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Synthesis of Research on Critical Thinking

Students need more than the ability to be better observers; they must know how to apply everything they already know and feel, to evaluate their own thinking, and, especially, to change their behavior as a result of thinking critically.

The field of critical thinking is more vibrant than ever. There is much research in progress on the meaning of critical thinking, on the transferability of critical thinking skills to a wide range of subject areas, and on methods of teaching critical thinking. A substantial body of knowledge exists in the area, and it is possible to suggest with confidence some research results to help teachers. In offering these suggestions I interpret research broadly to include not only empirical research, but also philosophical and policy research.

Critical Thinking Is a Complex of Many Considerations.

Thinking critically can be defined as rationally deciding what to do or believe (Blair, 1983; Ennis, 1981; Hitchcock, 1983). To be rational about such decisions requires more than avoiding some standard list of errors in thinking. Being a critical thinker of course implies assessing the views of others and one's own views according to acceptable standards of appraisal. But it implies more than this. One must also be *productive*, in the sense of conceiving of alternative courses of action and candidates for belief, before critically appraising which alternative to choose. People must be able to produce reliable observations, make sound inferences, and offer reasonable hypotheses. Finally, one must have the *disposition* to think productively and critically about issues, or else no amount of skill in doing so will be helpful.

Critical Thinking Is an Educational Ideal.

For many people in education it might seem like a needless question to ask why critical thinking is desirable. It is like asking why education is desirable. It can be argued that both are worthwhile *in themselves*. However, just mouthing or blindly concurring with an educational goal provides fragile support for it. There needs to be a justification for the teaching of critical thinking based on grounds that would be considered sound no matter what the current trends.

Recent work by philosophers of education begins to provide this needed justification (McPeck, 1981; Siegel, 1980, 1984). According to their view, critical thinking is not just another educational *option*. Rather it is an indispensable part of education, because being able to think critically is a necessary condition for being educated, and because teaching with the spirit of critical thinking is the only way to satisfy the moral injunction of respect for individuals, which must apply to students as well as to anyone else. According to this reasoning, students have a *moral right* to teaching that embodies the spirit of critical thinking and a *moral right* to be taught how to think critically. Thus, to abide by the moral principle of respect for persons, teachers must recognize "the student's right to question, to challenge, and to demand reasons and justifications for what is being taught" (Siegel, 1980, p. 14). In addition, there is a responsibility to teach them to do these things well, because in the end students must choose for themselves; there is no escaping this truth.

Critical Thinking Ability Is Not Widespread.

Many claims that critical thinking is not widespread are based on anecdotal evidence. However, more systematic research also suggests that most high school and college students do not perform extremely well on the kinds of tasks that are used to indicate critical thinking competence, and there is evidence to suggest that adults fare no better. In addition, there is considerable evidence on the consequences of people failing to subject their behavior to the standards of critical thought.

Evidence from performance on critical thinking tests. The most widely known general critical thinking tests are the Cornell Critical Thinking Tests, Levels X and Z (Ennis and Millman, 1985) and the Watson-Glaser Critical Thinking Appraisal, Forms A and B (Watson and Glaser, 1980). For the Cornell Tests, critical thinking is defined as "the process of reasonably deciding what to believe" (Ennis, Millman, and Tomko, 1985), with this rea-

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sonable decision making to be carried out in accord with certain principles of thinking (Ennis, 1980). Test items are intended to indicate whether examinees have a knowledge of these principles and their application. The highest reported median score on Level X is 48 out of a possible score of 71, obtained by 10th grade history students, and the lowest is 29, obtained by above average IQ 8th grade students. On Level Z, median scores reported for undergraduate university students are 30 out of a possible 52. These test results suggest that the level of critical thinking is not extremely high at any level of schooling, a disturbing result if it can be confirmed.

The Watson-Glaser Tests are designed to measure such things as ability to recognize assumptions, to evaluate arguments, and to appraise inferences. Results for high school students indicate median scores of between 41 and 47 out of a possible 80, with an increase in scores occurring with grade level. Median scores for college students range from 52 to 60. The students who do the best on the tests are enrolled in MBA and medical programs, with median scores of 66 and 68 respectively.

If we note that the problems posed on these tests are the sorts of problems we would like everyone to be able to solve well, then the results demand some attention from educators. By and large, median scores are low, indicating that at least half the student population cannot consistently think critically about the problems on the tests. This conclusion is in concert with recent findings in my research using a test of a single aspect of critical thinking—the ability to appraise observations. High school students' scores on the test averaged 49 percent, and ranged from less than 2 percent to 74 percent, with 90 percent of students scoring less than 65 percent (Norris and King, 1984). The test has about a 6th grade reading level, seemed to capture students' interest and diligence, and was well understood by most, leaving poor critical thinking ability as a very plausible explanation of low scores.

Evidence from psychological research. Psychological research on thinking does not usually deal directly with critical thinking. Some studies focus on errors of adults' thinking; others examine the thinking of experts in particular fields to discover how they approach problems differently from novices; while others examine how quality of thinking bears on social relations such as obedience to others and authority over others. Each of these sorts of research is relevant to education. It is helpful to know the errors in reasoning that persist into adulthood so that preventive measures might be taken in schools. It is also useful to know how experts think, since this can provide guidance for instruction in good thinking. Finally, it is crucial to know how critical thinking, or lack of it, affects our social relations.

One of the most extensive reports of studies conducted on the quality of adult thinking focused on aspects of the inferential ability of adults and indicated that there are systematic tendencies to err on some of the simplest judgments of everyday affairs (Nisbett and Ross, 1980). One such situation involves the determination of whether or not two things are associated. Consider the diagram in Figure 1. The numbers indicate the number of cases in which a disease was present or absent. Thus, the present/present cell indicates that in 20 cases the symptom and the disease were present together; the cell to its right indicates that on 10 occasions the disease was absent when the symptom was present, and so on. A common error, among many others, is to conclude that the symptom and the disease are related because more people who have the symptom have the disease than who have the symptom and do not have the disease. This thinking is erroneous. The main problem is failure to recognize that *all* the information must be considered together to arrive at a legitimate conclusion.

Similar errors are made by people who conclude that running is bad for you because people have died of heart failure while running, that smoking does not cause cancer because they know many people who smoke who have not contracted cancer, and that rural people are more hospitable than city people because the rural people they have met are hospitable. One aim of critical thinking instruction is to improve thinking about matters such as these.

A famous piece of research on the effects of quality of reasoning on social relations was conducted by Stanley Milgram at Yale University more than two decades ago (Milgram, 1963). The experiment studied the degree to which people will allow their commitment to obey someone in authority to override other competing moral principles. Contrary to all predictions, obedience to authority led to frightening and telling results.

The subjects were studied separately. Each was ordered to administer electric shocks to a learner whenever the learner failed to perform correctly. The subject administered the shocks by pushing a series of switches on an elaborately designed panel. The switches were clearly labeled with voltage readings ranging from 15 to 450 volts and with descriptions: slight shock, moderate shock, strong shock, very strong shock, intense shock, extreme intense shock, danger: severe shock, and just the letters XXX on the last two switches. The subject was told to push the next higher switch each time the learner failed to respond correctly. The learner was in a separate room visible to the subject through a window, and communicated answers to the subject by pushing buttons.

The learner was an actor and a confederate of the experimenter, and no real shocks were administered. The learner responded to the various "shocks" in standard ways. When the subject administered the 300-volt shock, the learner (who was bound to his chair) pounded on the wall of the room so that the subject could hear. From this point on the learner gave no more responses to the subject's questions. The experimenter asked the subject to continue and to treat no response as an incorrect one. If the subject hesitated, the experimenter

Figure 1. Association Between Symptom and Disease.

	Disease A	
	Present	Absent
Symptom X Present	20	10
Symptom X Absent	80	40

gave an order to continue. Despite "profuse sweating, trembling, and stuttering" only 14 of the 40 subjects defied the experimenter's order and refused to continue the experiment to the end. The remaining 26 subjects continued until the maximum shock of 450 volts was administered.

What do the results mean? The subjects, all adults, knew from childhood that it is wrong to hurt other persons against their wills. Yet, the majority of the subjects violated this principle on the command of someone who had no way to enforce his commands, and no way to punish those who disobeyed. From their expressions and words, many subjects clearly knew that they were acting immorally, yet they continued with the experiment. The results point to a breakdown between critical thought and action, a link that instruction in critical thinking is intended to forge.

Critical Thinking Is Extremely Sensitive to Context.

This is true for two reasons. First, the inferences and appraisals of inferences that a person can justify making depend on the background assumptions, level of sophistication, and concept of the task. Inferences that do not agree with those sanctioned by a test or with those a teacher might make do not necessarily indicate a critical thinking deficiency. There are other possible sources of the disagreement. Therefore, assessment of critical thinking competence *must* take into account the context in which the thinking is done.

This is never more apparent than in attempting to assess people's ability to make and appraise inferences. Ennis (1984) cites an example from the Watson-Glaser Test that requires the examinee to make certain political assumptions in order to choose the correct answer. Making one set of assumptions leads the examinee to choose the keyed answer, while making another set would mean selection of a response that would be marked incorrect. In Ennis' view, it is unfair for political beliefs to influence scores on a critical thinking test because such beliefs are "value judgments about which there is possible [reasonable] disagreement and which are not constitutive of critical thinking." So, in interpreting scores on the test, it is important to understand students' background assumptions because they help determine the context in which students reason and justify the conclusions students reach.

Second, critical thinking is sensitive to context because context can dramatically affect the quality of one's performance. This is a highly confirmed result in the area of deductive logical reasoning (Evans, 1982). Deductive logical reasoning is based on the form of the reasoning rather than on its content. Simply put, the question of whether or not a conclusion follows from some reasons is answered in deductive logic by examining the *structure* of the reasoning. If the structure is of a deductively valid form, then the conclusion follows. This decision about structure is made independently of the content of the reasons and the conclusion. Despite this, people reason better deductively when dealing with thematic contexts, with contexts that relate to their personal experience, and when they do not have presumptions about the truth of the conclusion. In addition, deductive reasoning performance is lowered in contexts involving threats and promises. There is reason to think that context will also affect critical thinking performance (McPeck, 1981; Norris, 1985).

Assessments of Critical Thinking Should Seek Explicit Indications of People's Reasons for Their Conclusions.

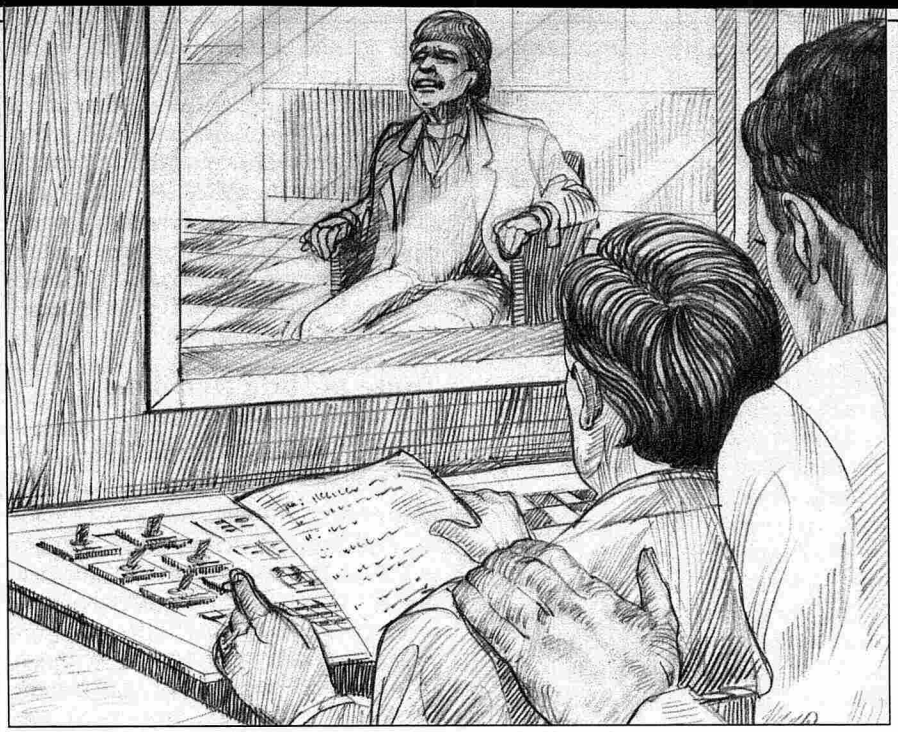
Explicit indications of people's reasoning are required in order to differentiate between deficiencies in thinking and differences in background beliefs and assumptions between the examiner and the examinee. Most critical thinking tests do not provide information about what the examinee is thinking. That is, they provide only the conclusions to thinking processes, not the processes themselves. This is particularly troublesome when test scores have direct implications for individuals, but can be alleviated in part by seeking reasons for answers on such standardized objective tests. Another technique is to use essay instead of objective tests. Essay tests are harder to grade, but they do lead to a more profound insight into the thinking processes the examinee used in arriving at solutions. The Ennis-Weir Critical Thinking Essay Test (Ennis and Weir, 1985) is one to consider in this regard.

In our research (Norris and King, 1984) we have addressed this problem by using protocols of students' thinking in the design of a critical thinking test on appraising observations (Norris and King, 1983). Test questions are put in the context of stories. One of the stories describes a traffic accident at an intersection, and people who were either involved in the accident or who were bystanders report on what they observed. Examinees are to judge the believability of the reports. Such factors as the observers' conflict of interest, their expertise, and their emotional condition are relevant factors in making the evaluations. We asked a sample of high school students to think aloud as they worked through the questions. The protocols assisted in adjusting the test until good and poor thinking were associated, by and large, with keyed and unkeyed answers. The following example illustrates one such adjustment.

The introduction to an earlier version of the test provided a list of the names of all the characters and what they were doing at the time of the accident. Since there were several characters in the story with different roles, we thought that providing the names in a single list would help students keep them straight. However, this raised unexpected problems. For the first six items many students referred to the introduction for evidence to support their choice of answers. While this is a legitimate thinking strategy, it contributed to uncontrolled influences on students' responses and thence to unjustified interpretations of the quality of their thinking.

For example, in item 1 two people who were in a car when the accident occurred, but who were not involved in the accident, reported on the number of cars at the intersection. Martine, the driver, reported that there were three cars. Pierre, a passenger, was reading a map and trying to decide which way to go. He said there were five cars at the intersection. The keyed answer is that Martine's statement is more believable. Good critical thinking would lead to this response because Martine, who was driving, would tend to be more alert to the number of cars than would Pierre.

However, several students chose the correct answer by referring to the introduction and counting the number of cars mentioned there. The introduction did not say how many cars were at the intersection, but does mention



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three cars that were involved in the accident. Thus, a student who was not thinking critically would assume that the number of cars at the intersection equalled the number of cars in the accident, whereas the critical thinker would realize the fallacy of this reasoning. Thus, the noncritical thinker would be rewarded with getting the item correct through an unsound thinking process. Having obtained records of the students' thinking, we were able to more accurately interpret their choice of answer and to make suitable modifications to the test. Without explicit indications of examinees' reasons for their conclusions, the test would not likely have been modified in this way, and thus would have continued to yield inaccurate indications of level of critical thinking.

Readily Identifiable Errors in Thinking May Be Indicative of Thinking Errors at a Deeper Level.

Errors in thinking are often described in terms of fallacies committed or principles of good thinking violated. However, addressing these deficiencies directly, and even correcting them, may not be a complete solution to the problem of poor thinking. In addition to what are often called *cognitive* or *nonexecutive* thinking skills, sound thinking also requires the use of *metacognitive* or *executive* skills. Cognitive skills are those directly used in carrying out some task and are the ones on which instruction typically concentrates. Recent studies have shown that in addition to these cognitive skills, good thinking involves the use of such metacognitive skills as planning, monitoring, and revising the progress of the cognitive skills. In the area of reading comprehension, for example, Brown (1978) has found that the sound use of metacognitive skills marks an important difference between better and worse readers.

Some of the more important information on this topic derives from research on the thinking of experts in particular areas compared to novices. The assumption is that experts should be critical thinkers (at least in their own fields) and that studying how they think ought to provide insights into how we can make novices into critical thinkers. Two features become immediately apparent when experts are studied closely: they possess far more information than novices and have automated many of the sequences in a problem solution; they are thus capable of arriving at a correct solution in far less time than the novices. Support for this belief lies in the research on expert and novice performance in solving physics problems (Larkin and others, 1980).

The possession of more information and more automated problem-solving techniques is, however, only part of what distinguishes the expert from the novice. Another difference involves the heuristics (problem-solving methods) employed by both groups. Typically, novices solve problems by working backward from the unknown solution to the facts that are given in the statement of the problem. Working backward in this way is usually thought to be a sophisticated strategy. Experts are more discriminating in their approach. When problems seem amenable to relatively straightforward solution, experts work forward from the given facts without any particular planning, except to generate as much information about the problem situation as is possible with the facts provided. Their thinking is that the solution will turn up among this information. Working-backward strategies are employed by experts only for more difficult problems.

In addition to this initial decision regarding the direction in which to work, expert physicists spend time at the beginning of a problem deciding on the appropriateness of other features of their approach. For example, they decide whether a qualitative or a quantitative approach is better, whether or not to employ a pictorial representation of the situation, and which physical principles seem most relevant to the problem. In short, the expert physicist approaches a problem by first making decisions about the overall strategy to be used before getting down to the actual process of solving the problem. The novice, on the other hand, gets immediately to work at the problem-solving process. The time the expert spends in initial planning pays off in the end.

Our current research supports the finding that the initial stage of problem solution is most crucial. The better thinkers on our observation test concentrate initially on identifying the correct problem they are to solve. Poorer thinkers usually fail to identify the correct problem, may simply repeat details of the item as their response to the problem, and often become embroiled in irrelevant details of the story line, which lead them on tangents away from the real problem they are to solve. Typically, they do all of this without any apparent recognition of the fact that they are going astray.

The Critical Spirit Is as Important as Skill in Critical Thinking.

No matter what level of critical thinking skill a person possesses, it is of no practical benefit unless the person is disposed to use these skills when they are appropriate (Sternberg, 1983); that is, unless the person has the critical spirit. This spirit has three requirements. The first is to employ critical thinking skills in reasoning about situations encountered in the world. The second requirement is that critical thinking be *turned upon itself*, that is, to think critically about one's own thinking (Paul, 1982). Without this, critical thinking becomes mere criticism instead of an honest and open search for truth. To avoid this result, teachers must explain the value of the critical spirit and display it in their dealings with students. Finally, there must be a disposition to *act* in accord with the dictates of critical thought. Having the correct belief or knowing the right thing to do is not sufficient, as the Milgram experiment startlingly illustrated.

Critical Thinking Skills Are No Substitute for Experience, Common Sense, and Sound Knowledge of Subject Matter.

A set of critical thinking skills, however well developed, cannot compensate for lack of knowledge in the area in question. The application of critical thinking principles involves a competence over and above knowledge of the principles themselves (Ennis, 1980; Norris, 1984). Successful application requires, among other things, a knowledge of the subject matter, experience in the area in question, and good judgment. This realization can lead to the conclusion that critical thinking is best taught within the traditional subject areas rather than as a separate subject (McPeck, 1981), but nobody really knows which approach is better (Norris, 1985). There is good reason to believe, however, that principles of critical thinking taught without *any* view to their application to real world problems will not be beneficial.

There Is Little Detailed Knowledge About the Effectiveness of Teaching Critical Thinking.

Research on the effectiveness of critical thinking instruction almost invariably uses indicators of effectiveness that are insensitive to fine details. The research typically concludes that instruction is effective (Annis and Annis, 1979; Frank, 1969; Moll and Allen, 1982; Ross and Semb, 1981; Wolf and others, 1968; Wright, 1977; Yeazell, 1981). In these studies, and ones like them, classes of students experience a treatment designed to improve some aspect of their thinking ability. The treatments usually consist of a unit of work extending over a few weeks or as long as a year, and are based on the intuitions of the researchers about what ought to be effective instruction in thinking. The criterion for determining whether or not the treatment has a positive effect is often one of the general critical thinking tests mentioned earlier, or a test designed specifically for the study.

Many of the studies do not use control groups, so special care must be taken when interpreting their results. Regardless of any specific limitations on the research design, however, two issues emerge. There is little, if any, evidence on the long-term impact of instruction in critical thinking, despite the fact that the vision of such impact is central to the justification of critical thinking instruction. In addition, while the conclusion of the studies is usually that instruction leads to better critical thinkers, we do not learn what *specifically* makes these students better thinkers and in what *specific* ways they can still improve. Are they better thinkers because they have acquired a greater knowledge of principles of thinking, such as those proposed by Ennis, or because they tend to monitor more skillfully the progress of their own thinking, or because they have more completely

Highlights from Research on Critical Thinking

- **Critical thinking is a complex of many considerations.** It requires individuals to assess their own and others' views, to seek alternatives, make inferences, and to have the disposition to think critically.
- **Critical thinking is an educational ideal.** It is not an educational option. Students have a moral right to be taught how to think critically.
- **Critical thinking ability is not widespread.** Most students do not score well on tests that measure ability to recognize assumptions, evaluate arguments, and appraise inferences. Adults, as well, frequently make simple judgmental errors on simple problems.
- **Critical thinking is sensitive to context.** Students' background knowledge and assumptions can strongly affect their ability to make correct inferences. Inferences are more likely to be correct when the context relates to the individual's personal experience and when performance is not associated with threats or promises.
- **Teachers should look for the reasoning behind students' conclusions.** Coming up with a correct answer may not be the result of critical thinking. Essay tests are more likely to reveal the student's thought processes than are objective tests. And the tests themselves must be evaluated critically to make sure they require critical thinking skills.
- **Simple errors may signal errors in thinking at a deeper level.** In trying to solve complex problems, for example, students may err not just by making a miscalculation, but by using an incorrerct approach to the problem. They should be encouraged to take time before solving a problem to decide how to go about finding the solution.
- **Having a critical spirit is as important as thinking critically.** The critical spirit requires one to think critically about all aspects of life, to think critically about one's own thinking, and to act on the basis of what one has considered when using critical thinking skills.
- **To think critically, one must have knowledge.** Critical thinking cannot occur in a vacuum; it requires individuals to apply what they know about the subject matter as well as their common sense and experience.
- **We do not know a great deal about the effects of teaching critical thinking.** Critical thinking programs may teach students to be better thinkers, but more detailed knowledge is required before we will know specifically how students improve and how they remain deficient.

adopted Siegel's critical spirit? The problem is similar to one encountered with some studies of the power of certain science curriculums to teach scientific thinking processes. While many of these studies conclude that the programs are effective in, for instance, teaching students to be better observers (Ayres, 1969; Somers and Lagdamen, 1975; Wideen, 1975), they do not specify (because they never were designed to find) the detailed ways in which students have and have not improved (Norris, 1984). If diagnosis and remediation of specific flaws in reasoning are goals of critical thinking instruction, then more fine-grained information on the effects of particular teaching strategies will have to be sought.

The critical thinking field is on the move. Educators are willing to support the production of new teaching and testing materials and to introduce critical thinking instruction in schools and colleges. Much work remains to be done, but care is needed so as not to waste time and resources reinventing the wheel. Although there remain many differences of opinion about the nature of critical thinking and how it is best taught, there are suitable teaching and testing materials available for the practitioner wishing to get a start. While adaptation for local use is often desirable, local districts need not plan critical thinking instruction from the ground up. Sound foundations have been laid by a number of scholars. The main requirement is to think critically about the selection of critical thinking materials.□

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