

Learners and workers must be willing, not just able, to make informed, skilled, and fair-minded judgments as they solve problems, make decisions, or engage in professional practice. What is the state of the art and science of identifying, measuring, and nurturing of the consistent internal motivation to think?

The Motivation to Think in Working and Learning¹

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How can we habituate learners and workers to engage in thoughtful, fair-minded problem-solving, decision making, and professional judgment? Demands for skillful and fair-minded thinkers arise today in every professional field and in our civic and personal lives. The pace of change accelerates, multiple sources of information saturate our senses, the rules are rewritten, and problems arise daily that defy predetermined solutions. At a minimum, to be effective learners and successful workers we must be willing and able to make informed, fair-minded, judgments in contexts of relative uncertainty about what to believe and what to do in a wide variety of situations. To go beyond the minimum, workers, learners, and citizens must be willing and able to critique intelligently and amend judiciously the methods, conceptualizations, contexts, evidence, and standards applied in any given problem situation. In short, we must habitually, not just skillfully, engage in critical thinking in a world that is so dynamic that today's verities are yesterdays misconceptions. Thus the driving question: how is the consistent internal motivation to think critically identified, measured, and nurtured?

Willing and Able

Unlike the nineteenth century, during which secondary schooling and college focused on the moral and intellectual character development of boys and men, for most of the twentieth century schooling and college addressed the techniques and content knowledge necessary for men and women to perform

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specific, well-defined mental or physical tasks in stable commercial, manufacturing, industrial, and professional settings. By mid-century comprehensive universities and technical colleges churned out cookie-cutter teachers, accountants, managers, engineers, allied health workers, attorneys, and secretaries by the thousands. Our mid-twentieth century captivation with the industrial social ideal of interchangeable workers focused almost exclusively on the “able” and hardly at all on the “willing.” Command and control leadership theories of the era implied that workers in industry after industry need never be thinkers since it was solely upper management’s responsibility to anticipate problems and script solutions, which the workers from the floor up through middle management should dutifully implement. Curricula grew long on what, when, where, and how to, but short on the why and whether. As the twentieth century ends uncertain world economic conditions and dynamic social realities reveal that strong thinking skills and solid content knowledge are essential, yet insufficient (Marshall and Tucker, 1992). We must prepare graduates who have the motivating habits of mind to be willing, if not eager, to engage in thinking. They must ask tough and challenging questions, they must be alert to potential problems, they must be judicious in making decisions, and they must be mentally oriented toward following reasons and evidence wherever they may lead. The challenge for educators and mentors is to identify, measure, and motivate thoughtful, fair-minded engagement in problem-solving, decision making, and professional judgment.

Habits of Mind

The familiar contrast between a habit and skills is evident in the case of healthful living. Depending on one’s beliefs about these practices, one habituated to healthful living is more likely to exercise, eat right, practice preventive health, avoid risky activities (e.g. smoking or unsafe sex), and the like. Another person might have the beliefs and skill to engage in a the same practices, which we can call the healthful life style, but not habitually do so. That person, we would say, is not so disposed. The same is true for thinking. People may have the skill to think well and the topic knowledge to deal with a given problem, and yet, unless it is demanded of them by some external force, they may not engage the problem and apply their skills and knowledge. These people do not have a strong disposition toward critical thinking; they are not internally motivated to use thinking as their main problem solving strategy. Just as we expect the person disposed toward healthful living generally to engage in what are believed to be healthful practices, we expect one disposed toward critical thinking generally to apply the skills of analysis, interpretation, inference, explanation, evaluation, and self-correction to the problem, decision, or judgment situation at hand.

Smokers who have tried to break that habit know well how easily some habits are formed and how difficult they can be to break. Forming habits, good or bad, often begins with actions performed because of external motivations, like compliance with rules or conformity to the social norm. The seedling

habit begins its tender growth nurtured by positive reinforcement for early, even if modest, successes. Failures and backsliding can be overcome by taking up the requisite practices again after each setback. Often a combination of internal and external motivators facilitate this, as any patient parent, supervisor, coach, mentor, counselor, or educator will attest. In time the motivation to engage in the behaviors associated with the habit becomes more consistent and internalized, and the habit takes root in our personalities. In theory, nurturing the habit of critical thinking is no more, nor less, mysterious than this.

Skillful and knowledgeable people may not always exhibit strong habits of mind. In the spring of 1996, senior undergraduates preparing to become teachers were offered an optional question on their final exam:

This election year two proposals are being presented to reduce violent crime among teenagers. One is to require a curfew in urban areas. Children under the age of sixteen would have to be off the streets by 9:00 pm on week nights and 11:00 pm on weekends. The other is to try those persons age fourteen and fifteen who commit violent crimes as adults. This would mean that their names could appear in the newspapers, their sentences, if convicted, would be comparable to those given adult offenders. These two results, it is claimed, embarrass and deter potential offenders. Sketch the steps of a process to determine the validity of the claims made by each of the two approaches and for deciding, in terms of crime reduction, which of the two should be adopted.

One would expect college graduates to have the thinking skills necessary to properly interpret the prompt as asking for a scientific way of finding relevant crime rate data. It would be a mistake to respond by stating one's pro or con opinion regarding the proposals, or by suggesting how to come to a politically acceptable policy, or by defending teens in general against adult narrow-mindedness. It does not take great insight or special expertise, once on the right path, to know which questions to ask. Given that ethically and legally we cannot run a controlled experiment on human beings, (for example, by imposing prison terms or curfews on an experimental group and not on a control group of teenagers just to see what might happen), are there crime statistics from communities that already have laws similar to these? If so, what were the results? What assumptions about human behavior guide these proposals and are those assumptions scientifically valid? Unfortunately, of the nine who chose to respond to this prompt, only four correctly interpreted the question and offered an appropriately scientific response. The other five offered well-written and well-argued but wrong, or very wrong, responses.

Why did these five intelligent and informed people address the wrong problem? Were they so distracted by the content of the prompt that they misinterpreted the question? Did they wrongly assume that this was just another give-your-opinion type question, where evidence takes second place to rhetoric? Or, were not alert enough to notice that the problem to which they responded was not the one presented? No one can say for sure. But educators and managers would readily attest that similar things happen

countless times in the classrooms and workplaces throughout the nation. Smart people sometimes fail to apply the skills we know they have to the real problems at hand.

Seven positive aspects of the disposition toward critical thinking in students and workers are the consistent internal motivation to be *inquisitive, organized, analytical, confident, judicious, tolerant, and intellectually honest*. Single word labels, while convenient, can be troublesome as well. We could express these same seven in terms of things like: being curious about how things work; systematically persisting even when the matter at hand is difficult; being alert to problem situations and potential difficulties; being appropriately trustful of one's own ability to reason and make sound decisions; seeing that there are times when decisions need to be made, revised, deferred; being open-minded about other approaches or new ideas; and asking tough but important questions particularly when it means pursuing reasons and following evidence wherever they may lead. When strong dispositions toward critical thinking are absent, people can demonstrate negative dispositions such as ambivalence or even hostility toward resolving problem situations through reason.

The overall disposition toward critical thinking is the *consistent internal motivation* to employ one's critical thinking abilities in judging what to believe or to do in any situation. If one is inclined or disposed toward thoughtful and intellectually honest problem-solving, and if one is also skilled and knowledgeable, there is a much greater chance that one will be consistently successful. The more high stakes the situation and the more likely that potential problems will be unexpected and ill-defined, the more significant these thinking dispositions become. The Secret Service rotates experienced agents off of Presidential security duty every few months to be sure that the analytic vigilance of those guarding the President does not wane due to the routine of the job. The United States Air Force Academy, where the preparation of combat ready military officers is a priority, built thinking dispositions like inquisitiveness and judiciousness into the educational outcomes performance standards right along side leadership development and problem solving skills (USAFA, 1995). In nursing and other health care professions, where life or death may depend on the problem solving done in an emergency situation or on the interpretations of subtle changes in a recovering patient's status, critical thinking is a mandatory outcome in professional school accreditation (NLN, 1990).

The Science and Application of the Disposition Toward Critical Thinking

Philosophical speculations and educational theories about the dispositional side of thinking can be traced back through the centuries to the Greeks. The rationale for a classical liberal education advanced in the nineteenth century at many American colleges was hardly the Renaissance notion of learning for its own sake, but rather the practical concern, often driven by the religiosity of the era, for character development through mental as well as physical discipline. By the first third of the twentieth century American higher education, with its land grant universities, was abandoning the classical liberal

arts in favor of more commercially useful curricula (Boyer, 1994). Important figures in American intellectual life, like John Dewey, continued to emphasize the development of thinking skills and dispositions as a cornerstone of democratic society (Dewey 1333). While the echo of Dewey's concern was sometimes heard, it was all but obliterated during middle and later decades of the century as comprehensive universities and research universities devalued the baccalaureate core and fixated on departmentally based majors. However, interest in thinking dispositions reemerged as educators in professional programs, sensing the limitation of the narrowly specialized skills only approach, began exploring broader conceptualizations of problem solving and encountered colleagues in the liberal arts who sought to connect their work on teaching for thinking with content rich professional fields. Today one finds a growing number of conceptualizations of the dispositional side of critical thinking, some purely speculative (Ennis, 1987; Kurfiss, 1988; Siegel, 1988; Browne and Keeley, 1990; Paul, 1990; Chaffee, 1992; Oxman-Michelli, 1992; Perkins, 1993, and others more empirically based, (Facione, 1990a, Jones, 1993; Wade and Tavis, 1993; Facione and others, 1995; King and Kitchener, 1995)

Empirical research on critical thinking and its dispositional component began as theoreticians, eager to get on with the business of measuring critical thinking, wearied of dulling, detailed, definitional diatribes and dogmatic, data-less dog-and-pony, didactic displays. Many felt that there was sufficient agreement about core ideas to move forward. Professional schools and their associations, concerned to measure the learning outcomes of preparation programs required workable assessment strategies (NLN, 1990; Gainen and Locatelli, 1995). Then, when the Congress of the United States made critical thinking an outcome for college graduates through *Goals 2000* (US Congress, 1994), many wondered whether critical thinking could ever be defined well enough to permit an inquiry as to whether and to what extent this goal was being achieved (US Department of Education, 1993).

Fortunately, theoreticians interested in critical thinking had been working toward a consensus conceptualization already. In 1990, after a two-year process, an expert consensus statement defined critical thinking in a broadly applicable non-technical way. Critical thinking is purposeful self-regulatory judgment; that is, a judgment made with some purpose in mind and subject to one's own review and revision. In coming to that judgement one gives reasoned consideration to evidence, methods, conceptualizations, contexts, and standards. The core skills one uses interactively in process include interpretation, analysis, inference, evaluation, explanation, and self-regulation (Facione, 1990a). Insisting that critical thinkers are persons not cyborgs, the experts participating in this Delphi project developed a detailed characterization of the dispositional features of the ideal critical thinker.

Independent empirical confirmation of the basic consensus concept of critical thinking came in interestingly different ways. Using previously extant testing tools and factor analytic methods, Taube (in press) verified that critical thinking had both a dispositional and a skills dimension. The list of specific core critical thinking skills and sub-skills was independently ratified by a research project, sponsored by

the US Department of Education, using survey data gathered from college faculty, employers, and policy makers. This study, originally conceived as addressing only skills, added a listing of dispositional attributes to its survey tool. There was virtual unanimity in the enthusiastic endorsement of these dispositional elements (Jones and others, 1994).

The first tool to measure the disposition toward critical thinking reliably took the 1990 Delphi study expert consensus description of the ideal critical thinker as its conceptual starting point. *The California Critical Thinking Disposition Inventory (CCTDI)* measures the strength of a person's disposition toward or away from critical thinking (Facione and Facione 1992; Facione, Facione, and Giancarlo (Sanchez), 1994). Given that the disposition toward critical thinking is its motivational component, the development of the CCTDI used established psychological testing strategies. The CCTDI measures that disposition globally and in seven aspects, described below. It reports a total score which can range between 70 and 420, with 280 or higher indicating a positive overall disposition toward critical thinking. Each of the seven aspect scales range between 10 and 60, with a positive score being 40 or higher. Scale scores below 35 suggest negative dispositional characteristics, such as intolerance, imprudence, lack of confidence, or disregard for relevant reasons and evidence.

Workplace and classroom application of the seven CCTDI scales is easy to grasp if one imagines a worker or learner negatively disposed on any given scale. *Truth-seeking* measures the **intellectual honesty** which gives one the courageous desire for best knowledge in any situation, the inclination to ask challenging questions and to follow the reasons and evidence wherever they lead. How many managers have failed their companies by shying away from the hard questions, discounting important and relevant but unpleasant data, and preferring to hold tight to outmoded ways of doing business or untested assumptions about the marketplace? *Open-mindedness* measures **tolerance** for new ideas and divergent views. What are the chances of helpful critique or innovation if one is intolerant and closed-minded? *Systematicity* measures the inclination to be **organized**, including to be focused, diligent, and persevering. How much business will be lost by a customer service representative whose approach to clients is disorganized, unfocused, sloppy, and half-hearted? *Inquisitiveness* measures intellectual curiosity and the intention to learn things even if their immediate application is not apparent. Workers who are indifferent or disdainful of learning more than the minimum necessary to get through the day's tasks should not expect frequent and speedy promotions. *Analyticity* measures alertness to problem situations and potential difficulties which means being alert to the need to intervene by the use of reason and evidence to solve problems. A health care professional, an attorney, a teacher, a manager, an engineer, or a policy-maker who is not inclined toward analyticity will likely fail to anticipate significant consequences and, thereby, increase the risk of malpractice and negligence. *Cognitive maturity* measures **judiciousness** which inclines one to see the complexity in problems and to desire prudent decision making. Those who see everything as starkly good or bad, black or white, right or wrong, are

unlikely to be sophisticated learners or good candidates for positions of increasing responsibility. They are apt to make decisions too hastily or too slowly, to be unwilling to reconsider, to be dogmatic and dualistic, if not outright simplistic, in their approach to problem solving, and to lack sensitivity to the nuances of circumstances and subtleties of context. *Critical thinking self-confidence* measures the trust one places in one's own reasoning and one's ability to guide others to make rational decisions. A career involving any form of thoughtful decision making or mediative problem solving is not encouraged for persons weak in reasoning self-confidence. But, if their reasoning self-confidence is well founded, that is, if they have the strong critical thinking skills as well as the disposition to use them, they can become quite successful in a wide variety of executive, managerial, client service, and professional occupations.

Personality research and concurrent validity studies on the disposition toward critical thinking offer promising ways to connect critical thinking, with its humanistic roots, to scientific knowledge. For example, the 1990 Delphi consensus description of the ideal critical thinker was tested by Giancarlo (1996b) using the California Q-sort (Block, 1961). Working independently of one another and without any prompts, Giancarlo asked twenty experts in adult critical thinking individually to sort the 100 Q-sort items such that the resulting sort would characterize, in their opinion, the ideal critical thinker. The results were merged to form a prototype personality profile of the ideal critical thinker ($r=.80$, $N=20$, $p<.001$). This prototype correlated with undergraduate students' CCTDI scores ($r=.36$, $N=91$, $p<.001$) and with CCTDI and Q-sort data collected about those students from their peers ($r=.32$, $N=91$, $p<.001$). This finding confirms the strength of the 1990 consensus description of the ideal critical thinker and also supports the validity of measurement tools based on that definition.

Seeking further connections between the disposition toward critical thinking and better established personality constructs, Giancarlo explored ego-resilience (Block, 1965, Block and Block, 1980), and openness to experience (Costa & McCrae, 1992). The disposition toward critical thinking, as measured on the CCTDI, is positively correlated with ego-resilience ($r=.58$, $N=198$, $p<.001$) and openness to experience ($r=.37$, $N=198$, $p<.001$). This research suggests that one scoring higher on the CCTDI is more likely to be highly engaged in their environment, focused, diligent, objective, intellectually curious, as well as psychologically flexible and healthy -- certainly a desirable combination of personality characteristics from the perspective of the workplace as well as the classroom.

Classroom research using the CCTDI began soon after its publication in 1992. Ferguson and Vazquez-Abad (1995) performed a principle components analysis of pretest and post-test CCTDI data on 254 French speaking Canadian seventh grade science students which provided additional evidence of the construct validity of the CCTDI. In this study CCTDI scores significantly correlated ($r=.35-.37$, $p<.001$) with the GALT (Roadranga and others, 1983), a tool which measures formal reasoning skills and with the TIPS II (Burns and others, 1985), a test of scientific reasoning procedures, ($r=.22-.44$, $p<.001$). These students showed a statistically significant mean gain from 290 to 296 on total CCTDI score over

the course of the year of junior high science ($t=4.54$, $p<.001$), which suggests that growth in the overall disposition toward thinking may occur in the context of instruction focusing on the skills and procedures associated with good reasoning in a content area.

Assessing the critical thinking process is a challenge if the only thing available to evaluate is the product -- the completed marketing proposal or the finished term paper, for example. It is difficult to discern the critical thinking skills or dispositional motivations that actually went into the process of producing that product. But if raters are able to observe learners or workers engaged in the process of doing their tasks, and particularly if those learners or workers are able to articulate what they are thinking as they go along, then scoring rubrics and rating forms can be applied with considerable success by persons trained in their use. Within a reasonably brief period of time people will become adapt at making reliable and valid judgments about the relative ranking of different workers or learners on such scales. More importantly, the raters as well as those being rated will internalize the language of critical thinking and be better able to communicate about the thinking and how decision making, either individual or collaborative, can be improved.

Combining multiple measures of thinking systematically gathered and reliably evaluated creates assessment portfolios. Properly used, these can provide valuable information to teachers and mentors about the progress, strengths, and weaknesses of learners and workers, particularly in professional settings (Facione and Facione, 1996).

Holistic strategies to assess the dispositional side of critical thinking use tools that mix skill measurement with dispositional measurement. These kinds of tools offer more qualitative and holistic data, but sacrifice precision and refined measurement. *The Holistic Critical Thinking Scoring Rubric* is in the public domain through www.calpress.com (Facione and Facione, 1994). Adaptations to the workplace yield rating forms such as the *Novice Professional Judgment -- Ability and Habits of Mind*, (Facione and Facione, 1996). The US Air Force Academy incorporated the language of critical thinking dispositions in developing a rubric to rate "Levels of Performance For Framing and Resolving Ill-Defined Problems," (USAFA, 1995) Work with fieldwork supervisors and employers for hundreds of human services and accounting internship settings in the Los Angeles area led to detailed evaluation checklists for written communication, speech communication, and critical thinking (Carter-Wells, 1995). The idea behind such tools, whether a scoring rubric applied to a classroom presentation or a rating form to evaluate a new hire or an intern, is that as we watch people engaged in the process of problem solving we can, with practice, reliably discern the habits of mind that they bring to the endeavor, not just their skill and content knowledge in working through the problem at hand.

An entirely different strategy suggested by some noted philosophers involves the use of multiple-choice or multiple-rating skill test items as an indirect measure thinking dispositions. Their suggestion seems initially plausible. One might hypothesize that a closed-minded, unsystematic, or

inattentive test taker would be more likely to select a given wrong answer on a multiple-choice skills test questions, than to reason their way to the right answer (Facione, 1990b). *The California Critical Thinking Skills Test (CCTST)*, a multiple-choice instrument, was designed so that some wrong answer choices are intended to distract persons with weak or negative thinking dispositions (Facione, 1990c). As valid as it may be for the measurement of skills, the CCTST is not a test of dispositions. Commercially available critical thinking skills tests can and should be evaluated on appropriate criteria relating to their feasibility and validity as skills tests (Pendarvis, in press).

We do not recommend using skills tests to measure dispositional attributes. It is implausible to suppose that one can reliably evaluate the specific motivation behind the thinking process if one's only data point is the product that process produced. It is unreasonable to draw firm conclusions about why a given person selected a given wrong answer from the mere fact that the person marked a particular choice on a test of thinking skills. Unless perhaps augmented by simultaneous talk-aloud data, we would not know whether the person selected the wrong answer due to weak analytical or inference skills, due to a misinterpretation of the prompt or an answer choices, due to an incorrect evaluation of those choices, due to having guessed wrong or having been distracted by weak dispositions, or perhaps due to something else entirely such as simply mismarked the scoring sheet. Further, reliably to discern whether or not a person is deeply motivated in a certain way requires scales of far higher alpha reliability than can possibly be obtained using a single response to a single item. Objective tools, built on sound psychological measurement principles, can yield valid and reliable information about a person's consistent motivation toward critical thinking without risking the many pitfalls associated with using skills test items.

Early Findings from School and Workplace Studies

How well are younger students disposed toward critical thinking? Ferguson and Vazquez-Abad (1995) reported an overall CCTDI mean score of 296 for 254 French speaking seventh grade science students. By contrast, a study of 85 English speaking junior high students in Texas reported an overall CCTDI score of 260, which indicates that overall these students expressed the disposition *not* to think critically (McBride, 1995). Lowest among the scales was the truth-seeking scale with a mean of 33.6, which indicates that the students in this sample were not disposed to ask tough questions nor seek best knowledge, and that they discounted reasons and evidence which led away from their cherished beliefs. We might wonder what environmental differences produced the positive scores from the Quebec schools and the negative scores from the Texas schools? Certainly more data on junior high students' thinking dispositions need to be gathered before one would hazard even a preliminary hypothesis.

Studies involving samples of secondary school aged children from the United States and from other countries have been proposed or are in progress (Giancarlo, 1996). Research and development on a version of the CCTDI for use with elementary school aged children is underway at this time. We are

greatly encouraged by this attention to achieving at least baseline measures of the thinking habits of mind of young learners. Our conversations with many of those who explore this educationally, socially, and politically significant question with the hope of developing or evaluating programs to nurture and deepen positive habits of mind in students lead us to urge that the cultivation of a healthy culture of learning at school and at home may be as important as any curricular or pedagogical activities in individual classrooms.

Ethnic and societal differences are often thought to be related to critical thinking. In a public high school in Phoenix which enrolls native English speaking students and native Spanish speaking immigrant students, critical thinking data was gathered from students using both Spanish and English language forms of the CCTDI and CCTST instruments. The mean for the English speaking high school students on the CCTDI was 270 ($N=271$), while the native Spanish speaking students ($N=240$) scored 275 ($t=2.03$, $p<.04$). Both totals support the findings of the McBride study indicating aggregate high school student indifference toward critical thinking. There was considerable overlap in the seven scale scores of both groups, although a few statistically significant differences were discernable, with native Spanish speaking students scoring higher on inquisitiveness, systematicity, and confidence, as compared to the native English speaking students who scored higher on truth-seeking and cognitive maturity. However, in no case did one group differ from the other as to overall positivity or negativity for any of the seven dispositional scales (Giancarlo and Facione, 1994). These data may partially debunk preconceptions about whether the disposition toward thinking might differ by language or cultural-ethnic group, but it reinforces concern about the possible broad weakness of this vital habit of mind among high school aged students in the United States.

Accents, culturally-based thinking styles, values, and physical appearance are perceived by employees as assets or liabilities in the corporate world (Mancinelli, 1996). However, when Mancinelli studied adult Mexican-American and Anglo-American middle managers working in corporations in Portland Oregon, he found that as compared to their Anglo counterparts, the Mexican-Americans had equal or stronger critical thinking skills. Yet, the Mexican-Americans experienced significant economic disadvantages in terms of salary and promotions.

In a study of 393 Latino public high school students in Southern California's Riverside County near Los Angeles, the disposition toward critical thinking was positively correlated to the academic success indicators: grade point average; high school basic proficiency examinations in mathematics, reading, and writing; and mathematics achievement. Interestingly the disposition toward critical thinking was inversely related to socioeconomic status suggesting strong values placed on education in economically disadvantaged neighborhoods. Cultural factors, such as respect for elders and traditional sex role orientation, were negatively correlated to academic achievement markers of grade point average, and reading and writing proficiency for Latino males, but were not correlated for females. (Giancarlo,

1996a).

Gender, like ethnicity, is a target of societal prejudices about differences in thinking. However in the Phoenix high school study no significant differences on overall CCTDI scores between females and males in either language group were found. The English speaking high school females ($N=115$) scored statistically significantly higher than the English speaking male students ($N=156$) on open-mindedness ($t=2.58, p<.01$) and cognitive maturity ($t=2.29, p<.02$). Spanish speaking females ($N=127$) scored statistically significantly higher than Spanish males ($N=113$) on analyticity ($t=2.0, p<.05$), while the Spanish speaking males scored higher than the Spanish females on truth-seeking ($t=2.39, p<.02$). But, as before, one gender group never showed a positive mean score while the other showed a negative mean. These findings regarding the fundamental equivalence of males and females on the overall disposition toward thinking, with some nuances of difference in some scales scores, are consistent with those we reported in our studies of college students (Facione, Giancarlo, and Facione, 1994).

College level longitudinal and cross-sectional studies began in the Fall of 1992, when we profiled entering Freshman at a selective, private, comprehensive, liberal arts oriented American university on the day before classes started in September (Facione and others, 1995). We tested those students as graduating seniors in the April and May of 1996, capturing data on 154 students at both ends of their undergraduate careers. The overall score grew from an initially positive pretest of mean of 303.4 to a post-test mean of 310.8. The matched pairs t-test showed that the positive increase in their disposition toward critical thinking was statistically significant ($t=3.244, p<.001$). Statistically significant growth occurred in truth-seeking, where the 1992 score was a disappointing 36.1 and the 1996 score landed in the neutral zone at 38.9 ($t=5.7, p<.001$). In all of the studies with which we are familiar, the consistently substandard truth-seeking -- intellectual honesty -- mean scores are worrisome indicators of serious weakness in this specific and crucially important aspect of the disposition. The other statistically significant growth occurred in reasoning self-confidence ($t=4.39, p<.001$), which, as with the other five scales, showed mean scores above 40 on the pretest and post-test.

Even more encouraging than the positive growth was the robust positive correlation ($r=.55, p<.001$) between the college students' 1992 Freshman pretest scores and their 1996 Senior scores. This is the first documented evidence which suggests that ***the overall disposition toward critical thinking appears to be stable over a period of years, but yet there is room for significant growth.***

Professional schools, including graduate and undergraduate programs in nursing, engineering, communication, management, pharmacy, military science, and education, concerned to measure the critical thinking skills and disposition of exiting students, have begun exploring the use of quantitative and qualitative measures. The nursing profession leads the way, being by far the most advanced at this time in both the conceptualization of the relationship between critical thinking and the ways of reasoning (Fonteyn, forthcoming) as described by experienced practitioners and in terms of learning outcomes

assessment and program development. Now completing the second round, our Nursing Meta-Study of undergraduate and graduate nursing students is receiving critical thinking test score data from 90 participating universities and colleges throughout the United States. The results, which will be considered in relation to a number of program and institutional variables as well as more traditional indicators of student academic data and licensure rates, will be published in 1997.

International interest in teaching for critical thinking is most evident in nursing, because throughout the world the growing realization that scripted problem solving in content heavy domains is inadequate professional preparation for the fast changing realities of professional practice and also because the professionalization of nursing in many countries has led them to emulate university-based US programs and adopt the standards of the National League for Nursing to the evaluation of programs in their countries.

Students' learning preferences and differences in teaching methods should have differential impacts on the development of critical thinking skills and the deepening of the habits of mind. For example, the work of King and Kitchener cited earlier, our work, and the writings of virtually every theoretician referenced in this paper commend to all educators and mentors the importance of *modeling thoughtfulness* and taking the time to *reflect with learners on their experience*. A study of 194 Chinese nursing students in Taiwan explored the relationship between the students' preferences among 27 teaching techniques and instructional methods and their disposition toward critical thinking. A preference for class discussion correlated positively with open-mindedness and analyticity, a preference for self-directed independent study correlated with systematicity and self-confidence, and a preference for clinical experience correlated positively with cognitive maturity and the overall CCTDI score. The faculty surveyed in that same study endorsed reflection on clinical experience as the most likely to engender stronger critical thinking (Chang, 1996).

Other studies are underway at the US Air Force Academy and at the Rose Hulman Institute for Technology, which is working with a consortium of other engineering schools, and among nursing faculty and students in Japan. Hopefully these studies, and others like them, will soon provide us with solid data through which to explore the actual as well as they hypothesized relationships between learning styles, teaching methods, related personality characteristics, and the development of critical thinking and professional judgment.

Recommendations for Workplace and Classroom

People able and willing to make thoughtful purposeful judgments will come from environments which nurture thinking and reflective problem solving over automatic or scripted problem solving. Within business as well as schools and homes the cultivation of a culture which encourages thinking and honest inquiry is essential. Mentors and educators in every professional field and academic discipline can guide

workers and students to use their thinking skills more effectively and become more motivated toward thinking without compromising content knowledge. It is not unreasonable to hypothesize that a stronger motivation toward critical thinking would actually increase the potential for content knowledge acquisition. The fundamental strategy for mentor and educator alike is to *balance nurture with challenge*. Those of us working specifically on how to nurture the disposition toward critical thinking would recommend these practices:

One: Cultivate a Culture of Reasoned Thinking and Evidence-Based Inquiry.

Leadership plays the most important role, for the leader must model those habits of mind and use those thinking skills which the other participants are expected to emulate and exercise. Every element in an organization from its personnel practices to its approach to client service and product quality must be scrutinized to determine whether those practices and policies enhance or inhibit thinking. While scripted or rote procedures are efficient responses to predictable problems, leaders must not be so recipe-bound that others are prevented by the hostility of the working environment from fully exercising their critical thinking skills and habits of mind. Not every problem can be anticipated and script-solved, not every innovation will come from the top. Mnemonics and slogans usefully assist recall of chunked information, but they should not be confused with knowledge. A corporate culture that encourages creative and critical thinking not only reflects the confidence leadership has in the vigor and viability of the enterprise, it invites the kind of employee loyalty which yields quality of effort as well as innovative solutions.

Two: Replace Rote Training with Thoughtful Mentoring. Workplace and classroom can be bridged not only by comparable learning experiences, but by teaching and assessment expectations which are outcomes oriented. Mentors and instructors must abandon rote training and memorization of scripted practice routines, for genuine education. Education in content heavy domains requires reflection on experience wherein the crucial scripts are made understandable at the level that permits the practitioner not only to execute the recipe but to understand the rationale for each step and to adapt the script, revise it, or discard it in appropriate situations. Education is knowing whether and why, not just what, how and when. As uncomfortable as this may be for learners at earlier stages of cognitive maturity and for those who think that good teaching means telling them exactly what will be on the test, the development of their professional disciplined practice demands more of them and us than they, at their level of inexperience can yet appreciate. Sophisticated evaluators of effective teaching understand how to interpret student comments in the light of the students' levels of appreciation for what good teaching really means. Challenging students to think includes asking probing questions, demanding understandable explanations, questioning untested assumptions, and, at times, letting people make mistakes which they can then fix themselves. Self-correction is the point of meta-cognition. An instructor or mentor can mix nurture with challenge and can point the way toward learning by helping learners to see relevant patterns in apparently chaotic information and to identify promising approaches to problems. However, the one guiding the

learning should never spoon feed solutions or accept right answers wrongly understood. The effective mentor does not become a co-dependent. Responsibility for learning is the learner's.

Three: Present Information from the Bottom Up. Corporations and professions, like academic disciplines, are digests of theories, methods, rules and standards to be applied to a given range of questions in a given set of circumstances to produce an expected set of results. But how we construct and package that knowledge is often the opposite from how we learn it. For most people learning on the job or in school starts with the particular, not the general. To take advantage of this, instructors and mentors should not begin with first principles and basic definitions, but with examples which are so engaging that learners are eager to acquire the targeted content and the skills. Thus motivated, the learners will then seek definitions and principles as aids to organize their growing bodies of new knowledge. Sequenced examples and assignments can draw on an ever greater content base and more sophisticated understandings of previous content. The case study approach, like problem-based learning, offers many advantages. Whether practiced in the workplace or the classroom, the analysis of cases representing the best and the worst of professional practice offer sufficient concreteness to engage learners, whether experts or novices. Case studies integrate content, skills, and dispositions in ways that are authentic relative to professional practice. Because they are memorably concrete, they can easily be called to mind when their lessons require reinforcement.

Too often when working cases or using other teaching strategies, we show our students and new colleagues the product of our work and not the processes through which it was accomplished (Kurfiss, 1988). Modeling thoughtfulness means showing, among other things, what it is to think through a problem and make decisions. It can be better not to rehearse what one wants to demonstrate in order to permit one's more spontaneous and authentic thinking to be revealed. Encouraging students to voice their thinking as well, by talking aloud as they work through a problem, can reveal crucial elements in their thinking process or habits of mind which can then be explored, reinforced, or amended.

Four: Evaluate Processes, not Results Only. When concerned about content knowledge and automatic or scripted problem solving we can look primarily, if not exclusively at the results to evaluate the worker or student. We have the product we can evaluate or the completed essay we can grade. But to build thinking skills and strengthen thinking dispositions, mentors and educators must look to the process. It is not enough to get the right answer, one must be able to get to that answer by solid reasoning. The right result achieved for the wrong reason could be a lucky thing one time and a disaster for clients and company alike the next. Educators and mentors can get at the process of thinking by encouraging learners to keep reflective logs of striking examples of very good or very poor thinking, by making a videotape classroom presentations or actual services to patients or clients to permit reflective analysis at a later time, or by using talk-aloud strategies to externalize thinking. Using qualitative performance rubrics which integrate the habits of mind with the thinking skills, and sharing these rubrics

with learners at the beginning of the instructional process, helps learners to internalize the standards of evaluation and reinforces the significance of the thinking process for them. What is measured is valued.

Five: Expect and Reward Virtue. The consistent internal motivation to be inquisitive, organized, analytical, confident, judicious, tolerant, and intellectually honest is an intellectual virtue. This virtue inclines us toward being learners our whole lives and toward being thoughtful, engaged, and effective problem solvers and decision makers in our jobs and professions. Workers and learners should be advised that the expectations go well beyond memorizing for the final exam or moving one's mail from the in-basket to the out-basket. Although some might think that virtue is its own reward, it need not be its only reward. Employers and educators looking for qualitatively superior work rather than compliant minimalist performances would do well to assure that rewards, resources and reinforcement flow to those who are able and willing to think.

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