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Critical thinking across the curriculum (CTAC)

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ABSTRACT: Implementing critical thinking across the curriculum is challenging, involving securing substantial agreement on the nature of critical thinking, areas of prospective application (subject matter? everyday life?), degree of need for a separate course, and the nature of coordination, including leadership, a glossary, selection of courses for incorporation, avoidance of duplication and gaps, acquiring required subject matter, and assessment of the total effort, teaching methods used, and decrease or increase in retention of subject matter.

KEYWORDS: across the curriculum, critical thinking, mixed approach, subject specificity, everyday life

1. INTRODUCTION

In previous discussions of issues and distinctions relevant to critical thinking across the curriculum, I have employed an analytic approach, making and explaining distinctions that bear on some of the issues. This time I take a different approach, starting with a fairly comprehensive proposal for a four-year higher education experience at hypothetical Wisdom University, followed by a discussion of various distinctions and crucial issues. The name of the proposed approach is "Wisdom CTAC" ("CTAC" is pronounced "see tack" for "Critical Thinking Across the Curriculum"). "Critical thinking" is here assumed to mean reasonable and reflective thinking focused on deciding what to believe or do.

This is an exploratory effort. Suggestions are welcome.

2. THE PROPOSAL

2.1 Broad goals of the program

There are three broad goals of the total program:

2.1.1. to help students think critically in their everyday civic, vocational, and personal lives during and after their university careers;

2.1.2. to help students think critically in the fields of their university courses to varying extents, depending a) on the extent of their focus in the fields of their courses; and b) on the extent to which reasonable critical thinking by them in the field is possible (given the need to master certain content of the field in order to

Mohammed, D., & Lewiński, M. (Eds.). *Virtues of Argumentation. Proceedings of the 10th International Conference of the Ontario Society for the Study of Argumentation (OSSA), 22-26 May 2013.* Windsor, ON: OSSA, pp. 1-16.

think critically about issues that call for the specialized and sometimes very advanced knowledge in a field)[1]; and

2.1.3. to help students become more interested in and excited by the subject matter in their courses of study (especially the subject matter involved in the issues about which they are invited to think critically). Almost anything can be interesting to anyone if they understand it and become involved in its issues.

2.2 The basic course

The Wisdom CTAC Program commences with a two-semester required course for freshmen called "An Introduction to Critical Thinking", meeting three hours per week for fourteen weeks each semester.

2.2.1. Two course goals. One goal of this course is to assure basic understanding and acceptance of, and competence in, *general* dispositions and abilities, such as those specified in "The Nature of Critical Thinking" (Ennis, 2013, henceforth "NCT"). A second goal of the basic course is to assure the same things for *field-specific* dispositions and abilities in six program-selected fields at the end of the course.

2.2.2. Schedule and content. For the first twenty-one weeks of this course, a variety of exemplifications of the general dispositions and abilities, and the accompanying general concepts, principles, and criteria of critical thinking (NCT) constitute the content. In the subsequent six weeks, general critical thinking is applied in the following six broad areas, one week per area: the humanities, the social sciences, the physical sciences, the biological sciences, business/agriculture/education, and mathematics/computers. The week for each of these six broad areas is devoted to application and exemplification of some general aspects of critical thinking to one or more field(s) within that week's broad area, probably as well as the introduction, application, and exemplification of one or more area-or-field-specific dispositions and/or abilities. A faculty representative of each area will be in charge for that area's week, including assignments, content, and mini-assessment. The final week (the 28th week) of the course will be devoted to a review of the full-year course, including and/or followed by assessment of the year's course.

Concurrently, there will probably be a one-year course for freshmen called "Writing Across the Curriculum".

2.3 Infusion of critical thinking in subsequent courses

Since promoting learning to think critically is part of the Wisdom University's

[1] For example beginning undergraduates in physics will not have sufficient knowledge of physics to think critically about advanced topics like quarks, dark matter, quantum theory and the general theory of relativity. But in a laboratory they can use the subject-specific critical thinking principle that they should take at least three readings in making an observation of a quantity, for example, the distance a smooth steel ball rolls on a smooth surface after rolling down a smooth three-foot inclined plane at a 20-degree angle.

mission, each field will be expected to make some contribution and will develop an approach in its courses that promotes general and field-specific critical thinking by students within the field. This will be accompanied by the applications of some critical thinking principles to their everyday lives with heavy use of examples both within the field and everyday life. The plan for this contribution will be developed within each field with the help of critical thinking consultants, and will respect the talents and interests of the faculty in the field, as well as the subject matter in each field. The guiding principle will be, "Do it well and thoroughly" rather than "Cover as much as you can."

This is a rough formula in order to accommodate the variations among fields and faculty members. No doubt some courses will utilize little or no critical thinking and will have as their primary, perhaps sole function, students' acquisition of subject matter in preparation for other courses or post-higher-education situations.

2.4 Senior project

Each student will do a senior project in some field (or combination of fields), the final report for which will include not only a description of the project, specifying and defending its main point, but also an exemplified list of the general and subject-specific critical thinking dispositions, abilities, principles, and criteria employed by the student in doing the project. The project will be advised, monitored, and evaluated by one or more representatives of the field with some input from a critical thinking consultant.

2.5 Coordination among the elements of the program

Considerable coordination among elements of this total CTAC program is needed.

2.5.1. Critical thinking content. The set of critical thinking principles, criteria, abilities, and dispositions used in the first-year critical thinking course must be accessible and clear not only to teachers of that course but to teachers of any other subject-matter course that might or will make use of part or all of what is taught in the first-year course. Usable presentations of this material (possibly NCT plus a detailed critical thinking text book with examples and discussion) will be made available to all faculty involved.

2.5.2. Gaps and repetition. The primary assurance that there will not be gaps in students' experience with general critical thinking concepts, principles, and criteria is the first-year introductory course. Students' missing of subject-specific critical thinking for fields they do not study is no worse than their missing the subject content, which is an unavoidable result of specialization in our education system.

Because it is usually helpful to have a wide array of applications of general critical thinking concepts, principles, and criteria, I do not worry much about repetition of the principles of critical thinking. I often encourage it.

2.5.3. Glossary. A common set of critical thinking terms and a set of definitions of these terms must be agreed on and made available in order to avoid confusion. Such terms as 'denotation', 'connotation', and 'logic' (which most

philosophers use in a different sense than the one used by non-philosophers), 'hypothesis', 'best-explanation argument', 'significant', 'straw person', and 'genus-differentia' require either specification of one meaning in a glossary, or the special labeling of different meanings, for example: "'denotation' in the philosopher sense", or "'denotation' in the English Department's sense".

2.5.4. Communication. Many avenues of communication among participants must be available through such means as university-wide newsletters, annual reports to participating faculty, consultancy by critical thinking consultants who are familiar with the subject matter into which critical thinking is infused and with ways of doing it, and intra-department conferences on how to infuse critical thinking in the subjects taught by that department.

2.5.6. Staff. There will be a central CTAC office responsible for the coordination activities. It will be run by a director and associate director, and staffed by critical thinking specialists, half of whom will be teachers in the first year course, the other half of whom will be advisors, well-informed in the fields into which critical thinking will be infused and in methods of teaching critical thinking. There will be a first-course supervisor and a specialist in critical thinking assessment, and of course there will be secretarial help.

2.5.7. Control. To oversee the total operation there will be a steering committee that meets twice a year, and which is responsible to the total Wisdom University Faculty through an annual report and review. The steering committee will monitor the teaching of the first year required course, and each field's plan for infusing critical thinking in its subject matter, including assessment of both.

This description of administration and control assumes that Wisdom University is basically controlled by faculty. In higher education situations in which the power figures are Legislatures, Boards of Directors, Presidents, Deans, and Department Heads; these figures or their appointees would perform the key roles and functions. Various accommodations would be made for in-between situations, but the functions must be performed.

2.6 Teaching

The actual teaching of critical thinking is affected by the nature of the subject matter, as well as many institution-specific factors, for example: student backgrounds and interests, teacher style, teacher interest, teacher grasp of critical thinking, class size, cultural and community expectations, student expectations, colleagues' expectations, the amount of time available to teachers after they have done all the other things they have to do. *There is no one formula for teaching critical thinking!*

2.6.1. Twenty-one strategies and tactics. The selection, "Twenty-one Strategies and Tactics for Teaching Critical Thinking" (Ennis, 2010, which is gleaned from my experience and others' suggestions and research, must be adjusted to accommodate institution-specific factors. But the two most important, overarching, guiding principles will be the example and the transfer principles:

2.6.2. The example principle. A variety of examples, thoroughly examined, is generally necessary for student to grasp and transfer critical thinking concepts,

principles and criteria, no matter who initiates the discussion.

2.6.3. The transfer principle. Transfer of learning to new contexts usually occurs when and only when we teach for it – which generally means that we deliberately make it clear to the students in a variety of situations and/or subjects how a concept, principle, or criterion applies in these situations. For example; the conflict of interest principle can be exemplified by a recent scandal in local politics; basic logical relationships (such as those exemplified by "if-then", "not both", and "only if A or B") can be found in income tax rules.

Someone, perhaps the teacher, perhaps a student, should state the principles, etc. But in any case the teacher should assure that the concepts, principles, and criteria are made explicit, unless it is abundantly obvious.

2.7 Assessment

It is easy to leave our decisions about assessment to last, or to forget it altogether until we feel the pressures of accrediting agencies and the accountability movement. But this is a topic that must be addressed early and continuously, especially if we want to do pre-post assessment (itself a controversial issue, given the usual need for a control group). It is a topic about which critical thinking specialists are usually not well informed, though there are a few items that might be consulted (Norris & Ennis, 1989; Fisher & Scriven, 1997; Ennis, 2008; Possin, 2008; and Sobocan & Groarke, 2009). Primary responsibility for initiating Wisdom-wide assessment of critical thinking will be in the hands of the central CTAC office, monitored by the Steering Committee.

2.8 Advantages of the proposal

2.8.1. It is a concrete proposal that can guide the pursuit of the critical thinking goal that we find in many mission statements.

2.8.2. It promotes students' critical thinking not only in their everyday lives but also in their subjects of study.

2.8.3. It is in accord with the example and transfer principles, which are well-accepted principles in educational psychology.

2.8.4. It fosters the increased comprehension and retention of subject matter when students participate in discussions calling for critical thinking.

2.8.5. Its conception of critical thinking is comprehensive, detailed, and important in our everyday lives as well as in various fields of study.

2.8.6. It provides for coordination activities that are needed when a number of different interests are combined in pursuit of a goal. Interaction among faculty and fields will be increased, as will students' seeing the similarities and dissimilarities among fields.

2.9 Disadvantages of the proposal

2.9.1. It requires adjustment to change on the part of many participants.

2.9.2. Some subject-matter coverage could be decreased due to the time devoted to infusing critical thinking. However, this disadvantage might be outweighed by the advantage that the proposal will likely result in increased comprehension and long-term retention of the subject matter covered.

2.9.3 The CTAC office and staff might well add to institutional expenses.

2.9.4 New disagreements among faculty, including those from differing fields, might develop in efforts to assume, or avoid, tasks in the new structure.

2.9.5. The higher education community has little experience with such programs.

3. BACKGROUND DISTINCTIONS AND ISSUES

I have developed the Wisdom CTAC proposal in the light of a number of distinctions and issues that have involved the critical thinking community over the years:

1) The choice among having a separate critical thinking course vs. the embedding of critical thinking in subject-matter courses vs. doing both.
2) The meaning of "critical thinking".
3) Breadth of the goal of critical thinking instruction.
4) The alleged subject-specificity (or "domain-specificity") of critical thinking.
5) Infusion vs. immersion.
6) The impact of critical thinking instruction on the learning of subject matter.

3.1. Separate critical thinking course vs. embedding in subject-matter courses vs. both

Often when the question arises about how to introduce critical thinking in a curriculum, the two alternatives, separate course vs. embedding in subject-matter courses, are the assumed alternatives. I support a third alternative, that both be done, an alternative that is often ignored. Robert Sternberg suggested the label "mixed approach" for this third alternative. An important advantage of the mixed approach is that it provides a much larger number and variety of examples of the application of critical thinking principles than does the separate-course approach. Furthermore it provides applications that students will believe to be significant, assuming that they think their subject matter courses have significant content. Lastly, it provides an early, organized, comprehensive presentation and explanation in depth of general principles of critical thinking that students will need in their daily lives and in their fields of study, thus assuring that the basics are covered and covered well.

3.2. The meaning of "Critical Thinking"

Another fundamental issue is the definition of "critical thinking". Because there are so many definitions of critical thinking, "myriad definitions of critical thinking"

(Ralph Johnson, 1996, p. 216) and many expressions of similar themes, I shall unavoidably neglect some specific ones, and apologize to authors of those not specifically represented in this discussion.

3.2.1. Mainstream definitions. Within the field we find descendants of John Dewey's "reflective thinking", which was renamed "critical thinking" by the Progressive Education Movement in the 1930's and 40's. In my opinion Dewey is the grandfather of the current critical thinking movement. Dewey's original definition of "reflective thinking" was "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (1933, p. 9 (first edition, 1910)).

3.2.2. Dewey's descendants. Fairly direct descendants of Dewey' approach are definitions offered by Siegel (1988), Johnson (1996), Fisher & Scriven (1997), and me (1987a, 1991c, 1996a).

The definition that explicitly underlies this proposal for the Wisdom CTAC, is "reasonable reflective thinking focused on deciding what to believe or do (1987a, p. 1; 1991c, p. 6; 1996a, p. xvii, 1). In the early 1980's as this definition was evolving, Gerald Nosich suggested that the end result can be not only a decision about what to believe, but also a decision about what to do. I liked this suggestion and added the last two words ("or do") to my evolving definition. This action component is a first key feature of my definition, one which it shares with Dewey, as can be seen in Dewey's subway example (pp. 91-92). It is also shared with Siegel (1988, p. 2) who says that a critical thinker is one who is "appropriately moved by reason". It is not shared with Johnson (1996, p. 226), whose definition is "thought evaluating thought", which he elaborates thusly: "critical thinking is the articulated judgment of an intellectual product arrived at on the basis of plus-minus considerations of the product in terms of appropriate standards (or criteria)"). Nor apparently is it shared with Fisher & Scriven (1997, p. 21): "skilled and active interpretation and evaluation of observations and communications, information, and argumentation".

This question about whether critical thinking also can be applied to decisions about actions to take, as well as what to believe, is an important one. I urge an affirmative answer because decisions about what actions to take are important decisions, because I see similar criteria applied to the grounds for them, and because, as I interpret the general educated public's usage (mission statements, tests (e.g., the currently-popular CLA test's "Performance Tasks" (CAE, no date)), and media mentions of critical thinking), thinking about what to do calls for critical thinking. But deciding whether to include the "or do" is a task for the institution wanting to incorporate critical thinking in its curriculum. It is included in the Wisdom CTAC Program.

A second key feature of the CTAT definition is the *implicit* inclusion, at the suggestion of Sharon Bailin (1985), of creativity in critical thinking because of the need to be creative in developing experiments to test hypotheses, examples and counter-examples, etc. Presumably the inclusion of creativity in this way would be a part of most approaches to critical thinking.

A third key feature of the CTAC definition is the explicit elaboration of dispositions and abilities (NCT). I commenced developing these originally (1959) by consulting the historical philosophical literature about good thinking (for example,

Plato, Aristotle, Francis Bacon, John Stuart Mill (1930), Cohen & Nagel (1934), and Max Black (1952), who in 1946 authored the first text named "*Critical Thinking*"); by asking the question, "In what ways can we go wrong when deciding what to believe or do?"; and by organizing the results.

This connection of a concept of critical thinking (the definition) with a detailed conception of critical thinking (NCT) is an important feature of the Wisdom CTAC Program. The conception is where we really see what the approach is all about. The details provided in NCT provide a ready-made structure for the first-year introductory critical thinking course.

3.2.3. Departures from Dewey. Definitions of note that are not directly in the Deweyan tradition include "persuasive thinking (various proponents); and "metacognition", more specifically, "thinking about your thinking while you are thinking in order to make your thinking better" (Richard Paul, n.d., p. 7). The trouble with persuasive thinking as a definition is that many persuasive moves are fallacious. The metacognition definition captures an important mental process that should often be going on while thinking critically but it does not reasonably constitute critical thinking. One could engage in metacognition and yet think quite fallaciously.

A rather different approach to the meaning of "critical thinking" includes all concepts used in making a decision. Under this view, *cell* is a critical thinking concept, as Gerald Nosich once urged in a televised discussion he and I had. I hold that *cell* is not a critical thinking concept, though it is a very important concept in biology. If we allow our conception of critical thinking to include every concept involved in making decisions about what to believe or do, then *critical thinking* itself would be a much less useful concept. By including everything, it loses focus and includes whatever we teach, no matter what it might be. The conception of critical thinking in NCT does not make *cell* a critical thinking concept.

3.2.4. Politically-motivated definitions. It is politically important for us to address certain definitions because they make critical thinking look bad in the eyes of the public. Some definers use "critical thinking" as a label for things they oppose. One such definition is "negative thinking" (Michael Roth, 2010). Roth takes one of the dictionary meanings of "critical", combines it with "thinking", and uses it as a label for much of the thinking that he sees in undergraduates, negative thinking. He then proceeds to offer his alternative approach to higher education.

Another is "race-class-gender reductionism", which Peter Wood (President of the National Association of Scholars) in a January 4, 2012 communication on AILACT-D[2], mistakenly I believe, claims is "the meaning [of "critical thinking"] that prevails in American higher education". Wood holds that the advocacy of what he calls "race-class-gender reductionism" is labeled "critical thinking" by its advocates in the humanities, and he challenges that movement under that label.

Neither of these politically-motivated definitions represents thinking that is advocated by the definer. Actually in other communications Wood does advocate what we in the field of critical thinking tend to think of as critical thinking, but he

[2] "AILACT-D" is the internet discussion list of "Association for Informal Logic and Critical Thinking".

does not call it "critical thinking". I do not think that either Roth's or Wood's definitions are serious contenders for the concept of critical thinking used in the media, in higher education mission statements, in critical thinking tests, or by people who consider critical thinking as their field of study. But we must make that clear when the question arises.

John McPeck's "reflective skepticism" (1981, p.8) sounds as if it is in the negative thinking camp. But as he develops it, it seems to be similar to the mainstream definitions with the restriction that its significant aspects apply only to specific subject-matter areas, because according to McPeck, there are no significant general critical thinking principles.

To summarize this discussion of critical thinking definitions: The definition underlying the Wisdom proposal, which is in the Dewey tradition, seems to capture what is generally meant by "critical thinking", refers to an important and useful process, and is directly associated with a detailed conception (NCT) consisting of important and useful concepts, principles, and criteria in making decisions about what to believe or do.

3.3 Breadth of the goal of critical thinking instruction

Should the goal of critical thinking instruction be to teach students so that they will think critically in a subject or topic they are studying, or also in all aspects of their present and future vocational, civic, and personal lives -- requiring transfer? Most public endorsements of teaching critical thinking assume that the ultimate goal should be the latter (e.g., Casserly (2012), college mission statements, Arum & Roksa (2011)). But in my experience many subject-matter teachers actually promote critical thinking only within the subject matter, if they promote any critical thinking. Some assume that the critical thinking they are teaching will *automatically* transfer to daily life and to other subjects. Some are not concerned about the daily-life critical thinking goal for higher education, and some just believe that teaching critical thinking for transfer to other areas is not their job.

The goal of teaching critical thinking in the Wisdom CTAC is not merely teaching students to think critically in their college subjects, although such teaching is a good idea. The goal is also to teach people to think critically so that they will extend it to their everyday lives, including situations that are not even covered by the subjects they studied, such as choosing political candidates in elections, buying insurance, deciding whether to join Facebook, dealing with the taxing authorities and understanding the complicated rules for taxation, raising children, and getting along with one's fellow workers and neighbors. This issue about the application of the goal to present and future vocational, personal and civic experiences is an issue that is often neglected in debates about the importance of incorporating critical thinking in the offerings of an educational institution. The potential life-long application of critical thinking is an important justification for the Wisdom CATC Program.

3.4 Subject (or domain) specificity of principles and concepts in critical thinking

Some people interested in teaching critical thinking (for example, John McPeck, Susan Carey, Lauren Resnick, and Robert Glaser) hold that all critical thinking is subject- (or domain-) specific, so it must be embedded in subject-specific instruction, implying that it is a mistake to have a separate general critical thinking course of the sort I envision for the freshman year. To deal with this view I have found it helpful to distinguish between two kinds of subject-specificity (1989, 1990), conceptual subject-specificity and empirical subject-specificity, and argue that neither kind rules out a separate critical thinking course.

3.4.1. Conceptual subject-specificity. Conceptual subject-specificity is the view that there are no non-trivial general principles of critical thinking at all, and that all significant critical thinking principles are specific to the subject, domain, discipline, field (e.g., John McPeck, 1981, 1990), or some other vague label. I use "vague" pejoratively here because I have seen no plausible ways to distinguish among subjects, domains, disciplines, or fields in a way that makes this subject-specificity claim plausible. For example, are statics and dynamics each a separate domain that shares no significant critical thinking principles with the other, or are they sub-domains of mechanics? Are mechanics and electricity domains, or is each a sub-domain of pre-relativistic physics? Is physics a different domain from science? Which of these is it that allegedly has its own critical thinking principles and shares none of them with other domains? How do we tell?

On the other hand, is physics a different domain from sociology or English literature? All three employ hypotheses that can appropriately be judged by argument-to-best-explanation[3] criteria, making the arguments for their hypotheses of the "same logical type", which is Stephen Toulmin's (1964, p. 14) criterion for being the same field. John McPeck (1981, p. 32) used Toulmin's claim that argument standards are "field dependent" to support his own subject-specificity claim. But would anyone want to say that physics, sociology, and English literature are the same field? The notions of subject, domain, discipline, and field are too vague and elusive to make conceptual subject-specificity a meaningful view.

A second problem with conceptual subject-specificity is that there really are significant general critical thinking principles. For example, two general argument-to-best-explanation principles are these: 1) the principle that a hypothesis should not be endorsed if there is a plausible alternative explanation, and 2) the principle that, before a hypothesis is endorsed, a competent sincere effort should have been made to find supporting and opposing data and to seek alternative hypotheses. The following two general principles apply to judging the credibility of sources: 1) the credibility of a source tends to be weakened if the source has a conflict of interest, and 2) the credibility of a source tends to be weakened if the source does not have experience in the field. No matter how one distinguishes domains, fields, subjects, and disciplines, these four significant principles apply widely across them.

[3] Mark Battersby (2006) has justifiably suggested "argument to best explanation" as a more accurate label for what is often called "inference to best explanation".

3.4.2. Empirical subject-specificity. Empirical subject-specificity is the view that critical thinking principles learned in one situation will as a matter of empirical fact not transfer from that situation to another type of situation (for example, to other subject areas, or to everyday life). This is an empirical factual claim, not a conceptual one. This position was advocated by Robert Glaser (1984). An expansion of it was expressed by a Review Committee of the National Academy of Education chaired by Glaser (1987), which in addition urged the development of subject-specific critical thinking tests. (Though it has barely been implemented, I think that the development of subject-specific tests is a good idea.) But the Committee opposed trying to develop general critical thinking tests. This last recommendation does not make sense if there are significant general principles of critical thinking such as the four examples above, and if the transfer principle is correct.

Most of my colleagues in educational psychology tell me that transfer can generally occur if -- but only if -- we teach for it. This is a short version of the basic transfer principle underlying the institution-wide approach to critical thinking that I recommend. But one must be sensitive to a range of exceptions. Some students have difficulty transferring, no matter what, while some very bright students make the transfer with little or no help.

If empirical subject-specificity were a correct position, then critical thinking taught in one discipline would not help us in other disciplines, nor in our daily lives. For example, the principle that I should generally take at least three readings when making an observation in a physics laboratory, which I learned in a freshman physics course at M.I.T., would not be applicable to my attempts to determine roughly how long it takes me to walk the one-mile circle around my neighborhood. Furthermore, in order to learn that principle so that I could apply it in a course in community planning, it would have to taught in such a course. And I would not be able to apply it in my everyday life interest in traversing my neighborhood. That seems far-fetched.

In sum, the proposed Wisdom CTAC Program is not vulnerable to the subject-specificity charge, whether interpreted conceptually or empirically.

3.5 Infusion vs. immersion

In a discussion of the subject-specificity of critical thinking (1989), I suggested that the labels, “infusion” and “immersion”, be applied to two different approaches to embedding critical thinking in subject matter instruction. Infusion calls for *making the critical thinking principles*, *etc., explicit*. Immersion calls for *leaving the principles implicit*. In infusion, students sometimes are the ones who make the principles explicit, perhaps at the invitation of the instructor, or the instructor makes them explicit, which is usually the case. But the instructor must assure that the principles are clear and explicit no matter who expresses them. I advocate the explicit-principles approach, infusion – at least until it is very clear to all which principles are in operation. I support this explicitness in order to facilitate the transfer of critical thinking to other contexts by providing something clear to students that they can remember. It is the approach recommended in the Wisdom CTAC program.

In teaching critical thinking by immersion, no effort is made by the instructor to assure that critical thinking principles are made explicit, although there can be heated discussion of issues. Although he did not call it "immersion", it is the approach endorsed by John McPeck (1990). In my experience the immersion approach generally fails to transfer critical thinking to other subjects or everyday life. Some students manage to transfer, but most do not.

3.6 The Impact of critical chinking instruction on the learning of subject matter

The incorporation of critical thinking in a higher education curriculum is sometimes regarded as a threat to subject matter instruction, either because overall it takes time away from attention to existing subjects, or because it is thought to reduce the subject matter coverage in a particular subject in which critical thinking is supposed to be embedded. These are complicated curriculum problems because they involve 1) judgments about what is important in education and 2) empirical factual judgments about what happens when students are involved, and about what involves them. Both of these types of judgments are complex.

With respect to judgments about what is important in education, the broad Wisdom CTAC position is that both subject matter and critical thinking are important. I will leave it at that, although there is much more to be said about it.

With respect to the empirical judgments about what happens when critical thinking is (let us assume) infused by way of dealing reasonably with issues in a particular subject, the *apparent* amount of subject matter *coverage* will be reduced. But if the students are involved, they might actually spend more time and effort on the subject and actually cover more subject matter. In a given course they might learn and retain more subject matter.

We are all familiar with the phenomenon of taking a large lecture course, reading a thick text book, cramming for the examinations, and remembering practically none of it years later. This happened to me in an undergraduate political science course from which I remember only the idea that power was important And even that experience might not be responsible for my now knowing that power is important, it being so obvious from my following of current events. If critical thinking had been embedded in discussing and disagreeing about issues in that course, I believe I would have remembered more about the issues.

Of course one case does not prove. Research is needed. The three studies of which I am aware that deal with the question show no reduction of content learning, and one of them showed greater total content acquisition. In Tom Solon's (2007) study in a higher education situation, retention of psychological content did not suffer when critical thinking was infused. In S. L. M. Winocur's (1981) and C. R. Lumken's (1990) high school and middle school studies of reading and social studies respectively, subject matter improvement did not suffer from the infusion of critical thinking instruction. But much more research is needed on this crucial question. These barely touch the surface.

Before leaving the topic, I would like to relate an anecdote and some testimony that bear on it. The anecdote is from my experience as a high school teacher of general science.

In this course I taught Newton's first law of motion, the law that a body in motion tends to stay in motion in the same direction and at the same velocity unless acted on by an external force. However, most of my students held the Aristotelian notion of motion: a body in motion tends to slow down and fall to the ground. The Aristotelian theory seemed best to fit students' experience when, for example, delivering newspapers by throwing them from moving bicycles, and when throwing things from moving automobiles. The things thrown would seem to curve back (slowing down) and drop to the ground. I suggested that air resistance and gravity explained why these object slowed down and fell to the ground. A heated discussion ensued. We conceived of an experiment to investigate the question. It was to throw a ball about two feet straight up while riding as a passenger in a closed car (where there is no air resistance to the ball's forward progress), and see whether it moved toward the back of the car. We all agreed to try it that weekend at least three times and report back our results.

The following Monday we reported our observations, which were consistently that the balls did not seem to move to the rear of the cars when thrown straight up. Of course some students were suspicious that this was a fluke, but the discussion and experiment made a deep impression on them and me. We obtained evidence regarding this law of Newton's, though I would not and did not claim conclusive proof of Newton's law from this one experiment, at least partly because of the plausible alternative explanations (an important critical thinking consideration) that we threw the balls slightly forward without realizing it, and that the balls did move to the rear but not enough for us to so observe in that small space. Some students reported much later that they remembered the whole experience (including Newton's law, planning the experiments, and noting possible alternative explanations), as do I.

As teacher, I could have used the time we spent planning the experiment to cover more subject matter. But the experience of planning experiments to test propositions in doubt, repeated observation, alertness for alternative explanations, and the remembering of Newton's law were I believe better uses of our time.

The testimony I mentioned arose in a critical thinking research project, when I was working with a physics teacher, Carl Burgener, at what was then the Niles Township High School in Skokie, Illinois. He had extensive experience infusing critical thinking in his subject matter, and asserted that the critical thinking work that he was doing with his students was helpful in their learning the subject matter, more helpful than more coverage of the text book would have been.

These anecdotes, testimony, and the three research reports certainly do not establish the point that greater retention, or at least as much retention, of subject matter occurs when critical thinking is infused in subject matter instruction. No doubt it depends to some extent on the ratio of the amounts of time and effort, as well as the subject matter and student interests. But I have at least driven a wedge into the common assumption that infusing critical thinking into subject matter instruction automatically reduces coverage and retention. Much more research is needed, with extensive variation of the variables.

4. SUMMARY

There are philosophical, institutional, conceptual, and cultural issues involved in implementing a program of critical thinking across the curriculum. What I hope to have contributed is an examination of a number of controversial issues and distinctions, and, taking the positions that I have on these issues, a possible approach to critical thinking across the curriculum, the Wisdom CTAC program.

Although there are many other assumptions that have contributed to the development of this Wisdom CTAC proposal, the resolution of the following issues and distinctions seems crucial in the current academic climate:

1) The choice among having a separate critical thinking course vs. the embedding of critical thinking in subject-matter courses vs. doing both. The Wisdom CTAC uses both.
2) The meaning of "critical thinking". The Wisdom CTAC assumes "reasonable reflective thinking focused on deciding what to believe or do", accompanied by a detailed conception of critical thinking.
3) The breadth of the goal of critical thinking instruction. The broad goal, critical thinking in everyday life and in specific subjects, is assumed in the Wisdom CTAC program.
4) The alleged subject-specificity (or "domain-specificity") of critical thinking. When the appropriate distinctions are made, the subject-specificity position will be shown defective, whether it be conceptual subject-specificity or empirical subject specificity.
5) Infusion vs. immersion. Wisdom will encourage infusion.
6) The impact of critical thinking instruction on the learning of subject matter. I believe that subject matter need not suffer, and is more likely to be retained in the Wisdom CTAC program.

Given my suggested resolution of these issues, I have developed a Wisdom University proposal for teaching critical thinking across the curriculum. I do not claim that it will be easy to implement. Changes are always difficult. But any proposal must come to grips with these distinctions and issues and defend its choices.

I certainly hope that one goal that other institutions will emphasize includes the application of critical thinking to our everyday lives. When seen from a life-long perspective, the value of teaching critical thinking in our educational system can not be overestimated.

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