to make coats; she was coded Compatible/Incompatible. David noted that fertilizer came from cattle bones. Jim knew about the exportation of niche products as evidenced by this comment, "I mean like some things they might ship it over to the people in Japan because they eat some of the weird things that we don't eat, like the brain and stuff like that." Also noteworthy was Jim's conceptualization of meat.

I: What are some parts that we don't eat?
J: The muscle.
I: Tell me about that.
J: It's an organism in your body that helps you move your bones and it pulls on 'em and makes 'em move.
I: What part is the meat?
J: The stuff underneath the muscle.

Those who had nonexistent codings, Greg, Lynn, and Jessica, repeatedly noted that the cattle parts humans do not consume are thrown away. No students knew that by-products from cattle are used in pharmaceuticals or cosmetics.

Benchmark two asked students to describe the size and scope of the farms where cattle were produced. Included in Table 6 are the student codings for this benchmark.

Table 6.
Student understanding of farms and their products.

Benchmark	Greg	David	Heidi	Jim	Jessica	Lynn	Melissa
1. Describe farms and their products.							
a. large farm size							
b. one main species							
Coding	IE	IE	IE	IE	IE	IE	IE

ø--No evidence; N--Nonexistent; IE--Incompatible Elaborate; IS--Incompatible Sketchy; CI--Compatible/Incompatible; CS--Compatible Sketchy; CE--Compatible Elaborate
Superscript indicates depth of understanding of the benchmark and was determined based on how many subconcepts the student identified.

All students knew that cattle were raised on farms; however, they were coded Incompatible-Elaborate because their conceptions of what these farms looked like was not in line with modern agriculture. No students understood that farm size where most cattle are produced is quite large, often encompassing hundreds or thousands of acres. Because a football field was a visual image students could easily comprehend and is comparable to an acre, the students were asked to use this measure to indicate the size of the farms where the cattle were raised. Student responses varied from one to twelve acres.

The fourth benchmark required an understanding of the process that meat products go through on their way from the farm to consumer. Benchmarks codings are included in Table 7.

Table 7.
Student understanding of the journey of meat products.

Benchmark	Greg	David	Heidi	Jim	Jessica	Lynn	Melissa
1. Describe the journey meat products travel.							
a. production	•	•	•	•	•	•	•
b. transportation	•	•	•	•	•	•	•
-trailer	•		•	•	•		•
-refrigerated truck		•		•	•		•
c. processing	•	•	•	•	•	•	•
d. distribution					•		
e. consumption	•	•	•	•	•	•	•
Coding	CS^5	C/I^5	CS^5	CS^6	CS^7	CS^4	CS^6

ø--No evidence; N--Nonexistent; IE--Incompatible Elaborate; IS--Incompatible Sketchy; CI--Compatible/Incompatible; CS--Compatible Sketchy; CE--Compatible Elaborate
Superscript indicates depth of understanding of the benchmark and was determined based on how many subconcepts the student identified.

Although students had a general idea of the agri-food system process, six of the seven students were assigned Compatible-Sketchy codings because they missed details. The language students used to describe the process was not congruent with experts' conceptions. The codings were assigned based on their understanding rather than on language use alone. Many students,

for example, used the term "butcher" instead of processor. Their understanding as to what occurred during that phase of the process (killing the animal and fabricating the meat), however, was clear by their explanation. The following is Jim's explanation of his concept map.

J: A cow ate the grass, which gave it fat or meat to the cow. Which then got butchered for the meat. Which then got shipped to McDonalds™ and then McDonalds™ sold it to you.
I: Where did the cow come from?
J: A farm.
I: The cows then come from the farm. How do they get to this butcher place?
J: In a wagon, or a trailer or yeah, a trailer.
I: So what all happens at this place?
J: They bring the cow in and then they butcher it. They usually butcher it outside though. And then once they do that, he brings the meat in that he got out from [the animal] and then he might season it or dry it for jerky or something and then he'll put it in the freezer and then you'll come pick it up or he'll have it shipped to you.
I: After they butcher the meat you said it gets shipped to McDonalds™, how does it get there?
J: They get it in a big semi and they pack [the meat] in big crates and boxes in slices. And all the people at McDonalds™ have to do is they take it and they put it in little box things and then opens it up and then it warms them really warm and then they put it in the bun and then they serve it.
I: Is it cooked when it gets to McDonalds™ then?
J: No.

His description of what the butcher does allowed the researchers to equate that phase in the journey with processing even though his language did not match the prescribed vocabulary.

Most students had a basic understanding of meat's journey from farm to plate. David was unique because he thought the cow was killed and cut into large pieces by the farmer and then taken to a butcher where it was further processed and packaged. The other fifth graders knew that the cattle were shipped from the farm to a place where the cattle were killed and processed. The language that the students used, however, varied as well as the depth of description about the stops the meat made within the agri-food system. Jessica was the only informant who included a distribution step in her description, although her language did not include the term "distribution."

Students whose families raised steers, Greg and Jessica, described cattle production in more detail than their classmates. These students, however, were not able to more elaborately explain the process after the cattle left the farm. This was evident in Greg's description of meat processing before it traveled to the fast food restaurant.

I: Who sent the meat to [McDonalds™]?
G: I don't know.
I: OK, so where did you say that the meat came from before it got to McDonalds™?
G: I don't know.
I: How do you think it got ground like that? Who did that?
G: Probably the butcher.

I: So it comes from a butcher then?
G: Maybe.

Greg thought the meat arrived at the fast-food restaurant as ground meat and then the restaurant employees made the patties before cooking. Lynn, Jessica, and David's schema also concurred with Greg's. All informants knew some type of processing took place before it arrived at the restaurant, but the students' answers varied as to how much.

The students' answers also varied with regard to the type of transportation used to move cattle and meat. Neither David nor Lynn mentioned the use of a trailer to transport the cattle. In David's conception, there was no need to transport live animals, because he believed that they were killed on farms. David, Jim, Jessica, and Melissa all understood that once the animal was killed, the meat had to be transferred in a truck with a cooling system. Greg, Heidi and Lynn never mentioned refrigerated trucks. Heidi compared a mail truck with the type of vehicle used to transport meat; and Greg compared it to a "truck that you sell Doritos or chips" from.

Conclusions/Implications

Objectives One and Three. Background and Experiences. No students' parents were primarily farmers. Therefore, even though these students grew up in a rural community, they, like other rural youth, cannot be labeled as farmers. These students lacked understanding of agriculture concepts even though they were raised in rural areas. This raises questions about agricultural education's primary focus of literacy initiatives on urban and suburban students.

In general, students who raised animals for meat could more elaborately describe the production of animals; however, they had no greater understanding of meat processing than their non-livestock raising contemporaries. Few cattle were raised in the area and row crops (corn and soybeans) dominated local agriculture. If the study was conducted in an area where livestock production was a primary agricultural entity, the results of the study may have been different with regards to students' language use and their conceptual frameworks.

Objective Two. Understanding of Benchmarks. Students were asked to describe food products that came from animals in benchmark one. Students understood very well that meat and dairy products originate from animals, which supports a similar finding made by Trexler (2000b) about urban youth. Organizations continue to focus agricultural literacy efforts on informing students about the origin of food. It seems, however, that resources could be reallocated to other areas where students actually lack knowledge.

The second benchmark concerned student understanding of cattle by-products. Most students did not understand that cattle produce many products besides meat and milk. Those in the agriculture industry would benefit from consumers realizing that agriculture producers and processors profit from reducing waste. If students understood that many of the products they use everyday rely on by-products from animals, then they may better understand the impact of agriculture on their lives. This is important because it may generate support for the industry as policy issues surface. To foster schema development about by-products, educators could design activities that require students to discover the sources of ingredients in many everyday products.

The third benchmark dealt with student understanding of farms and their products. Students had alternative mental frameworks compared to the expert conception about farm size and scope and elaborated on their understandings. This finding parallels Trexler's (2000b) study

of urban and suburban students in that students did not understand the large scale of farming today. This study's students also believed that most farms raise many different species of livestock, which was akin to Trexler's urban and suburban student's ideas about crop production.

Agriculture literacy efforts may benefit from helping students re-conceptualize their notions of a farm. It may be productive to devise curricula that help students change their conceptions toward a more accurate picture of modern agriculture. Educators (whether formal or informal) of elementary students can challenge student conceptions by taking students to large-scale production facilities and allowing them to experience first-hand the structure of agriculture. Or agricultural producer groups may benefit from producing media that show the realities of modern large-scale agricultural production.

Benchmark four described the journey that meat took from the farm to the consumer. Most of these rural students seemed to understand that meat is processed; and that this processing is completed by different companies. In a time of ready-to-eat food products, it is not surprising that most students were able to identify that fast-food restaurants receive meat that has been processed in some manner.

Although the students seemed to have a basic understanding of meat's journey from gate to plate, the results of this study indicate the language that the AAAS (1993) suggested this age group of children should have is either too advanced or had never been introduced to them. No students used words such as "processed" or "distributed" when describing the processes meat undergoes. The language they used instead was "butchered," "cut up" or "shipped." Further studies may indicate a need to change the benchmark vocabulary to one more appropriate for fifth grade students.

Further studies using a similar research protocol but different informants may lead to a more complete understanding of what students understand about livestock. Although the results of this study are not generalizable in the quantitative sense, they are transferable in the qualitative paradigm if the contexts of the comparison are similar (Guba & Lincoln, 1989). The current agricultural benchmarks have not been thoroughly tested to determine if they are suitable for the age groups for which they were designed. Once educators have a clearer picture of children's schema, they can more effectively develop agricultural literacy curriculum that causes dissatisfaction and pulls students into the conceptual change process.

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Agricultural literacy is an important topic for the agricultural education discipline. The national benchmarks have been in place for some time, and agricultural literacy curricula developed and implemented with the goal of developing a basic level of understanding of agriculture for all Americans. But do we have a sense of the basic level of understanding that students currently have, and are we tapping into the agricultural literacy construct effectively with the benchmark measures currently being utilized?

This study does a good job of using a qualitative methodology to explore rural fifth grade elementary students' understanding of literacy concepts related specifically to the meat and livestock industries. The study utilized a combination of interviews and concept mapping techniques to assess students' understanding about the 'size and cope of modern agriculture" focusing on plate to gate type concepts based on benchmarks adapted from a synthesis of the Benchmarks for Science Literacy and the Food and Fiber Systems Literacy Framework.

The methodology for this study is grounded in the qualitative paradigm, and as such, the procedures and instrumentation seem appropriate. The authors' do a good job of explaining the procedure used in detail and the report of the findings is well organized and clear. The authors correctly point out that their findings are not generalizable, but they do suggest some interesting implications with respect to students' basic level of understanding about agriculture and the potential difficulties of using benchmarks focused on vocabulary and terminology that might be too specialized to be appropriate for fifth graders.

The following are questions the authors may want to take into consideration with respect to this study:

- Although, by its nature, the study was exploratory and limited in scope, is there an opportunity to utilize this methodology with larger and more diverse groups of students? The seven students in this study were all from the same school in a rural midwestern area.
- I found it interesting that students lacked understanding of agricultural concepts even though they were raised in a rural area. Is this specific to only the livestock and meat areas that were assessed? Would it make sense to look at other areas of agricultural knowledge in follow-up study?

The authors are to be commended for utilizing an approach and procedure designed to elicit rich detail with respect to these students' knowledge and understanding of agricultural concepts. The results of the study appear to have yielded several fruitful directions for future research.