TEACHING CRITICAL-THINKING COURSES

Reasoning About Reasoning: A Course Project

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A course project for a sophomore-/junior-level course in thinking, reasoning, and decision making is described. Students in the course observe and describe the reasoning style of a partner from the class on four different tasks (e.g., geometric analogies and moral dilemmas). Then, they compare the performance across the four tasks to develop an argument about how many distinct kinds of reasoning they have observed in their partner. The assignment is designed to illustrate course material on theories and models of reasoning in concrete ways. Another and more important objective is to elicit from students a degree of critical thinking and creativity as they develop their own models and conclusions.

The psychology major offered by my department requires students to take four mid-level courses (i.e., ones that have Introductory Psychology as a prerequisite), distributed over three subareas of psychology: biological and behavioral processes, social behavior and development, and cognitive processes. One of the courses offered in the latter division is titled Thinking, Reasoning, and Decision Making. It is taught every other year and typically attracts about 25 students. About 50% of these students are women, and about 75% are psychology majors. The course also counts toward two interdisciplinary concentrations (akin to minors): cognitive studies and educational studies. This article describes a term project designed for this course.

The course covers major theories of thinking, problem solving, various models of reasoning (analogical, syllogistic, and propositional), creativity, heuristics and biases in decision making, and normative models of decision making. The latter half of the course includes material on everyday or informal reasoning and decision making, moral reasoning, and the development of reasoning competence. The course concludes with a consideration of methods of improving thinking, reasoning, and decision making. Throughout the course, students read primary literature and consider various specific models of these cognitive tasks (e.g., Sternberg's, 1977, model of analogical reasoning; Wason's, 1960, 1977, description of the four-card problem; and Gilligan's, 1982, description of reasoning about moral dilemmas).

The diversity of student preparation for the course and the somewhat technical nature of the course readings make for an interesting teaching challenge. As the course has developed during the past 6 years, I have found that the more I can involve students directly with the phenomena, the deeper their understanding of particular models or theories. The course project described herein grew out of a desire to design an assignment that involves a fair amount of hands-on experience with thinking and reasoning phenomena and asks students to go beyond simple experiential discoveries.

The project requires students to observe the reasoning of another person. Students in the class are paired, and each member of the pair serves as both reasoner for and observer of their partner. Four different reasoning tasks are administered. Two different versions of each task are prepared so that the problems on each version will be similar but not the same, so as to reduce the effects of prior exposure. Such exposure effects are impossible to eradicate, of course, as the member of the pair who serves as the first observer obviously has more time to think about the general nature of the problems before working on them.

The specific reasoning tasks I have used have varied over the years. For the past few years, I have used (a) a geometric analogies reasoning task, with the problems taken from Sternberg (1986); (b) a deductive reasoning task, adapted from Rips's (1989) knights/knaves problems; (c) an everyday reasoning problem; and (d) a moral dilemma. These last two tasks consist of single dilemmas generated by class members who caucus in two groups during one class period to formulate them. (I circulate between the two caucuses to make sure that the problems they originate are distinct and roughly comparable in difficulty.) My intention in having students create the latter two tasks is to help them think about ways in which rich examples of reasoning can be elicited.

The actual reasoning sessions are scheduled at a time mutually convenient for both partners. Students are instructed to use online protocols for data collection. Online (or think-aloud) protocols require a subject to speak aloud as she or he thinks through a problem. Hayes (1989) defined a *protocol* as a "description of the activities, ordered in time, in which a person engages while performing a task," and asserted that the technique of protocol analysis is "cognitive psychology's most powerful tool for tracking psychological processes" (p. 69).

Of course, online protocols are subject to limitations and distortions of various kinds (Ericsson & Oliver, 1988, presented a review). For this reason, one class period early in the term is devoted to a review of the strengths and limitations of online protocols for data collection. We also review techniques for eliciting useful online protocols (Perkins, 1981) and have some in-class demonstrations and practice.

The subsequent sessions are audiotaped, and the cassette of all sessions is turned in with the final paper.

The final paper is limited to 20 to 25 double-spaced typed pages. (Few papers come in shorter than 12 to 15 pages, although brevity is repeatedly encouraged throughout the term.) A detailed handout on the format and structure of the paper (copies available on request) is distributed early in the term. The major required sections of the paper are specified as follows: title page, introduction, method, results and discussion (the latter two sections divided into four subsections for each reasoning task), and general discussion.

This last section is identified to students as the most important section of the paper. In it, students are asked to describe their partner's reasoning style(s) (e.g., across-task willingness to generate alternatives, seek disconfirming evidence, and consider the strength of their evidence) and the similarities and differences they observed in the style(s) across the four tasks. Students are specifically instructed to view this section as the construction of an argument, in which they show how they have arrived at their conclusions—describing their criteria for defining something as a reasoning style and incorporating relevant examples. In brief, the general discussion requires that students build a microtheory of one person's reasoning. As I mention to the students, this assignment demands critical thinking, reasoning, decision making, and creativity—all of which strike me as highly appropriate for this course.

This assignment raises several ethical issues. One issue concerns requiring students to perform and to have that performance evaluated by their partner and then, potentially, by me when I read the paper. I try to address this problem in two ways. First, students are not allowed to use the names of their partners in their papers; they must make up a distinct code number. I also ask students to use their own student ID numbers, rather than their names, on the title page of their papers. These two steps make it difficult (although not impossible) for me to determine who a particular student's partner is. Second, and more important, I direct students to think about describing their partner's reasoning style, rather than evaluating its validity or correctness. Toward this end, I specifically avoid handing out correct answers to the first two tasks. I discuss with students the reasons for this slant on the assignment: The task is not to evaluate one another's smartness (that would assume that students were qualified evaluators and that the tasks as used were reliable and valid indicators of it). Midway through the project, students may mention a difficulty they face in sticking to description and avoiding evaluation. This often prompts a good discussion of the reasons why and suggestions for how to handle this problem.

No readings beyond those required for the course on the syllabus (also available on request) are required. I tell students that I will assume that they have completed course readings and that they should incorporate citations as appropriate, but that they should not try to cite everything on the syllabus.

The scope of the project makes it crucial that students work steadily throughout the term. To give early feedback and to discourage procrastination, I require a 3- to 4-page summary of the first task (geometric analogies) and offer students the option of turning in a brief summary of the second. One advantage of using geometric analogies as the first task is that Sternberg's (1977) article, which students report to be the most difficult reading in the course, is often nicely illustrated in the students' own data. Moreover, Sternberg's article gives examples of how to create a descriptive model of performance, which students can either adopt or adapt.

I have used a version of this assignment with four classes consisting of 108 students. Eighty-five of these students turned in an end-of-term course evaluation that asked for ratings and comments on the project, among other things. Sixty-five percent of these students ($n = 54$) rated the assignment as either very good or excellent, and a total of 94% ($n = 80$) rated it as good, very good, or excellent. The mean, median, and modal ratings of the assignment were all very good. Comments on the assignment from my most recent class included the following: "Good to help integrate class learning and to try to tie the different types of reasoning together in some way"; "I thought this had value in the fact that concrete examples were shown in the project which helped to understand the theories"; "Really great. Incredibly brain-draining, but really made me think about *several* different areas of the course and helped me to see an overall picture of how the material came together"; and "Excellent way to see theories in action/helped a lot." Not all students shared this level of enthusiasm. One commented bluntly on the scope and difficulty level of the assignment: "Ugh. It was a lot more work than it was worth." Others recognized the demandingness of the assignment but had a more favorable reaction: "The project was the most valuable part of the class for me, but I don't know if the professor realizes how much time it took," or "A lot of value but a lot of work (how nice!)."

I share the students' impression that this is a demanding and time-consuming assignment. I also find that, with the appropriate structure, support, and timely feedback, it can elicit a sophisticated level of response from many students. Thus, the end of the term finds me nearly buried in papers, but these papers are enjoyable to read and evaluate. Allowing students to draw on their own observations seems to permit creativity and insight to emerge more than is typically the case with other sets of papers.

My overall impression and that of most of the students is that the assignment elicits critical thinking and reasoning about the topics of thinking, reasoning, and decision making for a large majority of my students. This is due to the fact that students must integrate their observations with theory to construct a description of a style of reasoning. Because they are expected to draw on course readings, students must explicitly assess the fit between theories and models presented in lecture and readings and their observations of their partner's performance.

In-class demonstrations throughout the course are intended to foster the skills necessary for this project. In small groups, students observe a class member grappling with a reasoning or decision-making problem. Later, each group reports to the class as a whole what they observed and what the phenomena are. Next, I lecture on a model or theory of performance on that particular task. As a class, we assess how well the model or theory presented accounts for the observations previously reported.

How can this assignment be adapted for other courses? I believe it will work best in other cognitive psychology courses. In such courses, the phenomena are often of a technical nature (thus, less inherently interesting to students and, therefore, ones to which students may be tempted to pay less attention). Complex cognitive tasks that require more than one mental operation and that are not highly practiced are the most amenable for use with online protocols. I have found it useful to choose tasks for which a stylistic dimension of performance exists. This reduces some of my concern about asking students to assess the performance of a peer.

Overall, I am pleased with this assignment. Given the magnitude of the effort required from students, I am also gratified by their largely positive response to it. What I like best about the assignment is that it ties together the content of the course with processes I hope and believe are widely applicable beyond the classroom.

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Note

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Teaching Critical Thinking: Focusing on Metacognitive Skills and Problem Solving

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To become a better critical thinker, one not only must develop expert thinking skills but also become an expert at choosing the best skills for the particular situation. These two components of critical thinking can be described as maximizing the efficiency and accuracy of one's cognitive and metacognitive skills for successful actions. The development of students' cognitive and metacognitive skills was the approach taken to teach a required critical-thinking course. Students assessed different aspects of their own thinking and problem-solving skills before and after a module on problem solving and decision making. Comparisons between above-average and below-average students indicated that students learn to choose general approaches to their problems and learn more specific strategies for successfully resolving their problems. Factor analyses of the students' self-assessments and changes in factor structures indicated that students improved their critical-thinking skills and were aware of their improvements.

To become better critical thinkers, students must develop expert thinking skills and become experts at choosing the best skills for the particular situation. These two components of critical thinking can be described as maximizing the efficiency and accuracy of one's cognitive and metacognitive skills for successful actions. *Cognitive skills* refer to strategies used to encode, transform, organize, integrate, categorize, store, and retrieve information. *Metacognitive skills* refer to the strategies used to monitor and control one's own state of knowledge (Flavell, 1979; Nelson & Narens, 1990). Metacognitive skills give people the opportunity to gain some awareness of what they are thinking about and how their thinking progresses. If students are to exhibit critical-thinking skills, they must learn to decide when specific cognitive skills are relevant (a metacognitive skill) and then successfully apply the cognitive skills to solve problems.