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Introduction

This year for our annual symposium on teaching effectiveness the Embry Riddle Extended Campus Faculty Development Committee selected the subject of teaching critical thinking as our theme. Selection of this topic raises some interesting questions. Just what is critical thinking? Can it be taught, can it be taught to adult students who already have well-established thinking patterns and behaviors? What is the difference in scientific thinking, mathematical thinking, moral reasoning, thinking philosophically, and critical thinking? Are all of these terms parts of the same process or are there true differences? If they are not the same, are there preferences with which the teacher should be aware, in which applies in a given circumstance?

Is critical thinking just an orderly acquisition and compilation of information in some particular way? Is critical thinking a set of skills to be learned and practiced without regard for the results of the process to reach some neutral or static conclusion?

If critical thinking is not this, then what is it? If it is, as stated by Michael Scriven and Richard Paul, in Defining Critical Thinking, "the intellectually disciplined process of actively and skillfully conceptualizing, applying, synthesizing and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action", is this, then, a legitimate role for the teacher in higher education – this drive to "belief and action; based only on a thinking process. If we are to accept this definition are we in the business of teaching people how to arrive at what they believe and how to determine what actions they will take?

Hopefully, we will address some of these questions in the presentations to follow. I ask that each of you critically evaluate what is presented.

The views expressed in the papers presented are those of the authors. They do not necessarily reflect the views of Embry Riddle Extended Campus Faculty Development Committee, the Extended Campus administration, or the University.

The papers contain within were selected, in blind review by a jury of peers.

Jury:
Dr. Steven O'Brien
Dr. Vance Mitchell
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Dr. Ronald Clark
Mr. Dennis Grotrian

Editor and host: Dr. Earl Wheeler
Proceedings production: Ann Fagan
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(reference: M. Scriven and R. Paul, Defining Critical Thinking, A draft statement for the National Council for Excellence in Critical Thinking, http://www.criticalthinking.org/University/univclass/Defining.nclk)

Critical Thinking Skills:

Building Blocks for Success

Frances Johnson, Ed.D.

Abstract

Although research has been done to identity critical thinking skills, little has been done to extrapolate a comprehensive hierarchy of critical thinking skills sets necessary to the enhancement of academic performance. The link between critical thinking skills and course specific content has not been broken nor is there evidence to indicate that a link has been forged between course specific critical thinking skills and utility in life beyond the classroom. The extrapolation of a comprehensive hierarchy of sets of critical thinking skills provides the foundation to do the following:

1. Move beyond the course-specific link;
2. Develop methods to select appropriate critical thinking skills sets that may be utilized to incorporate critical thinking into most, if not all, aspects of the curriculum;
3. Develop methods by which to evaluate the results of such endeavors; and,
4. Promote an understanding of the utility of critical thinking skills in classrooms as well as electronically delivered courses.

Critical Thinking Skills:

Building Blocks for Success

Critical thinking skills are paramount to the utilization of the intellectual and professional growth opportunities that are provided by institutions of higher learning. It is generally accepted that the enhancement of critical thinking skills is possible in most, if not all, academic settings. However, much of the research is limited to development and delivery of course specific critical thinking skills. Such course specific use of critical thinking skills has a low rate of transference to other courses. Furthermore, there exists no single accepted standard by which to determine what constitutes critical thinking skills.

Examination of literature about critical thinking skills from available sources reveals that few research projects were initiated during the last decade at the college or university level. Research documents include the following:

1. Dispositions exhibited by critical thinkers, (Ennis, 2000);
2. Critical thinking behaviors that are course specific, i. e., high school business education (McEwen, 1994);
3. An effort to define and/or explain what it is (Facione, 2001); and,
4. Explain and promote a particular critical thinking essay examination.

Other sources offered predictable suggestions for eliciting responses in a safe environment through questioning. Papers that dealt with college level instruction include the following: teaching critical thinking skills at the community college level (Novak and Detloff, 1989) and "The Impact of College Residence on the Development of Critical Thinking Skills in College Freshman," (Inman and Pascarella, 1998). Neither dealt with a hierarchy of critical thinking skills although Novak and Detloff did present a task analysis that was

course specific to biology. Among their findings, Inman and Pascarella concluded that participation in activities on campus was valuable to cognitive development. No specific critical thinking skills were identified in the document. Subsequent efforts failed to locate in the research projects and papers either a definitive hierarchy of critical thinking skills or critical thinking skills sets appropriate for *across the curriculum* instruction.

A hierarchy of critical thinking skills should be focused but flexible. Such critical thinking skills sets should have applications from the most basic level to the highest level of critical thinking, the level that moves one to action (Huitt, 1998). Therefore, it has become necessary to extrapolate such a list as well as to devise logical and sequential sets of skills from the list. The critical thinking skills sets were extrapolated from course specific sources such as texts, papers, and research within the field as well as from actual classroom experience. The skills sets are devised to encourage utilization in most, if not all, courses through the extrapolation of skills appropriate to the course content at each skills level.

The need for a systematic approach for selecting course appropriate critical thinking skills for classroom presentation, electronic interactive television technology delivery, and web-based courses will be addressed briefly within the text for each skill set. Measurement and evaluation of the results of the use of the critical thinking skills sets may be divided into two distinct categories, i. e., those that are generated by the instructor and those that are commercially developed.

Examination of research literature has provided insights that suggest the creation of four critical thinking skills sets. The four sets are based on the criteria that follow:

1. That there exists a core of course specific knowledge prior to or when the enhancement of

critical thinking skills begins;

2. That recognition and identification of underlying assumptions, major ideas, and key issues within arguments, hypothetical assertions, course content, etc., must exist or must be developed as a requisite skill to enhancing critical thinking skills;
3. That guidelines shall establish parameters for judging the credibility, reliability, and validity of research sources;
4. That opportunities exist to develop and enhance the ability to eliminate extraneous information;
5. That the opportunities exist to master the concept that conclusions be supported by evidence;
6. That the enhancement of critical thinking skills requires an environment in which information is processed, assimilated, integrated, and utilized; and,
7. That evaluative and self-judgment activities are an integral part of the process.

Four Critical Thinking Skills Sets

The extrapolation of a list of critical thinking skills from specific course sources such as texts, papers, and research within the field as well as from actual classroom experience has resulted in the development of four sets of critical thinking skills. The skills sets have applications from the most basic level to the highest level of critical thinking which Huitt (1998) contends is the level that moves one to action. The skill sets are devised to encourage utilization in most, if not all, courses through the extrapolation of skills appropriate to the course content at each skills level.

Skills Set One: Acquiring Course Specific Core Knowledge

A prerequisite to the enhancement of critical thinking skills is the development of a basic core of knowledge related to specific course content. Therefore, entry level survey or introductory courses, of necessity, emphasize the acquisition of appropriate vocabulary as well as an understanding of course content that provides an overview of the subject. Appropriate vocabulary development is linked directly to course content, appropriate assignments, activities, and evaluation. Processing the information and evaluation of the results are the critical thinking skills sets that are emphasized. Activities, discussions, written assignments, laboratory sessions, etc., may be implemented to enhance intellectual growth and development.

Course content is determined in large part by the course description, selected texts, supplemental materials, required activities, discussions, research requirements, and self-directed independent efforts. It follows that enhancement of critical thinking skills for a given basic course may be limited to the initial processing of meaning and information stored for later retrieval. Examinations used to evaluate mastery of concepts delivered in a basic course of study may be designed to access ability to use critical thinking skills such as basic evaluation and obvious application as an adjunct to activities that develop core knowledge. Therefore, enhancement of critical thinking skills at step one will be evaluated almost entirely at the level of acquiring knowledge with minor focus on applying knowledge.

Interactive electronic delivery of the course should closely resemble that of the physical classroom and should work well with most courses. It may be difficult or impossible to replicate "hands-on" scientific activities and projects using interactive delivery unless the site chosen for electronic delivery is designed to provide needed laboratory equipment and supplies.

Web-based learning requires that appropriate adaptations be made particularly in the areas of in-class presentations and discussions. Carefully designed written assignments work well with many courses. However, it is difficult to accommodate speech making and certain scientific "hands-on" laboratory requirements via web-based presentations.

Skills Set Two: Critical Thinking Skills Involved in Processing Information

The initial processing of core knowledge may be accomplished through the use of such thinking strategies as inductive or deductive reasoning. Other critical thinking skills such as analysis, inference, interpretation, explanation, evaluation and classification also enhance the processing and retrieving of information. Mathematics and science courses as well as logic and philosophy provide opportunities to process information using inductive and deductive reasoning as well as analysis, classification, explanation, extrapolation, and evaluation. Social sciences, humanities, English, and communications are courses that also require that information be processed and retrieved in a methodical fashion. The critical thinking strategies of inductive and deductive reasoning used in conjunction with critical thinking skills such interpretation, inference, classification, analysis, explanation, and evaluation are among the appropriate tools to organize, store, and retrieve information. The lines between "Critical Thinking Skills Involved in Processing Information" in step two and "Critical Thinking Skills Extrapolated from Implied Meanings and Abstraction" in step three blur and overlap when applied to a college or university curriculum. However, these skills may be used individually or together as needed in many courses such as mathematics and sciences as well as English, social sciences, communications, the humanities, logic and philosophy.

Once information has been processed, it is assimilated and integrated into the thought processes

of the individual. These critical thinking skills might be thought of as change agents because both produce change in an individual's knowledge and belief systems as well as influencing his/her perceptions.

The enhancement of critical thinking skills used for processing and retrieving information is key to use of information for academic success and for other endeavors as well. Activities to enhance the preceding skills should be developed around the core course content. Writing activities for the humanities, social sciences, and English courses can easily require the use of inductive and deductive reasoning processes. Explanation papers may require the use of inductive and deductive reasoning, extrapolation, evaluation, etc., to explain such cognitive processes as assimilation and integration as well as other topics selected by the instructor and/or the students. Mathematics and science courses offer ample opportunities to process information and to retrieve it.

Both knowledge and application of critical thinking skills should be tested at step two in order to draw conclusions that are accurate about the effectiveness of enhancement efforts. Questions may be formatted to require that the answers reflect knowledge of both inductive and deductive reasoning as well as to demonstrate the ability to use both kinds of reasoning as required in any given situation.

Theoretically, interactive television technology presentations should require only minor adaptations provided that the receiving site has been equipped to meet the needs of each specific course content area accessing the site.

Web-based presentations for all subject matter, not just critical thinking skills, rely heavily on additional required reading, research, and writing activities as the means for developing all skills. However, academic use of chat rooms eventually may move beyond the few specific workshops, etc., available at this time. Although

much can be accomplished with web-based instruction, it may not work as well for "hands on" demonstrations for the sciences that require extensive use of laboratory equipment and supplies or for classes such as speech that may lack the means to provide interaction with an audience.

Skills Set Three: Critical Thinking Skills Extrapolated from Implied Meanings, Underlying Assumptions, and Abstractions

The presentation of information may be straightforward and didactic or less obvious and more speculative or it may be implied. The nature of the presentation depends upon the analysis of the criteria that follow: the content that is being presented, the reason or reasons for which the information is presented, the purpose for which it is presented, and the characteristics of those who will receive it. Likewise, the critical thinking skills needed to obtain, process, retrieve and utilize meaning vary. Therefore, analysis of the strategies used for presentation of course content precedes the selection of critical thinking skills to be employed.

Implied meaning calls into play such strategies as the recognition and identification of the use of connotation, satire, figures of speech, symbolism, irony, underlying assumptions, philosophies, etc. Observation coupled with an understanding of the conventions used in course content may reveal the implied meaning. Other strategies that may be classified as critical thinking skills are also used to determine meaning. In literature courses interpretation and inference have utility for providing insights into the author's use of tone, theme, point of view, allusion, figures of speech, symbolism, and drawing conclusions. Extrapolation or speculation of consequences based on known facts or observations are particularly helpful in courses such as English, humanities, communications, social sciences, logic, and philosophy.

Predicting and projecting are useful higher level thinking skills utilized to access implied meaning in literature through the use of foreshadowing. Both predicting and projecting are valuable as thinking skills in social sciences, mathematics and science, business courses, etc. In mathematics courses estimating is a useful critical thinking skill. Many content areas, especially the sciences, require the use of classification to bring order to information through the creation of categories, by examination of significance, and for the clarification and/or verification of meaning or results of manipulation or experimentation.

This level of academic behavior requires evaluation of the process of critical thinking. Measurements of this nature may be obtained by eliciting responses to well-drafted questions that require judgmental or evaluative thinking as well as knowledge of the course content. Explanations and demonstrations also reveal the quantity and quality of critical thinking skills. Evaluating both knowledge and its application are important aspects of testing at this level.

Interactive television technology should work well for delivering the higher levels of critical thinking skills in classes such as English, the humanities, social sciences, business courses, mathematics, and the sciences provided the receiving site is well-equipped to handle classes with laboratory requirements.

Web-based delivery works well with classes that require much reading and writing but do not offer enough at this time to be feasible for "hands-on" laboratories in science. Actual speech-making requirements for speech courses are difficult to meet with web-based delivery. Furthermore, the lack of an audience response to the activity denies access to an important aspect of delivering a speech. Web-based background information can be delivered in such a manner for such a class but it does not suffice for in-depth development of speech-making skills.

Skills Set Four: Critical Thinking Skills for Utilizing Meaning or Information

Critical thinking skills for utilizing meaning or information represent the highest level that can be achieved. Whereas, the skills in set three might be considered change agents, the skills in set four may be considered as the call to action. It is at this point that plans, ideas, and possibilities are developed and subsequently evaluated against more rigorous standards than previously. Problems are identified and options or solutions are drafted, modified, argued, analyzed, evaluated, and implemented. Through synthesis the old and new come together in different and, oftentimes, rewarding ways. Think for a moment about two mechanics, the engineers of their day, who walked into their machine shop that was filled with parts for creating bicycles and saw in their minds a flying machine. Accepting everything at face value was probably not a concept that they accepted. They chose a different approach that gives way to qualitative judgment that examines content, underlying assumptions and philosophies, proposes applications, projects long-term results as well as short term, and considers other relevant information before committing to action. While it is doubtful that they could have imagined the impact on this country, we can understand that their priorities made it possible for us to come together at this well-known institution of higher learning to explore ways to nurture that kind of thinking.

We also recognize that it is but a short step from synthesis to creativity. Some believe that the two are linked in ways that have only begun to be understood. Others contend that creativity is a different sort of thinking. It is likely that the Wright brothers were so busy transforming bicycle parts into a flying machine that they were not concerned about synthesis, creativity, or critical thinking skills. If they thought about critical thinking skills at all, they probably referred to them as having or lacking "common sense" or "horse sense."

However, stating problems and examining options and possible solutions are inherent in concepts of higher education. Therefore, instructional strategies and methodologies for delivery of course content as well as enhancement of critical thinking skills are concerns that are addressed in various ways. Techniques for solving a problem once it has been identified and stated will depend on the nature of the particular course. Brainstorming individually or in a group is one option. Research from authoritative sources or interviews with experts in the field to determine what is known is a possibility. Trial and error is sometimes used if no better options are available. The course itself will dictate to large extent the strategies employed for solving problems.

Evaluation of the effectiveness of enhancing problem solving skills can be accomplished through examination of knowledge of various procedures and application of that which has been learned. Format is determined by the nature of the course and may include hypothetical problems requiring both knowledge and it application to develop a logical solution.

If the evaluation is a pen and paper format, both interactive television technology and web-based delivery of instruction should produce the desired results. However, adaptation may be required if either delivers evaluation as a "hands-on" project.

Another aspect of critical thinking skills that will benefit from enhancement is that of establishing priorities based on criteria other than personal desires, wants, whims, or instant gratification. Goal setting for both the short and long term is involved. Consideration may be given to both short and long-term effects of striving to meet the goals that have been selected. Establishing priorities suggests the making of predictions and projections as well as giving consideration to probabilities. Well-thought out priorities lead to better planning and better planning provides the foundation for solving problems. Classification and

categorization skills can be transferred from one content area to another to enhance the development of the ability to establish priorities for academic purposes or for purposes beyond the academic setting. Priorities may be ranked according to importance, i. e., from greatest to least or according to probability of occurrence from most likely to least to mention just two possible strategies for establishing them.

It is likely that informal, if not formal, instruction for enhancing the establishment of priorities is an integral component in most courses because it becomes increasingly important to do so at the more advanced academic levels. If this assumption is correct, minor adjustments in delivery of instruction in the content area can accommodate emphasis on establishing priorities.

Testing the effectiveness of instruction to establish priorities can be accomplished through the use of hypothetical situations that require determining importance or probability of occurrence of various needs, concepts, or characteristics.

Both interactive television technology and web-based delivery should provide adequate forums for the inclusion of instruction in content areas for establishing priorities. Delivery of instruction can be accomplished through written responses and so can evaluation.

No discussion of critical thinking skills is complete until evaluation has been examined. Evaluation is used in academic settings to determine placement, progress, and achievement. It has medical, legal and business applications. Even driving skills are evaluated at specified intervals according to state laws.

Evaluation lends itself to further scrutiny, when we examine who evaluates and for what purpose. Much academic evaluation is performed for the benefit of an instructor, for the benefit of the student, and for the benefit of an institution. Instructors delivering course content assess student progress and achievement. In

addition, many assess their own performance and methods of delivering course content for effectiveness. Students benefit from such assessment because, ideally, it provides timely insights into individual performance and achievement in a given context. Such evaluative information has utility to students for planning for future endeavors. Institutions of higher learning benefit from various kinds of evaluation that may influence future directions and plans based on current and anticipated needs of enrollees, performance of the enrollees and the institution itself, projected expansion plans, risk factors, etc. Institutions of higher learning may perform statistical studies to map trends, to make predictions or projections, or to determine behaviors. Each type of evaluation can be analyzed, compared, contrasted, quantified, and qualified for the purposes of making inferences, or drawing conclusions.

The mastery of judgmental critical thinking skills provides a standard by which to evaluate the validity and reliability of authoritative sources, the validity and reliability of content of sources, and the feasibility of the application of the results of the evaluation process. Such mastery is required for successful completion of upper level, graduate, and post graduate projects and/or research.

Realistic self-evaluation is another aspect of critical thinking skills by virtue of the fact that the results are immediate and can be utilized toward achieving self-regulation which has been considered by some as the highest level of critical thinking. Such self-evaluation can be utilized to make reality-based decisions that dramatically increase the probability of success in academic settings, and business and personal settings as well.

With so much evaluation facing each and every member of society, it is evident that the enhancement of critical thinking skills including the evaluative or judgmental skills should be an

integral part of academic courses at all institutions of learning, not just institutions of higher learning.

Developing activities to enhance the evaluative critical thinking skills at various levels may be seen as a challenging task. However, enhancing the critical thinking skill of evaluative judgment is inherent in each research project undertaken in any course. Evaluation is required to develop a workable hypothesis for an experiment in science, to develop a thesis regarding a piece of literature, to predict the existence of a moon or planet that cannot yet be seen in space, or to develop a better method of treating illness. It is inherent in the nature of research to judge the quality of sources, authorities, concepts, possibilities, etc., as one engages in such efforts.

The question then becomes one of how to evaluate the instruction delivered to enhance the critical thinking skill of evaluative judgment. One possibility is to develop activities that may be used for evaluating or critiquing sources of information, determining the authenticity of research, policies, proposals, experiments, and course content as well as for determining the basis for authority in a given field.

Delivering instruction for solving problems, setting priorities, adapting information through synthesis to new and different uses, and evaluation for both self-evaluation and judgmental evaluation through interactive television technology is possible. If the receiving site is well equipped, most of the advantages of being present in a classroom should be in place. However, it may demand creative approaches as well as technological training to deliver web based quality critical thinking skills instruction equal to that available in a classroom or an interactive setting for critical thinking skills.

The threshold of the 21st century is here and it is fleeting. As the world changes, so must the strategies of instruction for course content with emphasis to offer more and better instruction as well as more

and better opportunities to enhance and use critical thinking skills. Quality course content in the respective subject areas must, if they do not now, incorporate instruction for critical thinking skills as an integral part of the preparation for academic success as well as success in life.

Necessity has dictated that the means of delivery of instruction have expanded to include interactive television technology and web-based instruction. Necessity now demands that institutions of higher learning, especially those on the cutting edge of technology, produce more and better critical thinkers than ever before.

It is time to embrace the challenge.

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Education's Quest for the Golden Answer: The Need Continues for Critical Thinking

Dr. Bruce Rothwell

Abstract

This paper addressed the need for critical thinking as an appropriate learning outcome for the majority of higher education classes. The paper reviewed critical thinking from a multi-disciplined perspective. A brief review of the history of critical thinking preceded a short discussion of the need. The main body of the paper addressed the reasons for a lack of critical thinking in today's classroom and centered blame on a failure of educators to take the time needed for adequate implementation and a long-standing false belief that there is one best answer to any given question. Finally, the paper addressed numerous approaches identified as effective by recent authors on the subject of critical thinking.

Background/History of Critical Thinking

Instances of critical thinking date back thousands of years to the time of Socrates and before. However, critical thinking did not come of age in America until the writings of Edward Glaser in 1941. There were very few scholars who saw a need for or wrote about critical thinking before Glaser (Paul, 1990). Critical thinking was first introduced into general education programs in the 1950s (Ignatavicius, 2001). Although introduced decades ago, critical thinking skills have not been fully embraced by everyone involved in education. Today, Richard Paul may be the most quoted if not the most well know scholarly advocate concerning the need for critical thinking. Paul's works have been cited in many different disciplines from health education (see Broadbear & Keyser, 2000), to social work, (see Huff, 2000), management (see Mingers, 2000) and others.

Critical thinking represents a major shift from traditional education practices in the United States. Although there are differences in the way critical thinking can be taught, several different academic disciplines now advocate the concept of critical thinking as a significant tool in preparing students for future challenges (Broadbear & Keyser, 2000).

In today's technology advanced society, there still are times when lower order thought processes are satisfactory for the task at hand. However, those instances where lower order thinking may be sufficient are quickly disappearing (Paul, 1990). In earlier times, simply being able to follow instructions was sufficient for most employees. Then came the need for employees to read, write, and solve math. School systems of that era were adequate to prepare workers with these lower level skills. However, in today's society, businesses need workers who can do more than just follow orders, they need individuals who can use judgement to make decisions (Celuch & Slama, 1999). In a global economy, critical thinking is a skill that is quickly becoming essential to obtaining an advanced job (McBride & Carrillo, 2000). Critical decision making skills are one of only two core competencies found in the most successful leaders in

business. Business leaders recognize the need for improved critical thinking. Critical thinking skills were cited as a core competency needed in their companies by all but a few senior executives surveyed in an earlier study (Helliwell, 2000).

There are an almost limitless number of definitions of critical thinking. Further, education has not found a single best methodology for teaching critical thinking. Even though educators may disagree on definitions or approaches to critical thinking, few would argue what the end results should be. "[W]hen one goes to a physician, one prefers to have a specialist who can observe, interpret, judge and evaluate rather than one whose educational career had been characterized by..." memorization of endless facts and regurgitating those facts back on tests (Taylor & Patterson, 2000, p. 3).

Few educators would argue that an objective of most higher education classes should be for the graduate to have mastered some ability to think critically about the subject they have studied. Some researchers believe the level of critical thinking should go far beyond this rudimentary mastery of a specific topic. These authors believe it may be equally important that the student who has mastered a subject should possess the ability to think critically beyond the one class completed and demonstrate the ability to think critically across an entire field of study (Jones, Merritt, & Palmer, 1999).

Since teachers first stood in front of a classroom, many educational trends have come and gone. Although minor changes in techniques have been seen, teachers still use the same basic methodology they have used for generations. There are numerous reasons for a lack of significant change. In education today, one thing remains constant. It is still the teacher who is ultimately responsible for seeing a need for change and then implementing it (Ward, 2001). Therefore, unless educators see a need for the change and are willing to take the time to implement changes, the necessary changes will not happen and there will continue to be limited critical thinking in the future.

Critical Thinking Defined

"Critical thinking is a complex phenomenon and is not easily defined" (Huff, 2000, p. 2). Although not easily defined, there are probably as many different definitions of critical thinking as there are authors who have written about critical thinking. Huff (2000) provides several different definitions crafted by earlier authors before settling on one for use within her paper. The definition she uses comes from the California Critical Thinking Skills Test and defines critical thinking as "the process of purposeful, self-regulatory judgement. Critical thinking so defined, is the cognitive engine which drives problem solving-solving and decision-making" (Huff, 2000, p. 2). Barnet and Bedau define critical thinking as "...searching for hidden assumptions, noticing various facets, unraveling different strands, and evaluating what is most significant" (1996, p. 3). Stated differently, critical thinking requires a willingness for individuals to examine their own assumptions and beliefs, to think about new ideas, adeptly evaluate arguments, and to coherently present one's ideas on a specific subject (Barnet & Bedau, 1996).

"Critical thinking is disciplined, self-directed thinking which exemplifies the perfections of thinking appropriate to a particular mode or domain of thinking" (Paul, 1990, p. 33). Paul later breaks this definition into two separate types of critical thinking, sophistic (weak sense) and fairminded (strong sense). The sophistic definition does not take all points of view into consideration and is centered on specific individuals or groups. The strong sense form of critical thought is designed to take all different interests into consideration no matter how much they differ from the individual doing the thinking (Paul, 1990). Although definable, Paul (1990) explains that no society has yet achieved, embraced, or sufficiently encouraged fairminded critical thought. Even though society has not reached the fairminded level, the sophistic critical thinker is still far advanced beyond the levels of the uncritical thinker.

Other authors have different views of what critical thinking is. "Critical thinking requires us to use our imagination..." (Barnet & Bedau, 1996,

p. 4). A vital part of critical thinking is that the one doing the critical thinking must be willing to investigate views that are different than their own. Each individual needs to look at all sides of a debate exploring the possible good and bad points from each possible position (Barnet & Bedau, 1996). Instead of providing a definition, some authors prefer to explain how to identify and recognize critical thought. For example, Lundquist states that it is essentially "...the ability to track inconsistencies in ones own or others reasoning" (1999, p. 3).

Some definitions are much more concise than others are. Some definitions used in many academic disciplines differ only marginally and seem to be tailored to the discipline under review. For example, McBride and Carrillo define critical thinking used for a wellness course of study as "...thinking that is used to make reasonable and defensible decisions about movement" (2000, p. 1). Yet, their paper is strongly reminiscent of other authors describing the need for critical thought in education, business, or management disciplines. Many instructors and institutions define critical thought too narrowly, which does not allow the freedom to explore the many varied possibilities. This lack of freedom in the defining process results in these institutions relying on a more formal definition of knowledge that stymies critical thinking (Walker & Finney, 1999).

Dialectical thinking is "...the ability to reflect critically on one's own thinking and to reason sympathetically within the frames of reference distinct from, and even opposed to, one's own" (Paul, 1990, p. 299). This ability to look critically at one's own beliefs is furthered by several authors. For example, Celuch and Slama assert that critical thinking means "...the ability to self-assess and continually improve one's thinking" (1999, p. 2). Critical thinking involves "...a scepticism or suspension of belief towards particular statements, information, or norms" (Mingers, 2000, p. 6). Critical thinking requires an individual to evaluate the thought process they use to arrive at the decisions they make and the opinions they have formed concerning the world around them (Walker & Finney, 1999).

In order to become a critical thinker, one must first learn how to learn. Individuals that have attained the ability to think critically can be identified by three specific traits that are dependent on each of the other two. First, critical thought has to be clear, accurate, relevant and logical. Next, these individuals need to be self-correcting in that they have the ability to modify their perceptions and beliefs based on the first criteria. Lastly, the critical thinker must internalize the process of critical thinking so that it becomes a part of them (Broadbear & Keyser, 2000).

Critical thinking is not a linear process that gets the thinker from point "A" to point "B" in the most direct route. Critical thinking is more of an interactive and circular process that requires the investigation of several possible competing possibilities (Huff, 2000). Critical thinking, by its very nature, implies that it involves finding more than one solution to a problem (Ignatavicius, 2001).

Reasons Why Critical Thinking is Not Taught

According to Paul (1990), in the very early years of education in America, catechism was the reason for any education. With God leading us, there was no need for self-reflective questioning. Into the mid 1800s schools basically taught those who attended what they needed to know to survive in early society. Students were taught the three R's, catechism, and the obligatory patriotic American history (Paul, 1990).

Paul (1990, p. 6) calls the lack of critical thinking in America the results of 400 years of "mis-education". Teachers and institutions are grounded in a didactic theory of knowledge and learning when they should strive for critical theory. In the didactic form, each course has a specific set of criteria that has to be remembered. Therefore, teachers talk and students listen, teachers test and students regurgitate. In such a didactic setting, interdisciplinary discussion is out of the question within the classroom and the students are not required to use or apply what they are taught. In the didactic setting, all course work is mired in details and the students

who do not ask questions are seen by their teachers as the ones who best understand (Paul, 1990). In the didactic setting, teachers incorrectly perceive they are totally responsible for student learning and their roles are very different than those of their students. Teachers also incorrectly believe that memorized information is retained and used. In actuality, such information is quickly forgotten and seldom applied in real life situations (Paul, 1990). When talking about the nature of knowledge and how students learn in a didactic setting, Paul states "Questions at the end of the chapter are framed in identical language and can be answered by repeating the texts. 'The correct answer' is in bold type or otherwise emphasized" (Paul, 1990, p. 22).

In today's classrooms, there is more talk about critical thinking that there is the actual achievement of critical thought. Many course outlines have been prepared contending that critical thinking will be enhanced, some with actual good intent. However, when met with an activity that is not welcomed by the student, most faculty fall back to what has worked in the past (Browne & Freeman, 2000). To be successful, the modern student simply does what they have found to be successful in the past. Primarily, they memorize what their teachers tell them is important so they can pass the test and continue to succeed (Paul, 1990).

When the teacher prepares a test that goes beyond simple memorization, they may be confronted with a chorus of "These are the most ambiguous tests I have ever taken!" (McKeachie, 1986, p. 86) Although teachers might tell themselves that the learning is the most important part of the course, to the student the most important part of the course may well be the final grade. In most classes, the final grade is very dependant on final answers on examinations (McKeachie, 1986). Teachers are faced with an interesting dilemma, the student does not like to have to think while taking a test and, those tests that do make the student think generally take an excessive amount of time for the teacher to create and grade (McKeachie, 1986). Therefore, developing and grading tests that measure critical thought is a time

consuming process that few educators attempt or maintain for very long.

There are several things taught in schools that restrict students to lower order thinking as opposed to higher order thought. For example, there is no specific set of steps, or even a direct approach that leads to higher order thought. Higher order thought leads to multiple possible solutions rather than a single correct answer. Higher order thought requires time and effort and involves uncertainty and interpretations. All of the preceding requirements are generally foreign to the current educational system (Paul, 1990).

Many times perpetuation of what has come before is easier than initiating change. Most teachers and professors teach the way they were taught. Since most were taught in a didactic format, they are comfortable teaching in this same format (Paul, 1990). The perpetuation of this type of teaching style can be the result of self-preservation and leaves the student totally unprepared for the future in a rapidly changing society (Broadbear & Keyser, 2000).

There are numerous reasons why there is not more critical thinkers coming out of education. First and foremost would be the apparent denial of the need on the part of the education system and the educators themselves. A second major consideration would be a failure to correctly view problems. There is a significant difference between technical and dialectical problems. Most people try to cast all problems into the technical arena because technical problems are easier to solve. Since the problems are placed in a technical realm that is how society naturally attempts to solve them. The big problem with this logic is that many problems are dialectical in nature. Another significant reason is the childhood ego-identification with adult beliefs, which creates a foundation for closed mindedness. Children learn to exhibit traits that earn them love and affection. First they learn to please their parents and then their teachers. Over time, these traits become ingrained within the child and are not easily changed. Therefore, individuals learn much of their closed mindedness from family and early teachers (Paul, 1990).

Although all humans think, it is not a natural process for the human mind to think critically. Humans want to believe in what makes them feel comfortable, what is simple, and what is rewarded by the society that they live in. Therefore, it is unnatural for the human mind to think critically (Paul, 1990). Thinking critically may cause them to arrive at conclusions that are different and not completely accepted. To truly attain the level of a critical thinker, an individual has to be capable of self-assessment. Self-assessment is possibly one of the most difficult and important skills needed to become a critical thinker. Self-assessment is described by Broadbear and Keyser (2000, p. 4) as an "unnatural act". The only way to get students to become critical thinkers is for teachers to require their students to think critically. Once the students have grasped the process of critical thinking, the teacher can then introduce them to "[m]odeling, numerous practice opportunities, and recognition of real achievement in self-assessment of thinking..." (Broadbear & Keyser, 2000, p. 5). Huff (2000) furthers the idea of modeling critical thinking skills and indicates that the proper environment needs to be created for the student. In this environment, positive critical thought should be nurtured through rewards and poor critical thinking ability should be challenged.

Students who display the ability to think critically can be recognized as the ones who have had teachers that enabled them to differentiate between good ideas and bad ideas. If students are only shown one side of the argument or one means of thinking they will not develop the internal skills they need to think critically for themselves. Therefore, one of the best ways of challenging a student to achieve critical thought is through "...the clash of good and bad ideas" Luckowski & Lopach, 2000, p. 1). For the most part, teachers that used critical thinking techniques did not teach today's teachers. Robert Lundquist (1999) discusses the importance of conflict to critical thought but also indicates that it is not the only method. When conflict is not present, reflection can take its place to stimulate critical thought in the student.

Doubt causes the student to think and controversy can cause the doubts to

occur in the student's mind. Controversy causes the student to analyze a position that is different than his or her own. Many educators soon find that the problem with introducing controversy into the classroom is that it can get out of hand if not properly directed and managed. Further, being made aware of positions that are different can make the student feel uncomfortable with their own beliefs (Browne & Freeman, 2000). Sometimes, doubting one's beliefs can cause discomfort as the individual realizes they may have been wrong in their previous thought processes. Being able to control such situations requires practice. If the teacher does not succeed at first, they may be hesitant to attempt the same methodology again.

There are several problems created when a teacher decides to use critical thinking in the classroom. One of the first of these problems has to do with the amount of class time that must be dedicated to the process. Fostering critical thinking almost necessitates the need for in-class exercises. These exercises are time consuming and will take time away from the presentation of content. The measurement of content is an easier process than analyzing the attainment of critical thinking which will require the teacher to take more time to grade these higher order level assignments (Celuch & Slama, 1999). Although it takes a considerable amount of time to master, just about anyone can learn to be a critical thinker (Ignatavicius, 2001). It is precisely the increased amount of time required to effectively teach critical thinking that may prevent its wider use and ultimate acceptance.

One of the reasons that critical thinking is not found in the business world is that managers and executives have become bogged down in knowledge. In an age of instant information, technology constantly bombards management with knowledge. Before the information can be used, it needs to be absorbed, classified, and applied. Problem is, there is so much information vying for management's attention that the quantity of information has been placed ahead of substance, content, and critical thinking (Dilenschneider, 2001a). According to Dilenschneider (2001a) universities are

teaching people how to use hardware and software which simply adds to the amount of information produced but does not train people how to ask the right questions, to analyze, or even use the information created.

When students arrive in higher education classes, they arrive with an entire spectrum of preconceived ideas, values, and learning techniques (Jones, Merritt, & Palmer, 1999). Many of these students have learned their study habits through years of lower level education classes.

When educators provide in class responses to student questions, many view the question in the wrong way. Instead of seeing the question as an opportunity to foster creative thought they view the question as an interruption to their lecture. Viewing the question as an interruption instead of an opportunity, many instructors answer the question in the shortest means available. Instead, they should answer the question in a way that generates contrasting views instead of a quick-fix response (Lind, 2001).

Although educators generally agree that critical thinking needs to be encouraged critical thought is seldom stimulated within the classroom. Part of the reason critical thought is not achieved is because too many educators focus on the results instead of the methodology used in getting to the results. Lundquist (1999) classifies these educators as behaviourists. Although educators need to place emphasis on the outcome, they must understand that the learning process is complex and that not everyone learns in the same way. Many students have to be able to reflect on and draw conclusions from less successful attempts to obtain answers.

Educators are faced with rational students. Simply stated, the goal of every student is not to excel or increase his or her ability to think critically. Instead, the goal of many students is to pass each course and graduate. Such an attitude can be especially prevalent in courses taken as an elective. Therefore, these students will rationally do the as little as possible to get through the course even though they are capable of achieving much more (Lundquist, 1999).

Too many educators approach their subjects as isolated bodies of knowledge that their students should

internalize. They seem to feel that the accumulation of large quantities of facts by their students about their specific field of interest qualifies the student to pass through the course (Mingers, 2000). Even when new teachers are taught how to encourage critical thinking in school, most revert back to more traditional methods of teaching facts within a short time when in front of the classroom (Yost, Sentner & Forlenza-Bailey, 2000). Traditional modes of teaching take less time and effort. Therefore, the teacher's busy schedule and the daily grind take their toll on the best of intentions.

Different interpretations of the word critical can lead to problems with educators trying to implement critical thinking in their classrooms. Being critical is not critical thought. Being critical is more akin to being negative which can be destructive instead of facilitating critical thinking in the classroom (Mingers, 2000). Other authors agree that the word critical may be problematic because it brings to mind images of negativity (Walker & Finney, 1999).

Not all discussions within the classroom are the same. Although some classes have discussions between and among students and teachers, the discussions never reach the level necessary to achieve critical thought. Many times this problem stems from the fact that the teacher is uncomfortable with dissent and challenges. Therefore, they insist on maintaining an atmosphere where no one can challenge another's ideas so that no one's feelings can be hurt (Yost, Sentner & Forlenza-Bailey, 2000).

Possibly the one thing that prevents critical thinking more than anything else within education is the concept of the golden answer. It is difficult for students to learn to be skeptical. It is even harder for them to learn it is all right to have a different view than that of those writing the texts or teaching the course. Part of this difficulty stems from the fact that they have spent years in educational settings learning from previous instructors that there is only one correct answer. In their past, they have probably been in a setting that discouraged rather than encouraged them to question their

teachers (Mingers, 2000). Too many teachers focus on the right answer (Yost, Sentner & Forlenza-Bailey, 2000). Students and educators alike have been searching for the single correct answer for too long.

> Much of our education system... is geared toward teaching people the *one right answer*. By the time the average person finishes college, he or she will have taken over 2,600 tests, quizzes, and exams... [t]hus, the 'right answer' approach becomes ingrained in our thinking (Oech, 1983, p. 21).

How to Develop Critical Thinkers

One of the biggest problems in teaching critical thinking is that no single method will work with all students or even with all teachers. Therefore, all educators can do is learn all they can about the subject and implement it in a way that works best for them and their students (Broadbear & Keyser, 2000).

Educators need to concentrate more on how students learn instead of simply concentrating on what the student has learned (Lundquist, 1999). To teach students how to become good problem solvers, teachers need to stop teaching what students should know and concentrate more on how they should think (Celuch & Slama, 1999). If teachers continue to teach what students should know, the student will never learn how to become a creative thinker. Therefore, the teacher needs to concentrate less on content and more on the process. Once the student masters the process, the content will come as a natural side effect (Celuch & Slama, 1999).

In a critical thinking environment, teachers encourage their students to ask questions. The more perceptive and probing the student's questions are, the better the indication that higher order learning has resulted. Student questions that start with "Is that why.....Does this mean that...." are all sound indications that critical thinking has taken place within the student (Paul, 1990, p. 23). It is vitally important for educators to ask critical questions. Posing a critical question causes the student to explore the validity of an author's main point. One needs to be careful not to criticize an author's writing or the student will

feel their reading was a waste of time. Therefore, posing an alternative point of view or conclusion may start the student questioning future readings for different opinions than their own (McKeachie, 1986). McKeachie also suggests that using comparative and connective questions can help student discussions and ultimately student thought. Comparative questions are those that cause the student to compare one author's thoughts to another. While connective questions require students to find relationships between dissimilar subjects (McKeachie, 1986). Classrooms that are comprised of critical thinkers are marked with numerous questions. Some of these questions come from the teacher while the students initiate many others. Reinforcing the appropriate types of questions by the teacher goes a long way in fostering critical thought. "Why" questions are more important in the search for stimulating critical thinking and help foster reasoning on the part of the students (Browne & Freeman, 2000). Many teachers ask and are asked questions, but few of these questions reach the level required of critical thought.

Students who actively participate in the classroom are the ones who retain the information and become the most independent learners (Ward, 2001). One of the keys to critical thought is getting the student to participate instead of simply being an observer. Active involvement is a critical element in any teacher's arsenal of tools (Browne & Freeman, 2000). Where it is sometimes difficult to get some students involved in a class discussion and even tougher to get some to think critically, games and simulations are an excellent means of getting everyone involved at a higher order level of learning. Games and simulations seem to evoke a sense of competition. Competing students one against another is good, but placing them on competing teams improves their level of involvement even further. "An educational game involves students in some sort of competition or achievement in relationship to a goal, a game that both teaches and is fun" achieves the best results (McKeachie, 1986, p. 170). The best thing about games and simulations is that they make the student

an active participant where they must "...make decisions, solve problems and react to the results of their decisions" (McKeachie, 1986, p. 170). Critical thinking has to be a participatory activity on the part of the student. Closely linked to games and simulations is the case method approach. This approach also helps involve the student and teaches them how to solve problems using what they have learned in the class (McKeachie, 1986). Being able to apply what they have learned is a dynamic means of introducing critical thinking skills in the classroom. Many researchers recommend the use of case studies to further class discussions and student involvement. Such discussion fosters an environment that results in reflective decision making and critical thinking (Lind, 2001). When selecting the correct case study the educator should look for one that allows their students several levels of understanding. By selecting such cases, the instructor allows multiple possible decision strategies to be discussed in the class which in turn furthers the amount of critical thinking that transpires (Lind, 2001).

Motivation is essential to students doing well in their classes. Students learn what they want to learn and generally will not learn something they are not interested in (McKeachie, 1986). Implementing critical thinking into the curriculum is always going to be tougher than not trying. Therefore, educators need a motivating force to convince them of the need for the efforts. As a part of the motivation, educators should always remember "...that the work students do should have value beyond being an indicator of success in school" (Taylor & Patterson, 2000, p. 5).

Critical thinking is more than just knowledge and skills learned in the classroom. Critical thinking is also an attitude the student brings with them or learns to develop (Loo & Thorpe, 1999). Grades are important to students and they will do what they need in order to achieve good grades. Therefore, if a teacher is satisfied in grading on memorization, the student will memorize. If the teacher expects application of course materials and critical thinking, the student will rise to the requirement (McKeachie, 1986). It

is "...misleading to talk of developing a student's ability to think critically as something separate from the student's ability to think creatively" (Paul, 1990, p. 219).

Although not stated directly, it is obvious that Barnet and Bedau (1996) believe that a good means of teaching critical thinking is to first provide definitions and explanations. Then, present thought provoking essays on controversial issues such as gay marriage, legalization of drugs, or abortion then present thought provoking questions for each of the essays to allow the reader to practice their critical thinking skills. The essays they selected for their book were specifically chosen to evoke very strong opinions. The questions they present with each essay were designed to force the reader to explore the issue from many different points of view in order to adequately answer the questions (Barnet & Bedau, 1996). Paul (1990) seems to provide tacit support for this concept because he explains that teachers and professors must be willing to play devils advocate in their classes.

In a critical thinking environment, students learn more by explaining to others what they know or have learned. Further, students have to take the responsibility for their learning and they must be actively involved in the learning process either in the class or on their own. Teachers encourage students to bring their personal experiences into the classroom discussion and use these experiences as a form of application and assessment of the learning (Paul, 1990).

According to Paul (1990), there are seven intellectual and interdependent traits that must be present to allow critical thinking. They are humility, courage, empathy, integrity, perseverance, reason and a sense of justice. A short explanation of each highlights their importance to one another. Humility requires one to understand that they cannot know everything. Courage requires an openness to think about views that are very different than one's own. Empathy necessitates that the individual places themselves into another's position to see someone else's point of view. Integrity requires the critical thinker to be fair in the evaluation of his or her own

arguments in comparison to others. Perseverance simply reminds that the path to critical thinking is not an easy one and will require much effort. Reason means the critical thinker needs to truly believe that they will not be deceived by giving a fair appraisal of ideas that are very different than their own. Lastly, justice indicates that all viewpoints have to be evaluated fairly (Paul, 1990).

To improve critical thinking, Paul (1990) also suggests a four pronged approach that teachers and professors should learn to use. First, they need to know the difference between multilogical and monological problems and issues. Second, educators need to learn (or re-learn) the Socratic method of teaching. Third and fourth, they must not only use dialogical and dialectical teaching methods, they need to also learn how to correctly assess them (Paul, 1990). Quite simply, there are some questions that need not be analyzed from different angles to arrive at the answer. Such things as simple mathematical questions work well using the monological methodology. For the vast majority of other subjects however, the educator has to learn how to stimulate the desire to learn in their students through many different means. The use of Socratic questioning is simply one such important tool at their disposal. The dialogical and dialectical methods focus on the way students arrive at answers instead of the final results and requires practice on the part of the educator to facilitate and assess this method of problem solving (Paul, 1990).

In order to foster creative thinking in their classrooms, teachers should first introduce the fundamentals of creative thought. In other words, teach the students how to question, interpret, and draw conclusions among other things. Next, the teacher should evaluate student progress against standards such as depth, logic, and significance. Through this process, the teacher will create intellectual autonomy on the part of the student. Finally, the teacher has to hold the student accountable for accomplishing critical thought (Celuch & Slama, 1999).

Education needs to focus more on how to effectively communicate and less on how to use modern tools that allow us to communicate faster

(Dilenschneider, 2001b). The most important thing does not appear to be the type of venue where the critical thinking skills are learned. The important thing is that the skills are learned and reinforced. Huff (2000) found that there was no difference between the critical thinking skills learned by students in a traditional classroom setting and those receiving the same instruction through distance education. Huff (2000) indicates that since interactions between students and teachers are more difficult in the non-traditional classroom, educators must be more vigilant in such settings to provide interactions that improve the student's critical thinking abilities. One of the main things that make the non-traditional setting more difficult for the educator is the lack of visual communications on the part of the student. Designing non-traditional classes that will facilitate critical thinking take more preparation on the part of the teacher to ensure discussion, questions, and reflection occur than the amount of time required to prepare for a more traditional setting (Huff, 2000).

Beyond education and into application, Ignatavicius recommends that critical thinking must be a "...part of the organization's philosophy and core values with a definition that everyone understands...essential [critical thinking] skills should be part of the employees' job/role description and performance appraisal. Holding staff accountable for critical thinking is a minimum expectation" (2001, p. 3).

In addition to teaching critical thinking in an unstructured format, some researchers have advocated and developed standardized tests to determine the level of critical thought people possess. Loo and Thorpe credit Watson and Glaser as being "...pioneers in the development of the conceptualization and measurement of critical thinking" (1999, p. 1). The test developed by Watson and Glaser contain five areas that identify the test taker's ability to infer, recognize assumptions, deduce, interpret, and evaluate arguments. The composite of these five sub-tests provides the overall assessment of an individual's critical thinking abilities (Loo & Thorpe, 1999).

Several approaches to teaching how to think critically contain several steps or levels for the educator to work

though or observe in their students. One such approach advocated by Lundquist (1999) provides four levels the educator should look for and attempt to develop. In the first level, the student attempts to arrive at an appropriate solution. This level is common and can normally be found in most classroom settings. In the second step, the students should discuss their solutions among their peers. The third level requires the student to contrast the results they came up with against a recommended solution provided by the teacher. In the last level, a class discussion is held with all the students and the teacher discussing the various means the students and teacher individually used to arrive at their solutions (Lundquist, 1999). Obviously, the nature of the problem being worked in such a learning environment needs to be conducive to multiple correct solutions. Absolutely essential to using this approach is the need to change the student's mind-set. When a teacher first starts to use such an approach, the students "...are often disturbed by noting that there often is no single correct solution or that the teacher does not have the traditional role as the one who decides what is correct and what is not" (Lundquist, 1999).

Constructivism is a term Ward (2001) uses to explain a process where students move from knowledge about a topic to understanding the subject. Constructivism means that students must build on previously constructed knowledge. The building block approach of this methodology allows the student to look at new ideas from multiple directions to gain a higher level of understanding. Critical to this process is that solutions can be constructed from numerous different directions. The educator has to follow the student's constructed answer although it will often be different than his or her own. For a teacher to encourage such a constructivism approach, the teacher must willing to reward the construction of an answer as much or even more than simply rewarding the correct answer. Grading the steps leading up to an answer in addition to the answer is a foreign idea to most educators but is a critical component to the constuctivism methodology. Further, constructivism teaching methods means the teacher is required to understand the student's

thought process in deriving their answers. In addition to being the exception, using such an approach will be much more time consuming for the teacher implementing this approach especially initially (Ward, 2001). Constuctivism is an approach furthered by other authors as well. Some indicate that in addition to a system of building knowledge, constructivism should cause conflict in the student. The addition of conflict causes the student to question, which also means they learn new alternatives (Yost, Sentner & Forlenza-Bailey, 2000).

Reflection is an important element of critical thinking to many researchers. Knowledge by itself is not sufficient. In order to reach the desired level of critical thought there needs to be reflection of the knowledge attained (Lundquist, 1999). Reflection requires open-mindedness on the part of the student to accept that there are points of view different than their own. Reflection is a concept that must be learned and nurtured as it is not something that occurs naturally. Equally significant, because reflection does not come naturally, it has to be taught to the teacher before it can be used in teaching the student (Yost, Sentner & Forlenza-Bailey, 2000).

Although most authors indicate that critical thinking needs verbal communication, one group (Yost, Sentner & Forlenza-Bailey, 2000) indicate that writing assignments can also improve critical thought. Yost et al., provide four different levels of writing. The first, descriptive writing is not reflective and does nothing to further critical thought. Descriptive writing is commonly found in many classrooms. In the second level, descriptive reflection, the student's assignment should require them to interpret their readings. The third level, dialogic requires the student to write about possible reasons for the author's writings. In the last level, termed critical, the student is required to provide reasons for their position (Yost, Sentner & Forlenza-Bailey, 2000). Writing is an important component of enhancing critical thinking. Simply writing a list of reasons for and against an idea requires the writer to think about an issue from at least two differing points of view (Barnet & Bedau, 1996).

In today's classrooms, the teacher is the knowledge expert. Therefore, what generally happens is that "...the one with the knowledge speaks; and the one seeking the knowledge listens" (Browne & Freeman, 2000, p. 3). Even if the teacher feels they need to do the speaking, there are ways to enhance the amount of critical thinking accomplished. The speaker must choose their words in a manner that requires the listener to reflect on and integrate what has been said. Through these active learning methods, the teacher can improve critical thinking when they feel they have to lecture (Browne & Freeman, 2000).

When drafting learning outcomes for higher education, educators should make critical thinking about the subject a top priority (Jones, Merritt, & Palmer, 1999). No matter the educator's preference for methodology used to teach critical thinking, educators need to make a commitment to their students to introduce critical thinking into their classes. Educators need to move away from their quest for the golden answer and come to grips with the fact there is no single right answer or best approach to solving most questions.

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Creative Thinking – Skills for an Electronic World

By Dr. Gary Schornack

Abstract

To instill creative thinking in students requires a shift in thinking for the faculty, which begins with a shift in their own thinking. The faculty obviously must be a knowledge expert or have a significant level of knowledge. However, to become effective in the classroom the faculty member must develop new creative thinking skills for themselves so they can help students develop those skills. This change requires a new attitude on the part of both the faculty and the students so that they can to expand themselves to meet a higher standard in developing the potential of the mind.

To develop creativity and a new level of creative thinking, this paper will first examine the significance of individual backgrounds and then briefly educational theory as it applies to creativity. The theory is not sufficient by itself: what is needed is an organizational environment that can enhance the students' efforts. By understanding the nature of creativity, the professor can create a new climate for effective learning. This paper identifies ways to create an effective communication climate to instill creativity, highlighting the approach of using non-threatening questions so that students feel free to explore their unique and creative thoughts.

Creative Thinking – Skills for an Electronic World

> *" . . . the brain can learn far more than we have the skill or knowledge to teach it."*
>
> ***Bennett Daviss***

To instill creative thinking in students requires a shift in thinking for the faculty, which begins with a shift in their own thinking. The faculty obviously must be a knowledge expert or have a significant level of knowledge. However, to become effective in the classroom the faculty member must develop new creative thinking skills for themselves so they can help students develop those skills. This change requires a new attitude on the part of both the faculty and the students so that they can to expand themselves to meet a higher standard in developing the potential of the mind.

> *Having a creative mind leads to improved problem-solving abilities. New and different concepts arise from asking questions such as why, how, what if, what about, when, and who.... Creative thinking also involves the capacity to deal with conflicting ideas, vagueness, uncertainty, or self-contradictory statements. Paradoxes often express a possible truth and doubt can be converted into an opportunity to be creative.*
>
> ***Tom Verberne***

To develop creativity and a new level of creative thinking, this paper will first examine the significance of individual backgrounds and then briefly educational theory as it applies to creativity. The theory is not sufficient by itself: what is needed is an organizational environment that can enhance the students' efforts. By understanding the nature of creativity, the professor can create a new climate for effective learning. This paper identifies ways to create an effective communication climate to instill creativity, highlighting the approach of using non-threatening questions so that students feel free to explore their unique and creative thoughts.

Individual Background

In approaching classroom learning, a familiar discussion concerns whether intellectual ability is inherent with an individual or is it learned. Robert Sternberg gives us a perspective on this issue:

> *Creative giftedness is, in effect, a gift one can give to oneself. Abilities are like any other form of expertise: they represent an interaction between genes and environment. Anyone can develop their abilities, at least to some extent, within broad limits set by genetic endowment.*
>
> ***Robert J. Sternberg***

As professors approach individual students, they must recognize that creativity development for students involves a wide range of approaches in their thought patterns. Some students may be stronger in some areas than others, but these types of patterns reflect the ability of students to become creative thinkers. Table 1 identifies these practices.

Table 1: Thought Patterns for Creative Thinking

Active imagination *Flexibility* *Curiosity* *Independence* *Ability to work an several ideas simultaneously*	*Acceptance of own differentness* *Tolerance for ambiguity* *Trust own senses* *Openness to subconscious material* *Ability to abstract from the concrete*

Arthur J. Cropley

Some of the characteristics listed above may be inherent in students or they already are highly developed. However, the faculty member can enhance these characteristics in the students if the faculty can create the appropriate environment for creative thinking. Within the categories listed by Cropley, we do not emphasis the degree to which students have achieved these or precise measurements: rather, we're trying to expand the range of ways of thinking so that students indeed can expand their ability in creative thoughts. Robert Sternberg sees creativity as a decision process that applies to a given task:

Ten decisions characteristics [describe] people who decide for creativity. They can be the present view, the bases for identification, development, and assessment of creativity, rather than any allegedly fixed traits of abilities or even personality. They are what enable people to produce work that is novel, high in quality, and appropriate to the task at hand.

Robert J. Sternberg

Educational Theory

Some educators see educational theory as unnecessary, boring, irrelevant background: in contrast, some educators see this as the be all and end all. Among the more recent buzzes in educational theory is Howard Gardner's "Seven Intelligences":

Verbal and linguistic
Logical and mathematical
Musical
Visual and Spatial
Intrapersonal
Kinesthetic
Interpersonal

Howard Gardner

While Gardner provides a concise list, it is often difficult to take such a list and provide something meaningful in the classroom. To help us in this process

Elizabeth Shaunessy identifies how "Questioning Techniques" can permit the faculty member to easily create an effective learning environment.

> *To help students grow through questioning, they must be provided a safe, nonthreatening' encouraging, mutually respectful environment. Teacher behavior strongly affects the learning environment:*
> *Tone of voice, facial expression, body language, and other nonverbal cues must be appropriate to learn to foster an inviting, stimulating atmosphere that encourages risk.*
>
> ***Elizabeth Shaunessy***

Robin Fogarty takes the broad concepts of the intelligences and provides a general set of instructions that faculty can use in approaching the classroom.

1. *Set a safe emotional climate.*
2. *Create a rich learning environment*
3. *Teach the mind-tools and skills of life*
4. *Develop the skillfulness of learning*
5. *Challenge the experience of doing. (Active, experiential learning is the norm, as the learner is invited to become an integral pare of the teaching/learning process.*

Robin Fogarty

Creativity

The area of creativity is one that obviously contains diverse perspectives. Different authors approach it in a variety of different ways. We begin this discussion with a generalized description of creativity by Joseph Anderson.

> *Creativity is the process of searching for or using relationships among objects, people, and ideas. Only three broad types of creativity exist: making, combining, and changing. Each type is equally creative.*
>
> *Creation is the act of making something out of nothing.*
>
> *Synthesis is the act of relating two or more previously unrelated phenomena. Modification is the act of altering something that already exists so it can perform its function better, perform a new function, perform in a different setting, or be used by someone new.*
>
> *Surmount obstacles. Others will oppose ideas because they go against the current way of doing things; so creative people expect and welcome opposition as a way to refine ideas.*
>
> ***Joseph V. Anderson***

If we accept Anderson's definition of creativity, then the faculty member must create the environment so that creativity can indeed arise in the classroom. Ken Lizotte gives us four broad tenets based on his summary of experts in creative thinking:

> *Let ideas flow*
> *Make failure ok*
> *Mix in color and music*
> *Travel down roads rarely taken*
> ***Ken Lizotte***

With the four categories for the Creative State of Mind that Lizotte presented, the faculty member can make these practical, primarily by focusing on questions.

> *When you ask a question, you set boundaries of relevance:*
> *"Can you think of anything from your experience that would explain this?"*
> *"How do you feel about this?"*
> *"Can you imagine?"*
> ***Charles H. Kepner and Iikubo Hirotsugo***

Communication Climate

Within the literature dealing with creativity, many of the techniques and guidelines actually fall within the broader context of communication climate. In general, communication climate is a two part continuum, defensive versus supportive. A defensive climate is closed, where individuals are reluctant to raise ideas or try possibilities. They basically feel threatened and tend to restrict themselves as a survival technique. In contrast, a supportive environment is open: It invites question, new ideas, and new ways of thinking in non-judgmental ways. By providing a supportive communication climate, the faculty member can ultimately build the kind of environment that will enhance creative thinking. Elizabeth Shaunessy combines the focus on questioning as well as the focus on communication climate in presenting guidelines for instructors:

> *To help students grow through questioning, you teachers must provide a safe, nonthreatening, encouraging, mutually respectful environment. Teacher behavior strongly affects the learning environment:*
>
> Probe beyond simple, convenient, yes/no questions
> Consider specificity or vagueness of questions and purposes
> Divvy up summarizing and concluding responsibilities among students
> Respond to questions in an encouraging way
> Wait for responses to questions - give adequate think time

Pose a variety of types of questions
Address students by name during questioning
Avoid judgments, criticism, condescension

Tone of voice, facial expression, body language, and other nonverbal cues must be appropriate to learn to foster an inviting, stimulating atmosphere that encourages risk taking and divergent thinking.

Elizabeth Shaunessy

In general, communication climate follows the principles established by Gibb in addressing six different continuum that contribute to climate. The continuation of our discussion will use these categories. Gibb provides the categories for discussing creativity and the climate that the faculty members can create. See Table 2.

Table 2: Communication Climate Continuum: Defensive versus Supportive

SUPPORTIVE	*DEFENSIVE*
Problem Orientation	***Control***
Description	***Evaluation***
Empathy	***Neutrality***
Spontaneity	***Strategy***
Equality	***Superiority***
Provisionalism	***Certainty***

Problem-Orientation vs. Control

The first category within supportive versus defensive climate is problem-orientation vs. control. Faculty tends to seek control based on their own knowledge base of expertise. To promote creativity, however, they need to back away from control and focus on problem-orientation: defining the problem, analyzing the problem, and seeking questions and perspectives that have evolved from the problem. Shaunessy provides the obvious choice to begin this discussion as a continuation of her focus on questioning techniques.

A variety of questioning techniques . . . focusing on the higher end of Bloom's taxonomy to engage students in higher-level thinking. Teachers can incorporate questions effectively by knowing the various purposes, types, and intended outcomes; and they must also establish a classroom climate that promotes active engagement, student exploration, and student inquiry to further student achievement.

Researchers indicate that questioning strategies are essentials to the growth of critical thinking skills, creativity, and higher level thinking skills.... Unfortunately, even though this practice can positively affect achievement, most classrooms operate devoid of these types of questions as a regular part of learning.... In reality, "there are

many classrooms in which teachers rarely pose questions above the 'read-it-and-repeat-it' level."

Table 3
Bloom's taxonomy as a guide to structure questions at each level
Inference questions ***Interpretation questions propose that students understand*** ***Consequences*** ***Transfer questions*** ***Reflective questions to encourage thinking process and strategies***
Provocative and hypothetical:
Comparison-analysis, ***Synthesis*** ***Evaluation*** ***Sensitivity to problems*** ***Clarifying problems***

The most commonly recommended is the divergent thinking question that probes beyond the convergent, one-correct-answer question to delve more deeply into an idea...teacher questions should be broad or open so that students will be free to respond with their own thoughts. (See Table 4).

Table 4	
Other uses	*Can it be put to use as is?*
Adaptation	*What else is it like?*
Modification	*What new twist could be made?*
Magnification	*What could be added?*
Minification	*What could be omitted?*
Substitution	*What else can do it?*
Rearrangement	*Can you use a different sequence? Can*
Reversibility	*you do the opposite?*
Combination	*What items can be blended?*
Transformation	*Can you change its form in any way?*

Elizabeth Shaunessy

In focusing on problem-orientation versus control, the questioning process becomes a guided method of providing brainstorming. Brainstorming sessions do not just happen; rather, they take thought and preparation. As Winston Fletcher says,

> *Brainstorming can just happen, but most inventive thinking results from hard work and practice plus having the confidence to see it through.*
> ***Winston Fletcher***

Description vs. Evaluation

Within the communication climate a significant category is description versus evaluation. The process of evaluation closes off students or creates a defensive environment where students feel threatened,

feel uncertain, and tend to restrict their thinking. In contrast, by focusing on description, the educator takes the focus away from evaluation and allows students to more directly focus on the problem or issue at hand. Copley provides significant techniques to focus on description (See Table 5).

Table 5: Techniques to Foster Description
"Uncensored" perception and encoding information
Fluency of ideas (large number of ideas)
Problem recognition and concentration
Unusual combination of ideas (remote associates, category combination, boundary breaking)
Construction of broad categories (accommodating)
Recognizing solutions (category selection)
Transformation and restructuring of ideas
Seeing implications
Elaborating and expanding ideas
Self-directed evaluation of ideas

Arthur J. Cropley

Empathy vs. Neutrality

Empathy versus neutrality implies looking at students as individual persons. Neutrality looks at students as cogs in the wheel or numbers of credits. To develop a sense of empathy educators need to switch from education stimulus response to a learning environment of challenge and discovery. In this process, educators must recognize that students think in their own ways and think in a variety of new ways. The professor in particular needs to recognize that students are special individuals, despite the fact that individuality makes it more difficult for the professor to manage all unique needs in the classroom. Ultimately, there is no single approach that can be ideal because we are dealing with a range of individual students. From the student perspective, faculty must enhance a climate in which students can believe in themselves. As Robert J. Sternberg indicates:

> *Believe in yourself. Especially in view of being poorly received by others.*
>
> ***Robert J. Sternberg***

By looking at students as individuals and responding to their individual needs the professor can indeed help create a supportive communication climate that encourages creative thinking for everyone.

Spontaneity vs. Strategy

In this category, the professor must overcome the tendency to follow strict lesson plans to the nth degree and allow room for the spontaneity that encourages creative thinking. Jeffrey Shields provides a way of getting started.

Prime the group to think creatively from the start by focusing creative energy on a subject other than the task at hand.
Consider employing an icebreaker activity to trigger outside-the-box thinking.
Ask the group open-ended questions unrelated to the problem at hand.

Jeffrey N. Shields

Spontaneity requires that professors re-think their objectives, process, and environment. The Creative Group provides a series of techniques that can encourage, and create spontaneity in a variety of dimensions. (See Table 6).

Table 6: Techniques to Encourage Spontaneity

Change music and colors in work environment to keep it creative
Think out loud. Talk to yourself
Write down every idea, whether you use it or not.
Maintain a good sense of humor and engage in laughter
Take in as many cultures and trends as you can and draw form them
Don't allow interruptions. Just turn off the phone.
Allow time for personal rejuvenation. Spend time on outside hobbies and interests
Start a project well in advance and stay one step ahead of the game
Keep your mind open at all times, avoiding parameters
Have a solid strategy and sufficient information to solve the problem from the start.
Be courageous. Don't fear anything; just dig into it.

Creative Group

Equality vs. Superiority

Within the classroom, superiority and the challenge for excellence is a given. Professors are hired for their expertise, and they go to the front of the class because of this expertise. Students are expected to follow their example. This knowledge superiority can get in the way of creative thinking process. Rather than a sense of superiority, the faculty member needs to develop a sense of equality in searching for knowledge. "We are in this together is the teaching philosophy." Although, the faculty member has more experience, he or she does not have a complete lock on knowledge or creative approaches to knowledge. To provide the supportive climate, the faculty member needs to instill a sense of equality. From the student perspective, developing equality is being able to stick up for him or herself, to stick through with ideas and to follow them to a conclusion. As Sternberg identifies this quest for knowledge:

Surmount obstacles. Others will oppose ideas because they go against the current way of doing things; so creative people expect and welcome opposition as a way to refine ideas.

Robert Sternberg

Provisionalism vs. Certainty

The final category of provisionalism versus certainty actually reflects the scientific method. The scientific method uses the best theory that seems to work, yet it always remains open to another better theory in discovering new truth. Provisionalism does not mean being wishy-washy but is open to new ideas. Anderson praises the sense of provisionalism by

undoing the wall of rationality that often locks us into a final way of thinking.

> *Undoing the wall or rationality - most people live within a wall of rationality that is defined by the real and apparent limits of the world they inhabit.*
>
> *Mind mapping is the tangible representation of stream-of-consciousness thinking, which constantly branches, rejoins, and branches once again.*
>
> ***Joseph V. Anderson***

To instill the sense provisionalism and break down the barriers, the faculty member must get beyond the assured assumptions and beyond the 'shoulds' that seem to guide thinking in general.

> *Creating thinking helps us get beyond all the "shoulds" and "spozed-to's," revving up the lesser-used parts of the brain that prompt breakthrough ideas. This process is essential in a marketplace that reverberates with quick-shifting customer expectations."*
>
> ***Ken Lizotte***

As a practical method for insuring provisionalism, the faculty member needs to be ingrained with common question words that will help refocus and revamp any chain of thought.

Keywords for the questioning process:

Why What (if)
How What (about)
Who When

Ways to stimulate new ideas:

Make new combinations (break up problem or product into major components)
Reverse the problem
Carry a notebook (ideas come spontaneously)
Practice

Tom Verberne

Conclusion

Creative thinking requires a climate that encourages students to become free to develop their inherent abilities. Following the context provided by from Elizabeth Shaunessy, professors set the tone by way that they ask questions. By asking questions in the proper manner, they can create a challenging climate for creativity.

> *Through modeling of questioning and appropriate behaviors, educators encourage students to move into role of facilitator, which is essential to development of lifelong learning skills.*
>
> ***Elizabeth Shaunessy***

Faculty have a key role in developing creativity within their students by focusing themselves on aspects of creative thinking and in particular, providing the environment in which creative thinking can occur.

> *Great thinking is about people . . . Innovation is about the tools of the trade. If there's a trade-off between the two, always go for the thinking. If you can get both, you are on to a winner.*
>
> ***Paul Simons***

If professors provide the proper climate, then students feel free to develop themselves more fully. They can indeed make the decision to become creative and follow the models and patterns that the professor provides.

> *In sum, anyone can make the decision to be creative . . . But students will probably not do so unless they are encouraged to do so. It is our responsibility as teachers to provide such encouragement and to reward students who decide for creativity. We need to teach students not only to learn the facts, and not only to think critically about them. To become the people they are capable of being, we need to teach students to decide for creativity.*
>
> ***Robert J. Sternberg***

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Use of Electronic Spreadsheets to Facilitate Critical Thinking in Quantitative Courses

Daryl K. Ono, PhD, CCE/A

ABSTRACT

Electronic spreadsheets such as Microsoft Excel or Lotus can make a valuable contribution in the quantitative courses such as accounting or engineering. These spreadsheets can facilitate critical thinking by eliminating the repetitive calculations associated with scenario analysis. Students can then focus on the applications of managerial decision making or engineering analysis, instead of being overwhelmed by recurring mathematical iterations. It is crucial that the faculty member demonstrate to importance of critical thinking in the quantitative courses.

Use of Electronic Spreadsheets to Facilitate Critical Thinking in Quantitative Courses

Electronic spreadsheets such as Microsoft Excel or Lotus have powerful scenario analysis capabilities that can be used to enhance the critical thinking process for your students. Scenario analysis is important because it helps decision makers to consider all possible outcomes, including the worst case, base, and best case scenarios. Quantifying all benefits and costs is a critical step in the risk management process. The planning process is improved by identifying all potential pitfalls and using all resources available to mitigate these problems.

It is important to perform the calculations manually to develop an understanding of the mechanics involved, but there are little incremental benefits gained by calculating spreadsheet iterations manually, which is necessary for scenario analysis. In the past, scenario analysis was difficult to demonstrate in the classroom because of the amount of tedious mathematical calculations involved. There was a high probability of making a simple math error that would damage the validity of the results. Learning to construct and analyze scenarios is crucial when a final outcome cannot be predicted with a reasonable amount of certainty. Scenario analysis can help the students identify alternatives that they may not think of themselves and it promotes management by exception because it helps identify potential problem areas. Scenario analysis brings realism and pragmatism into the classroom and it presents an essential application that students must be able to effectively utilize to deal with complex situations.

If a scenario were attempted in the classroom, the students would be exhausted by the amount of calculations, they would be too engrossed in the mathematics, and they would not ask the essence of critical thinking: "How do I use these results for managerial decision making or engineering analysis?" Electronic spreadsheets would eliminate the repetitive calculations and allow the students to analyze the results to develop the strategies, processes and tactics to achieve the specified objective.

Use of electronic spreadsheets is also a good way of bringing technology into the classroom and it gives the students an

opportunity to develop an important new computer skill.

Financial Analysis

The following spreadsheet is a demonstration of the benefits of the income statement in contribution margin format. A range of revenue alternatives was inserted into the spreadsheet to determine the effect on net income. Total variable costs changed in direct proportion to the changes in units sold in each scenario while total fixed costs remained constant throughout.

Total Fixed Costs	$	100,000
Price Per Unit	$	25
Variable Costs Per Unit	$	15
Units Required to Break-Even		10,000

	Units Sold				
	10,000	25,000	50,000	75,000	100,000
Total Revenues	$ 250,000	$ 625,000	$ 1,250,000	$ 1,875,000	$ 2,500,000
Total Variable Costs	150,000	375,000	750,000	1,125,000	1,500,000
Total Contribution Margin	100,000	250,000	500,000	750,000	1,000,000
Total Fixed Costs	100,000	100,000	100,000	100,000	100,000
Net Income	$ -	$ 150,000	$ 400,000	$ 650,000	$ 900,000
Contribution Margin per Unit	$ 10	$ 10	$ 10	$ 10	$ 10
Contribution Margin Ratio	40%	40%	40%	40%	40%

The first income statement took about five minutes and was difficult to construct, but the subsequent spreadsheets took less than a minute in total to create. If the scenarios had been calculated manually, these income statements could take about 30 minutes to complete in the classroom. This time is valuable and should be used to discuss the critical thinking process associated with this scenario analysis.

These scenarios indicate the importance of growth in revenues and the corresponding advantages of a greater contribution margin. This spreadsheet would consume valuable time in the classroom if it were constructed manually. Classroom time would be cleared to analyze the results of the scenarios and to discuss business policy if an electronic spreadsheet was utilized. A paper handout of the spreadsheet would be helpful, but because of its static nature, additional scenarios cannot be analyzed. Fielding questions from the

students and demonstrating the effects of their requests on an electronic spreadsheet immediately conveys a sense of practicality in the classroom. It helps the students answer for themselves, "How do I use this tool to help me make managerial decisions?" This is the question that initiates the critical thinking process in the students.

Scenario analysis is inherent in financial planning, cost estimating, capital budgeting and valuation models.

Engineering Analysis

The following schematic will be used to determine the reliability of the system, which is constructed in a parallel configuration. The elements have a wide range of applications. They could be transistors in electronics, transformers in a power system, or servers in a computer network. The system must meet a minimum level of required reliability, but total costs of the elements must be kept to a minimum. The more reliable an individual element is, the more expensive it will be. The students can engineer a system that is ultimately reliable, but it would be prohibitively expensive and would violate the least cost criteria. Inexpensive elements could be utilized, but the system would not attain the reliability requirement.

The following calculations and parameters were implemented to construct the schematic:

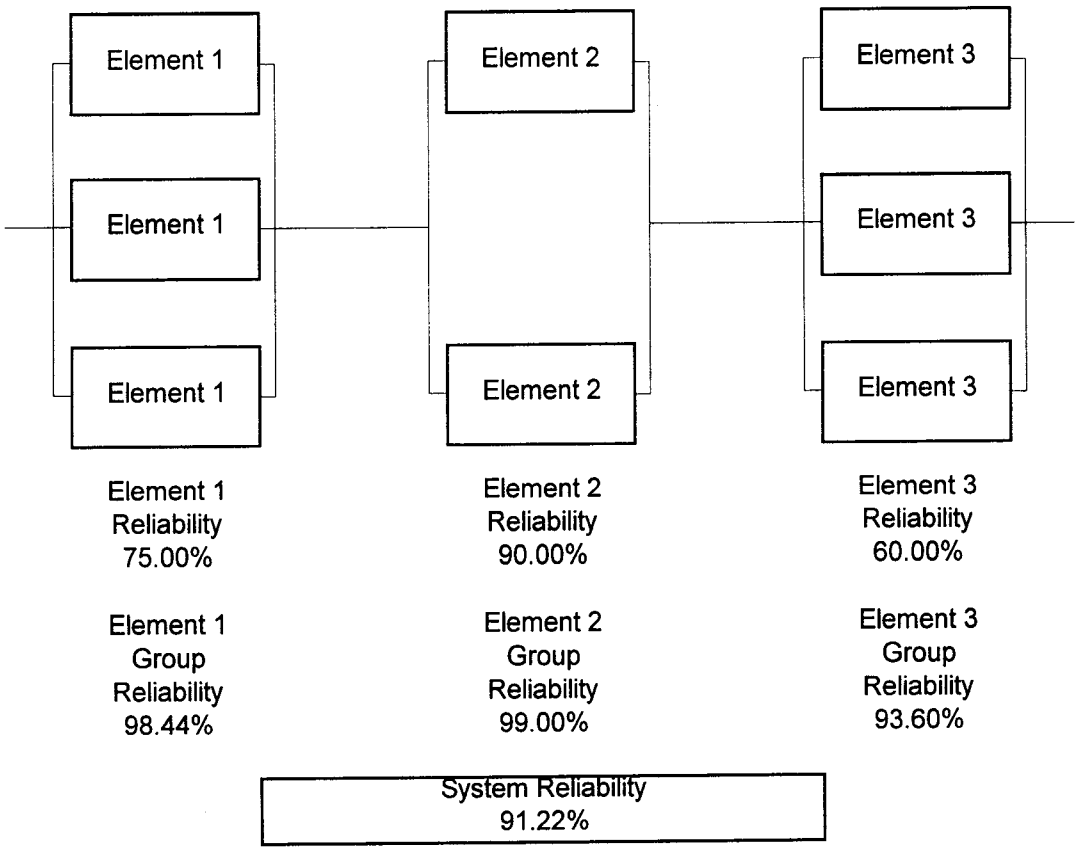
Reliability per Element Group: $1 - (1 - R(\text{Element}))^{n}$ where n = # of elements

System Reliability: $\prod_{i=1}^{3}$

Reliability per Element Group

Constraint: $0\% \leq$ Reliability per Element $\leq 100\%$

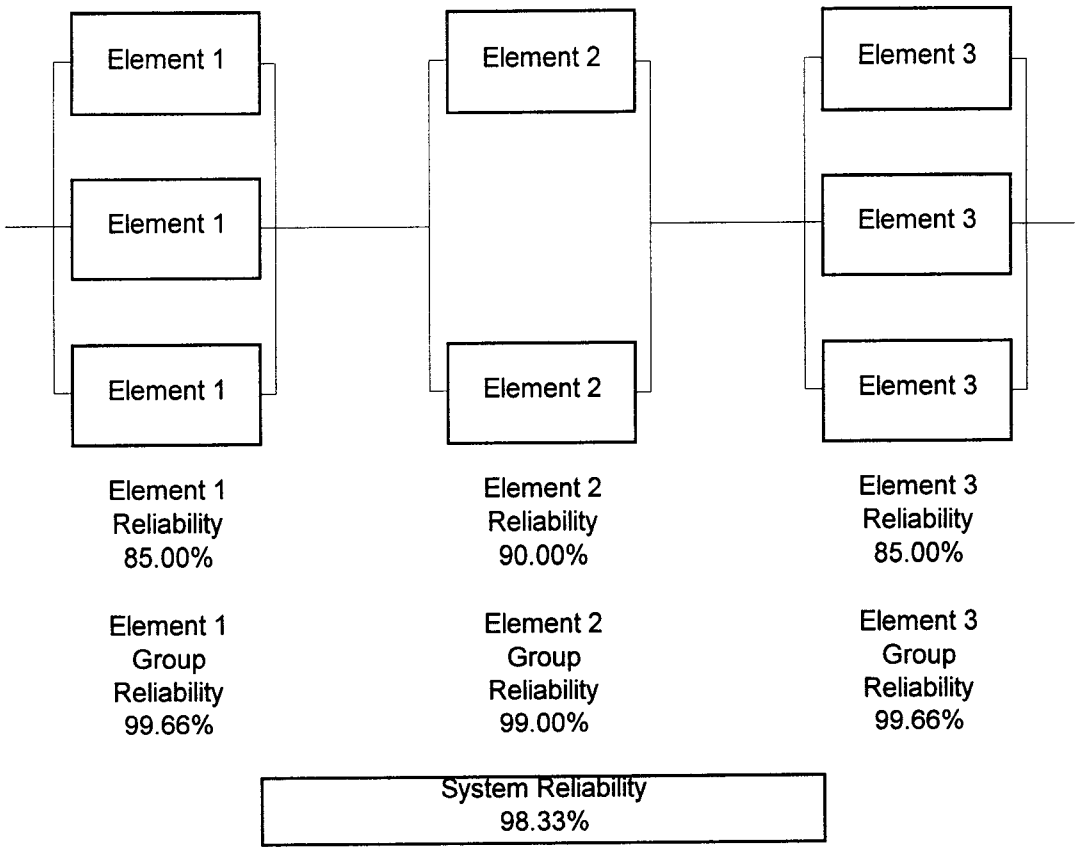
PARALLEL CONFIGURATION



The greater the reliability of the individual element, the greater the system cost; however, elements with lower levels of reliability can be used to achieve the least cost objective but still attain the required system reliability. Students must understand the inverse relationship between element reliability and system cost. If the required reliability for the system is increased, different scenarios could be run in the schematic to determine the reliability of each element necessary to attain system reliability.

The next schematic is a demonstration of reliability scenario analysis. If the required system reliability is 98%, the following configuration can be considered (note the change in the reliability estimates of the individual elements).

PARALLEL CONFIGURATION



To re-engineer the configuration above could take time if done manually, but if the system reliability calculation is done on a spreadsheet, systems analysis can be done quickly and without error. This particular scenario took about 2 minutes to re-engineer and calculate. Students will be able to perform cost/benefit analysis of the different configurations without becoming too involved in the manual calculations. This scenario introduces the importance of critical thinking in engineering analysis, particularly cost/benefit analysis. The system can be engineered to deliver a high level of reliability, but is the high cost justified?

Electronic spreadsheets facilitate critical thinking when this facet of engineering analysis is required. In our analysis, it does not matter if the system configuration is series, parallel, or with standby systems, the spreadsheets will facilitate critical thinking in engineering analysis. It is this type of demonstration that

illustrates the value of electronic spreadsheets in the quantitative courses. Critical thinking then leads to the intuition that is inherent in successful problem solvers.

Conclusion

Students must develop the ability to perform risk management and to solve complex problems. Both of these abilities begin with the critical thinking process. In most cases this will involve analyzing various scenarios, interpreting the results and developing the strategies and tactics to achieve the ultimate objective. The difficulty with large-scale problems is that many will require complex, repetitive mathematical calculations to be solved. In advanced courses, these calculations can be time consuming, which would burn valuable time in the classroom, and this time is necessary to help students answer the question "How do I use these results for managerial decision making or engineering analysis?" These repetitive calculations can detract from the main objective of developing strategies and tactics, so electronic spreadsheets should be employed whenever scenario analysis must be performed. These spreadsheets can perform the repetitive calculations and allow the problem solver to allocate time to and to focus on the holistic aspects of the problem. The electronic spreadsheets allow the instructor to facilitate the critical thinking process in the classroom.

Critical thinking, problem solving and risk management must be the main focus of those quantitative courses where the objective is to teach students how to provide a product or service. Electronic spreadsheets are an essential tool in scenario analysis, which is an integral part of the planning process. These spreadsheets allow the instructor to focus on these imperative aspects and to facilitate discussion throughout the course to develop the intuition in problem solvers and decision makers.

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ENHANCING STUDENTS' CRITICAL THINKING SKILLS THROUGHOUT THE CURRICULUM THROUGH THE USE OF "APPLIED CRITICAL THINKING"

by
Dr. Ronald Clark and Ms. Kathleen Chumley

ABSTRACT

Using elements of Bloom's Taxonomy, Critical Thinking, and Scientific Research theory, Embry-Riddle Extended Campus adult learners can be taught how to become more effective critical thinkers by studying the elements of critical thinking necessary to succeed in each course they take. As the specific situational demands for academic success in each course dictate, these adult learners learn to first succeed in identifying the critical thinking elements in each course, then in the overall academic discipline of each course, and, eventually, in each professional and personal life situation they become involved in. Relying on the critical thinking skills necessary to succeed in information retrieval using online technology and finding solutions to problems through database searching and WWW search engines, adult learners can effectively become critical thinkers and information finders. It was concluded that Bloom's Taxonomy is an appropriate educational critical thinking guideline, and that extended campuses should create and support "critical thinking across the curriculum" programs. It was recommended that critical thinking across the curriculum and information retrieval skills be adopted by ERAU's Extended Campus as syllabus learning outcomes for all courses.

Chapter I
INTRODUCTION

According to many leading educational authorities, promoting and fostering critical thinking skills is an important goal of higher education (McBride & Reed, 1998). Facione et al. (1998) mention that people who possess critical thinking skills are likely to provide reasoned consideration to context, evidence, theories, procedures and criteria in order to form a purposeful judgment.

In 1984, the National Institute of Education recommended that university-level curricula provide for "the development of capacities of analysis, problem solving, communication, and synthesis" (p.43). Likewise, the Association of American Colleges (1985) strongly advocated that students learn inquiry skills, critical thinking skills, abstract logic thinking skills and the like.

In 1997, the Extended Campus of Embry-Riddle Aeronautical University (ERAU) passed a Faculty Senate motion requiring a learning outcome of enhanced student computing, speaking and writing skills "across the curriculum". The Southwest Region of the Extended Campus went a step further and added critical thinking to this "across the curriculum" (ATC) list.

In spite of nine week terms which do not immediately lend facility to any ATC effort, over 360 Southwest Region courses a year, involving over 5,000 undergraduate and graduate students, require critical thinking learning "across the curriculum". This "CTATC" program is only as successful as the skill of each instructor in creating a critical thinking learning environment in each class taught.

Like many extended campus learning environments of other major colleges and universities in America, Embry-Riddle Aeronautical University's Extended Campus is both similar, yet unique, when compared to all others. The 100-plus resident centers in the US and Western Europe have a five-term-a-year, nine-weeks-per-term academic schedule. Compared to traditional campuses, including the ERAU Daytona Beach and Prescott campuses, accomplishing an "across the curriculum critical thinking" learning environment on ERAU's Extended Campus is very challenging, yet do-able.

Normally taught in either eight or nine class sessions, usually once a week, both undergraduate and graduate courses, no matter what the discipline or specific course content, can be taught in a manner that enhances student critical thinking learning. It is the intent of this paper to provide those Southwest Region faculty and those in attendance at the 2001 Teaching Effectiveness Symposium with a comprehensive and understandable (both faculty and student) set of critical thinking learning tools.

This paper addresses the issue of providing a non-traditional campus critical thinking and information retrieval learning environment in nine-week
courses, and recommends a model called "Applied Critical Thinking". In subsequent chapters, the authors present

a definition of critical thinking, assess current critical thinking programs, discuss the retrieval of information as a critical thinking element, and pose a model for extended campus critical thinking learning.

Chapter II
CRITICAL THINKING ELEMENTS

Few would doubt that the world is becoming increasingly complex, with more words printed in an hour today than it is possible for a single person to read, much less comprehend, in a lifetime. There is an acute and accelerating need for all education institutions to teach, and for all students to learn, critical thinking skills. Undoubtedly, all societies valued some form of knowledge comprehension and transmission from generation to generation.

Sternberg (1986) defines critical thinking as comprising the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts. He states that the study of critical thinking combines the elements of educational, philosophical, and psychological traditions of thought. For purposes of this paper, we will begin our discussion of the educational aspects of critical thinking with the work of Benjamin Bloom and his cohorts, who began their formal work on critical thinking at the American Psychological Association Convention in Boston in 1948.

Bloom's Taxonomy

In 1956, following approximately eight years of two to four day conferences with a group of achievement testing psychologists, Benjamin Bloom published the first of what would become three taxonomies on the cognitive,
affective and psychomotor domains of educational objectives. Sternberg (1986) classifies Bloom's Taxonomy as a taxonomy of critical thinking skills. This first work, titled, Handbook I: Cognitive domain, listed six competency levels, with skills demonstrated at all six levels, from lowest to highest, as follows:

- **Knowledge:**
  - observation and recall of information
  - knowledge of dates, events, places
  - knowledge of major ideas
  - mastery of subject matter
  - question cues:
    - list, define, tell, describe, identify, show, label, collect, name, who, when, where, etc.

- **Comprehension:**
  - understanding information
  - grasp meaning
  - translate knowledge into new context
  - interpret facts, compare, contrast
  - order, group, infer causes
  - predict consequences
  - question cues:
    - summarize, describe, interpret contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
- **Application:**
  - use information
  - use methods, concepts, theories in new situations
  - solve problems using required skills of knowledge
  - question cues:
    - apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover
- **Analysis:**
  - seeing patterns
  - organization of parts
  - recognition of hidden meanings
  - identification of components
  - question cues:
    - analyze, separate, order, explain, connect, classify, arrange,

      divide, compare, select, explain, infer
- **Synthesis:**
  - use old ideas to create new ones
  - generalize from given facts

- relate knowledge from several areas
- predict, draw conclusions
- question cues:
  - combine, integrate, modify, rearrange, substitute, plan, create, design, invent, compose, formulate, prepare, generalize, rewrite

- **Evaluation:**
  - compare and discriminate between ideas
  - assess values of theories, presentations
  - make choices based on reasoned argument
  - verify value of evidence
  - recognize subjectivity
  - question cues:
    - assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

Critical Thinking Skills

Sternberg (1986) states that there appears to be a certain core of critical thinking skills that would appear in any reasonably complete list. He uses Gubbins' 1985) unpublished Matrix of Thinking Skills as an example of a list that reflects the critical thinking skills listed by numerous theorists, as listed below.

I. Problem Solving

A. Identifying general problem

B. Clarifying problem

C. Formulating hypothesis

D. Formulating appropriate questions

E. Generating related ideas

F. Formulating alternative solutions

G. Choosing best solution

H. Applying the solution

I. Monitoring acceptance of the solution

J. Drawing conclusions

II. Decision Making

A. Stating desired goal/condition

B. Stating obstacles to goal/condition

C. Identifying alternatives

D. Examining alternatives

E. Ranking alternatives

F. Choosing best alternative

G. Evaluating actions

III. Inferences

A. Inductive thinking skills

1. Determining cause and effect
2. Analyzing open-ended problems
3. Reasoning by analogy
4. Making inferences
5. Determining relevant information
6. Recognizing relationships
7. Solving insight problems

B. Deductive thinking skills

1. Using logic
2. Spotting contradictory statements
3. Analyzing syllogisms
4. Solving spatial problems

IV. Divergent Thinking Skills

A. Listing attributes of objects/situation

B. Generating multiple ideas (fluency)

C. Generating different ideas (flexibility)

D. Generating unique ideas (originality)

E. Generating detailed ideas (elaboration)

F. Synthesizing information

V. Evaluative thinking Skills

A. Distinguishing between facts and opinions

B. Judging credibility of a source

C. Observing and judging observation reports

D. Identifying central issues and problems

E. Recognizing underlying assumptions

F. Detecting bias, stereotypes, clichés

G. Recognizing loaded language

H. Evaluating hypotheses

I. Classifying data

J. Predicting consequences

K. Demonstrating sequential synthesis of information

L. Planning alternative strategies

M. Recognizing inconsistencies in information

N. Identifying stated and unstated reasons

O. Comparing similarities and differences

P. Evaluating arguments

VI. Philosophy and Reasoning

A. Using dialogical/dialectical approaches Scientific Research/ Reasoning Collins and Onwuegbuzie (2000) use the idea of higher critical thinking as enhancing learning in research methodology courses. They mention the work of Burns and Grove (1987), who hold that a five stage scientific reasoning process is involved in critiquing a research article. The first stage involves identifying the study's elements and understanding the nature, significance and meaning of both implied and explicit components. This can be likened to the analysis component of critical thinking.

The second stage of Collins and Onwuegbuzie (2000) article critiques involves the interpretation of the theories and concepts in the report consistent with the report authors. This is likened to the interpretational aspect of critical thinking. The third stage involves knowledge of each aspect of the research process to determine the extent that the article followed the process. This is likened to the evaluation skills associated with critical thinking.

The fourth stage involves identifying the expressed and unexpressed assumptions of the study (Collins & Onwuegbuzie, 2000). This is seen as parallel to the explanatory aspect of critical thinking. Last, conceptual clustering that maximizes the meaning of the research findings, is seen as parallel to the inferential aspect of critical thinking, as well as with other critical thinking facets.

According to Schwartz, Slate and Onwuegbuzie (1999), action research involves an eight-step cyclical process: (a) identifying an issue or problem to investigate; (b) gathering and reviewing relevant literature; (c) formulating

research questions and/or hypotheses; (d) developing a research plan; (e) implementing the research plan; (f) analyzing the data and interpreting the findings; (g) communicating the findings; and (h) repeating the research cycle with a modified problem derived from what was learned. These eight phases each appear to involve at least one of the cognitive skills associated with critical thinking. In their research, higher critical thinking skills, whenever acquired, resulted in significantly greater research methodology education skills.

It is apparent that there are significant parallels between both the critical assessment of relevant literature and research methodology skills, and critical thinking precepts. Higher critical thinking skills equaled higher research methodology functioning.

CHAPTER III

CRITICAL THINKING PROGRAMS

According to Sternberg (1986), critical thinking programs have been around for thousands of years. These programs have been known as "logic" courses, and at the college level, these courses are usually taught in the philosophy department.

The Copi (1978) text for courses in logic has gone through five editions. Copi's course consists of three parts: use of language in logic, deduction and induction. While there may not be a substitute for the full power of the philosophy discipline in this type of course, there is also incomplete training on critical thinking. Life is much more pragmatic and flexible than the rigid rules of logic that apply best to structured situations.

Bransford and Stein (1984) have developed a course called the ideal problem solver, where IDEAL is an acronym for Identifying the problem, Defining and representing the problem, Exploring possible strategies, Acting on the strategies, and Looking back and evaluating the effects of one's activities. A 150 page, eight chapter paperback covers (1) the importance of problem solving; (2) the model for improving problem solving; (3) improving memory skills; (4) learning with understanding; (5) intelligent criticism; (6) creativity; (7) effective communication; and (8) concluding remarks.

Sternberg (1986) teaches a course called Understanding and Increasing Intelligence: A Triarchic Program for Training Intellectual Skills. Normally taught ideally as a yearlong course, Sternberg's course teaches for transfer of knowledge, energizes both teachers and students, and emphasizes the training of both metacomponents (systems), as well as performance and knowledge-acquisition components.

Logan (1987) teaches critical thinking by using what she calls the Scientific Process as a model system. Her general plan is to identify and clearly define critical thinking skills for students, model them, and give students frequent feedback by describing what they are doing and evaluating it. Logan mentions that an important element of critical thinking is the development of an attitude to "want" to reason. According

to Logan, the Scientific Process is a method for evaluating observations and experiences in the world in order to discover underlying principles that govern nature. It is a "strong-sense" critical thinking process since the student must ask questions such as: "Is the evidence sufficient to allow this conclusion?"; "Is this the only conclusion that this evidence supports?"; and "Is the evidence reproducible and reliable?"

Hannel and Hannel (1998) mention that two impediments stand in the way of helping students to become critical thinkers: a widespread misdiagnosis about why students fail to become critical thinkers in the first place, and the lack of a practical instructional strategy for teaching critical thinking skills in the classroom. They pose a seven-step model for teaching critical thinking.

1. Look at the information (label or identify). Having students identify what they see (what the issues are) provided early clarification of the issues.
2. Seek similarities and differences (compare/interrelate/analogize). Socratic questioning by the teacher elicits parallels and contrasts.
3. Find overall themes or relationships (classify/integrate/pre-summarize). Socratic questioning is done by the teacher to achieve classification, and begin to summarize.
4. What do we do now? (decode/deduce). The teacher asks Socratic questions to help the students decode the class-specific information or requirements.
5. Answer correctly (encode). The teacher asks Socratic questions to have students logically defend or discard their tentative answers.
6. Apply to similar situations (infer/project/apply). The teacher asks the students to compare the course information or process to real life situations, perhaps in their professional work.
7. What have we learned? (summarize). This helps to sharpen the student's understanding of what was just learned.

Spencer and Angus (1998) mention that in the California State university system, the importance of higher-level literacy skills is being directly addressed by requiring students to take a class on critical thinking as part of their undergraduate education. They teach a class called Critical Reading as Critical Thinking. In this course, students focus on developing and applying reading skills in the interpretation, analysis, criticism and advocacy of ideas encountered in academic reading. Their work is largely fashioned after the critical thinking writings of Paul and his associates (Paul & Binker, 1991). Critical thinking is describes as having two components: a set of cognitive skills to process information and construct new ideas and beliefs; and a disposition towards using critical thinking skills to guide behavior.

Through the use of small and large group presentations of reading assignments, Spencer and Angus (1998) have their students model what they have learned through their reading assignments. Critical thinking is seen as essential to higher order reading skills.

CHAPTER IV
APPLIED CRITICAL THINKING

Developed over the past three years as an experience within the creation of a critical thinking "across the curriculum" model in Embry-Riddle Extended Campus classrooms in the Southwest Region, this Applied Critical Thinking model is based on course learning outcomes and syllabus demands. As the course learning outcomes are all partially based on Bloom's Taxonomy, there is a solid critical thinking base.

Each ERAU course outline has a set of learning outcomes, developed by a course monitor, normally a subject matter expert in this discipline or field. In addition, every individual instructor or professor who teaches this course establishes a schedule and specific way of achieving each course learning outcome. Students learn what each individual course learning outcome and schedule-specific learning situation is required, as the instructor uses the **knowledge, comprehension, application, analysis, synthesis and evaluation** language of Bloom's Taxonomy. As was discussed earlier in this paper, Bloom's Taxonomy can also be viewed as an educational critical thinking taxonomy.

There is a subtle, yet open movement from course learning outcomes and demands to that of the course discipline, then, finally, to real life situations, perhaps at work. This three-part critical thinking learning schema is intended primarily for those students who have not yet developed their own personal critical thinking schema, but it also appears to work well with more "critical thinking mature" students as well.

Course Demands/Critical Thinking Elements

As an example of this process, consider a graduate course in research methods and statistics, similar to a situation described in the previous chapter. After detailing the course syllabus and learning outcome demands, each one is explained in detail, as a part of a continuous sequence. If the choice of research topic changes during the nine week course, the graduate students fall back on their knowledge of the process, and are able to synthesize a new schema, patterned both after the process and the new research topic. Consider the following steps in the ERAU graduate research methods and statistics course:

- Select a research problem (topic)
- Review relevant literature and research
    - Develop key word descriptors
    - Choose reference location/repository
    - Collect XX abstracts
    - Collect hard copies of pertinent abstracts
    - Critically analyze references/research materials
- State a tentative hypothesis or research question
- Choose a research method
- Choose a research plan
- Select a population/sample

- Select/construct a data collection device
- Begin to write the proposal in Graduate Research Project /APA style
- Critique/revise data collection device
- Learn/practice descriptive statistics
- Learn/practice inferential statistics
- Select GRP Committee members
- Complete GRP Proposal
- Present research proposal (as a RFP response)
- Collect/analyze data
- Write final GRP report

As can be seen from the short, unexpanded list of course and syllabus demands and learning outcomes above, there are many course critical thinking elements to be solved. All are openly discussed in class as critical thinking elements of the course.

Transposing Course Demands Into Academic Discipline and Work Applications

As course learning outcome and syllabus requirements are satisfied, a transposition from the course to the discipline can be accomplished through Socratic questioning. In the case of research methodology, it can be postured that there will be countless opportunities for additional scientific research modeled after the steps on the previous pages, as questions arise at work concerning unknown situations requiring casual or rigorous analysis. It can also be postured that there will be times when the steps will have to be shortened, or modified, as time and circumstances might not permit the sterile timeframe of the nine week research methods course.

Finally, it can be suggested that the critical thinking steps and process used in this course can be used as a lifelong skill for problem solving. In the following chapter, the critical thinking skills required for information location and retrieval are discussed, both as a critical element of the research process described above, and as a personal skill set to be applied in any conceivable situation.

CHAPTER V
INFORMATION RETRIEVAL AND COMPUTER TECHNOLOGY

A study conducted at Alice Lloyd College in Kentucky (Murray & Graham, 1996) illustrates how instruction in critical thinking skills can be applied in any college course containing a research component. The authors integrated instruction in database searching and critical thinking skills into an undergraduate educational psychology course. Instruction included a one-hour session on effective use of the ERIC database, including use of the ERIC Thesaurus, critical analysis of citations and abstracts, advanced searching with Boolean operators, and limiting citations.

Students were also provided with two classroom sessions covering critical thinking concepts and systematic planning for decision-making. Students were asked to solve a research problem posed by the faculty member, and, in

order to succeed in solving the problem, they were required to use critical thinking processes, applications of systematic planning, and technological applications which were taught during the classroom sessions.

During the course of instruction, students were asked to define and investigate a problem, develop a rationale, construct search strategies, compile descriptors, search the ERIC database, and connect relationships of citations to the educational topic or problem they had identified. They also were required to review citations, summarize the data collected, draw conclusions, and make recommendations and propose potential solutions to the problem. Students worked collaboratively in searching the database, and they produced an annotated bibliography at the end of the course. The emphasis of the course, in both the database searching and problem-solving sessions, was the development of higher-level critical thinking processes (analysis, synthesis, and evaluation) delineated in Bloom's taxonomy.

Murray and Graham (1996) emphasize that instruction in the use of any database develops problem-solving and analytical skills as a knowledge base, which can be transferred to other learning situations – research assignments at the undergraduate or graduate level, workplace problems requiring solutions, and life in general.

Murray and Graham (1996) provide a table of Bloom's Taxonomy by Cognitive Categories Linked to Learning Descriptors and Activities (Figure 1) that supports the development of critical thinking skills at various levels by students participating in database searching and critical thinking research projects.

Figure 1.

The descriptors and learning activities provided by Murray and Graham can serve as a basis for teaching applied critical thinking skills across the curriculum.

Murray and Graham (1996) conducted both summative and formative evaluations of the critical thinking and database-searching project and made improvements throughout the course of the study. Several components of the evaluation process were noteworthy:

1. The majority of participants in the project (more than 80%) had very little previous computer or bibliographic searching experience.
2. More than 90% of the participants in the project rated the overall relevance and value of the classroom and library instruction sessions as good to excellent.
3. When asked to state their opinions on the value of search components as they related to problem solving, 98 percent of the participants in the project agreed that learning to define an instructional problem was of the highest value, but developing a rationale for an instructional topic was also very significant. Over 85 percent of the students also placed a high value on

constructing a search strategy and organizing descriptors into logical groups, connecting relationships of citations to the topic or problem, and examining the problem through analysis of the meaning and content of citations.

4. Participants identified the strengths of the project as relating to skills development through hands-on bibliographic searching activity and opportunities to work through a problem solving process. They recognized that these skills and learning experiences in developing systematic thinking processes and identifying and analyzing information resources could be transferred to other courses, as well as to experiences beyond the classroom.

5. Students also recognized the value of computer literacy skills in general and their applicability to a number of different fields beyond education. They concluded that conducting an online search was not really difficult at all when approached as a systematic, logical process. Instruction in Bloom's cognitive hierarchy and hands-on activity related to critical thinking processes allowed students to draw correlations between searching activity and problem solving supported by technology.

Although the study by Murray and Graham (1996) serves as an example of current practices involving faculty and librarian collaboration, it is certainly not the only instance of such activity. Bibliographic instruction has been integrated into classroom instruction since the 1970s.

Walter et al. (2000) cite several examples of faculty and librarians working together to create course-integrated instruction in database searching and critical thinking skills. Exemplary programs at Earlham College, Indiana University-Purdue University at Indianapolis, Evergreen State College, the University of Washington, and the Virginia Polytechnic Institute and State University serve as benchmarks for other institutions attempting to develop a collaborative teaching model of faculty and librarians working together to create instructional objectives appropriate to the information age.

Gallegos and Wright (2000) provide further examples of case studies in collaboration, and Ward and Cook (2000) have created a directory of electronic resources (web sites) detailing instances of librarians and faculty working together to overcome the problem of information overload through the development of new instructional paradigms that include critical thinking and information retrieval skills.

In response to these kinds of initiatives and the criteria mandated by the Southern Association of Colleges and Schools (SACS), the Embry-Riddle Extended Campus should certainly consider establishing a curriculum-based program in information literacy and critical thinking skills utilizing the instructional skills and experience of its faculty and reference librarians. According to the Center for Critical Thinking at Sonoma State University, the components of a good program should include teaching content as a mode of thinking, involvement of students in an active learning process,

and reasonable access to information and established criteria against which they can assess their thinking and its potential.

Such a program should also focus on well-formulated questions or problems and should address real-life problems through engagement in technological applications. A program meeting these criteria would, by definition, involve students in higher-level cognitive processes.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

It is apparent that Bloom's Taxonomy fits the educational triad of Sternberg's (1986) critical thinking triad, and can be considered as an appropriate educational critical thinking tool. Apparent, also, is the need for applications in critical thinking across the curriculum, instead of in special classrooms where only critical thinking is discussed. There would be a special advantage to having all faculty trained to teach critical thinking skills to their students.

There appear to be many ways to teach critical thinking in classrooms, but not all would work in ERAU Extended Campus classrooms over a nine week course meeting eight or nine times. Applied Critical Thinking, or another critical thinking teaching/learning schema needs to be developed more fully, and offered across the width and breadth of ERAU's Extended Campus.

Critical thinking applications relating to information location, retrieval and analysis appear to be as important as those involving only the course syllabus demands and learning outcomes. As specified in accrediting agency "must" statements, information location and retrieval by faculty and students in a variety of media and applications is a critical element of adult literacy in the 21st century.

Recommendations

It is recommended that the ERAU Extended campus adopt "critical thinking across the curriculum" as a course outline learning outcome in every Extended Campus undergraduate and graduate course. It is also recommended that information location and retrieval skills, preferably from the ERAU Hunt Library, also be required as a course outline learning outcome in every Extended Campus undergraduate and graduate course.

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Crossing Another Chasm

Entering the Electronically-Delivered Class Setting Involves Change for Both Student And Teacher

Dr. Melvin Anderson

Abstract

The author of this paper addresses his recent experiences as he "crosses the chasm" from the traditional live classroom environment into the production and delivery of distance learning courses in the electronically-delivered class setting. Beginning with first reactions (and cautious resistance) to the emergence of "cyberschools" and college courses delivered via video tape and internet, he investigates his five-year path to acknowledgement, acceptance and appreciation for the distance learning environment as a viable delivery medium for business management courses and the realization that both student and teacher face adjustments in this journey.

At a later point in the process of self-development, the author is offered the opportunity to create and deliver two graduate management courses using video tapes, internet, specially-designed course materials and written examinations to be taught not only by himself, but by a number of other qualified teachers via an interactive internet link to hundreds of students worldwide. This paper is based on these experiences.

The transition from traditional classroom teacher to on-screen professor proves to be much more than gaining an appreciation for the value of distance learning in the modern academic environment. Despite ample experience in the business world and in teaching courses in the modern high-tech classroom, creating distance learning versions of "standard" management courses presents previously unimagined challenges in both course design and delivery.

Reflecting on his immersion into the distance learning environment, the author suggests that each professor must indeed "cross a chasm" in both method and willingness to do the same things in different ways. Each teacher must first discover the real "chasm" that separates hem from the new distance learning environment, and then replace the illusion of what s/he considers to be the "modern electronic classroom" with an enlightened view of what that "modern electronic classroom" really is.

The paper concludes that students entering the electronically-delivered class setting also cross a chasm of uncertainty, and that their success in doing so also depends on the organization and relationships that facilitate it and prepare teachers to use it.

Crossing Another Chasm

Entering the Electronically-Delivered Class Setting Involves Change for Both Student And Teacher

Melvin J Anderson, Ph.D.

Foreword

Not too many years ago, the traditional live classroom learning environment focused mostly on a chalkboard or whiteboard. Most teachers lectured from prepared notes and perhaps overhead slides. In recent years, however, new high-tech teaching tools emerged that include TVs and videotapes, computers, LCD projectors and the ability to access the internet actively during lecture sessions. With interactive computer simulation software, teachers discovered that they could immerse students in exercises and programs that emulate the real world in a way that no textbook or one-way videotape can.

Enhanced by a resurgence of Socratic teaching methods, the traditional classroom has become a place of inquiry where students can learn not only the right answers, but more importantly, how to ask the right questions. The classroom is still a classroom and teachers are still teachers, but these methods and the new teaching tools combine to provide tremendous new opportunities for enhancing learning outcomes. It's an exciting time for academe, and today's classroom learning environment is an exciting place to work.

However, another and very different learning environment is gaining in popularity as we progress into the 21st Century. Whether it's called Distance Learning, Online Learning, Web Learning or one of the not-so-complimentary names like "Cyberschool," it means, among other things, that teachers are faced with meeting a new challenge. And this new challenge is much more than learning how to use new tools in the classroom. This challenge involves crossing a *chasm* that seems wider and deeper than anything most educators have ever experienced, but it is not unlike the chasm that businesses encounter when new technology products and services emerge.

In 1991, Geoffrey Moore wrote a book entitled *Crossing the Chasm: Marketing and Selling Technology Products to Mainstream Customers.* This thought-provoking work begins by describing new efforts to keep the means of production—our products and services—in touch with evolving social and personal conditions. Marketing expert and author Regis McKenna writes in the Foreword of this book:

> In an era when the pace of change was slower, the variety of products and services fewer, the channels of communication and distribution less pervasive, and the consumer less sophisticated, marketing could enjoy prolonged periods of relative stability, reaping profits from "holding the customer constant" and optimizing the other variables. That is no longer the case.

McKenna explains that in the present age of greater choice, we are continually bombarded with new alternatives in every aspect of our lives; people demand more and more, which leads to increasingly fragmented markets for services and products that are truly customized to meet each customer's needs. We may celebrate change and growth, but that does not make either one less demanding or painful:

> Our emerging and evolving markets are demanding continual adaptation and renewal, not only in times of difficulty but on the heels of our greatest successes as well . . . It is only natural to cling to the past when the past represents so much of what we have strived to achieve.

Crossing the Chasm addresses the gulf between two distinct environments for the acceptance of technology products. While producers of new technology products generally have great initial success in increasing their acceptance among a few early adopters, it requires immense effort and radical transformation to make them popular in the mainstream market. Both customer and vendor are challenged in their ability to absorb and make use of new things.

Americans don't get comfortable with innovative things very quickly, especially if there are conflicting opinions about it. Old things, despite their hazards, are fine. Natural gas kills 200 people a year, but we accept it because it's old. We accept coal but we're terrified of nuclear power. We let 16-year-olds drive cars weighing two tons, but the automobile would probably never make it off the drawing board in 2001. IBM used to refer to the challenge of complex decisions as the "FUD factor"—the fear, uncertainty and doubt that plague decision makers when confronted with unfamiliar products and services.

McKenna and *Chasm* author Moore both believe that what is perceived as a chasm is in reality a state of mind based on uncertainty and doubt. *Crossing the Chasm* confronts the uncertainty of a large segment of the high-tech market about adopting new high-tech products and services, and proposes that overcoming this uncertainty involves creating organizational relationships to buffer the shock of change.

Another Chasm?

In the academic environment, a similar chasm and a similar FUD factor exists. We are being confronted by new teaching technologies, usually without the inspiration for change promised in business by new market successes, greater profits and the attendant job enhancement factors.

Academicians have long enjoyed the comfort provided by tenure, status, rank and the assurance that our tried-and-true knowledge would enable us to keep doing what we've been doing in order to keep getting what we've been getting. The reality of today is that we are confronted with not only the gradual appearance of new technologies in the traditional classroom learning environment, but the sudden and perhaps terrifying prospect that we will soon be

plying our trade in the netherworld of the television studio and internet.

Distance learning is here to stay. It is already a major segment of higher education. For those of us with long experience in the traditional classroom with or without the new teaching tools, there is yet another chasm to discover and cross—in that order.

Discovering the Chasm

A relatively small number of today's educators are thinking, "If Dan Rather (with his new hair style) can talk to TV cameras, then I can talk to TV cameras." In every profession and every market, there are a few innovators and early adopters who are at the cutting edge of new technologies, methods and theories.

In the business world in any era, a few visionary companies and individuals possess the courage and foresight to look into the future and dream of things that do not yet exist or are not yet popular. These visionaries not only reap enormous financial benefits from their efforts; they also produce dramatic change in their industries and in the world around them--eventually. A few, sensing the true value of innovation, really do "get rich quick."

Fears and Fads

Higher education is not known for its tendency to spring forward with every new teaching method and learning theory. Along with the comfort of the status quo there is also the fear that innovative methods will fail to attract the needed new enrollments, not to mention fall under the scrutiny of accrediting organizations and mainstream public opinion.

Like new management theories, new teaching methods tend at first to be labeled as "fads" and either trampled by the fearful or simply ignored in hopes they will fade away. As a result, a healthy caution concerning genuine fads is often transmuted into unreasoned fear that change, especially radical change, will jeopardize the known, comfortable, working-well methods that should change only through evolution. Before change occurs in academe, a number of layers of resistance must first be peeled away.

Peeling away layers of resistance to change is not simply a matter of exercising authority or emotional appeal. Learned, professional people must first be convinced about making any change, based on a number of legitimate concerns.

(1) Is there a need to change? "What's wrong with the way I'm doing it now?"

(2) Is this the right change? "What if it does more harm than good?"

(3) Can we overcome all the obstacles to such change? "Good idea, but what if we can't make it work?"

(4) Can we get the others to do it? "If I do it, I don't want to be the only one."

A Personal Chasm

These are all legitimate responses to change based on perceived individual concerns about career, professional status and personal financial future. No intelligent educator is likely to slide comfortably into a new learning environment without first having confronted these personal concerns. The chasm that each of us perceives about entering into the new distance learning environment is a personal chasm.

Only when a person discovers what is on the other side of a chasm will s/he be willing to cross it. Alas, for too many of life's challenges, there is no way to really know what is there without "being there and doing that." The chasm that separates those who have ventured into the distance learning environment from those who haven't is purely a lack of knowing what it's like "over there"--a lack of visibility about what lies on the other side.

Distance learning, for most present-day classroom teachers, is a set of unknowns and mistaken impressions—illusions—about how this new learning environment works and what one does to make it work. This illusory chasm, as we would describe it, is in reality a lack of knowledge, not some ominous rift that one must cross and from which one cannot come back. There is a bridge that can provide an enlightened view of what this new environment really is.

The majority of today's educators want improvement in our academic world, but we want evolution, not revolution. Most of us would prefer that this new learning environment enhance, not overthrow, traditional classroom teaching. Also, most of us don't want to have to debug what someone else has devised; we want it to work properly and to integrate appropriately with existing methods. This contrast just scratches the surface relative to the differences and incompatibilities between the early adopters and the majority. And because of the majority's concern for not disrupting their organizations, good references are important before they actually move ahead.

So what we have here is a catch-22. The only suitable reference for the majority, it turns out, is another member of the majority. But few upstanding members of the majority will recommend moving into the distance learning environment without first having consulted with a suitable reference—someone who's doing it, likes it, and can describe some of how it works. No matter that a university is moving into this new environment with effective, balanced courses; overcoming personal uncertainty depends mostly on relationships between those who are informed and those who aren't.

Relationships: the Bridge Across

Illusions replaced by other illusions are no closer to enlightenment. Crossing an illusory chasm requires a real—not illusory—bridge of understanding. But when a new concept or technique is presented, there is often a lack of information about it. There is little to overcome the imagined sight of "bodies in the chasm"—academics who've tried to cross and fallen into its depths. This

is evident with most distance learning transitions today; those who've tried it are as yet few and unskilled in training and motivating others about it. There is no bandwagon—yet.

For most of us, crossing the chasm depends on how we relate to those who have already been across. And that is complicated somewhat by the fact the each of the early adopters has a unique experience in his first attempt at distance learning. Each, in developing distance learning courses, prepares outlines, syllabi and study guides, creates visual aids and in most cases, delivers lectures to video cameras. And after all that, each of us will be invited to deliver these courses on the Worldwide Web using specialized software and conducting near-real-time dialog with students.

These last two events—video taping lectures and online teaching—separate all of us from what lies on the other side of the chasm, and from each other as well. One may think s/he knows what the studio experience and online teaching tasks will be, but for anyone who is about to do them for the first time, there is little to provide a true understanding of what these tasks are like. These, or rather the illusions about them, are what really constitute the chasm.

Crossing the Chasm

Individuals, Groups and Organizations

Each individual teacher confronted by the distance learning chasm is also part of an undefined "group" that is for the most part only a group, not an organization. Each is simply a member of the majority—a group of individuals—who could shed little light on what lay just across the perceived chasm. Several speak highly of the merits of distance learning because they know it is an innovation whose time has almost come. Each probably believes that after others get the hang of it, there will be some more information and encouragement from the group that will provide a view of what's across the chasm. Unfortunately, waiting for others when others are waiting for you is not likely to create much motion. That is the nature of informal groups; position is more important than motion.

What must happen next is beyond individual and group. It needs someone to actually explain what a distance learning course entails--someone who is part of a formal organization committed to developing distance learning programs and capable of leading the newcomers to both motivation and understanding.

The magic word here is "organization." What uninformed individuals can never supply for themselves, and what an uninformed group can only confound further, a capable organization—a team—can present as a clear and believable account of what a traditional classroom teacher would do in creating and delivering a distance learning course.

With this clarity, the chasm moves closer to being nothing more than a scheduling problem, complicated perhaps by having to address a TV camera and learn how to use online learning software. Again, with the direction of a knowledgeable team, these steps are procedural and learnable. Anyone competent in the new high-tech classroom lecturing with the aid of PowerPoint presentations will find doing the same thing in a TV studio is not really much different.

Distance learning online software is not difficult to master by either teacher or student. We must remember that it has to be simple enough for all students to use, driven by menus and prompts that aren't confusing to students who are perhaps less computer-literate than the average teacher. The programs can do a lot of the teacher's work; they track student activities, exams, log-ins and online discussions without confusing anyone. And yet they should be flexible enough that the teacher can customize his own site or just use the basic pages; it works well either way.

Getting Beyond the Chasm

Distance learning is all about relationships. The teachers don't change and the course content doesn't change. Most of the course materials don't change. The relationship between teacher and student is different, but no less academic and certainly not a compromise in student learning or teacher involvement.

The distance learning chasm motivated by uncertainty yields to clarity and eventually no longer exists. With a professional organization team leading and assisting, any teacher who can design and deliver a classroom college course can also design and deliver a distance learning course.

The pre-chasm teacher is motivated by noble academic and personal goals. To truly leave the chasm behind, a teacher must recognize that s/he has added new confidence and skills, but has not become a different person. All the skills and talents a teacher possesses in the classroom are enhanced by having crossed the chasm and entered the distance learning environment.

The post-chasm teacher recognizes that the chasm separates not only those who've crossed it from those who haven't. It also separates the colleges who have done it and done it well from those that haven't. To leave the chasm behind and not fall back into it is to move from being a "pioneer" to being a "settler." But settlers require leadership and organization, lest they operate in vacuums or gravitate into uncooperative groups.

The student who's completed even one distance learning course has probably overcome any uncertainty about how it works and how it expands learning opportunities. But the remaining challenge for academe is to ensure that students' learning goals are truly achieved. If the goal of higher education is preparing people for life, then the purpose of any learning environment is to serve that goal. As we build a balanced approach in the new learning environments, we must always consider

how students, even more than teachers, adapt to it, use it and learn in it. And to do that, we must begin by making sure teachers understand it clearly and use it effectively.

The answer to the chasm is, as claimed, organization—an organization empowered and capable of leading its members across the chasm and past the illusions caused by uncertainty, misconceptions and fear about the distance learning environment we will all be invited to enter.

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