PROCESS AND PRODUCT VARIABLES FOR THE STUDY OF READING IN SECONDARY AGRISCIENCE

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Abstract

Secondary agriscience, along with all education, is facing pressure to document and contribute to student achievement in math, science, and reading. Agriscience teachers often expect their students to enter the classroom with adequate skills for reading and comprehension, yet the vocabulary, concepts, and structure of secondary agriscience is foreign to many students. Agriscience teachers may be able to enhance students' reading performance through implementation of reading strategies in secondary agriscience. While similarities exist between reading in other content areas and secondary agriscience, differences exist in the products of reading in agriculture. This study reviews research related to content area reading to develop research questions and a model for studying reading in secondary agriscience. Building on Dunkin and Biddle's (1974) model of the study of teaching, this research proposes areas of inquiry regarding process and product variables associated with reading. Research in process variables includes setting purpose, strategy instruction, use of strategies, monitoring reading, discussion, and question generation. Research in product variables includes comprehension, agricultural literacy, motivation to read, creating lifelong readers, critical thinking, and communication of ideas.

Introduction

"Adolescents entering the adult world in the 21st century will read and write more than any other time in human history" (Moore, Bean, Birdyshaw, & Rycik, p. 3, 1999). High school graduates will be entering a world where success depends on a high degree of literacy (Snow, 2002). Students need literacy skills in careers, households, in citizenship, and in their personal lives (D'Arcangelo, 2002; Meltzer, 2001), because literacy development prepares adolescents for successful learning in school and throughout their lives (National Reading Panel (NRP), 2000; Vacca & Vacca, 2002). Students will employ higher order literacy skills to analyze and comprehend the plethora of knowledge available through the Internet and other media (Moore et al.; Vacca).

American students compare poorly with their global counterparts, especially where content knowledge and literacy is central to the curriculum (Snow, 2002). At the twelfth grade, 30% of boys and 17% of girls cannot read at a basic level (National Center for Educational Statistics, 2001). Almost all students need support in learning new vocabulary, managing new reading and writing styles, developing a positive attitude toward literacy, and independently learning and applying reading strategies (Meltzer, 2001; Moore et al., 1999).

Reading occurs in all areas of learning (D'Arcangelo, 2002). Intensive reading instruction declines as students progress through school (Forget & Bottoms, 2000; Meltzer, 2001); thus, the range of reading abilities grows wider (Baer & Nourie, 1993). Content area reading is difficult (Bryant, Ugel, & Thompson, 1999), especially when students change classes and are required to shift content knowledge (D'Arcangelo). If students fail to grasp the language, then they fail to grasp the concepts in that language

(Meltzer). Students may realize their reading limitations, but lack the knowledge of strategies to improve; thus, many secondary students risk reading failure and need instruction to continue building their reading skills.

"Promoting active, mindful reading and teaching students to use strategies is every teacher's responsibility" (Rhoder, 2002, p. 498), including secondary agriscience teachers. Good instruction is the most effective means of increasing student comprehension and developing skilled readers (Snow, 2002), yet few teachers employ reading strategies in their classrooms. Irvin and Connors (1989) found that less than 14% of teachers employed content area reading strategies in their classrooms. "Content area reading is a matter of good teaching" (Vacca & Vacca, 2002, p. 184), where teachers integrate "reading and subject matter learning in seamless fashion, using language and literacy to scaffold student learning" (p. 184). Research has demonstrated that when teachers infused reading strategies into content area lessons and developed structured reading assignments, student performance and learning increased (Forget & Bottoms, 2000; Meltzer, 2001). Teaching collections of reading comprehension strategies improves comprehension (Duke & Pearson, 2002). Instruction in the development and use of reading strategies requires "explanation, modeling, practice, and application" (Vacca & Vacca, p. 194). While content area teachers may not be expected to teach reading, they are expected to facilitate reading processes through activation of students' prior knowledge and clearly defined purposes for reading (McKenna & Robinson, 2002).

Vocational programs are less likely to employ communication skills, such as writing reports, reading texts, and presenting speeches (Forget & Bottoms, 2000). Agriscience courses do not rely solely on textbooks, but integrate other sources of information (Gartin, Varner-Friddle, Lawrence, Odell, & Rinehart, 1994). Agriscience programs have been striving to integrate math, reading, and science into classroom curricula. Conroy and Walker (2000) concluded that there is great need

and room for improvement in integration of subject matter, although it is often difficult to achieve. Belcher, McCaslin, and Headley (1996) determined that the most frequently reported academic measures of student performance in high schools were mathematics (85%), reading (80%), and language (77%). However, agriscience teachers often have difficulty in assessing student reading performance (Gartin et al.).

Theoretical / Conceptual Framework

Content area reading develops active, engaged, independent readers (Forget & Bottoms, 2000). The NRP (2000) suggests five essential components of healthy reading: phonics, phonemic awareness, fluency, vocabulary, and comprehension. "Content area reading is a matter of good teaching" (Vacca & Vacca, 2002, p. 184), where the teacher integrates "reading and subject matter learning in seamless fashion, using language and literacy to scaffold student learning" (p. 184). While content area teachers may not be expected to teach reading, they are expected to facilitate reading processes (Bean, 1997; McKenna & Robinson, 2002).

Content area reading emphasizes application, reading to learn, and comprehension of content area material (Baer & Nourie, 1993). Adolescents need well-developed content area reading instruction in order to improve comprehension (Meltzer, 2001; Moore et al., 1999). Students should be able to question themselves about what they have read, synthesize information from various sources, identify and understand vocabulary, recognize text structure and learn from that structure, organize information, interpret symbol systems, judge information for their own understanding, and evaluate authors' ideas and perspectives.

Reading in secondary agriscience is a function of interactions between students, text, instructor, routines or strategies, and expected outcomes of reading. Building on Dunkin and Biddle's (1974) model for the study of classroom teaching (Figure 1), reading in agriscience involves the interplay of context, presage, process, and product

variables. What processes are critical to reading in agriscience? What are the probable outcomes for reading in agriscience?
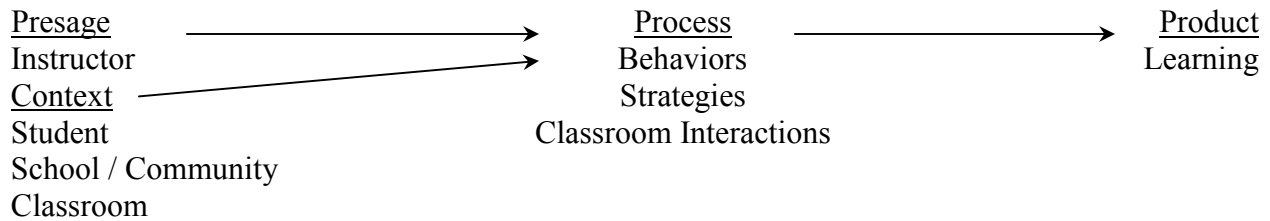
Presage ————————————→ Process ————————————→ Product
Instructor ————————————→ Behaviors   Learning
Context ——↗   Strategies
Student   Classroom Interactions
School / Community
Classroom

Figure 1. Dunkin and Biddle's (1974) model for the study of classroom teaching (adaptation)

Bryant et al. (1999) clarified content area reading as "students interact[ing] with the text to interpret and construct meaning before, during, and after reading by using their prior knowledge and the skills and strategies developed during early reading instruction" (p. 293). Content area reading "frequently covers concepts that extend beyond the knowledge of many children and adds to this difficulty by introducing them in rapid-fire fashion" (Baer & Nourie, p. 1), and students are expected to remember and use volumes of facts, figures, and information.

Purpose and Objectives

This investigation's primary objective was to develop a model for research about reading in agriscience. The objectives of this study were:

1. to synthesize research about process and product variables in content area reading specifically related to secondary agriscience, and
2. to propose a model for the study of reading in agriscience.

Procedures

A library and Internet search was used to gather data for this synthesis. Several sources were used to gather data to meet the objectives of the study: the University of Florida library, *Journal of Agricultural Education*, *ERIC Documentation Reproduction Service*, and *WebLUIS Indexes*. References were located through library services at the University of Florida. Key words used in locating research included content area reading, secondary reading, content area literacy, and secondary literacy. Studies were reviewed based upon their titles, purposes, findings, and conclusions. Forty-four resources were chosen as representative of current content area reading research. Researchers grouped articles under themes related to process and product variables related to content area reading, specifically reading in secondary agriscience.

Findings

Forty-four resources were cited to contain research in content area reading, specifically process and product variables. Twenty-six books, 12 journal articles, two ERIC documents, and four online articles contained research in content area reading (Table 1).

Process Variables

Reading is "an interactive process that allows the reader to construct meaning by using information obtained from various knowledge structures" (Ryder & Graves, 1994, p. 16). It is "a skillful and strategic activity in which the reader's mind is alive with questions – cognitive questions" (Vacca & Vacca, 2002, p. 18). Knowledge structures include knowledge of letters, letter-sound relationships, words, syntax, and schema. Chapman describes reading as "the construction of flexible and usable knowledge" (1993, p. 4).

Table 1
Total Number of Resources Addressing Content Area Reading

	Books	Journal Articles	ERIC	Online	Total
Process Variables	13	12	1	2	28
Product Variables	13	0	1	2	16
Total[a]	26	12	2	4	44

[a] Resources may be duplicated for process and product variables.

Reading involves the interplay of three micro-periods: pre-reading, reading, and post-reading that constitute microdevelopmental processes (Snow, 2002). During each of these periods, readers develop and are developed through application of previous knowledge, reading skills, and comprehension. Reading also has a macrodevelopmental aspect, formed by reader's purpose, questions, and engagement in reading, which may change throughout the entire process as students learn, derive benefit from reading, and experience more challenging text.

Purpose

Good readers begin reading with purposes, which serve as guides for reading processes, (D'Arcangelo, 2002; Snow, 2002) and are actively engaged in reading (Ryder & Graves, 1994). Readers comprehend text based upon purpose (Snow) and read for knowledge, application, and engagement. Purpose is influenced by prior knowledge and interest in the reading subject. Along with thinking about reading purposes, proficient readers activate prior knowledge in setting and re-evaluating purposes while they read (Forget & Bottoms, 2000; Ryder & Graves).

Reading Capacities, Abilities, Knowledge, and Experience

Readers bring several characteristics to reading, including capacities, abilities, knowledge, and experience (Snow, 2002). Capacities and abilities include

"cognitive capacities (e.g., attention, memory, critical analytic ability, inferencing, visualization ability),

motivation (a purpose for reading, an interest in the content being read, self-efficacy as a reader), and various types of knowledge (vocabulary, domain, and topic knowledge, linguistic and discourse knowledge, knowledge of specific comprehension strategies)" (Snow, p. 13).

As a reader begins, engages in, and completes a reading task, some or all of these abilities may change.

Monitoring

Proficient readers "know their purposes for reading, keep track of whether the purposes are being met, and take action if they are not" (Ryder & Graves, 1994, p. 174). They know a number of strategies, how to use them, efficiently employ them, and have enough background knowledge to profit from their use (Collins, 1997; Forget & Bottoms, 2000; Pressley, Snyder, & Carigula-Bull, 1987), thus helping retain, organize, and evaluate information (Snow, 2002). Successful readers "increase their reading fluency and adjust their reading speed according to their reasons for reading" (Moore et al., 1999, p. 3). Proficient reading involves a "constant, ongoing adaptation of many cognitive processes" (NRP, 2000, p. 4-7), where readers continually "adapt, adjust, modify, and test until they construct meaning and the problem is solved" (NRP, p. 4-47).

Strategy Instruction

Good readers are active readers. They have clear goals for reading. Good readers look over the text before they read, noting

structure, making predictions and reading selectively for specific information. They construct, revise, and question the meaning, as well as determine the meaning of unfamiliar words and concepts. In doing so, they draw from, compare, and integrate their prior knowledge and think about the authors of the text, their style, beliefs, intentions, and historical milieu. Good readers monitor their understanding of the text, while evaluating the text's quality and value. They read different kinds of texts differently. When reading expository text, they construct and revise summaries of what they have read and use multiple strategies constantly (Duke & Pearson, 2002). For good readers, comprehension is a consuming, continuous, and complex activity, but one that, for good readers, is both satisfying and productive (Duke & Pearson, p. 205).

Students require preparation to read, guidance during reading, and reinforcement for learning after reading (Readence, Bean, & Baldwin, 1989; Snow, 2002). Reading can take several approaches, including independent silent reading, teacher read-alouds, reading in groups, and round-robin oral reading (Forget & Bottoms, 2000; Ivey, 2002; McKenna & Robinson, 2002). Students should predict, clarify, question, and summarize their reading. Effective reading involves more than the use of one individual strategy; it involves the "constant, ongoing adaptation of many cognitive processes" (Williams, 2002, p. 244). Teachers should provide students with a chance to read silently and aloud (Forget & Bottoms; McKenna & Robinson) and encourage content area sustained silent reading (Duke & Pearson, 2002; Ivey).

"Strategy instruction is not blind, but informed by theory and research" (Vacca & Vacca, 2002, p. 194). Teachers who employ and instruct students on appropriate reading strategies enable students to be more successful in reading experiences and comprehension development (Fielding & Pearson, 1994; Snow, 2002). Strategy instruction should enable students to select appropriate strategies, adapt them to particular texts (Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989), and be initiated by students (NRP, 2000; Snow).

Effective reading incorporates the coordination of several strategies (Bean, 1997; Meltzer, 2001; Pressley et al., 1989; Snow). Teaching a variety of strategies leads to "increased learning of the strategies, to specific transfer of learning, to increased retention and understanding of new passages, and, in some cases, to general improvements in comprehension" (NRP, p. 4-6). Students not explicitly taught reading strategies are unlikely to learn, develop, and spontaneously employ them (NRP; Snow).

Teaching reading strategies should be incorporated with content area instruction so that students can understand the importance and application of strategies and become active learners (Pressley, Symons, McGoldrick, & Snyder, 1995; Rhoder, 2002). Teaching reading strategies improves awareness and use of strategies, performance on comprehension measures, scores on standardized tests (Williams, 2002), and motivation to read (NRP, 2000). Strategy instruction should be selected upon the following three criteria: ease of instruction, flexibility, and comprehension monitoring (Palinscar, 1986). The type of strategy used for a particular text depends upon reading purpose, reader characteristics, and text characteristics (Ryder & Graves, 1994). Students should have a choice of many reading strategies that are best suited for specific text, applications, and student preference (Ryder & Graves; Snow, 2002). Readence et al. (1989) proposed a model for strategy implementation: "a) awareness, b) knowledge, c) simulation, d) practice, and e) incorporation" (p. 11). NRP found eight strategies that are research-based, improve student recall, enrich question answering and generation, enhance summarization of texts, and show general gains on standardized comprehension tests. They are comprehension monitoring, cooperative learning, graphic and semantic organizers, story structure, question answering, question generation, summarization, and multiple-strategy teaching.

Teachers foster reading comprehension and motivation by maintaining maximal time on task, minimizing interruptions during student reading (Readence et al., 1989; Snow, 2002), and providing ample

quiet time for classroom reading, not the final few minutes of class (Donahue, Voelkl, Campbell, & Mazzeo, 1999). Reading assignments should be "challenging, but not frustrating" (Readence et al., 1989, p. 26) and should not be relegated to busy work (Ryder & Graves, 1994).

Interactive Reading

Reader response theory (Rosenblatt, 1982) suggests readers interact with text using emotion and intelligence, although different readers respond differently to different texts (Bryant et al., 1999; NRP, 2000). Teacher-student and student-student interactions affect student reading success (Duke & Pearson, 2002; Readence et al., 1989). The Nation's Report Card indicated that students who were asked to discuss and explain interpretations of their reading scored higher on standardized reading test than their classmates (Donahue et al., 1999). Whether classroom discussions are student or teacher directed affects students' motivation to read (Readence et al., 1989).

Discussion and Questions

Questions affect reading interest and attention to text discussion. Research indicates that the majority of questions asked in classrooms are low-order thinking questions requiring only rote, verbatim responses (Alvermann & Hayes, 1989; Armbruster, Anderson, Armstrong, Wise, Janisch, & Meyer, 1991). When students are encouraged to ask questions, they take greater interest in reading and explore new ideas in novel ways (Ryder & Graves, 1994).

Product Variables

Comprehension and Agricultural Literacy

Comprehension is a purposeful and active search for knowledge, which involves an intentional, thoughtful interaction between reader and text, incumbent upon activation of prior knowledge, connections of such with new knowledge, and knowledge of text, vocabulary, and structure (Gillet & Temple, 2000; Harris & Hodges, 1995; NRP, 2000; Pearson & Johnson, 1978; Rumelhart, 1977; Ryder & Graves, 1994; Smith, 1982;

Snow, 2002). Hands-on activities, field trips, discussions, and other experiences aid in development of comprehension, vocabulary, and concept knowledge (Duke & Pearson, 2002). Reading comprehension can be improved by teaching students to use specific cognitive strategies and to reason through comprehension barriers (NRP). Learners must learn to regulate reading and thinking processes to read for comprehension (Collins, 1994). Palinscar and Brown (1989) proposed six general strategies that monitored and fostered comprehension: clarifying purposes of reading, activating background knowledge, allocating attention, evaluating content critically, using monitoring activities, and drawing and testing various kinds of inferences.

Motivation to Read and Lifelong Readers

Reading programs should produce capable readers, who read "on a regular basis for recreation, to satisfy a curiosity to learn, or for self-improvement" (Readence et al., 1989, p. 44). Attitude comprises "feelings that cause a reader to approach or avoid a reading situation" (Readence et al., 1989, p. 102). Closely associated with attitude toward reading is motivation. Motivation depends upon "1) the degree to which the individual expects to perform successfully if they try reasonably hard, and, 2) the degree to which they value the available rewards for success" (Good & Brophy, 1991, p. 26).

Critical Thinking

Critical thinking is "the active use of formal logical procedures involving cognitive and metacognitive processes to understand the world beyond its literal meaning" (Ryder & Graves, 1994, p. 213). Critical thinking is subject matter dependent (Resnick, 1987). It involves

"1) the ability of the learner to draw on background knowledge, 2) the ability of the learner to obtain or derive meaning from diverse sources of information, and 3) the ability of the learner to recognize or generate objectives that direct

attention and regulate thinking" (Ryder & Graves, p. 211).

To read critically, readers should draw inferences, analyze lines of reasoning, apply logic, weigh evidence, evaluate language, and relate different readings to each other (Moore, 2003).

Communication of Ideas

Critical thinking affects decisions and conclusions that learners must communicate in written or oral form. Donahue et al. (1999) reported that students who wrote long answers to test questions in response to reading at least once a week scored higher on standardized reading assessments than did their counterparts who did not write long answers to test questions. Students complete their thoughts more completely when writing and/or speaking.

Conclusions

Contexts for reading in secondary agriscience consist of student's reading ability, interest in agriscience, prior knowledge, prior reading experiences, motivation to read, age, and experience (Figure 2). Other contexts include home, classroom, and school environments and the readability, vocabulary, structure, content, and selection of agriscience texts. Agriscience reading processes encompass classroom management, pre-reading, reading, and post-reading activities. Pre-reading processes involve setting purposes for reading; the reading capabilities, abilities, knowledge, and experience that students employ prior to reading; and strategy instruction. During reading, processes include interactive reading, use of strategies, monitoring, and the reading activities themselves. Post-reading processes generally revolve around discussions and questions, including oral and written assignments. Student reading outcomes or products in secondary agriscience include comprehension, agricultural literacy, motivation to read, the development of lifelong readers, critical thinking about agriculture, and effective communication of ideas using fluency and vocabulary.
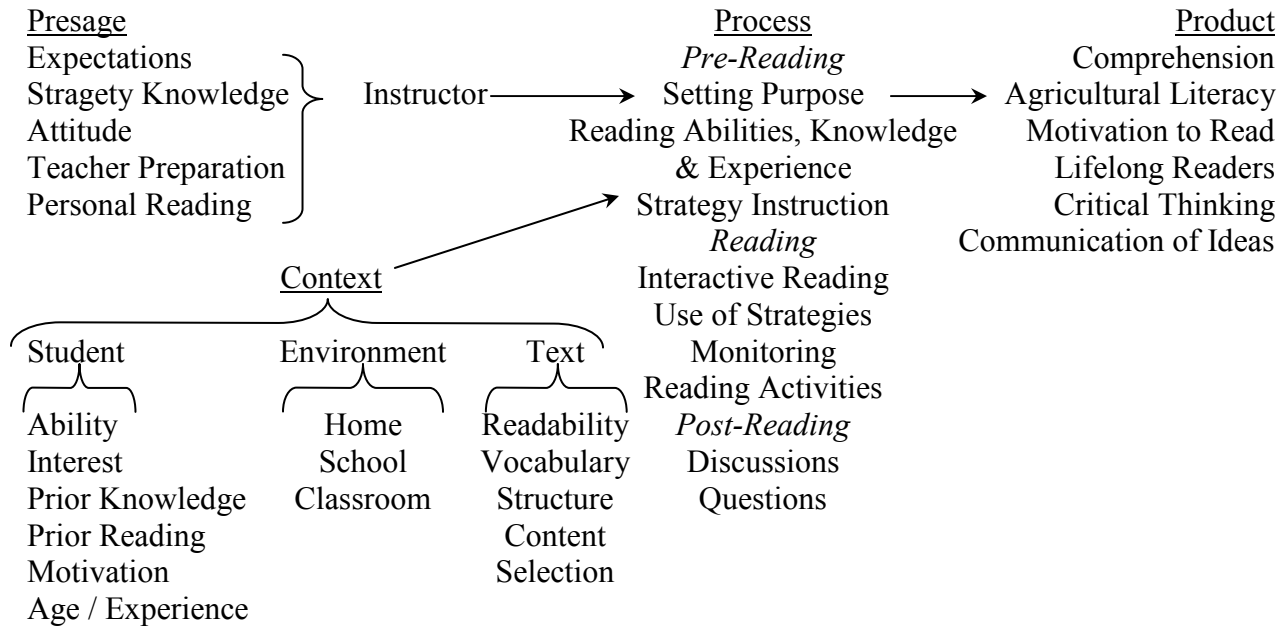
Presage
Expectations
Stragety Knowledge
Attitude
Teacher Preparation
Personal Reading

Instructor

Context

Student   Environment   Text

Ability   Home   Readability
Interest   School   Vocabulary
Prior Knowledge   Classroom   Structure
Prior Reading   Content
Motivation   Selection
Age / Experience

Process
Pre-Reading
Setting Purpose
Reading Abilities, Knowledge
& Experience
Strategy Instruction
Reading
Interactive Reading
Use of Strategies
Monitoring
Reading Activities
Post-Reading
Discussions
Questions

Product
Comprehension
Agricultural Literacy
Motivation to Read
Lifelong Readers
Critical Thinking
Communication of Ideas

Figure 2. A Model for the Study of Reading in Secondary Agriscience

Recommendations

To date, little research has been conducted regarding the effects of reading in secondary agriscience, yet, with the advent of high-stakes testing, agriscience teachers are being called upon to contribute to students' reading performance. Additionally, reading is vital to student performance in agriculture courses. Based on this synthesis of research related to content area reading, several questions should be investigated with regard to reading in agriscience. For example, how is reading in secondary agriscience different than reading in other content areas? What reading activities and strategies do agriscience teachers employ to aid students in comprehending the highly technical content found in many agriscience courses? How are teachers using textbooks and reading as a vehicle for teaching students? Do teachers engage students in reading and employ research-based reading strategies when teaching agriscience reading and concepts?

Clearly, the processes involved with text utilization in agriculture courses affect a student's comprehension, motivation to read, and thinking about agricultural concepts and issues. Specific research-based reading strategies that complement instruction in agriscience must be identified and implemented to assist students in comprehending agricultural concepts. Given the current state of education and high-stakes testing, a sense of urgency prevails upon agriscience teachers to seek and implement methods of improving student reading performance. Whether that urgency is felt by teachers and researchers is yet another question.

Research demonstrates eight general areas of strategy instruction that improve comprehension, and thus need to be employed in agricultural classrooms. University teacher educators may lead the charge of improving reading performance in secondary students by ensuring that future agriscience teachers are prepared with research-based content area reading strategies that complement the traditional approaches to education in agriculture. Thus, research is needed to explore the most efficacious reading strategies for incorporation into secondary agriscience courses, and approaches to instruction, such as problem-solving, experiential learning, and competency-based instruction.

Outcomes of effective reading in secondary agriscience hold promise for all of the food and fiber industry. Once

graduated from high school, one of a person's most frequent contacts with agriculture and agricultural issues may be through print media; thus, impetus is placed on secondary agriscience to provide a sound springboard for comprehension and critical thinking about agricultural issues through reading. Research is needed to ascertain the effects of print media on agricultural literacy and critical thinking about agricultural issues. What does the public read and infer about agriculture through reading? Further, to meet the needs of society, agricultural educators can contribute to all students by developing their motivation to read and potential to become lifelong readers.

To some extent, all teachers, including agriscience teachers, are teachers of reading; thus all of agricultural education should begin to change the mindset of secondary agriscience teachers to embrace their role in the development of student achievement in reading. To ensure adequate student learning and to develop lifelong learners, teacher educators should add research-based reading strategies to the toolbox of instructional techniques used to prepare future teachers. Students graduating from secondary agriscience programs should possess agricultural literacy, which includes reading for comprehension and critical thinking in and about agriculture, motivation to read throughout life, and the communication abilities based on reading to communicate effectively about agriculture.

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