

Professional Commitment to Cognitive Skill Development

Janet Henderson
Assistant Professor

Agricultural Education
University of Illinois

The ability to think is usually an assumed by-product of the educational process. Many teachers would agree that as students are learning specific facts and skills, they are simultaneously learning how to think. Yet, research indicates that most adolescents and adults are limited in their ability to think or to use problem solving strategies (Tobin & Capie, 1980). If thinking is defined as the capacity to recall previously learned information, then the apparent concern over the lack of cognitive skills may not be warranted. Most educators would adhere to a more rigorous definition of thinking.

Many terms have been used interchangeably in the literature to describe the cognitive process: analytical reasoning, divergent thinking, creative problem solving, productive thinking, formal operational skills, and inductive/deductive reasoning. For purposes of this paper, the term critical thinking will be used to describe the higher levels of cognition and is defined as the restructuring and reorganizing of one's knowledge to arrive at a solution to a problem situation, where no ready-made response is available. Critical thinking skills are especially important in a rapidly changing industry like agriculture. Vocational agriculture students in an advanced farm management course are developing critical thinking skills when they learn to evaluate the alternatives of owning or leasing acreage and to analyze the cost efficiency of various equipment/acreage ratios.

Research in Critical Thinking

What is currently known about the critical thinking process? Developmental theories of learning have attempted to explain the growth stages in cognitive development. According to Piaget (Day, 1981), at about 11 or 12 years of age children develop formal reasoning skills that enable them to hypothesize about solutions to problems, to determine the reality of situations, to consider the logical relations between variables, and to deduce from hypotheses that certain events should occur. Formal operational thinkers are aware of their thought processes and have developed a repertoire of critical thinking skills (Campbell, Litwin, Miles, & Murphy, 1979). Some educators doubt that formal operational skills are universal in older children and adults, stating that only 34% to 50% of the population possesses such reasoning abilities (Day, 1981).

Although researchers disagree on the underlying variables that govern cognition, the characteristics of critical thinkers have been documented by Hudgins, (1977). Critical thinkers assume an active role in absorbing information; they believe they have a significant function in the learning process. Critical thinkers have an organized, systematic approach to new situations; they realize the impor-

tance of making comparisons and of identifying discrepancies among variables. Critical thinkers do not view items or events in isolation, but understand the reasonable relationships that will result in solutions. They restate new information into their own words and visually imagine personal illustrations to aid in retention of facts (Chance, 1981; Lochhead, 1981). No one theory has been advanced which explains all the factors that influence the development of critical thinking. However, educators do know that critical thinking is related to memory, intelligence, motivation, and perception (Vinacke, 1974). The quality and quantity of an individual's prior experiences also effect critical thinking.

Critical Thinking in the Classroom

Is cognitive skill development a realistic classroom activity? Should the development of higher level cognitive skills be an objective of vocational agriculture instruction? Most students passively absorb factual information and deliver the same information back on a paper/pencil test. Cognitive processes are frequently channeled and restricted by conditioned responses. Students are often required to remember particular pieces of information, such as the breeds of beef cattle, or a list of soybean varieties. Even though the memorization of specific facts, terms, and lists is not educationally unsound, many teachers seldom go beyond this low level of learning. Consider two production agriculture instructors: One teacher asks students to name the recommended varieties of soybeans for their county. The other teacher asks students to analyze the factors in soybean variety selection. Understanding the process of variety selection may be more important than remembering particular variety names that could change from year to year. Students can develop a passive approach to learning, depending on the teacher to provide information and direction. Most teachers have had the experience of students asking: "Do we need to know this?" "Should this be written in our notebook?" Students do not see themselves as actively involved in the learning process; they wait for the teacher to instruct them. Students are not developing the ability to reorganize and use knowledge through critical thinking. Few teachers offer direct instruction in developing critical thinking; most teach "what" to think, rather than "how" to think (Vye & Bransford, 1981).

Educators and researchers have recently confronted the challenge of teaching cognitive skills directly. Causing students to become aware of their own cognitive processes and instructing them in particular thinking strategies has a direct effect on critical thinking ability (Day, 1981). The teacher can be viewed as a mental or cognitive engineer who can directly influence cognitive skill development (Kuo, 1976). Evidence indicates that students who are taught to think, along with traditional subject matter instruction, will retain the knowledge much longer and can integrate the information into other settings (Campbell, et al., 1979).

Teaching Techniques for Critical Thinking Skills

If cognitive skills can and should be taught, then what techniques or conditions encourage and promote critical thinking? Educators have known for some time that verbal questioning is a way to stimulate thinking. Yet, most teachers ask only factual recall questions. For example an agricultural mechanics teacher, discussing the procedures for drilling and tapping holes in cold metal, asks the class "What are the steps in the process?" The students would list: measure correctly, mark with a scratch awl, center with a punch, drill, and tap. The teacher can go beyond these knowledge/comprehension type questions by also asking students how would they determine the minor diameter of two types of threaded fasteners? Or given 150,000 lb. proof load, what factors would they consider in selecting a bolt for a specific application? When students are exposed to analysis and evaluation type questions, there appears to be a positive correlation between high order teacher questions and high level cognitive responses from students (Barnes, 1979).

Costa (1981) has identified classroom conditions that contribute to the development of critical thinking. Students must realize that thinking strategies are one of the objectives of instruction. Sufficient time must be provided for preliminary data accumulation with teachers furnishing direct, concrete experiences first, and then providing practice in critical thinking. During a pest management unit, students need time to learn the characteristics of certain pests: life cycles, host plants, damage, and mouth parts before they can troubleshoot a pest problem in the greenhouse or in the field. Critical thinking activities do not occur in place of the lower levels of learning, but rather to complement and extend student thinking and learning.

Critical Thinking Programs

In the past several years various programs have been developed by educators to promote critical thinking. The goals of these programs are to teach students how to think more efficiently, to cultivate habits of critical thinking, and to help make the critical thinking process more explicit. Most of the programs emphasize process, rather than content attainment. Critical thinking programs encourage participants to defer judgement of ideas, to risk cognitive uncertainty, and to practice divergent reasoning. As students become aware of their own thinking process, they should be more free to operate without continual aid and prompting from the teacher. Yet, students need assistance in recognizing and arranging the specific cognitive skills that are to be taught (Chance, 1981). Telling students to think "hard" or critically about a certain situation will usually produce disappointing results. Instructors cannot assume that students will instinctively develop critical thinking skills; supervised practice is needed to insure continued growth of higher level cognitive skills.

Critical Thinking in Vocational Agriculture

The problem solving approach to teaching has been one of the cornerstones of vocational agriculture instruction. This approach to teaching encourages the use of real-life situations and "learning by doing" activities to teach students agricultural skills and competencies. The vocational agriculture curriculum has an unlimited number of opportunities to involve students in critical thinking activities. Secondary vocational agriculture teachers often appear to lack the formal training required to design and incorporate critical thinking activities into the classroom.

What can teacher educators do to provide future teachers with effective techniques for teaching critical thinking skills? Appraising personal teaching methods and course objectives will indicate the type of thinking emphasized in a particular setting. Discussing and demonstrating the various aspects of critical thinking with prospective teachers will begin to build a framework for continued cognitive development. Reviewing written tests and curriculum materials for the level of thinking required can also designate the presence or absence of critical thinking activities.

Little research has been conducted in the area of critical thinking as the topic relates to vocational agriculture instruction. Several concerns exist that need investigation: a review of vocational agriculture curriculum materials to document the kinds and amounts of thinking activities, an assessment of cognitive skills to determine the thinking abilities of undergraduate students, an evaluation of the types of questioning techniques used in teacher education courses, and an experimental comparison of different thinking programs.

Professional Commitment to Critical Thinking

In summary, critical thinking is a cognitive skill that can be directly developed by specific practices and strategies. Creating a classroom environment that supports and nurtures critical thinking should be a consideration of vocational agriculture instructors and teacher educators. Vocational agriculture students need to know, not only, specific facts, but how to apply these facts in different job related settings. As current agricultural trends and practices become obsolete, the industry will need students who can readily adapt to change and can use critical thinking skills in a wide variety of situations. The student who can correctly list the scientific name for certain trees, should also be able to evaluate or assess the landscape value of each specimen in a particular setting. Prospective teachers should be observing and practicing critical thinking so they can teach these cognitive skills to their future students. Few teacher educators would question the value and importance of developing critical thinking, but is the profession committed to providing future teachers with such skills?

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