



Title:Fostering critical thinking through effective pedagogy: evidence from four institutional case studies.

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Although Americans today are more highly educated than ever before, they are not necessarily better educated. In this country formal education largely entails knowledge building through subject matter content coverage. Unfortunately, this often comes at the expense of skills building. Rather than devote so much effort to teaching students what to think, perhaps we need to do more to teach them how to think. Higher-order cognitive skills, such as the ability to think critically, are invaluable to students' futures; they prepare individuals to tackle a multitude of challenges that they are likely to face in their personal lives, careers, and duties as responsible citizens. Moreover, by instilling critical thinking in students we groom individuals to become independent lifelong learners--thus fulfilling one of the long-term goals of the educational enterprise.

A preponderance of evidence from the research literature on critical thinking suggests that significant gains in critical thinking are both perceived (Astin, 1993; Pace, 1974; Terenzini, Theophilides, & Lorang, 1984; Tsui, 1999) and experienced by college students (Dressel & Mayhew, 1954; Keeley, 1992; Keeley, Browne, & Kreutzer, 1982; King, Wood, & Mines, 1990; Klassen, 1983; Lehmann, 1963; Mines, King, Hood, & Wood, 1990; Pascarella, 1989; Spaulding & Kleiner, 1992). Yet, many consider the level of critical thinking displayed by students to be inadequate. Norris (1985) noted that competence in critical thinking is lower than it should be at every stage of schooling. In a study by Keeley, Browne, and Kreutzer (1982), seniors outperformed freshmen in analyzing articles through an essay response format despite showing "major deficiencies" in their performance. For instance, 40-60% of the participating seniors could not provide a single example of a logical flaw, significant ambiguity, or misuse of data, when asked to assess a written passage containing several such errors. Using the same data source, Keeley (1992) found both freshmen and seniors exhibiting "poor performance" at identifying assumptions. In a study involving 874 sociology students, Logan (1976) concluded that those at every level (from freshmen to graduate students) scored "very low" in critical thinking as measured by a test to assess students' abilities to recognize uncritical or unsound thinking.

Research can and should assist faculty in their efforts to nurture students' abilities to think critically. As yet, however, little substantiated knowledge on effective pedagogy comes from research on critical thinking. Very few studies on critical thinking among college students examine the impact of instructional factors (see Tsui, 1998b). Limited efforts to investigate the effects of specific teaching techniques may stem from the difficulty of attaining direct indicators; studies that address classroom experiences tend to rely on self-reported data rather than observational data. Among the research that examines the influence of instruction on critical thinking, the focus on pedagogy varies. Moreover, studies addressing the same teaching elements have yielded some conflicting findings. Consequently, little consistency emerges from the empirical research literature as to specific instructional techniques that effectively enhance students' abilities to think critically (McMillan, 1987; Tsui, 1998b).

In a 1995 study by Terenzini, Springer, Pascarella, and Nora, critical thinking, as measured by scores on the critical thinking module of the Collegiate Assessment of Academic Proficiency (CAAP), was found significantly and positively related to only a few classroom and instructional experiences. Once students' pre-college level of critical thinking was controlled for, however, only hours per week spent studying remained statistically significant.

Smith (1977, 1981) found three kinds of instructor-influenced classroom interactions to be consistently and positively related to gains in critical thinking (as measured by the Watson-Glaser Critical Thinking Appraisal and the Chickering behavioral self-report index): the extent to which faculty members encouraged, praised, or used student ideas; the amount and cognitive level of student participation in class; and the amount of interaction among students in a course. In a study by Terenzini, Theophilides, and Lorang (1984), students' level of classroom involvement was found to exert a significant and positive effect on an academic skills measure that included aspects of critical thinking. Unfortunately, in reporting the results of this study the nature of the classroom involvement composite variable was not clearly specified. Analyses of data drawn from a national sample of college students by Astin (1993) and Tsui (1999) revealed that self-assessed growth in critical thinking is positively related to such instructional factors as having a paper critiqued by an instructor, conducting independent research, working on a group project, giving a class presentation, and taking essay exams; negatively related to this outcome is taking multiple-choice exams. In a recent study on campus culture and critical thinking, successful development of students' critical thinking skills was linked to an emphasis on

cooperative exploration of knowledge and divergent thinking (Tsui, 2000).

On the whole, research studies on critical thinking have not displayed great variation in research design. There appears to be an overwhelming reliance on quantitative data of a certain sort. More specifically, researchers tend to use standardized multiple-choice tests to measure critical thinking and students' responses on questionnaire surveys to measure classroom and out-of-class experiences. Yet, any single research method is necessarily limited in its capability and endowed with its own particular shortcomings. For example, the common use of such standardized tests as the Watson-Glaser Critical Thinking Appraisal and the Cornell Test of Critical Thinking to measure critical thinking is not without its own weaknesses and limitations (Berger, 1985; Helmstadter, 1985; Modjeski & Michael, 1983).

Valued research knowledge comes largely from the accumulation of contested and confirmed findings culled from skillfully conducted studies that are diverse in methodology. This study contributes to research on critical thinking by expanding the type of approach traditionally taken to investigate this subject. In this study, involving comparative institutional case studies, I employed qualitative methods to tap multiple sources of data. This led to rich contextual evidence of the types of pedagogy that are associated with the reported enhancement of students' abilities to think critically.

Research Methods

Data Collection

In this study the relationship between pedagogy and critical thinking development is treated as one that is not divorced from its environs, but rather intricately linked and dependent upon it. An institutional case studies approach was adopted in the hopes of attaining a fuller understanding of the influence of pedagogy on students' cognitive development. A comparative analysis of instructional differences found at four distinct institutions illuminates the workings of various constellations of factors and reveals how the influence of a single factor may vary according to the presence or absence of certain other elements within the same learning environment.

Qualitative data were collected through a series of site visits to four purposefully chosen case study institutions between October 1996 and May 1997. The bulk of the data come from classroom observations and interviews. A minimum of one administrator, five professors, and five students were interviewed at each institution. Prospective interviewees were randomly contacted from phone and e-mail listings. Attempts were made to solicit voluntary interviewees from among individuals who participated in the classroom observations. In sum, fifty-five individual interviews took place at the four sites. The interviews, which on average lasted an hour, were each audio-taped and transcribed verbatim. These semistructured interviews entailed predominantly open-ended questions. Here are three examples drawn from the interview protocol: "To what degree and in what ways do you find yourself involved in the classroom?" (Prompts: Do you volunteer answers, pose questions, or challenge statements made?); "How do you think students' abilities to think critically have been impacted by the education they receive from this college?" (Prompts: Degree of change? If change, what are the factors inside and outside of the classroom that you believe cause this change? How is this change demonstrable to you?); and "In your time here what specific experiences, if any, have enhanced your ability to think critically? Describe in-depth the nature of these experiences." (Prompts: Types of classes, teaching practices, or extracurricular activities?).

Because of the potential vagueness and varied interpretations that may surround the use of the term "critical thinking," this study's operational definition of this concept was clearly conveyed at the beginning of each interview. Interviewees were informed that for the purposes of this study, "critical thinking" refers to "students' abilities' to identify issues and assumptions, recognize important relationships, make correct inferences, evaluate evidence or authority, and deduce conclusions." This definition is borrowed from the manner in which researchers typically operationalize critical thinking (Furedy & Furedy, 1985). The definition adopted here is less inclusive than that advanced by some theorists. For example, more encompassing definitions may specifically include aspects of problem solving. Indeed, strong arguments can be made about a close connection between problem solving and critical thinking (Ennis, 1987; McPeck, 1981; Siegel, 1988). In this instance the choice of an operational definition that does not specifically include "problem solving" was largely motivated by the fact that on the national survey questionnaire from which data were derived in selecting this study's case study sites, respondents were asked to self-assess their growth in "the ability to think critically," in addition to being asked to self-assess their growth in "analytical and problem-solving skills." If aspects of problem solving had been clearly made part of this study's operational definition of critical thinking, it is likely that the focus of this study's findings would have expanded from an emphasis on the relationship between literacy skills and critical thinking to one that included an emphasis on the relationship between numeracy skills and critical thinking.

At the four case study institutions a total of 28 classes were observed on a one-time basis for a fifty-minute period. To compare and contrast a variety of classes, a roughly equal number of courses at varying levels were

sampled from the physical sciences, social sciences, and humanities. Descriptions of the categories of quantitative data retrieved appear in Appendix A.

Two focus group interviews were conducted. One occurred at School B at the conclusion of a class that I was observing, and the second at School D during break time of a seminar course that I was observing in a professor's home. Most of the questions posed were drawn from the interview guide used in the individual interviews and augmented by questions that arose from the preceding classroom observations. In addition, relevant documents and artifacts were gathered and analyzed at each site. Such materials included books, almanacs, admission catalogs, website information, issues of the student-published newspaper, and class handouts. Finally, informal conversation interviews were conducted wherein contact was made with additional participants who could provide further information on a relevant issue of interest.

Case Study Sites

The primary criterion whereby the four case study sites were chosen is linked to an analysis of some national data pertaining to critical thinking. In a related study that analyzed data gathered from over three hundred higher education institutions through the Cooperative Institutional Research Program (CIRP), a positive correlation of 0.56 was found between an institution's selectivity and its score on a measure that reflects the average self-perceived change in critical thinking reported by students at that institution (Tsui, 1998b). Referred to as institutional growth in critical thinking, or IGCT, this variable was calculated from responses to a question that asked students to self-report the amount of change they felt they had experienced in the "ability to think critically" since entering college. Possible responses to this question were "much weaker," "weaker," "no change," "stronger," and "much stronger." The substantial correlation cited indicates that greater gains in critical thinking are more likely to be reported by students attending selective institutions than by those attending less selective institutions. This is consistent with past studies that show students at selective institutions, and in particular those at selective liberal arts colleges, are more likely to both perceive and experience greater growth in complex cognitive skills (Braxton & Nordvall, 1985; Pace, 1974, 1984; Winter, McClelland, & Stewart, 1981).

In an attempt to study factors that are related to the development of critical thinking skills but are not contingent upon an institution's selectivity, I deliberately sought to separate institutional selectivity and IGCT in the case study site selection process. These two dimensions juxtapose one another in Figure 1. An institution falling into each of the four quadrants was chosen for inclusion in the sample. As the matrix scheme indicates, case study sites included two institutions with a high institutional mean in student self-assessed growth in critical thinking (one high and the other low on institutional selectivity), and two institutions with a low institutional mean in student self-assessed growth in critical thinking (one high and the other low on institutional selectivity).

Because institutional size might affect critical thinking development, sites with similar student body size were selected. Each participating institution has a student body population of less than 5,000 and enrolls primarily full-time students. The average SAT score of students at the low selectivity institutions (Schools A and B) is about 1000, while that at the high selectivity institutions (Schools C and D) exceeds 1300. Schools C and D are considered residential institutions, whereas Schools A and B enroll relatively high proportions of commuter students. School A is a public institution that offers an alternative education, one reputed to be based on "reform and innovation." School B is a private institution that offers a comparatively traditional curriculum. School C is a private institution with a strong curricular emphasis on math, science, and engineering. And, finally, School D is a private liberal arts institution.

In a related study, which investigates the relationship between campus culture and critical thinking development (Tsui, 2000), an epistemological orientation that promotes cooperative exploration of knowledge and divergent thinking, higher levels of student responsibility and self-reflection, and greater social and political awareness were found at the two high IGCT institutions (Schools A and D) in comparison to the two low IGCT institutions (Schools B and C). In another related study, which examines faculty attitudes and critical thinking development (Tsui, 2001), greater degrees of faculty enthusiasm for teaching and faculty perception of teaching as a process of mutual learning were detected at the high IGCT schools relative to the low IGCT schools. Furthermore, low faculty confidence in students' abilities and potential was identified as a serious impediment to critical thinking development efforts at the low selectivity, low IGCT institution.

Data Analysis Strategies

The dominant mode of data analysis chosen for this qualitative case study research was that of "explanation building," wherein the researcher strives to identify causal links and/or explore plausible or rival explanations in the attempt to construct an explanation about the case (Yin, 1989). Through repeated review of all interview transcripts and observational notes, patterns and regularities were identified, and in turn, appropriate categories were devised. The clustering of such categories generated themes from which conclusions were drawn.

A number of verification procedures were undertaken. Triangulating data from various sources of information and methods of data collection resulted in the solidification of findings by allowing for the convergence of results from multiple data sources and by offsetting some of the inherent bias found in any single data source or method. Data that conflicted with emerging patterns were vigilantly searched for, documented, and analyzed. Where strong and substantial exceptions and discrepancies could not be justifiably reconciled, tentative concepts or hypotheses were either modified or eliminated. The procedure of "member checking" was utilized within interviews and with key informants in an attempt to attain validity of recorded data and tentative interpretations. Because of my knowledge of the IGCT status of the four institutions prior to data collection, I recorded my expectations and assumptions at the beginning of the study in order that they could be included in the subsequent data analysis.

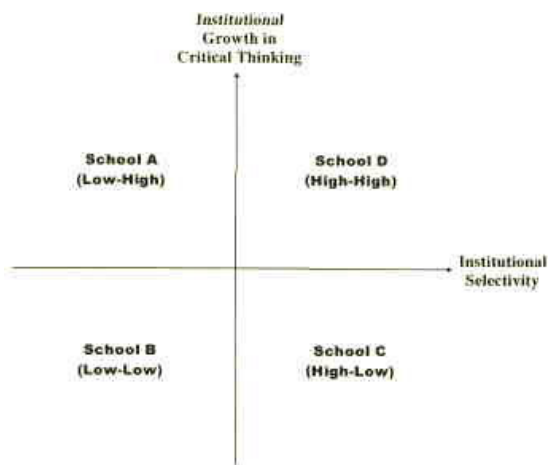


FIG. 1. Selection Criterion for Case Study Sites

NOTE: The variable institutional growth in critical thinking appears on the vertical axis, while the variable institutional selectivity appears on the horizontal axis. To preserve confidentiality, each case study site is represented by an assigned letter.

Findings

Writing

Evidence derived from the case studies suggests that the development of critical thinking is likely to be linked to an emphasis on writing and rewriting. At both institutions that scored high on IGCT (Schools A and D) there is a strong focus on writing that is conspicuously absent from the two that scored low on IGCT (Schools B and C). When asked about possible academic factors that might be influencing the development of critical thinking skills, several of the interviewees at School A (low selectivity, high IGCT) spoke about the hefty amount of writing that is assigned to students. Given the bloated size of classes at many higher education institutions, multiple-choice examinations have become commonplace. Yet, at School A writing assignments are prevalent and multiple-choice examinations are rare. This is due in part to a curricular policy that stipulates that teaching writing be an integral part of all course programs (which are each taught by a multidisciplinary team of faculty members). Most course programs also have a writing workshop component, which entails students reviewing and providing feedback on one another's draft papers. Assessing the work of others may be conducive to the practice of critical thinking skills as students attempt to comprehend and critique material. Moreover, the rewriting process appears to stimulate students to think more deeply about their own written product and to utilize peer feedback to improve upon it. At School A another instance of how an emphasis on writing and critical thinking is linked can be found in the customary last assignment of a course program--a written self-evaluation in which students are prompted to reflect critically upon their performance and growth.

Similar to School A, an emphasis on writing is formally grounded in the curriculum at School D. Students at School D (high selectivity, high IGCT) are required to take two courses each in the natural sciences, social sciences, and humanities that emphasize writing and that are in conjunction with the Writing Tutor Program on campus. In these courses a student writes a paper, meets with a student tutor to discuss changes, reworks the paper, and then submits both the original and revised paper to their professor. This "two-step process"--which allows one to work on writing within the context of a particular discipline and to utilize criticism in refining one's own work--is likely to invoke greater practice of critical thinking skills by students than the traditional single-step writing assignment.

The strong writing orientation found at the two high IGCT institutions does not simply entail plentiful writing and rewriting, but also a focus on the synthesis, analysis, and refinement of ideas through the medium of writing. Because of a premium placed on critical analysis, writing assignments typically ask students to demonstrate more than a mere understanding of someone's work. One School D professor offered an example to illustrate how the

rewriting process allows students to integrate ideas and improve upon their own thinking and writing:

A senior came and wrote a paper for me...I decided it was crap. He was outraged because he thought he was a very bright student. I told him why: I thought it was superficial and not well argued. And I think it must have triggered something because he did about six or seven versions of it, and finally he got the award for the best paper in the department for seniors that year. And my colleagues all agreed that he produced a first-rate work that had these critical thinking skills in it. There are other instances like that where I see students working on their theses since the fall. In seminars students write their papers and get feedback. In economics, they tell them to rewrite papers for journal review.

In contrast, writing is not emphasized at the two low IGCT schools. Unlike the two high IGCT schools, neither School B nor C has any curricular policy pertaining to writing requirements. Classroom observations at the two low IGCT institutions did not uncover any instances in which class time was devoted to peer exchange and feedback on writing, unlike in the cases of the two high IGCT institutions. At School B (low selectivity, low IGCT) student performance is commonly assessed by multiple-choice examinations rather than writing assignments. Only one School B student mentioned writing when asked about classroom factors that influence critical thinking skills.

At School C (high selectivity, low IGCT), where the curriculum revolves around math, science, and engineering, homework and examinations tend to entail work problems rather than writing assignments. Recognizing this fact about his institution, a non-science faculty member at School C reported feeling an added need to work with students on writing. He explained that although School C students were very bright and capable, he found their writing skills to be far weaker than those of students at less selective institutions where he had taught. The faculty members I interviewed at School C generally reported doing little to incorporate writing in their courses. One professor explained that the short duration of a single term made it "practically impossible" to assign research papers. Another professor reported that when he first started teaching he did assign writing assignments or research papers, but he stopped doing so because students seemed rushed and did not appear to spend enough time on such assignments.

They are probably not getting enough writing assignments. But it just didn't seem worth it. And I sort of didn't want to correct grammar. I do that for my graduate students because it is part of that professional training, and it reflects on me. With the undergraduates it does not reflect on me, but only indirectly.

School C highlights the fact that some instructors may not undertake the development of critical thinking through an emphasis on writing because it demands additional time and effort. As Schools A and D illustrate, this commonly entails reserving time to devise constructive assignments; designing in-class opportunities for students to share drafts of their work and receive peer input; and, reading, evaluating, and providing substantive feedback on papers. The case of School C suggests that a curricular emphasis on writing comes about more readily in some disciplines (e.g., humanities and social sciences) than in others (e.g., math, science, and engineering). This, however, can be overcome as demonstrated by the successful efforts at Schools A and D to stress writing across the curriculum. For example, while science faculty members at these two high IGCT institutions do give out work problems, many also assign term papers and construct tests that utilize a short essay response format.

Class Discussion

Another classroom factor that appears to be related to the development of critical thinking skills is an emphasis on class discussion, which exists at the two high IGCT institutions but not at the two low IGCT institutions. At School A class discussion is a fundamental feature of the seminar component of each course program. This active learning approach might be facilitating critical thinking development by encouraging students to verbalize and try out ideas. One student spoke about how an emphasis on class discussion at School A affords her opportunities that were inaccessible at her previous institution.

Well, all I can do is compare it to community college, where sometimes I would be in lecture and I really wanted to say something, and I couldn't because it was a lecture. And I would want to ask a question, make a comment, or make a correlation, and I wouldn't because I would feel like it was not appropriate. And here I feel that it is. And so the development of ideas is really encouraged.

Class discussion is reportedly much embraced by students at School A, as explained by the following student:

Students prefer seminars where they talk with each other and are allowed to form their own opinions as opposed to being lectured to and opinions are forced down their throat. There is definitely this matter of trying to develop yourself, ... a very individual bent. This school really emphasizes community and the importance of individual opinions simultaneously.

Likewise at School D much evidence emerged to support a relationship between class discussion and the development of critical thinking skills, as some interviewees cited the former as a "crucial factor" to the latter. A student at School D explained why he feels class discussion is related to critical thinking.

The difference of being here and educating yourself is the exchange with other people.... On the one hand you feed off of other people's observations and they can complement and enrich your own. But it is also the need to drive other people's thinking that way. To reciprocate this kind of exchange forces you to be more critical and analytical in terms of whatever you are doing. And that is facilitated when you read other people's papers as opposed to it being just between professor and student.

Another School D student explained that she had come to value critical thinking more since entering college because of ample opportunities to discuss and disagree with her peers. "I find myself more engaged with the thoughts of my peers, ... giving more validity to what my peers say.... And, to really think about why I don't agree with what they say ... and to push myself beyond yeah or no." Another School D student offered an explanation as to why discussion-based courses are more effective than lecture-based courses in promoting critical thinking. He reasoned that with the former "you have to focus the whole time and really pay attention, ... even while you are writing notes you have to be thinking of questions and making sure you know what is going on," while with the latter "you don't have to be able to talk about it right then; ... you can be sort of asleep and just write down what she is saying; ... you don't have to really process it in a way."

Such emphases on class discussion are in contrast to what is found at Schools B and C, the two low IGCT institutions. Though the courses that I observed at School B were generally small, the most common mode of instruction witnessed was lecture, with the majority of class time taken up by a professor's efforts to impart information to students. The perceptions of interviewees generally offered further evidence that most courses at School B are lecture-based. Students are not engaged in class discussions more frequently, explained one student, because the interruption of a lecture by student input is not always seen as helpful.

Well you have to get through the material. You need to know the stuff that is taught on the syllabus. And those kinds of [student] interjections, while they can be beneficial to the rest of the class, sometimes aren't. And a lot of times they confuse the direction of the course or the lesson of the day.

A School B professor offered an explanation as to why some students are simply unwilling to participate in class discussion:

Students are afraid of give and take because they don't have much to give, because again, most of them are poorly read.... So they are not too terribly challenging generally.... Maybe the problem is they are afraid of making themselves look foolish in front of their peers.

The lecture format also appears to be the most common approach to conducting class at School C. As at most institutions, science courses, especially the lower level ones, in comparison to non-science courses, tend to be larger and entail more lecturing than discussion. For example, one School C professor estimated that he devotes about three-fourths of class time to lecture, and remarked that "there is a fine line between interactive monologue and lecture." According to one student, professors at School C "tend to ask two or three questions per lecture or they won't ask any questions at all and wait for students to ask." According to another professor, students at School C represent "a very strange group," because although they are "incredibly smart, ... they do not think it is their role in life to get involved much in class discussions."

At School C the strong emphasis on lecturing appears to be in part driven by some instructors' desires to optimize course material coverage. Several professors explained that class time is usually devoted to presenting material not covered in the assigned reading or homework. Most of the faculty members I spoke with seemed to feel pressed for time to address all that they want to in a course. Concomitantly, students may be complicit in devoting time to lecture-supported content coverage instead of class discussion. The sentiment, "If you spend too much time asking people questions then you can't get through the material," voiced by one School C student was similarly expressed by a number of her peers.

Some School C students appear to refrain from speaking up in class for fear of disrupting the class. The majority of the students I interviewed prefer to ask questions of their professors after class rather than during class. One student explained that it is "more convenient" to do so since most questions asked in class are for "clarification" and he does not like to interrupt "the flow of lecture." Responding to my inquiry regarding classroom involvement, this student's comment typified those offered by her peers:

But then in something like math, there is really not much to be said, since the professor lectures. So unless you have a question--and if I do, I usually mark it in my notes as opposed to asking--unless you have a really relevant

question that you think a lot of people share, you will be wasting time and people will get really irritated with you if you keep like stopping him and he can't get through all the notes that day and it's just a mess. I ask directly after class--this is pretty much the standard way. After class there are usually eight or nine people up in the front wanting to clarify whatever was said.

Another student explained that he does not engage in class discussions more frequently because sometimes he feels it is not "safe" to do so. He reported that like many of his peers he is more "comfortable" consulting the teaching assistant than the professor, because the former "can't change a test score or give a bad recommendation."

Despite what appears to be limited opportunities for class participation, those School C students who participated in this study generally appear satisfied with the manner in which courses are conducted. The lecture format may be the preferred approach for many students, because not only does it allow the instructor to address more course material, but it also requires less psychic energy from students--a significant portion of whom are reported to engage regularly in the practice of staying up all night. School C students would more frequently raise questions and challenge mistakes made in class, according to one professor, if they were not so "overworked" and "burdened by the course load."

The classroom observation data, summarized in Table 1 below, on the whole support a higher incidence of classroom discussion at the two high IGCT schools (A and D) in comparison to the two low IGCT schools (B and C). The average class size at each institution is approximately 20 students or less. The average number of questions posed per class tends to be higher at the high IGCT institutions (15 and 15.7 at Schools A and D, respectively) than at the low IGCT institutions (13.7 and 7.6 at Schools B and C, respectively). In terms of proportion of questions that were posed by students (as opposed to the instructor), no trend was detected between the high and the low IGCT schools. The high and low IGCT institutions also did not consistently differ on the percentage of questions posed in discussion that elicited multiple responses. There was, however, quite a spread in the results for this category with a high of 30% for School D (high selectivity, high IGCT), and a low of 0% for School C (high selectivity, low IGCT).

The classroom observation data indicate that students at the high IGCT schools, in comparison to those at the low IGCT schools, were much more likely to respond to questions posed by their classmates. The percentage of questions posed by a student that were met by some kind of a response from a fellow student were 60% and 34% for the two high IGCT schools, and only 3% and 0% for the two low IGCT schools. Observations revealed a greater percentage of students participated in class discussions at the high IGCT schools (64% and 59%) in comparison to the low IGCT schools (33% and 29%). Students at the high IGCT institutions, in comparison to the low IGCT institutions, tended to make a greater number of challenging statements in class (averages of 4.3 and 1.4 in comparison to 0.1 and 0.5). Students at the high IGCT institutions also volunteered a greater number of comments in class than did students at the low IGCT institutions (averages of 6.3 and 4.7 in comparison to 1.1 and 0.8). Moreover, professors at the high IGCT schools, in comparison to those at the low IGCT schools, are more likely to compliment students for what they said in class (averages of 2.3 and 0.9 in comparison to 0 and 0.5).

The seemingly higher degree of class discussion found at the two high IGCT schools relative to that found at the two low IGCT schools is likely to be more than mere coincidence. Perhaps participation in classroom discussions encourages the exercise of critical thinking skills by allowing students to test out their ideas verbally, to reflect upon the views of one's peers, and to modify critically one's own views through incorporating feedback from others. This relationship appears to be recognized by those who teach at Schools A and D (the high IGCT institutions), for many of the professors there deliberately seek to elicit a high degree of class discussion in the courses they teach. In contrast, those teaching at Schools B and C (the low IGCT institutions) appear to do relatively little to promote class discussion. Comparative analysis of the case studies also suggests that seminar courses may be playing a vital role in the development of students' critical thinking skills. Seminar courses are more prevalent at the high IGCT institutions in comparison to the low IGCT institutions. Because seminar courses tend to entail smaller class sizes and to pursue focused concentration of subject matter, they are likely to be more conducive to intensive class discussion and writing assignments.

TABLE 1
Summary of Classroom Observation Data

	High IQCT Schools		Low IQCT Schools	
	A	D	B	C
Class size	20.3	18.2	13	19.3
Number of questions	15	15.3	13.7	7.6
Percent of questions by students	54	36	47	30
Percent of multiple responses	12	30	14	0
Percent of students responding to students	60	34	1	0
Percent of student participation	64	50	33	29
Number of student challenges	4.3	1.4	0.3	0.5
Number of volitional comments	6.3	4.7	1.1	0.8
Number of compliments by professor	2.3	0.9	0	0.5

Note: Figures presented in this table are classroom averages for the treatment. Descriptions of the above categories are found in Appendix A.

Discussion

While pursuit of innovative pedagogy that enhances students' critical thinking skills can certainly be beneficial, there is also a need to investigate how standard teaching methods can be modified and made more efficacious. This is important because, as some observers have pointed out, faculty are not more actively engaged in fostering critical thinking in students, because many view it as being time-consuming and risky (Haas & Keeley, 1998). Hence, widespread efforts to heighten students' critical thinking through instructional change are more likely to come about if they involve altering commonplace teaching techniques rather than radically replacing them. Because most college courses entail writing and discussion in varying degrees, it is especially worthwhile to study how such prevalent course elements can be effectively utilized to enhance students' critical thinking skills.

Rather than seeking to identify classroom factors that are statistically and significantly related to scores on critical thinking tests, as most studies in this area have strived to do, the focus of this particular study is on the contextual conditions surrounding certain instructional techniques that appear salient to critical thinking development. Although this study is limited from drawing any causal connections, ample evidence from this sample shows that emphases on certain types of writing assignments and class discussion are more commonly found at institutions where students report experiencing greater rather than less growth in critical thinking. Though further research is needed to substantiate a causal link between gains in critical thinking and these two instructional methods, the qualitative nature of this study yields significant insight into how and why these factors may be related to critical thinking development.

In the case of writing, both the amount of writing and the nature of the writing assignment seem to matter. Writing that is likely to be conducive to critical thinking is that which demands more analysis and less description. Furthermore, feedback on one's writing may further facilitate critical thinking, especially if it involves rewriting an assignment. This is because rewriting behooves students to take an added step in exercising critical thinking by utilizing feedback to refine one's work. As the case studies suggest, writing is likely to exert a greater impact on student cognitive outcomes when it is stressed throughout the curriculum. Consequently, an institution's success in fostering critical thinking may in part be contingent upon the degree to which faculty members from across disciplines can effectively incorporate writing assignments into their courses.

Findings here also suggest that class discussion can enhance critical thinking. But to do so it requires faculty to rely less on passive learning methods, such as lecturing, which is the most commonly employed method of instruction in undergraduate education. It is estimated that teachers in the typical classroom spend about 80% of their time lecturing to students (Fischer & Grant, 1983; Smith, 1983), who in turn are attentive to what is being said about 50% of the time (Pollio, 1984).

In order to optimize learning, a critical balance must be struck between subject matter breadth and depth. Although discussion may detract from breadth of subject matter coverage, it is conducive to extending its depth. Students are more likely to comprehend and to retain ideas when they participate in a dialogue or debate on them. This is supported by empirical evidence which suggests that information that is actively processed rather than merely "recorded," is more readily retrieved from memory, more accessible for application to new situations, and less likely to be forgotten (Bransford, 1979; Craik, 1979). In a review of the relevant research, Pascarella and Terenzini (1991) found that when the goal of instruction is higher-order cognitive skills (e.g., critical thinking, problem solving), classroom discussion is somewhat more effective than lecturing. Effective class discussion, however, requires considerable effort from both faculty and students. To propagate useful discussion, instructors need to skillfully guide discussion and to facilitate student participation. This means knowing when to interject and when not to, how to pose thought-provoking questions, and what to do when students too readily reach consensus. Moreover, in order for effective class discussion to come about students will need to feel that they are not being disruptive of class, but rather being contributory to it.

Limitations

One methodological concern with this study is that instructors and students were aware of the presence of an

outside observer during the classroom observations. Although instructors were informed that this study pertained to critical thinking development at the college level and that the purpose of the classroom visit was to observe classroom interaction, they were not told in specific detail about the kinds of information being recorded (i.e., the nature of the classroom observation protocol was not conveyed to them). Moreover, in most instances students in the observed classrooms were merely informed by the instructor that the observer was a visitor who was there to learn more about the institution (in a handful of instances instructors made no mention of the observer's presence to students). While the possibility that some instructors might have prepared a "special" class in anticipation of the visit cannot be completely discounted, by all indications this did not seem to be the case. Because most instructors taught multiple classes and the schedule for classroom visits often was not finalized till arrival on campus, in many instances instructors were not aware of which of that week's class meetings would be observed. Moreover, in walking out of class with students the observer took the opportunity to ask randomly selected students about whether they thought that this had been a "typical" class meeting and why.

Another study limitation is the absence of a more objective instrument for measuring students' abilities to think critically. This study cannot conclude causality between the use of specific pedagogical techniques and student improvement in critical thinking because self-assessed growth in critical thinking is not a direct measure of actual growth. Evidence that the two are positively related, however, lends credence to this study's design and validity of findings. According to Bowen (1977), the results of cognitive outcome studies based on objective measures are generally similar to those derived from students' self-reports. In comparing the use of self-reported gains, standardized test scores, and college grades, Anaya (1999) found that self-reported growth survey items have a "modest relative validity." Assessing the stability of relationships among self-reports of cognitive abilities and actual test scores, Pike (1995, 1996) concluded that despite the absence of a one-to-one correspondence between the two, self-reports can be justifiably used as general indicators of achievement. Previous research studies have found low to moderately high correlations between self-reports of academic development and scores on achievement tests (Anaya, 1992; Astin, 1993; Baird, 1976; Berdie, 1971; Dumont & Troelstrup, 1980; Pohlmann & Beggs, 1974). A related concern with the use of students' self-reports to identify institutions of high and low impact on critical thinking lies with the difficulty, if not impossibility, of disentangling the effects of recruitment and college environment. After all, students who report the greatest growth in critical thinking may be those whose background characteristics enable them to be most affected by college impact. An address of how student's precollege characteristics (e.g., academic preparation and motivation) come into play appears in some related studies (Tsui, 1998; Tsui, 2001).

Lastly, another limitation is the narrow definition of critical thinking adopted in this study. As mentioned earlier, while many may consider problem solving as an integral component of critical thinking, a design constraint prevented the inclusion of this concept in this study's chosen operational definition of the term. Undoubtedly this greatly affected the outcome of findings. Most notably, this can be seen in the case of School C (high selectivity, low IGCT), where a heavy emphasis on problem solving leaves little room for any emphasis on writing. Here faculty members seemingly opt to foster reasoning in students through handing out complicated work problems rather than writing assignments. Thus, if problem solving had been included in the definition of critical thinking, then it is likely that School C would not have been classified as a low IGCT institution. Instead, School C might have proved an exemplary case in the relationship between critical thinking and problem-based inquiry.

Study Implications and Recommendations

A number of implications and recommendations for practice are extrapolated from the findings that emerged from the four case studies. With regard to writing, professors need to include in their courses a greater number of writing assignments that require students to demonstrate synthesis of material, evaluation of arguments, deduction of conclusions, and so on. Furthermore, professors can stimulate students to exercise critical thinking skills by incorporating a rewriting component in the design of their courses. Promotion of critical thinking through rewriting can be boosted by opportunities for students to receive constructive feedback--whether it comes from the instructor, teaching assistant, writing tutor, or classmates. To successfully implement substantive writing assignments in their courses, faculty members will need to invest significant time and effort. Institutions can assist in this matter by limiting class sizes. Moreover, institutions should formally ground writing in the curriculum by requiring students to take from various disciplines specially designed courses that emphasize analytical writing. By iterating analytical writing across disciplinary boundaries students will experience opportunities to apply critical thinking to diverse subject matter and throughout each of their college years.

In trying to foster critical thinking through class discussion, professors first need to seek ways to raise students' confidence in their ability to contribute to class. Tactics employed by some faculty members in this study included arranging class seating in a circular or semi-circular pattern, calling on students to answer questions, grading on student participation, e-mailing students questions for future discussion, asking students to address their comments to the entire class rather than to the instructor solely, holding class in a more informal setting such as a

professor's home, and utilizing small group work or student class presentations. Finding that peers can exert a substantial influence on students' confidence, and that positive emotional climates occur when students are cooperative and supportive and make friends in class, Fassinger (1995) recommends that instructors might consider developing more assignments using study groups or learning partners. In a study by Nunn (1996), class participation was found to be significantly related to certain teaching techniques: praising students, asking questions, probing for elaboration of student contributions, accepting answers, repeating answers, using student names, and correcting wrong answers.

Results from the classroom observation portion of this study reveal that at institutions where students report experiencing greater growth in critical thinking, class discussion tends to be facilitated by a number of actions: having both professors and students ask more questions in class; encouraging students to respond to questions posed by their peers; seeking not only a greater degree of discussion per se, but participation by a greater proportion of students; motivating students to question or challenge what is being said; complimenting students on their contributions to the discussion; and encouraging students to volunteer comments rather than participating in discussion only when they are called upon or have a question.

Professors need to guard vigilantly against class discussions where the dominance of a majority perspective silences the expression of minority views. In a series of studies of undergraduate life undertaken by Levine and Cureton (1998), findings revealed that 54% of students feel uncomfortable expressing unpopular or controversial opinions. Instructors need to do more to bring about a class atmosphere where students are comfortable voicing a diversity of viewpoints and where they feel safe to question, critique, and disagree. Again, class size matters; classes ought to be small enough to allow each student adequate opportunity to participate meaningfully in discussion. The intimacy of seminar courses and its more intense focus on limited subject matter appears to be amenable to student debate and scrutiny of ideas. Rather than reserve seminar courses solely for seniors or honors students, it ought to be made accessible to all students early on. This is crucial, because as the Boyer Commission (1998) points out, "The first years of university studies, in many ways the most formative of all years, are usually the least satisfactory in terms of concept, curriculum, and pedagogy" (p. 19). A freshman seminar requirement can set a precedent for high intellectual engagement from students by enabling a professor "to imbue new students with a sense of the excitement of discovery and the opportunities for intellectual growth" (p. 20).

Lastly, if institutions are truly committed to achieving the widely professed educational objective of instilling critical thinking skills in students, then they need to actively support and guide faculty in teaching reform efforts. Seminars, workshops, and training sessions should not be a one-time event but rather a regular component of an institution's ongoing professional development program for faculty. The refinement of pedagogical technique should be expected from all those who teach. Furthermore, avenues for collegial exchange on teaching need to be sought out and instituted. Faculty members are likely to benefit from sharing teaching successes and frustrations with colleagues who are dealing with similar challenges (Tsui, 2001). These efforts will not only promote faculty collaboration and the generation of new ideas on teaching, but will yield a more united front against student resistance. In their study Everett and Zinser (1998) found that while an active learning approach led to greater critical thinking, some students resented corrective feedback on their papers and the lack of traditional lectures. Students who are used to encountering passive instructional methods that require little cognitive energy from them may resist active instructional methods that require substantial cognitive energy. Student resistance may result in less favorable teaching evaluations and withdrawal from courses. The impact of these actions is diminished, however, when there is a collective commitment from the faculty to refashion and strengthen instruction for more effective cognitive development.

The educational goal of developing critical thinking skills in students is an important and challenging one. Unfortunately, in most cases it is one in which reality falls short of the aspiration. Success on this front requires greater investment by students, faculty, and the teaching institution. Evidence from this study offers hope that concerted and mindful efforts by educators and institutions to strengthen the efficacy and potency of such ordinary instructional elements as writing and class discussion can go a long way in bringing about the kinds of processes that will facilitate development of students' abilities to think critically.

APPENDIX A

Descriptions of Categories for the Classroom Observation Data

Category	Description
Class size	The number of students in a class

Number of questions	The total number of questions posed by students and instructor
Percent of questions by students	Percent of total questions that were posed by a student (as opposed to the instructor)
Percent of multiple responses	Percent of total questions that elicited a response from more than one individual
Percent of students responding to students	Percent of questions posed by a student that was met by a response from another student
Percent of student participation	Percent of students present in class who participated in the class discussion
Number of student challenges	Number of statements by a student that expressed dissent or disagreement with what had been said in the class discussion
Number of volunteered comments	Number of comments that were volunteered by a student (this excludes questions posed by students or student responses to a question posed)
Number of compliments by an instructor	Number of compliments by an instructor to a student for his or her contribution to the class discussion

TABLE 1

Summary of Classroom Observation Data

	High IGCT Schools	
	A	D
Class size	20.3	18.2
Number of questions	15	15.7
Percent of questions by students	54	36
Percent of multiple responses	12	30
Percent of students responding to students	60	34
Percent of student participation	64	59
Number of student challenges	4.3	1.4
Number of volunteered comments	6.3	4.7
Number of compliments by professor	2.3	0.9
	Low IGCT Schools	
	B	C
Class size	13	19.3
Number of questions	13.7	7.6
Percent of questions by students	47	50
Percent of multiple responses	14	0
Percent of students responding to students	3	0
Percent of student participation	33	29
Number of student challenges	0.1	0.5
Number of volunteered comments	1.1	0.8
Number of compliments by professor	0	0.5

NOTE: Figures presented in this table are classroom averages for that institution. Description of the above categories are found in Appendix A.

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