DIMENSIONS OF CRITICAL THINKING

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Abstract

Critical thinking is a skill that most faculty members would readily agree is important for students to develop. Unfortunately, many of our students have poorly developed critical thinking skills (Rudd, Baker, Hoover, Gregg, 1999). Perhaps the problem is rooted in us, the faculty. Do faculty members understand the concept of critical thinking well enough to teach students to think critically in and about the discipline being studied? This paper is an attempt to define critical thinking for college of agriculture faculty members and to offer a primer for discussion of strategies to teach students to think critically in agricultural disciplines.

Teaching students to remember factual information and return it in the form of an examination is the prevalent teaching mode employed in secondary and post-secondary institutions today. Teaching thinking skills is a difficult and much different endeavor. Teaching to promote thinking takes more time to prepare, is difficult to plan, and limits the amount of content "taught." Teachers can no longer be information givers. Students must learn thinking and reasoning skills to reach their fullest potential in today's society (Meyers, 1986).

The more information is better attitude unfortunately prevails in modern education. That is unfortunate considering that factual matter has a relatively short life span with students (Terezini, Springer, Pascarella, & Nora, 1993). When coupled with the fact that information learned today quickly becomes outdated, is it any wonder that our students struggle when they reach the work place? Good thinking skills will not develop on their own, they must be taught (Beyer, 1987). Teaching students to think must be a priority of our schools today.

The term critical thinking is common in educational, psychological, and philosophical, circles today. Employers, parents, administrators, and students themselves want critical thinking skills developed in today's graduate. Developing critical thinking skills is not a new idea. Osborne (1932 p.402) stated that "…it is assumed that development of thought power is one of the major aims of education." Dressel and Mayhew (1954) believed that educational institutions were responsible for teaching students to go beyond the simple mental activities of recall and restatement of ideas and facts to the higher level skills and habits involved in critical thinking.

Sutton and de Oliveira (1995) asserted that although students complete basic courses they have only a superficial understanding of what they have learned. In fact, few students are taught the skills needed to examine principles, values and facts.

Purpose / Methods / Procedures

Critical thinking skills in agricultural audiences have not been widely studied. Rudd, Baker, Hoover, & Gregg (1999) found that a disproportionate number of students sampled in the College of Agriculture at the University of Florida had a low disposition for critical thinking (when compared to the national data set). In the same study (Rudd et.al., 1999) found no correlation between learning style and critical thinking (as measured by the California Critical Thinking Disposition Instrument). Torres & Cano (1995) found a moderately positive relationship between students' ability to think critically (as determined by the Developing Cognitive Abilities Test) and students' learning style. In a study conducted by Whittington, Stup, Bish and Allen (1997), a relationship between the level of cognitive thinking required on the part of students and critical thinking was hypothesized. Although Torres and Cano proposed a conceptual framework for addressing cognitive ability, and Whittington et. al. postulated a relationship between the cognitive level of instruction and critical thinking, a working definition of "critical thinking" for agricultural students remains elusive.

The purpose of this study was to clarify the concept of critical thinking for agricultural education audiences. In an effort to clarify the concept of critical thinking for agricultural educators, the researchers conducted an extensive literature review within the context of agricultural education, philosophy, and psychology. The authors have attempted in the descriptive and interpretive discussion that follows to present multiple views of critical thinking and to propose critical thinking dimensions, drawn from the literature, that can be utilized in agricultural education.

Findings

Critical Thinking Defined

To date, much work has been completed in multiple disciplines in the name of critical thinking A great deal of this work not only leaves one wondering how it is measured, but also leaves one groping for a clear definition of critical thinking. Paul (1995) wrote that the "master of critical thinking" uses a set of intellectual standards while thinking. These standards guide the thinking process as well as help individuals heighten their ability to think critically. Thinking about thinking for the purpose of improving the thought process is at the heart of critical thinking (Paul, 1995).

Halpern (1996 p.5) defined critical thinking as "…the use of cognitive skills or strategies that increase the probability of a desirable outcome." Other definitions include: the formation of logical inferences (Simon & Kaplan, 1989), developing careful and logical reasoning (Stahl & Stahl, 1991), deciding what action to take or what to believe through reasonable reflective thinking (Ennis, 1991), and purposeful determination of whether to accept, reject, or suspend judgement (Moore & Parker, 1994). Burden and Byrd (1994) categorize critical thinking as a higher-order thinking activity that requires a set of cognitive skills. In a comprehensive attempt to define critical thinking, Pascarella and Terezini (1991) compiled the following,

> critical thinking has been defined and measured in a number of ways but typically involves the individual's ability to do some or all of the following: identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority." (p. 118).

Crunkilton (1996) presented a pragmatic approach to promoting critical thinking in students through conditions necessary for thinking. The first condition is having something to think about such as a person, an object, a situation, problem or process. Crunkilton's second condition is having something to think with, such as background knowledge and resources (maps, charts, notes, computers). The third condition is having ways in which to think. In other words, students need thinking structures to guide the thinking process. Examples include comparing, estimating, evaluating, problem solving and interpreting. The final condition is a reason to think. Reasons to think vary from thinking to resolve a controversy, to solving a problem, to satisfying an interest, or completing an assigned task.

Some clarity in defining critical thinking was achieved when a group of leading researchers with expertise in the field was asked to define critical thinking through a Delphi study in 1990 (Facione). They hypothesized that there is a set of intellectual virtues or habits of mind that reflect one's disposition to think critically. These virtues are identified below in the Delphi consensus statement (page 2):

> The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit.

Critical Thinking Traits and Processes

In a 1987 comprehensive review of existing literature, Beyer posited that critical thinking requires a set of skills and approaches to be effective. A delineation of cognitive operations was offered by Beyer (1987) that included thinking strategies, critical thinking skills, and micro-thinking skills. His thinking strategies included problem solving, decision making, and conceptualizing. Examples of micro-thinking skills included recall, interpretation, application, synthesis, evaluation, reasoning, and extrapolation. Beyer's proposed the following as critical thinking skills:

Distinguishing between verifiable facts and value claims

1. Distinguishing relevant from irrelevant information, claims, and reasons;
2. Determining factual accuracy of a statement;
3. Determining credibility of a source;
4. Identifying ambiguous claims or arguments;
5. Identifying unstated assumptions;
6. Detecting bias;
7. Identifying logical fallacies;
8. Recognizing logical inconsistencies in a line of reasoning;
9. Determining the strength of an argument or claim.

According to Facione (1990), critical thinkers also possess a set of affective dispositions that enable them to seek to address situations that require critical thinking. Although a person can have the cognitive skills to think critically, they are more effective thinkers if they exhibit the affective dispositions listed in Table 1.

In an effort to clarify the process of critical thinking, Paul (1995) wrote that critical thinking is a unique and purposeful form of thinking that is practiced systematically and purposefully. The thinker imposes standards and criteria on the thinking process and uses them to construct thinking. Table 2 summarizes Paul's operational definition of critical thinking.

Paul (1995) further refined critical thinking by identifying three thought traits and / or processes possessed by the critical thinker. They are elements of reasoning, traits of reasoning, and reasoning standards.

Elements of reasoning consist of seven components that help guide the reasoning process. These components include the purpose of the thinking or the question at hand, information and or facts about the question, assumptions made about the question, interpretation of the facts and data collected, theories and concepts related to the question, and inclusion of other points of view. Finally, an assessment of the conclusions is drawn with emphasis on implications and consequences of the decisions reached as a result of the thinking process (Figure 1).

Table 1
Affective Dispositions of Critical Thinking

Approaches to Life in General

- Inquisitiveness with regard to a wide range of issues
- Concern to become and remain well-informed
- Alertness to opportunities to use critical thinking
- Trust in the process of reasoned inquiry
- Self-confidence in one's ability to reason
- Open-mindedness regarding divergent views
- Flexibility in considering alternatives and opinions
- Understanding of the opinions of others
- Fair-mindedness in appraising reasoning
- Honesty in facing one's own biases, prejudices, stereotypes, egocentric and sociocentric tendencies
- Prudence in suspending, making or altering judgements
- Willingness to reconsider and revise views where honest reflection suggests change is warranted.

Approaches to Specific Issues, Questions, or Problems

- Clarity in stating the question or concern
- Orderliness in working with complexity
- Diligence in seeking relevant information
- Reasonableness in selecting and applying criteria
- Care in focusing attention on the concern at hand
- Persistence though difficulties are encountered
- Precision to the degree permitted by the subject and the circumstances

(Facione, 1990)

Table 2
What is Critical Thinking

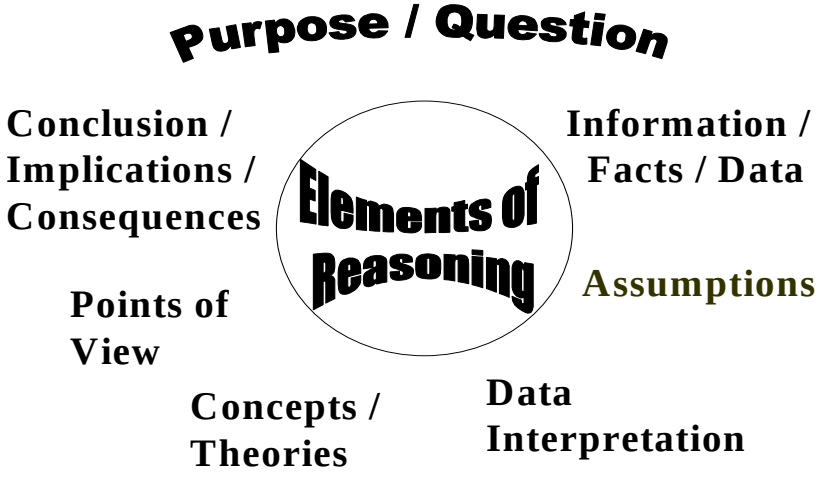
A unique kind of purposeful thinking	In any subject area or topic whether academic or practical, requiring intellectual training for the mind, akin to physical training for the body
In which the thinker systematically and habitually	Actively develops traits such as intellectual integrity, intellectual humility, fairmindedness, intellectual empathy, and intellectual courage.
Imposes criteria and intellectual standards upon the thinking	Identifies the criteria of solid reasoning, such as precision, relevance, depth, accuracy, sufficiency, and establishes clear standards by which the effectiveness of the thinking will be assessed.
Taking charge of the construction of thinking	Awareness of elements of thought such as assumptions and point of view that are present in all well-reasoned thinking, A conscious, active, and disciplined effort to address each element is displayed.
Guiding the construction of the thinking according to the standards	Continually assessing the course of construction during the process. Adjusting, adapting, and improving using criteria and standards.
Assessing the effectiveness of the thinking according to the purpose, criteria, and standards	Deliberately assessing the thinking to determine its strengths and limitations according to the defining purpose, criteria, and standards. Studying the implications for further thinking and improvement.

Paul (1995, p21).

Traits of critical thinkers include independent thinking, intellectual empathy, intellectual humility, courage, integrity, perseverance, intellectual curiosity, faith in reason, intellectual civility, and intellectual responsibility. These traits are not only present in critical thinkers, they are consciously utilized to guide the thinking process (Paul, 1995).

Standards that guide thinking include clarity in the thought process; accurate, precise, and relevant thinking, utilizing information that is directly related to the thinking situation; deep thinking; and broad thinking. These standards can guide the critical thinker to a thinking product or decision that is not clouded by irrelevant information and has been investigated fully.

Figure 1. Elements of Reasoning



Although thinking critically utilizes higher-order thinking, critical thinking and higher-order thinking are not equivalent terms. Critical thinking is not a "catch-all" category for higher-order thinking. It is one of a family of closely related forms of higher-order thinking. Others include problem solving, creative thinking, and decision-making (Facione, 1990). The skills and sub-skills identified by the Delphi group are listed in Table 3.

Facione (1990) used the information from the Delphi study to identify seven constructs of critical thinking. These constructs include analyticity, self-confidence, inquisitiveness, maturity, open-mindedness, systematicity, and truth-seeking.

Analyticity targets the disposition of being alert to potentially problematic situations, anticipating possible results or consequences, and prizing the application of reason and the use of evidence, even if the problem at hand turns out to be challenging or difficult. The analytically inclined person is alert to potential difficulties, either conceptual or behavioral, and consistently looks to anticipatory intervention, reason giving, and fact-finding as effective ways to resolve matters.

Table 3
Consensus List of Critical Thinking Cognitive Skills and Sub-Skills

Skill	Sub-Skill
Interpretation	Categorization
	Decoding Significance
	Clarifying Meaning
Analysis	Examining Ideas
	Identifying Arguments
	Analyzing Arguments
Evaluation	Assessing Claims
	Assessing Arguments
Inference	Querying Evidence
	Conjecturing Alternatives
	Drawing Conclusions
Explanation	Stating Results
	Justifying Procedures
	Presenting Arguments
Self-Regulation	Self-Examination
	Self-Correction

(Facione, 1990)

Self-confidence refers to the level of trust one places in one's own reasoning process. Critically thinking self-confident persons trust themselves to make good judgements and believe that others trust them as well, since they believe that others look to them to resolve problems, decide what to do, and bring reasonable closure to inquiry.

The inquisitive person is one who values being well informed, wants to know how things work, and values learning even if the immediate payoff is not directly evident. This person seeks knowledge without provocation for the intrinsic benefit of knowing.

Maturity addresses cognitive maturity and epistemic development. Mature thinkers are disposed to approach problems, inquiry, and decision making with a sense that some problems are ill-structured, some situations have more than one plausible option. Mature thinkers also realize that judgements based on standards, contexts, and evidence often must be made without having the benefit of knowing all information about the situation.

Open-mindedness is a construct that targets the disposition of being tolerant of divergent views with sensitivity to the possibility of one's own bias. The open-minded person respects the rights of others to differing opinions.

Systematicity targets the disposition to being organized, orderly, focused, and diligent in inquiry. No particular kind of organization (i.e. linear or nonlinear) is given priority. The systematic person strives to approach specific issues, questions or problems in an orderly, focused, and diligent way.

Truth-seeking thinkers are those eager to seek the truth, who are courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's interests or one's preconceived opinions. The truth-seeker would rather pursue the truth than win the argument.

Results / Conclusions / Implications

Individuals who can think critically are invaluable as employees, leaders, and members of society. Increasing the number and quality of critical thinkers in agriculture will be a great asset to the industry. Unfortunately, our discipline lacks a cohesive definition of critical thinking. How can we teach our students to think critically if we cannot define critical thinking?

Critical thinking is a broader concept than has been addressed in the agricultural education literature to date. Critical thinking is not equivalent to problem solving or cognition. Professionals in agricultural education need to look outside of the profession to begin to learn about this complex concept.

The authors hope that this paper will lead to additional scholarly inquiry in and about critical thinking with agricultural audiences. If the profession wishes to move forward with scholarly inquiry in and about critical thinking, we must reach agreement on a definition for critical thinking. The authors would propose the following definition, based on this literature review, as a starting point for critical thinking discussion:

Critical thinking is a reasoned, purposive, and introspective approach to solving problems or addressing questions, with incomplete evidence and information, and for which an incontrovertible solution is unlikely.

Literature Cited

Beyer, B.K., (1987). *Practical strategies for the teaching of thinking*. Boston MA: Allyn and Bacon, Inc

Burden, P.R., & Byrd, D.M., (1994). *Methods for effective teaching*. Boston, MA: Allyn and Bacon, Inc.

Crunkilton, J.R., (1996). *Setting the stage to enhance critical thinking skills in our students*. Workshop presented to the faculty of the University of Florida College of Agriculture. (November).

Dressel, P.L., & Mayhew, L.B., (1954). *General Education: Explorations in Evaluation.* Washington DC. American Council on Education.

Ennis, R. H., (1991). Critical thinking: A streamlined conception. *Teaching Philosophy*. 14(1), 5-24.

Facione, P.A., (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction.* Millbrea, CA: The California Academic Press.

Halpern, D.F., (1996). *Thought and knowledge: An introduction to critical thinking.* Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Meyers, C. (1986). *Teaching students to think critically*. San Francisco, CA. Jossey-Bass Inc. Publishers.

Moore, B.N. & Parker, R. (1994). *Critical Thinking.* Mountain View, CA: Mayfield.

Osborne, W.J., (1934). Testing Thinking. *Journal of Educational Research*. 27,(1). P. 402.

Paul, R. W., (1995). *Critical thinking: How to prepare students for a rapidly changing world.* Santa Rosa, CA: Foundation for Critical Thinking.

Pascarella, E., & Terenzini, P. (1991). *How college affects students: Findings and insights from twenty years of research*. San Francisco, CA: Jossey Bass.

Rudd, R.D., Baker, M.T., Hoover, T.S., Gregg, A., (1999*). Learning styles and critical thinking abilities of College of Agriculture students at the University of Florida*. Proceedings of the 49th Annual Southern Region Agricultural Education Research Meeting. Memphis TN. 123-134.

Stall, N.N., & Stahl, R.J., (1991). *We can agree after all: Achieving aconsensus for a critical thinking component of a gifted program using the Delphi technique.* Roeper Review, 14(2), 79-88.

Sutton, J.P., de Oliveira, P.C. (1995). *Differences in critical thinking skills among students educated in public schools, christial schools, and home schools*. Eric Document. ED 390-147.

Torres, R.M., & Cano, J. (1995). Learning style: A factor to critical thinking*? Proceedings of the 22nd Annual National Agricultural Education Research Meeting*, 373-282.

Terrenzini, P.T., Springer, L., Pascarella, E.T., Nora, A., (1990). *Influences affecting the development of students' critical thinking skills.* Eric Document. ED 372-666.

Whittington , M.S., Strup, R.E., Bish, L. & Allen, A., (1997). Assessment of cognitive discourse; A study of thinking opportunities provided by professors. *Journal of Agricultural Education.* 38 (1), 46-53.