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IMPROVING LEADERSHIP THROUGH BETTER DECISION MAKING: FOSTERING CRITICAL THINKING

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by

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14. ABSTRACT

Critical thinking is presently an area of emphasis at the Air Force?s Air Command and Staff College (ACSC). This project provides the background information and framework to assess ACSC?s success at fulfilling its goal of fostering critical thinking. Along the way it answers four salient questions concerning critical thinking. First, why critical thinking is so vitally important for leaders today. The world?s rapidly changing contextual factors and turbulent environment dictates that critical thinking be a necessary characteristic in leadership development. Secondly, the problem with defining exactly what is meant by the term critical thinking; The lack of a consensus on a precise definition is overcome by synthesizing a definition that contributes to the solution of the two remaining questions: how to assess critical thinking and how is critical thinking fostered? A number of different evaluation techniques are analyzed with the conclusion that the Watson-Glaser Appraisal combines the best combination of validity, reliability and ease of use. Four instructional techniques are also evaluated with current research literature suggesting a more explicit teaching approach (infusion) might be beneficial for ACSC. A critical analysis of the current program indicates that although critical thinking is being fostered, effectiveness and efficiency cannot be determined with the descriptive evaluation data presently available; this deficiency could be eliminated with the use of the Watson-Glaser appraisal. Areas for additional research are also suggested.

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Preface

I chose the area of critical thinking for the focus of this research project because of my interest in education and my belief that innovative problem solving, critical analytical thought and sound professional judgment have been and will continue to be keys to battlespace dominance. Additionally, since ACSC focuses on shaping and molding tomorrow's leaders, this research can contribute to the continued improvement of the professional military education it provides. While much progress has been made transforming the ACSC curriculum from a passive one, based primarily on lectures, to an active seminar based discussion format, I believe that the area of assessment needs additional emphasis to validate that these new improvements are in fact improving students' abilities to think critically. My recommendations provide areas that need further study and I hope to conduct further research in support of a dissertation to complete my Doctorate in Education.

I am greatly indebted to Maj Brenda Roth (PhD) for her guidance and assistance. Her dissertation on student outcomes assessment at ACSC provided a foundation for my research and allowed me to focus on critical thinking, a specific area of her work. She was an invaluable research advisor giving both encouragement and constructive criticism. Lt Col Michael Conn also was quite helpful and provided information on Myers-Briggs Type Indicator research and feedback on the overall ACSC evaluation system.

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Abstract

Critical thinking is presently an area of emphasis at the Air Force's Air Command and Staff College (ACSC). This project provides the background information and framework to assess ACSC's success at fulfilling its goal of fostering critical thinking. Along the way it answers four salient questions concerning critical thinking. First, why critical thinking is so vitally important for leaders today. The world's rapidly changing contextual factors and turbulent environment dictates that critical thinking be a necessary characteristic in leadership development. Secondly, the problem with defining exactly what is meant by the term critical thinking; The lack of a consensus on a precise definition is overcome by synthesizing a definition that contributes to the solution of the two remaining questions: how to assess critical thinking and how is critical thinking fostered? A number of different evaluation techniques are analyzed with the conclusion that the Watson-Glaser Appraisal combines the best combination of validity, reliability and ease of use. Four instructional techniques are also evaluated with current research literature suggesting a more explicit teaching approach (infusion) might be beneficial for ACSC. A critical analysis of the current program indicates that although critical thinking is being fostered, effectiveness and efficiency cannot be determined with the descriptive evaluation data presently available; this deficiency could be eliminated with the use of the Watson-Glaser appraisal. Areas for additional research are also suggested.

Chapter 1

Introduction

> *The dynamic nature of joint operations in the 21st century battlespace will require a continued emphasis on developing strong leadership skills….Effective leadership provides our greatest hedge against uncertainty.*
>
> — Joint Vision 2010

Background and Problem Definition

Leadership is important in any organization and this is especially true in the military.[1] Researchers have proposed many leadership models over the years in an attempt to develop theories that describe, predict, evaluate, and develop better leaders. These efforts to develop leadership theories have been only marginally successful and thus new and more complex theories have continued to evolve in an attempt to fill this void. The premise of this research paper is that the world's rapidly changing contextual factors and the increased importance of interdependence force us to look at leadership in a revolutionary new way—leadership as a process rather than a position.[2] Furthermore, because critical thinking is a primary tool for dealing with the many dilemmas and paradoxes in today's turbulent environment, the support of critical thinking is a necessary characteristic in effective leadership development.[3]

Basic Air Force doctrine acknowledges this connection between leadership and critical thinking and provides the following general guidance: "Professional military education should encourage critical analytical thought, innovative problem solving and sound professional judgment."[4] Based on this guidance the Air Command and Staff College has incorporated "Preparing leaders to think strategically, operationally, and critically" as one of its stated goals.[5] However, problems arise when one begins to look closer at the specifics: Exactly what is critical thinking? How can it be measured? What is the best way to foster it? Finally culminating with the bottom line question: Is ACSC succeeding in fulfilling its critical thinking goal?

Methodology

In order to answer these questions, a literature search was conducted to identify and obtain as much current information on the area of critical thinking as possible. Recent empirical studies were primarily sought; however, older studies were also used if they were judged to add value. The references used in this paper were obtained by electronic searches of the ERIC database (1986-1996) and the on-line catalog at the University of Southern California and Air University Libraries. Hand searches were also conducted for the past year of the following journals: *American Educational Research Journal, Cognition and Instruction, Educational Psychologist, Higher Education, Journal of Educational Psychology, and the Review of Educational Research.* Descriptors used included key terms such as leadership, leadership training, professional military education, critical thinking, metacognition, and cognitive strategies along with a number of authors who specialize in this field such as Robert Ennis, Stephen Norris, Harvey Siegel, and

Richard Paul. Finally a thorough search of the Internet World Wide Web also uncovered several web sites, for example, (http://www.sonoma.edu/cthink/) dedicated to this area of study that yielded a considerable amount of information. Additional information was also obtained from personal interviews with ACSC leadership and staff along with a review of curriculum, teaching methods, and evaluation techniques.

Overview

This project will provide the background and a framework that can be used to assess Air Command and Staff College curriculum, instructional techniques, evaluations, and staff development in relation to its goal of fostering critical thinking and this current research. Along the way it will answer four salient questions concerning critical thinking. First, the problem with defining exactly what is meant by the term critical thinking ; The lack of a consensus on a precise definition contributes to the problems discussed in the next two questions: how to assess critical thinking is the second area of discussion? A number of different evaluation techniques presently used in research will be analyzed according to their strengths and weaknesses in an attempt to select one that might be used in the future for ACSC. The preceding support the discussions to the third question: how can critical thinking best be fostered through instruction? Four instructional techniques, infusion, immersion, general and mixed approach will be evaluated on which might be most beneficial for ACSC instruction. Finally, the research will be summarized in an attempt to assess the current ACSC program to foster critical thinking and proposals will be given that can be used to validate and improve this area of instruction.

Notes

[1] Joint Vision 2010, *America's Military: Preparing For Tomorrow*

[2] Richard L. Hughes, Robert C. Ginnett, and Gordon J. Curphy, *Leadership: Enhancing the Lessons of Experience* (Burr Ridge, Illinois: R. R. Donnelley & Sons Company, 1993), 1-18.

[3] Luke Novelli, Jr., and Sylvester Taylor, "The Context for Leadership in the 21st-Century Organizations," *American Behavioral Scientist* 37, no. 1 (September 1993): 139-147.

[4] Air Force Manual (AFM) 1-1, *Basic Aerospace Doctrine of the United States Air Force*, vol. 1, March 1992, 19.

[5] "Air Command and Staff College," *Air University Catalog*, 1995-96, n.p.; on-line, Internet, 6 February 1997, available from http://www.au.af.mil/au/cat/acsc.html.

Chapter 2

The Language of Critical Thinking

In a world of shallow values, instant gratification, and quick fixes, critical thinking is for those few that see the benefit of intellectual traits, standards and abilities that enable them to cut through the propaganda, the information blitz, and make sense of the world.

— Richard Paul
Critical Thinking: How to Prepare Students For a Rapidly Changing World

Demystifying the Concept: What is Critical Thinking

Air Force doctrine states that leaders need to be able to think critically and this attribute should be fostered through professional military education. This sounds reasonable and thus the Air Command and Staff College (ACSC) has fostering critical thinking as one of its stated goals. However, the term "critical thinking" is no where defined in Air Force publications, no guidance is given on how to accomplish this goal, and no criteria is provided so that progress may be assessed. One might assume that these answers are readily provided by academia, and therefore they do not need to be specifically addressed. However, as we shall see, this would be a serious mistake.

Critical thinking scholarship is in a mystified state. There is no single definition that is widely accepted and the use of many other strange terms such as infusion, immersion, general and mixed approach, just add to the confusion.[1] To rectify this situation, we need to synthesize a definition to clarify exactly what is meant by the term critical thinking.

Robert Ennis, one of the leading authors in critical thinking from the University of Illinois at Urbana-Champaign, defines critical thinking as "reasonable and reflective thinking that is focused on deciding what to believe or do."[2] John McPeck, another leader in this field and a critic of Ennis, views critical thinking as "the skill and propensity to engage in an activity with reflective skepticism within the context of a discipline and the knowledge within a given field"[3] Halonen uses these definitions from the two extremes of the generalizability debate to form a hybrid: *critical thinking is the propensity and skills to engage in an activity with reflective skepticism focused on deciding what to reasonably believe or do.*[4] From this it can be seen critical thinking has (at least) two central components. The first, a "reason assessment" component involves the abilities and skills relevant to the proper understanding and evaluations of reasons, claims, and arguments; The second, a "critical spirit" component that is characterized by a propensity to apply their critical thinking skills. This component may be broken down into a complex of dispositions, attitudes, habits, and traits. For instance, open-mindedness is one of the more important "critical spirit" aspects. Taking another look at the definition one can see it hinges on three key words: reasonable, reflective, and focused.

Criteria for Critical Thinking

The first criteria is that critical thinking must be reasonable as opposed to arbitrary or unreasonable. It must rely on the use of valid supporting evidence and appropriate inference from which, in general, the best conclusions are drawn. Secondly, critical thinkers must be reflective. They must consciously evaluate their own and others' thinking in an effort to improve it. Third, critical thinking is focused thinking. It is

thinking with a purpose. That purpose is to make the best decision about what to believe or do. Figure 1 provides a visual representation of the critical thinking process.[5]

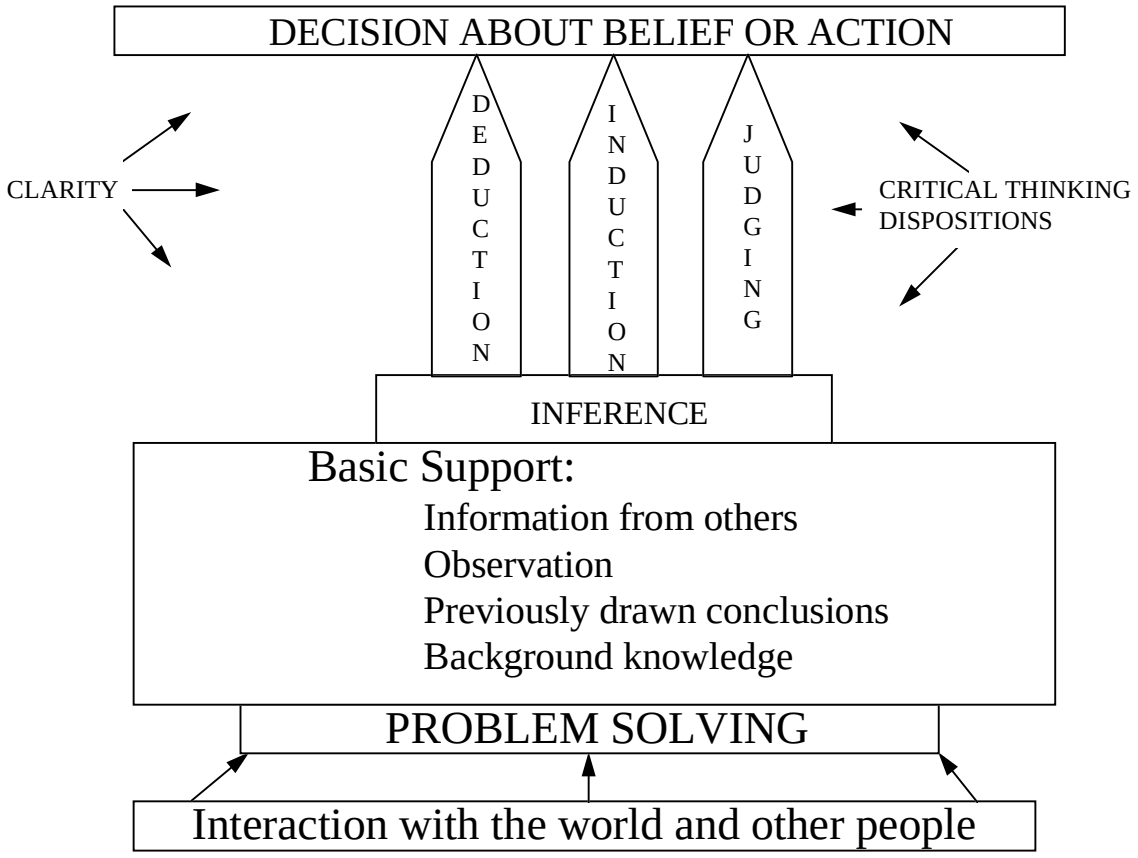

Figure 1. A Pictorial Representation of Critical Thinking

Looking at the model, we can see that it depicts the central criteria (reasonable, reflective, and focused) for our definition of critical thinking. The entire process takes place in a problem solving context, this focuses the thinking. The decision rests on some basic support which is used to reasonably infer some conclusion. The inference link is very important for critical thinking to proceed, a person needs both the skills of the "reason assessment" component and the dispositions of the "critical spirit" component. Reflection acts as a quality check throughout the process. Up to this point we have talked in very general terms, some specific examples should now be helpful. Tables 1 and 2

provide a further breakdown of the reason assessment skills and disposition components of critical thinking.

Table 1. Critical Thinking Reason Assessment Skills

Elementary Clarification	Focusing on a question
	Analyzing arguments
	Asking/answering questions that clarify & challenge
Basic Support	Judging the credibility of a source
	Making & judging observations
Inference	Making & judging deductions
	Making & judging inductions
	Making & judging value judgments
Advanced Clarification	Defining terms & judging definitions
	Identifying assumptions
Strategies & Tactics	Deciding on an action
	Interacting with others

Source: Stephen P. Norris and Robert H. Ennis, *Evaluating Critical Thinking* (Pacific Grove, CA: Critical Thinking Press, 1989), 6.

Table 2. Critical Thinking Dispositions

Critical Thinkers	Seek a statement of the thesis or question
	Seek reasons
	Try to be well informed
	Use credible sources and mention them
	Take into account the total situation
	Keep their thinking relevant to the main point
	Keep in mind the original or most basic concern
	Look for alternatives
	Are open minded and seriously consider points of view other than their own; reason from starting points with which they disagree without letting disagreement interfere with their reasoning
	Take a position and change a position when evidence and reasons are sufficient to do so
Critical Thinkers	Seek as much precision as the subject permits
	Deal in an orderly manner with parts of a complex whole

Table 2—continued

	Employ their critical thinking abilities
	Are sensitive to the feelings, level of knowledge, and degree of sophistication of others

Source: Stephen P. Norris and Robert H. Ennis, *Evaluating Critical Thinking* (Pacific Grove, CA: Critical Thinking Press, 1989), 6.

Summary

This chapter has addressed the question, "What is critical thinking?" In order for us to speak the language of critical thinking there must be a shared meaning of just what this term entails. For this paper critical thinking is *the propensity and skills to engage in an activity with reflective skepticism focused on deciding what to reasonably believe or do.* Three broad criteria can be extracted from this definition: thinking must be reasonable, reflective, and focused to be considered critical thinking. Critical thinkers must not only possess the set of skills we have labeled the "reason assessment" component (elementary clarification, basic support, inference, advanced clarification, and strategies), but, also have the "critical spirit" component. These dispositions rest fundamentally on open-mindedness and the desire to use one's critical thinking abilities on one's own and others' thinking. As we shall see, this definition is useful in evaluation, instruction, and curriculum development. The usefulness comes from the desired characteristics which are listed in Tables 1 and 2. For instance, these lists provide the content specifications for developing tests that evaluate students' critical thinking, the next topic of this paper.

Notes

[1] J. Halonen, "Demystifying critical thinking," *Teaching of Psychology* 22, no. 1 (1995): 75-81.

[2] R. Ennis, "Critical thinking and subject specificity: Clarification and needed research," *Educational Researcher* 18, no. 3 (1989): 4-10.

[3] John McPeck, *Critical Thinking and Education (* New York: St Martins, 1981)

Notes

[4] J. Halonen, "Demystifying critical thinking," *Teaching of Psychology* 22, no. 1 (1995): 75-81.

[5] Stephen P. Norris and Robert H. Ennis, *Evaluating Critical Thinking* (Pacific Grove, CA: Critical Thinking Press, 1989), 6.

Chapter 3

Measuring Critical Thinking

If a thing exists, it exists in some amount. If it exists in some amount, it can be measured.

—E. L. Thorndike
Handbook in Research and Evaluation

Evaluation of Critical Thinking Skills

The definition of critical thinking is of great benefit in the evaluation process. It enables us to evaluate the aggregate, critical thinking, by looking at its components. The evaluation can be accomplished by a variety of different methods: tests, direct observation, individual interviews, student and teacher journals or some combination of these. Tests can be further subdivided into multi-aspect tests, which are sometimes called general critical thinking tests because they attempt to cover all of the components of critical thinking as a whole and aspect-specific tests, which, are only concerned with a specific component or part of critical thinking.

Multiple choice tests

Multiple choice tests are currently the most commonly used assessment tool for a variety of reasons. Simplicity, is probably the best one. These type of tests are easily graded by hand and can even be machine scored making them ideal for assessing a large number of individuals on a large number of critical thinking components. This ease in

scoring allows for almost immediate feedback to the student and timely reinforcement of proper behavioral or corrective instruction if necessary. Multiple choice tests also are typically very reliable, that is to say individual scores tend not to vary much when the test is re-administered. However, ensuring that the multiple choice test is valid takes a great deal of expertise and definitely does not happen by accident. Additionally, since the responses to multiple choice tests are simply to pick the "best answer" we have no insight into how they arrived at their answer. Another problem is that while this type of test works relatively well on the "reason assessment" component of critical thinking, for instance, evaluating inductive or deductive reasoning, it is not well suited for assessing the "critical spirit" disposition component such as open-mindedness.

Constructed response tests

Constructed response assessments (essays) are not near as easy to score as multiple choice tests. The scoring process requires much training and even then test score reliability is much less than in multiple choice tests. They also take considerably more time to grade making the feedback process less effective because of the time lag between student performance and reinforcement or corrective action. They do have some advantages though. First when developed properly they are better suited for assessing the "critical spirit" critical thinking dispositions. They also can give us insight into an individual's thinking process. We not only have their answer to a question, but, we can see how they arrived at this conclusion. The Panel on Military Education, Armed Services Committee, House of Representatives, 101st Congress, endorsed this method as part of an effort to increase the rigor in PME: "All intermediate and senior level PME schools should require students to take frequent essay type examinations and to write papers and reports

that are thoroughly reviewed, critiqued, and graded by the faculty. Examinations should test the student's knowledge, his ability to think, and how well he can synthesize and articulate solutions."[1]

Currently, this type of test is used at ACSC, and although critical thinking is not explicitly assessed in the examinations, many of the components of critical thinking impact one's grade. Focusing on the question, clarifying, using credible sources, and looking for alternatives are just a few of the skills and dispositions that must be used in ACSC essay exams. In this manner, the evaluations do seem to fulfill the Panel on Military Education intent, but because of the long time lag between the evaluation and the feedback process a valuable learning and reinforcement opportunity is being missed. By the time an exam is returned, both the student and instructor are both heavily involved in the next course, thus, the feedback process is superficial and of little value. One other point of constructive criticism is that the current in class exams are heavily dependent on good typing skills, something that may or may not have originally been intended. There are some commercially available alternatives that could be used at ACSC to explicitly evaluate critical thinking.

Commercial tests currently available in both multiple choice and essay format are identified by Norris and Ennis in their book entitled, *Evaluating Critical Thinking*.[2] They have broken them out into multi-aspect (a test that attempts to measure all or most of the critical thinking skills and dispositions) and aspect-specific (a test that concentrates on a single skill or disposition of critical thinking) categories and listed them in alphabetical order:

Multi-aspect tests

1. Cornell Critical Thinking Test, Level X (1985), developed by Robert Ennis and Jason Millman and appropriate for students in grades 4 through college.[3] There is also a Level Z version which is appropriate for advanced high school students, college students and adults. Both versions focus on the evaluative aspects of critical thinking.

2. Ennis-Weir Critical Thinking Essay Test (1985), is designed for secondary and college students.[4] This test is non-machine scorable and is characterized as a diagnostic and research tool. The authors indicate that the test could be used in an exploratory pretest-posttest design, providing educated guesses about the effect of a specific curriculum.

3. New Jersey Test of Reasoning Skills (1983) by Virginia Shipman. The test can be used with students from fifth grade to college level.[5] About half of the test items are concerned with deduction, which puts it somewhere in the middle between a multi-aspect test and a aspect-specific one.

4. Watson-Glaser Critical Thinking Appraisal (1980), designed for students in Grade 9 and above, by Watson and Glaser.[6] Two equivalent alternate forms are provided. This is undoubtedly the most popular of the critical thinking tests. Its validity and reliability have been extensively studied and confirmed and a wealth of statistical information is available on this measure.[7] Sample questions and additional information is included in Appendix A of this report.[8]

Aspect-Specific Tests

1. Logical Reasoning (1955), by Hertzka and Guilford, consists of two parallel parts that were standardized on two populations-high school students and college students.[9] The authors refer to it as a logical evaluation.

2. Test on Appraising Observations (1983), by Norris and King, is intended for students ranging from junior high school to college level.[10] The test items cover a set of principles, and items were selected after students were interviewed.

Although each of these tests provide some help in studying critical thinking, Sormumen and Chalipa found that the use of one commercial test did not adequately measure gains that were apparent when qualitative measures were applied.[11] For instance, a deeper level of discussion and greater enthusiasm for learning expressed by students in their experimental groups were apparent to both teachers but were not measured.

Observation

Another type of assessment is observation. The observation can be self observation as in a student journal or by thinking out loud while working. It could also be the observations of a teacher or researcher. As mentioned this type of qualitative study can contribute much information when used in conjunction with quantitative tests. It allows the thinking process to be explored and can provide insight into how and why a particular answer was given. Care must be exercised to avoid the Hawthorne Effect, in these types of observations though. This effect was first noted during a study of the relationship between factory lighting and worker productivity. Researchers found that as light levels went up so did productivity. However, they also found that the converse was true. Lower light levels in factories also produced increased productivity. The main factor in

increased productivity was not the light level, but the fact that the workers knew they were being closely studied. Thus observation should be as discrete as possible since the act of observing someone tends to effect their behavior. The Top Performer Program in each course is determined through an observation process of students and the instructors. Although it is more of a leadership evaluation in general, intuitively, it would seem to involve some critical thinking aspects also.

Surveys

Still another type of measurement is surveys. One such survey is the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich & colleagues.[12] This questionnaire is a self-report consisting of 40 motivational and 65 cognitive strategy questions. It is a Likert type scaled instrument and a typical question would be: When a theory is presented in class, I decide if there is good supporting evidence? An answer of 1 would indicate that this was not true for the individual, while an answer of 7 indicates that this is very true of the individual. Table 3 gives a complete look at the variables of the MSLQ.[13]

Summary

This chapter has addressed the question, "How can critical thinking be assessed?" Using the definition synthesized in chapter one, it is possible to assess critical thinking by looking at its component skills and dispositions. The assessment can attempt to measure only a particular skill or disposition (aspect-specific) or a broad range (multi-aspect) and may come in the form of multiple choice, essay, observation, or survey. Each type of assessment has strengths and weaknesses and the best possible situation would entail the

use of several different types to give a complementary assessment picture. However, if this is not practical, the Watson-Glaser Critical Thinking Test is the most widely used assessment and probably the best single measurement available. These assessment tools have been used extensively by researchers to evaluate critical thinking programs in order to determine what works in fostering critical thinking and what doesn't—our next topic of discussion.

Table 3. Variables of the Motivated Strategies for Learning

1. Motivation

1.1 Values
1.11 Goal orientation
1.12 External reward focus
1.13 Task value
- 1) usefulness
- 2) value
- 3) interest

1.2 Expectations
1.21 Control beliefs
- 1) for learning
- 2) for using strategies to learn

1.22 Self-efficacy beliefs
- 1) self-confidence to learn
- 2) self-confidence to master (and perform)

1.23 Affect
- 1) learning anxiety
- 2) performance anxiety
- 3) evaluation anxiety

2. Cognitions and Metacognitions

2.1 Cognitive
2.11 Rehearsal
- 1) recalling
- 2) repeating
- 3) recognizing

2.12 Elaboration
- 1) summarizing
- 2) paraphrasing

2.13 Organization
- 1) outlining

2) integrating
3) synthesizing
2.2 Metacognitive
2.21 Planning
2.22 Monitoring
2.23 Regulating
2.24 Critical thinking
2.3 Strategy Management
2.31 Use of time
2.32 Study environment
2.33 Effort management
2.34 Help-seeking behaviors
(Abstracted from Pintrich and Johnson, 1990; pp. 87-88)

Notes

[1] House Committee on Armed Service, Panel on Military Education, *Report of Panel on Military Education of the One Hundredth Congress*, 101st Cong., 1st sess., 1989, 169-170.

[2] Stephen P. Norris and Robert H. Ennis, *Evaluating Critical Thinking* (Pacific Grove, CA: Critical Thinking Press, 1989), 54-97.

[3] Ibid., 61-68.

[4] Ibid., 80-83

[5] Ibid., 73-75.

[6] Ibid., 57-61.

[7] Richard Bruce Modjeski, "A Critical Analysis and Evaluation of the Validity and Reliability of the Cornell Critical Thinking Test and the Watson-Glaser Critical Thinking Test," (Ph.D. diss., University of Southern California, 1982), 51-95.

[8] Watson-Glaser Manual, *Critical Thinking Appraisal*, (New York: Harcourt, Brace & World, Inc., 1964).

[9] Stephen P. Norris and Robert H. Ennis, *Evaluating Critical Thinking* (Pacific Grove, CA: Critical Thinking Press, 1989), 88-89.

[10] Ibid., 90-92.

[11] Carolee Sormunen, and Marilyn Chalupa, "Critical Thinking Skills Research: Developing Evaluation Techniques," *Journal of Education for Business*, January/February 1994, 174.

[12] Paul Pintrich et al, *A manual for the use of the Motivated Strategies for Learning Questionnaire* (Ann Arbor, Michigan: National Center for Research to Improve Post-Secondary Teaching and Learning, The School of Education, The University of Michigan, 1991).

[13]Ibid.,

Chapter 4

Fostering Critical Thinking

> *The boom in efforts to explicitly teach thinking has provoked a wide variety of disparate approaches, claims and advocates. They all tell us what we should be aiming at in teaching thinking and how best to do it. Often, however, hidden beneath the use of more or less the same terminology are quite different goals and means.*
>
> — Robert J. Swartz
> Teaching Thinking: Issues & Approaches

Instructional Techniques

Educators are facing a tremendous challenge developing and implementing programs to foster critical thinking. Politicians, military leaders, and educators all agree that in order to compete in the new world order and exercise the rights and responsibilities of citizenship that Americans need to be able to think critically. Although there is a strong agreement on critical thinking as an outcome, there is much debate over what instructional methods best bring it about.[1] Four terms related to instructional approaches used to foster critical thinking must now be introduced. First, infusion is the process of inserting critical thinking instruction within subject-matter instruction. The general principles of critical thinking are made explicit within subject-matter instruction and students are encouraged to use them as tools for better understanding. The second instructional approach, immersion, is similar to the first in that there is also a thought provoking kind of subject-matter

instruction. However, in this approach the critical thinking principles are not made explicit. Proponents of the infusion approach include Glaser (1984), and Resnick (1987), while McPeck (1981) prefers the immersion approach.[2] The third approach is referred to as the "general approach" and seeks to teach critical thinking separately from existing subject-matter instruction. Non-school contexts provide the content about which critical thinking is done. Examples of the pure general approach are summarized by Kruse and Pressesisen (1987), and Sternburg and Bhana (1986).[3] The final approach, termed the "mixed approach," combines the general approach with either infusion or immersion. Ennis (1989) and Perkins and Salomon (1989) favor this method.[4]

These different instructional approaches are the result of a methodology debate centered on whether critical thinking is generalizable or domain specific. The answer to this question has a dramatic impact on the instructional methods employed. In fact, one could rephrase the question to: should critical thinking be taught as a single body of general, transferable skills or as diverse sets of skills, each peculiar to an academic subject area? If critical thinking is domain specific, the answer is the latter, if critical thinking is totally generalizable, the answer is the former. This question is of vital importance because it has a direct impact on the effectiveness of the educational intervention. and so we now will attempt to answer it.

The Debate: To Generalize or Not to Generalize?

In one of his papers entitled, "A Concept of Critical Thinking," Ennis (1962) identified twelve general aspects of critical thinking that he claims are both teachable and transferable.[5] This initial list has been added to and has evolved into the lists of "dispositions" and "abilities" previously shown in Tables 1 & 2. One of the basic premises

behind such inventories is that identifying the components of critical thinking constitutes a major step towards teaching people to become critical thinkers. Once learned these aspects of critical thinking can be transferred to any other domain, given adequate knowledge of the subject area in question.

McPeck challenges the domain general premise by claiming that since all thinking is necessarily thinking about "X," there can be no such thing as a general set of critical thinking skills that can be applied in all contexts and that to teach critical thinking in general is fruitless. As mentioned earlier, McPeck defines critical thinking as " the appropriate use of reflective skepticism," to establish "good reason for various beliefs." He maintains that since what constitutes "good reasons" depends on the particular epistemological (ways of thinking) and logical norms of the subject area in question, critical thinking must vary from one domain to the next. Rather than trying to teach critical thinking in general, McPeck believes that we should concentrate on giving students a more thorough grounding in the epistemological underpinning of the key subject areas.

These views represent the two extremes of the present generalizability debate. This dichotomy in opinion has been present for many years, with each side rising and falling in favor as new studies were conducted to support their claims. Perkins and Salomon (1989) give a detailed historical sketch of how the trend has shifted from the generalist to the specialist and now is moving back in favor of the generalist camp.[6] Moreover, using theoretical and empirical evidence from numerous studies, they suggest that both camps may have oversimplified the interaction between general strategic knowledge and specialized domain knowledge.

Theoretical Evidence

Almost forty years ago heuristics, or general strategies for solving problems, were thought to be the key to excellence in thinking. IQ and "g" for general intelligence were thought to represent some general abilities that were able to be used across a broad spectrum of domains. Initial work in computer programming and artificial intelligence also supported this idea. Means-end analysis was a very popular strategy that relied on these ideas. The study of expertise, most notably that of grand master chess players, also seemed to confirm that all that was needed was general reasoning abilities applied to a few simple rules. However, as the games of grand master chess players were analyzed more closely, it was found that their expert play was the result of an enormous amount of knowledge regarding important chess patterns (domain specific knowledge), a tremendous blow to the idea that excellence in thinking was a result of only general abilities.

Additional evidence against the generalizable theory also came from research on transfer. If excellence in thinking was truly generalizable, then learning strategies in one subject area or domain should improve thinking or transfer to other subjects or domains. However, many studies have failed to substantiate this anticipated transfer (for a summary, see Pressley, Snyder, and Carigila-Bull, 1987).[7] Computer programmers also found out that programs that were written containing a vast amount of domain specific knowledge (strong method) were must better at solving problems than those programmed only with general strategies or heuristics (weak methods). Evidence seemed overwhelming in favor of domain specific thinking skills. General heuristics appeared to be no match for a rich domain specific database, stored in memory, accessed by the recognition process, and

ready to be brought to bear on the most demanding of problems. In spite of this evidence there was still much that could not be explained by using this theory alone.

These difficulties can be overcome by abandoning the idea that general and domain specific abilities are mutually exclusive and challenging the supposed dichotomy. Perkins and Salomon (1989) suggest that "there are general cognitive skills; but they always function in contextualized ways."[8] General strategies and domain specific knowledge are seen to work hand-in-hand and this requires special emphasis during instruction to improve thinking. New methods such as Reciprocal Teaching, which will be talked about more later in this paper, are producing dramatic gains in reading, science and other subjects. The key seems to be that general principles of reasoning need to be taught together with self-monitoring practices and potential applications in varied contexts. Using this approach produces the desired transfer that was previously so elusive (Nickerson, Perkins, & Smith, 1985).[9] Blatz (1989) further clarifies the matter of transfer by looking at dimensions and extent of transfer rather than simply transfer or non-transfer.[10] He outlines four levels of generality, with level one being the broadest and without qualification to level four at which we must confront not only universal logic, subject-independent and subject-specific constraints, but also the particular case, problem or issue to which we are applying our reasoning.

Perkins and Salomon have also proposed two mechanisms by which the transfer of skills between domains takes place.[11] The first, called the "low road" to transfer depends on extensive and varied practice of a skill to near automaticity. By practicing the skill in a large variety of instances it is thought that this skill will also be applied to similar instances through the process of stimulus generalization. The second mechanism called the "high

road" depends on the learners' deliberate mindful abstraction of a principle. One obstacle to this type of transfer is that it is often necessary to decontextualize a skill in one domain before it is seen to apply to another similar situation in another domain. This would seem to put the negative research findings on transfer in another light. Rather than implying that transfer can't occur because of domain specificity, the negative results reflect that certain conditions must be met to facilitate transfer.

The notion of standard conditions as used in the sciences is also put forth by Norris (1985) as an explanation to the generalizability debate.[12] He asserts that it is reasonable to maintain that given our lack of detailed knowledge concerning reasoning, that the inability to find reasoning abilities that cut across subjects and contexts is due only to our inability to identify and institute the required set of standard conditions. Ennis (1989) adds complimentary evidence by pointing out three versions of subject specificity, domain, epistemological, and conceptual.[13] While he concludes that conceptual subject specificity (McPeck's view) has no basis and is too vague the other two offer important insights. They both emphasize the importance of background knowledge. Epistemological subject specificity notes that there are differences in what constitutes a good reason between fields of knowledge. While domain specificity sees the importance of teaching for transfer combined with frequent application of principles in many different areas.

Brell (1990) also took a look at the conceptual battle between Ennis and McPeck and came up with conclusions similar to Norris.[14] Namely, that although the mastery of domain-specific knowledge is the major challenge in learning to think critically, as McPeck predicts, general concepts and strategies of thinking do exist and are teachable. In addition, thinking can neither occur or be taught independently of the epistemological

norms of some frame of reference or knowledge domain. Finally, that although both general and subject-specific knowledge are important conditions of critical thinking, the teaching of neither adequately addresses the fundamental problem of getting students to transfer their knowledge and skills to new areas. Niaz (1995) came to a like conclusion after looking at helping science educators choose between domain-specific and domain-general strategies for enhancing the thinking skills of their students.[15] He concluded that the content-process dichotomy is an artificial one and in fact the two approaches to teaching science complement each other.

Empirical Evidence

Now let us turn to the empirical evidence that has a direct bearing on the generalizability question. Sternberg and Bhana (1986) make some general observations about studies that are associated with thinking programs.[16] Their advice is to look at the data and experimental procedures used closely since much of the research and publication is done by individuals with possible conflicts of interest. This having been said, the first evidence to be looked at documents the deficiencies the majority of students in this country demonstrate. de Sanchez's (1995) study indicates that most college students are at Piaget's concrete thinking level rather than the formal level ascribed to adults.[17] She attributes these deficiencies, at least in part, to academic settings that emphasize memorization of isolated knowledge, which are devoid of meaning, lack transferability, and are easily forgotten. She characterizes this status quo as "incidental thinking" and asserts that for thinking skills to be fully developed and transferable the thinking skill instruction must be deliberate. Her deliberate instruction involves a critical thinking model composed of processes, information, and products. Nine processes are listed that are

thought essential to critical thought: observation, comparison, relations, classifications, ordering, hierarchical classifications, analysis, synthesis, and evaluation. Several studies (Herrnstein, Nickerson, de Sanchez & Swet, 1986; Reif, 1981) have concluded that these process-based skills do transfer when the instruction is designed to facilitate such transfer.[18]

Halpern (1993) assessed the effectiveness of critical thinking instruction and concluded that at least seven qualitatively different forms of outcome evaluations show that thinking can be improved through deliberate instruction to do so.[19] He cites numerous studies that have included student self-reports, gains in IQ scores, cognitive growth and development, expert-like mental representations, improvement in cognitive skills, and spontaneous transfer that support his claim. Hanley (1995) has reported successful thinking instruction that focused on metacognitive skills and problem solving.[20] He believes that in order to be a critical thinker one must first learn to decide when a specific cognitive skill is relevant (a metacognitive process) and then successfully apply the cognitive skills to solve problems. This would seem particularly relevant as a desirable outcome of ACSC. Two more studies by Pirolli and Recker (1994) also suggest that the acquisition of cognitive skills is facilitated by high degrees of metacognition (a generalizable skill).[21] Improved learning in the domain of programming was related to reflection on problem solutions that focused on understanding the abstractions underlying programming problems.

In a review of more than 100 studies on training of learning strategies, Belmont, Butterfield, and Ferretti (1982) identified further evidence from seven studies that produced transfer effects on the cognitive functioning of young and mentally retarded

children.[22] Of these seven successful studies, six showed that significant transfer occurred only when there was instruction of self-management skills, such as goal setting, strategy planning, and self-monitoring—in addition to training in specific skills involved in transfer. Another study conducted by Riesenmy, Mitchell and Hudgins (1991) involved training 38 children in four thinking roles.[23] The roles were called task definer, strategist, monitor, and challenger. This experimental group showed superior retention scores on three variables over the control group. The variables were use of self-directed thinking skills, amount of information used in solutions and the quality of their answers.

Another instructional procedure that numerous research studies (for a summary see Rosenshine and Meister, 1994) have deemed successful is called Reciprocal Teaching.[24] It has two major features, the first is instruction and practice in four comprehension-fostering strategies: question generation, summarization, prediction, and clarification. The second consists of using dialogue as a vehicle for learning and practicing these four strategies. The teacher begins by modeling the strategies and then gradually the students become more active until finally the teacher is merely a facilitator of the process. One final example of the successful use of the infusion approach is given by Zohar, Weinberger, and Tamir (1994).[25] Their carefully designed instruction incorporated activities for developing specific critical thinking skills that were incorporated into biology curriculum. Improved critical thinking skills were observed both in the biology context and non-biology everyday topics, further suggesting generalization across domains.

Summary

Modern attempts to foster critical thinking have been only moderately successful. A consistent theme is that a short-term course of study covering one subject matter area

does not have enduring effects on solving problems in other subject matter domains. However, this doesn't necessarily mean that critical thinking skills are domain specific. The research, both the theoretical and empirical data, suggests that the answer to the original question (Is critical thinking generalizable or domain specific?), is that it is neither. The question assumes a dichotomy and research points to a dynamic almost synergistic effect between the two.

The general theme of agreement in the literature is that efforts need to be focused on bringing together context-specific knowledge with general "critical thinking" skills instruction with deliberate efforts made to facilitate transfer to real life applications. McPeck is one of the few exceptions that still clings to supporting a strictly immersion (implicit) approach to teaching critical thinking. Although his position has forced considerable theoretical considerations to be evaluated further, the majority of evidence points to an infusion (explicit) approach to fostering critical thinking as having the greatest probability of success.

Notes

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Chapter 5

Conclusions

> *Preparing airman for future rather than past wars involves constant encouragement of open-minded thinking to ensure intellectual growth. Yet American PME schools, including those of the Air Force, have often suffered from rigidity, normalization, and a lack of dynamism in nurturing thought.*
>
> — AFM 1-1 Vol. II

Research Implications

Curriculum

The current curriculum at ACSC (see table 4 for a summary) focuses on ten courses of study and a research program comprising approximately 600 academic contact hours.[1] From the course descriptions in the Air University catalog it is clear that critical thinking is required throughout the curriculum. However, actual explicit instruction on the skills and dispositions that make up critical thinking is limited. The only mention of critical thinking instruction is in the War Theory course. Here students are introduced to critical thinking via the process of Clausewitzian critical analysis. This analysis consists of three steps: establish the facts, trace effects back to root causes, and consider and evaluate alternate courses of action. Notice that these three steps depend heavily on the mastery of the five critical thinking "reason assessment" skills listed in Table 1. These necessary skills are only implicitly addressed in this course.

While critical thinking is implicitly addressed, through the immersion approach, the research outlined in chapter four of this paper suggests that a more explicit approach would be beneficial. Critical thinking instruction is more successful when efforts are focused on bringing together context-specific knowledge and general critical thinking skills instruction with deliberate efforts made to facilitate transfer to real life applications. This would point to an infusion or mixed approach to the curriculum, that explicitly teaches critical thinking skills and dispositions as part of each of the ten courses currently offered, as having the greatest probability of fostering critical thinking.

This is not to say the curriculum is bad. The current curriculum provides a solid foundation of domain specific knowledge in airpower, joint operations, leadership and thinking skills within these domains. The overwhelming majority (90.84%) of students perceive the ACSC experience as increasing their ability to think critically when conducting an in-depth analysis of complex situations or problems.[2] Moreover, ACSC graduates perception of the curriculum has risen over the last several years from merely satisfactory to approaching outstanding on a five point scale.[3] The point is that research documented in this paper suggests the inclusion of explicit critical thinking skills and disposition instruction would result in an additional quantitative improvement in students' critical thinking abilities.

Table 4. ACSC Curriculum Summary

Course	Approximate % of Curriculum
War and Conflict	3%
War Theory	10%

Table 4—continued

Course	Approximate % of Curriculum
Strategic Environment	14%
Operational Structures	16%
War and Conflict Resolution	3%
Joint Operations and Campaign Concepts	11%
Air Power and Campaign Planning	22%
Joint Warrior	9%
Leadership and Command	9%
Force 2025	3%
Research	N/A

Source: Air Command and Staff College, *Air University Catalog*, 1995-96, n.p.; on-line, Internet, 6 February 1997, available from http://www.au.af.mil/au/cat/acsc.html.

Instructional Techniques

Over the last three years, ACSC educators have made a major paradigm shift in the way students are instructed. Passive learning through lectures and teacher directed instruction in rote memorization of isolated facts is no longer the way they do business. Seminar based active learning is facilitated with an integrated curriculum, ample student discussion, case studies and computer simulations. In fact, these active learning activities account for approximately three-fourths of the resident curriculum.[4] Nonetheless, new methods of instruction should be explored. For example, reciprocal teaching, which first teaches students learning and thinking strategies and then moves on to more student directed learning is strongly endorsed by this research. Again, this is consistent with the infusion or mixed approach to fostering critical thinking.

Evaluations

No approach should be followed blindly though, "measures of success" are just as important in education as they are in campaign planning. Looking specifically at the current evaluation system in place at ACSC, it is unclear what these "measures of success" for critical thinking are. The ACSC goal of fostering critical thinking is vague and the current evaluation methods at ACSC provide decision makers with only information that is largely descriptive and anecdotal in nature.[5] As mentioned earlier, the current evaluation system (essay exams, direct observation, and surveys) can provide some qualitative information, but these methods take a considerable amount of time and effort to overcome their inherent validity and reliability problems. This is why a valid and reliable quantitative measurement of critical thinking, that is easily administered and graded, is needed.

Administering an internationally recognized measurement of critical thinking, such as the Watson-Glaser Appraisal, at the beginning of ACSC and at the end would have tremendous benefits. First, it would provide a quantifiable measurement (measure of success) upon which the critical thinking goal of ACSC could be evaluated. This data could also be correlated to the present grading system to establish credibility and validate the program. For instance, as mentioned earlier over 90% of in residence ACSC students believe that the current program has increased their ability to think critically, this additional data could be used to evaluate these perceptions and quantify the value added by the program. Finally, such a measurement would establish a very valuable database. Benchmarks could be established and used from year to year to evaluate the effects of any changes in the ACSC program. Many other studies, such as correlations between Myer-

Briggs Personality Type Indicator and critical thinking gain could also add to the body of knowledge.

Staff Development

There is a definite link between instructors' critical thinking ability and the progress of their students in this area.[6] By administering the critical thinking measurement discussed above to instructors, staff development instruction in critical thinking could be provided on an as needed basis. Across the board in education, low instructor ability in critical thinking is a primary cause in students' low scores in this area.[7] It would also be interesting to see the change in an instructor's critical thinking score over the term of a three year assignment at ACSC.

Critical Analysis

It is now time to tie all the theory just presented to the reality at hand and provide some final conclusions and recommendations. This research project sought a framework that could be used to assess the ACSC program to foster critical thinking and now it is only appropriate to use the Clausewitzian critical analysis to do just that. The first part of the analysis is to establish the facts. We did this by synthesizing a definition for critical thinking, *the propensity and skills to engage in an activity with reflective skepticism focused on deciding what to reasonably believe or do.* Next, the facts revolving around how to assess critical thinking were sorted through. From this, the Watson-Glaser Critical Thinking Appraisal was identified as having the best overall characteristics of validity, reliability, and ease of use.

Tracing effects back to root causes is step two of the critical analysis. Here, the analysis starts to run into some problems. The data ACSC has compiled on the "effects" of its critical thinking program are largely descriptive and thus very hard to trace to any root causes. In general, we might be able to attribute perceived student gains in critical thinking to an active versus a passive curriculum, but, without quantitative data and additional studies nothing can be determined for certain. The bottom line would seem to be that the current program does foster critical thinking, however, with what effectiveness and efficiency? The Watson-Glaser appraisal could prove most helpful in answering these questions. These limitations also carry over into the final area of analysis, evaluating and considering alternative courses of action.

Chapter four evaluated the research concerning alternative teaching methods to foster critical thinking Although this was the longest and most theoretical part of this paper, the conclusion was finally drawn that ACSC could better foster critical thinking through more explicit critical thinking skills instruction, an infusion versus the current immersion approach. Again, better quantitative critical thinking data would be required to prove this in practice. Although, this analysis was limited somewhat by a current lack of data, it provides a helpful framework and suggests ways to improve upon the current critical thinking program.

Recommendations

The following recommendations are provided based on the discussions above:

1. A critical thinking measurement, such as the Watson-Glaser Critical Thinking Appraisal should be administered to incoming students and instructors and again upon ACSC completion.
2. Data from these appraisals should be used to set measurable goals and monitor the effects of program changes.

3. Critical thinking should be addressed more explicitly in the ACSC curriculum using an infusion approach.
4. Data should also be correlated against other databases, in particular the Myer-Briggs Type Indicators to explore relationships between student inputs (i.e. personality type, gender, age, etc.), the school environment (i.e. curriculum, teaching methodologies, etc.), and outcomes (i.e. TPs, grades, etc.).

The potential impact of improving ACSC's critical thinking program is immense. Innovative problem solving, critical analytical thought and sound professional judgment have been and will continue to be keys in our military leadership achieving battlespace dominance. Thus, any improvements that can be gained by critical analysis of the program will provide our future leaders with a great advantage. This research and the accompanying recommendations are only a potential starting point, but, one upon which a firm foundation of continuous improvement can be built.

Notes

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Appendix A

Watson-Glaser Critical Thinking Appraisal

The Watson-Glaser Critical Thinking Appraisal is composed of a series of five tests which require the application of important "reason assessment" abilities of critical thinking. The five sub-tests cover the following areas: Inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments.

The "Inference Test" gauges ones' ability to discern the degree of truth or falsity of inferences drawn from the data that you are given. The ability to recognize unstated assumptions in statements is sampled in the "Recognition of Assumptions Test." The "Deduction Test" samples the ability to reason properly when given a statement of premise; to recognize the relation of implication between propositions. The ability to weigh evidence and make valid generalizations is sample in the "Interpretation Test." Finally, the "Evaluation of Arguments Test" samples the ability to distinguish strong and relevant arguments from ones which are weak or irrelevant. The 80-item appraisal can be completed in 50 minutes, and produces a single score that can be compared with a wide range norm groups. The materials to administer a pre and post test at ACSC would cost approximately $2,000.

Two examples of typical questions are given below:

Interpretation Example: A study of vocabulary growth in children from eight months to six years shows that the size of spoken vocabulary increases from zero words at age eight months to 2562 words at age six.

1. None of the children in this study had learned to talk by the age of six months. Does this conclusion follow or not? (This conclusion follows beyond a reasonable doubt since, according to the statement, the size of the vocabulary at eight months was zero words)

2. Vocabulary growth is the slowest during the period when children are learning to walk. Does this conclusion follow or not? (This conclusion does not follow since there is no information given that relates growth of vocabulary to walking.)

Deduction Example: Some holidays are rainy. All rainy days are boring. Therefore—

1. No clear days are boring. (The conclusion does not follow. You cannot tell from the statements whether or not clear days are boring. Some may be.)
2. Some holidays are boring. (The conclusion necessarily follows from the statement since, according to them, the rainy holidays must be boring.)
3. Some holidays are not boring. (The conclusion does not follow, even though you may know some holidays are very pleasant.)

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