

# Comparing Problem-Based Learning and Traditional Instruction in High School Economics

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**ABSTRACT** The potential differences in the effectiveness of problem-based learning (PBL) and traditional instructional approaches regarding high school students' attainment of economics concepts and principles and attitude toward learning economics were examined. The authors also considered potential interactions between learning outcomes in PBL and traditional instructional contexts and differences in students' academic ability, entering knowledge of economics, attitude toward economics, negative feelings after failure, preferred level of task difficulty, and behavioral response to failure. No differences between PBL and traditional classes were found regarding unit-specific student learning outcomes, although there was a difference in changes in general economics knowledge measured at the beginning and end of the semester, with the traditional classes learning more.

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Education reformers seeking to make schools and classrooms more effective learning environments have frequently proposed restructuring traditional curriculum and instruction to focus more on realistic situations and problems. Problem-based learning (PBL), an instructional approach in which students are confronted with simulated, real-world problems, is frequently advanced as a powerful instructional approach that is engaging and that leads to sustained and transferable learning (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990; Jones, Rasmussen, & Moffitt, 1996; Stepien & Gallagher, 1993). Although the theoretical basis of that approach is compelling (Norman & Schmidt, 1992; Regehr & Norman, 1996), little empirical literature exists on the impact of PBL at the high school level. (Most research has been conducted with students preparing to become physicians.) Consequently, there are a number of questions regarding the success of PBL instruction approaches with high school students in contrast with traditional (e.g., lecture/discussion) instruction methods.

Research on PBL conducted in medical schools suggests that that approach may be less effective in learning basic

science content (as measured by the National Board of Medical Examiners Examination), while being more effective in generating student interest and sustaining motivation. A meta-analysis of English-language research on the impact of PBL in medical education by Albanese and Mitchell (1993) concluded the following:

PBL . . . is more nurturing and enjoyable [than traditional instructional approaches]; PBL graduates perform as well, and sometimes better, on clinical examinations and faculty evaluations. . . . However, PBL students in a few instances scored lower on basic sciences examinations and viewed themselves as less well prepared in the basic sciences than were their conventionally trained counterparts. . . . While weaknesses in the criteria used to assess the outcomes of PBL and general weaknesses in study design limit the confidence one can give conclusions drawn from the literature, the authors recommend that caution be exercised in making comprehensive, curriculum-wide conversions to PBL until more is learned. . . .

A second meta-analysis by Vernon and Blake (1993) identified PBL students' superior evaluations of their training programs and their superior clinical performance. Although the authors found no differences in student achievement on tests of factual and clinical knowledge, they identified weaknesses in content knowledge, as indicated by student scores on the National Board of Medical Examiners (NBME) Part I Examination. The review concludes by questioning the reliability of this last finding, given the variability found in NBME Part I results and substantial structural differences among the PBL medical training programs.

Those overlapping studies reviewed research conducted on students in medical schools.\* Medical students, however, are substantially different from high school students. They are not only older but are also an elite group in terms of their previous education and verbal and quantitative

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skills. Moreover, they have chosen to attend medical school and view their training as instrumental to their future occupational success. Given those differences in student characteristics and learning context (Maxwell, Bellisimo, & Merendoller, 1999), it is impossible to know if the findings from the above meta-analyses are applicable to high school courses structured around a PBL format.

In addition to incomplete knowledge regarding the impact of PBL strategies on high school students, we know little about the impact of individual differences among high school students on learning in PBL instructional contexts. In a review of the implications of cognitive theory for problem-solving instruction, Fredericksen (1984) raised the question: "Should instructional methods vary with the specific skills of the learner?" noting that "There is considerable evidence that aptitude-treatment interactions exist." (Aptitude-treatment interactions occur when certain treatments have different effects on students with different aptitudes.) The question of PBL aptitude-treatment interactions is of particular interest because PBL environments have been specifically recommended as vehicles to engage lower achieving or chronically unmotivated students who often do not take advantage of traditional lecture/discussion learning situations (Delisle, 1997; Glasgow, 1997; Jones et al., 1996).

The claim that PBL is a more effective instructional approach for lower achieving or unmotivated students is not substantiated by previous research. There is evidence, however, that individual differences in motivation and self-perception affect learning behavior. Meyer, Turner, and Spencer (1997) depicted the different behaviors and perceptions of fifth- and sixth-grade students using materials from the Activities Integrating Math and Science Foundation to solve the problem, "What makes a kite aerodynamic?" Although that learning experience is different in some ways from that of the high school PBL economics we studied, the two learning environments have much in common. Both conditions require students to make individual and collective decisions about the best way to solve an unstructured problem and to select from a variety of resources those most relevant to the task at hand. Also, students are required to explain publicly the decisions they make to solve the problem and the logic behind their solutions. In addition, both learning environments require students to grapple with unfamiliar concepts and to think on their own.

Given the similarities, we believed that the findings of Meyer et al. (1997) were pertinent to our research, so we incorporated some of their thinking regarding individual differences in student engagement and performance into our study design. Meyer et al. described two types of students: "challenge seekers" and "challenge avoiders." Those student categories were distinguished by their level of academic risk taking (Clifford, 1991), which was strongly associated with meaningful engagement in the learning activity. Challenge avoiders displayed superficial cognitive and physical engagement in learning and appeared to share

many behavioral and affective characteristics with the lower achieving students for whom problem-based learning is being proposed as an effective, motivating instructional methodology.

Given the general lack of empirical knowledge regarding the comparative impact of problem-based and traditional (lecture/discussion) instructional approaches on student learning and attitudes, we designed a pilot study in preparation for a more extensive study of the impact of PBL instruction methods in high school economics classes. We attempted to answer two general questions:

1. Are there differences in the effectiveness of PBL and traditional instruction approaches with regard to students' (a) attainment of economics concepts and principles and (b) attitude toward learning economics?
2. Are individual differences in students' (a) academic ability, (b) entering knowledge of economics, (c) attitude toward economics, and (d) academic risk taking associated with differential learning outcomes in PBL and traditional instructional contexts?

## Method

### *Participants*

*Students.* One hundred and eighty-six students in nine classes taught by 3 teachers completed all instruments used in the study; their data are the basis for all subsequent analyses. The students accounted for 72% of all the students in the classes. Two different PBL units were considered as the treatment. Table 1 displays the distribution of students across teachers and schools and the units taught by each teacher. In the state where this study took place, economics is a required course for all high school seniors.

*Teachers.* The 3 teachers who implemented the PBL treatment were veteran instructors. Each teacher taught in a different school. They had attended week-long training workshops to prepare them to use the PBL economics units in their classes. Teachers A and C had worked as trainers during the workshops. All instructional resources necessary to teach the PBL units were provided, including a carefully prepared curriculum guide and suggested lesson plans. Teachers were counseled to include all the components described in the following treatment section in their lessons. Teachers implemented the unit during the Spring 1998 semester. Conversations with teachers as they taught the units and at training workshops when the units were completed suggested that the economics units were implemented as planned.

*Treatment.* The treatment consisted of the two problem-based economics units designed to meet part of the Voluntary National Content Standards in Economics developed by the National Council on Economic Education in partnership with the National Association of Economic Educators, the Foundation for Teaching Economics, and the American

Table 1.—Student Participants

Teacher	School context	Unit taught	Students in treatment group	Students in comparison group	Total students
A	Suburban comprehensive	President's Dilemma	51(2)	24(1)	75
B	Rural/suburban technology	High School Food Court	73(3)	0	73
C	Suburban comprehensive	High School Food Court	24(2)	14(1)	38
	Total students		148(7)	38(2)	186

*Note.* The figures in parentheses indicate the number of sections within a group.

Economic Association's Committee on Education. The two units are part of a six-unit PBL economics' curriculum that was designed for a semester-long high school course, although each of the six units can be used in isolation. The six-unit PBL course meets all of the Voluntary National Content Standards in Economics. The units focus on the core economic concepts of scarcity, opportunity costs, and trade-offs. (For more information on the structure of each lesson and the resources provided, see the teacher's handbook published by the Buck Institute for Education, 1998.)

The President's Dilemma was taught by Teacher A and is a 5–10 day unit covering the core concepts of fiscal and monetary policy, including economic incentives, public policy alternatives and costs, gross domestic product, unemployment and inflation. As the problem unfolds, students discover that scarcity dictates that society must face trade-offs and opportunity costs in pursuing a healthy economy.

The High School Food Court was taught by Teachers B and C. It also takes 5–10 days to complete and focuses on the core concepts of production cost and demand as well as market systems, economic incentives, and public policy. That problem presents students with straightforward demand and cost issues that reflect resource scarcity. The economic solutions in the High School Food Court become confounded as political forces begin to intrude on the economic allocations and the students discover that trade-offs and opportunity costs can be both political and economic.

The structure of each unit is similar and is described in more depth by Maxwell, Bellisimo, & Mergendoller (1999). Briefly, students and teachers confront an ill-structured problem that, as a result of investigation, research, and cooperative discussion, allows for more than one possible correct solution. As students work on the problem, they discover that understanding economics concepts are essential to framing and solving the dilemma. Problems, although loosely structured to allow for student discovery and independent learning, contain a fixed set of components. These components include:

1. *Entry point*—Students receive simulated correspondence that draws them in to the problem.

2. *Framing the problem*—Teachers coach students through a questioning process that leads to the construction of a problem statement that asks the following generic question: "How can we, as \_\_\_\_\_, do \_\_\_\_\_, so that \_\_\_\_\_ happens?"

3. *Knowledge inventory* (know/need to know)—Teachers lead the class through a discussion and recording of knowledge that the students already have (know) and information that they need (need to know) to arrive at a solution. This knowledge inventory process is repeated periodically throughout the unit.

4. *Problem log*—Students keep a "to do" list, time line, questions, observations, outline for their group or individual project, and a list of resources. The problem log reflects students' lines of inquiry, new questions that arise during the process of investigation, and their thoughts on the problem. Teachers can review the problem log to track student progress toward solving the problem.

5. *Research and resources*—Teachers seed the investigation process with resources in the form of additional simulated correspondence, text, tables, and benchmark lessons. Students gather information to answer the questions: What do we know? What more do we need to know? What are potential solutions to the problem?

6. *Teachable moments*—Students, with teacher as coach, continuously engage in a dialogue about what they have discovered and what they know/need to know. This results in a reconsideration and possible redefinition of the problem statement. During this process, students recognize the need to know more about the principles of economics necessary to solve the problem. They often ask the teacher at this point for instruction or coaching.

7. *Exit from the problem*—Students define their solution and make a class presentation and/or report.

8. *Wrap-up and debriefing*—The teacher leads a discussion with the whole class encouraging students to consider the thinking that went into their problem solving. This summation includes analysis of both content and process issues (e.g., the adequacy of competing solutions as well as the difficulty of having to make choices).

*Comparison classes.* Before the semester began, Teachers A and C selected one of their assigned classes as a comparison class. At that point, they had not yet received their class lists and did not know which students would be enrolled in each assigned period. When they taught the PBL units to the treatment classes, Teachers A and C covered the same economic concepts using a traditional lecture/discussion approach with the comparison classes. (Teacher B did not have a comparison class.)

### *Instruments*

*Academic ability.* Academic ability was measured using a shortened 40-item version of the Verbal Meaning Test from the Primary Mental Abilities Battery (Thurstone, 1962). We created that version by deleting every third item from the original 60-item test. Each item consisted of a target word in capital letters followed by four lower case words. Students were asked to circle the appropriate synonym for the target word. A student's score was calculated by summing the correct answers.

Although we acknowledge that academic ability may be defined and measured in a variety of ways and has been shown to be reactive to assessment task and situation (Greeno, Collins, & Resnick, 1996), one cannot ignore nearly a century of research that has consistently shown correlations between verbal ability and achievement in school, ranging from .2 to .6 (Gage & Berliner, 1998). Given the predictive power of this relationship and the continuing concern for the achievement of students scoring poorly on traditional vocabulary-dominant tests of academic ability, we perceived that this academic ability assessment was appropriate.

*General economic knowledge.* We assessed students' general economic knowledge with a 15-item multiple-choice test. One item was taken from the Test of Economic Literacy (Soper & Walstad, 1987), a nationally normed test of basic economic concepts at the high school level. The test was designed by the Joint Council on Economic Education (which is now called the National Council of Economic Education). The remaining 14 items were taken from the test bank accompanying a widely used high school economics textbook (Mings, 1995). The items included in this test addressed comprehension, application, and analysis levels of cognitive objectives described by Bloom, Englehart, Furst, Hill, & Krathwohl (1956).

This test was constructed to assess students' knowledge of the core economic concepts of scarcity, opportunity costs, and trade-offs. The three concepts represent the heart of economics, which is often defined as "the study of the allocation of scarce resources." Once students understand the critical nature of scarcity, they understand that scarce resources create opportunity costs (i.e., something must be given up), which necessitate trade-offs in decision making. The popularized version of those principles is the phrase "There's no such thing as a free lunch."

All items were in multiple-choice format. Students were presented with a statement (e.g., "If resources were not scarce, which of the following would be true?") and chose among four possible answers (e.g., "Resources would have opportunity costs"). Student scores were calculated by summing the number of right answers. The instrument demonstrated borderline reliability, perhaps because of the heterogeneity of cognitive objectives addressed. For the initial administration at the beginning of the semester, Cronbach's alpha was .61. For the second administration at the end of the semester, Cronbach's alpha was .63. Data analyses were based on a prechange/postchange score.

*Attitude toward economics.* We measured attitude toward economics with an adaptation of the Attitude Toward Economics Inventory (Hodgin, 1984), an instrument originally designed for college students. We made minor wording changes to the item so that it would be appropriate for high school students. The revised instrument contained 14 items stating positive and negative sentiments about economics (e.g., "I enjoy economics"). Students responded on a 5-point Likert-type scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). After reversing negatively worded items (e.g., "Economics is dull"), we calculated scores summing the points ascribed to each item. The instrument demonstrated adequate reliability. For the initial administration at the beginning of the semester, Cronbach's alpha was .88. For the second administration at the end of the semester, Cronbach's alpha was .87. Data analyses were based on a prechange/postchange score.

*Academic risk taking.* We assessed students' willingness to persevere in difficult and challenging learning situations with the School Failure Tolerance Scale (Clifford, 1991). That instrument employs a 5-point Likert-type scale format ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). It yields three subscales: (a) negative feelings after failure (Cronbach's alpha = .86)—higher scores indicate stronger negative feelings following failure; (b) preference for difficult tasks (Cronbach's alpha = .85)—higher scores indicate stronger preferences for difficult learning tasks; and (c) proactive behaviors after failure (Cronbach's alpha = .78)—higher scores indicate that students proactively try to learn from failure and to apply a variety of learning strategies. After reversing negatively worded items (e.g., "It doesn't bother me to make a mistake"), we calculated student scores by averaging the points ascribed to each item for each subscale.

In research conducted by Meyer et al. (1997), students both completed the School Failure Tolerance Scale and were interviewed about their learning experience. The authors found a definite relationship between interview responses and scale scores, suggesting that the School Failure Tolerance Scale provides a valid measure of academic risk taking.

*Unit-specific content knowledge.* We created unit-specific content knowledge tests using items drawn from the Test of Economic Literacy (Soper & Walstad, 1987) and the test bank accompanying a widely used high school economics textbook (Mings, 1995). The items included in the tests

addressed the full range of cognitive objectives (knowledge, comprehension, application, analysis, and evaluation) described by Bloom et al. (1956). In contrast to the test of general economic knowledge, the examinations were designed to assess students' knowledge of the specific concepts that they were supposed to learn from the units. The test was designed as a general examination of the concepts of the PBL units and not as an assessment of specifics about the PBL unit. The majority of questions were taken from a test bank that accompanied a traditional economic textbook for high school students.

Both the treatment and the comparison students completed the tests at the conclusion of the units. The President's Dilemma examination contained 29 items; the High School Food Court examination contained 30 items. All items were presented in a multiple-choice format and student scores were calculated by summing the number of correct answers. The instruments demonstrated borderline reliability, perhaps because of the heterogeneous levels of cognitive processing demanded by different items. Cronbach's alpha was .71 for the President's Dilemma examination and .60 for the High School Food Court examination.

*Data collection.* Students in both the treatment and comparison groups completed assessments of their academic ability, general economic knowledge, attitude toward economics, and academic risk taking at the beginning of the semester. Immediately after the completion of the economics units, students in both the treatment and comparison groups completed a unit-specific content test. At the end of the semester, they completed assessments of their general economic knowledge and attitude toward economics.

*Data analysis.* This research was a pilot study with a relatively small sample of students; we intended to identify potential differences and relationships for further study. Consequently, we set the alpha level at .10. We conducted four sets of analyses. The first correlational analysis enabled us to examine relationships among the student characteristic variables and eliminate those that appeared redundant. The second analysis used *t* tests to examine the equivalence of students in PBL and lecture/discussion groups according to their academic ability, entering attitude toward economics, negative feelings after failure, preferred academic difficulty, and behavioral response to failure.

Analysis of variance (ANOVA) was the basic analytic strategy for our third set of analyses examining relationships among treatment, outcome, and student characteristics. We first sought main effects and then entered student characteristics (academic ability, attitude toward economics, academic risk-taking subscales) as covariates. We then looked for interactions between treatment and student characteristics; this tests the homogeneity of regressions. In the third analysis, we considered relationships among treatment, outcome, and student characteristics (academic ability, attitude toward economics, academic risk taking) by teacher. In the fourth analysis, we combined data from all teachers (including Teacher B who did not have a comparison group) across units and examined relationships among treatment, outcome, and student characteristics.

Because content tests for the President's Dilemma and High School Food Court units contained different numbers of items (29 and 30), we converted students' unit-specific content knowledge scores into *z* scores to create a combined outcome measure for the fourth analysis. Scores were created by subtracting each teacher's population mean from each individual student value and then dividing the difference by each teacher's population standard deviation.

## Results

### *Analysis by Student*

*Correlational analyses.* Table 2 reports the correlations among the student characteristic variables. General economic knowledge at the beginning of the class was significantly related to academic ability. In addition, preference for difficult tasks was significantly related to entering attitude toward economics and negative feelings after failure. Proactive behavior after failure was significantly associated with entering attitude toward economics and preference for difficult tasks.

Given the confounding of academic ability with entering general economic knowledge, we dropped entering general economic knowledge from subsequent analyses. The academic ability construct seemed more conceptually robust, as teachers as researchers more frequently consider students as "higher/lower academic ability" rather than "students who already know a great deal/little about economics."

**Table 2.—Correlations Among Student Characteristics Variables (*N* = 186)**

Variable	1	2	3	4	5
1. Academic ability					
2. Entering general economic knowledge	.35***				
3. Entering attitude toward economics	.16	.22			
4. Negative feelings after failure	-.12	-.15	-.17		
5. Preference for difficult tasks	.10	.10	.35***	-.25**	
6. Proactive behaviors after failure	.07	.12	.38***	-.13	.64***

\*\**p* < .01, \*\*\**p* < .001.

**Table 3.—Means of Student Characteristics Variables, by Teacher**

Variable	Teacher A			Teacher C		
	PBL (n = 51)	Lecture/ discussion (n = 24)	t	PBL (n = 24)	Lecture/ discussion (n = 14)	t
Academic ability	33.80	34.25	0.43	35.43	32.54	1.72*
Entering attitude toward economics	3.70	3.69	0.50	3.36	3.18	1.24
Negative feelings after failure	2.60	2.36	-1.71*	2.21	2.40	0.91
Proactive behaviors after failure	3.53	3.50	0.24	3.09	3.36	1.45

Note. PBL = problem-based learning.  
\*p < .01.

*Equivalence analysis.* The group means of students in the PBL and lecture/discussion conditions within teachers are reported in Table 3. There were statistically significant differences on negative feelings after failure and behavioral response to failure for both Teacher A and Teacher C. Students in Teacher A's PBL classes reported stronger negative feelings after failure than did students in the lecture/discussion classes. For Teacher C, students in the lecture/discussion treatment reported a more proactive approach to learning after failure experiences. No other contrasts were statistically significant. Table 4 reports the group means of students in the PBL and lecture/discussion conditions pooled across teachers. There were statistically significant differences in academic ability and willingness to take action after failure. Both of those differences favored students in the lecture/discussion condition.

*Analyses by Teacher*

*Content knowledge.* For Teacher A, there was no treatment effect on the President's Dilemma content test. There was a statistically significant difference in the prechange/postchange scores on the test of general economic knowledge,  $F(1, 73) = 3.0, p = .09$ ; students in the PBL treatment

showed less positive change than did students in the traditional lecture/discussion class.

For Teacher C, there was also no treatment effect on the High School Food Court content test, but there was a difference in changes in students' general economic knowledge,  $F(1, 36) = 10.18, p = .003$ . Again, students in the PBL treatment showed less positive change than did students in the traditional lecture/discussion class.

*Attitude toward economics.* For both Teachers A and C, no difference existed between the PBL and traditional lecture/discussion class in changes in students' attitude toward economics.

*Student characteristics covariates.* For Teacher A, when student characteristics were used as covariates in the ANOVA with unit-specific knowledge as the dependent variable, the following proved statistically significant: academic ability,  $F(1, 72) = 10.40, p = .002$ , negative feelings after failure,  $F(1, 72) = 15.31, p = .001$ , and proactive behavior after failure,  $F(1, 71) = 8.99, p = .004$ .

For Teacher C, the following student characteristics were significantly associated with post-unit content knowledge: academic ability,  $F(1, 35) = 9.75, p = .004$ , and negative feelings after failure,  $F(1, 35) = 3.04, p = .09$ .

When we used change in general economics knowledge as the dependent variable, there was a statistically significant relationship with academic ability in Teacher A's classes,  $F(1, 72) = 5.29, p = .02$ . There were no statistically significant associations between student characteristics and change in general economics knowledge in Teacher C's classes.

*Aptitude-treatment interactions.* To test for interactions between treatment condition (PBL and lecture/discussion) and student characteristics (academic ability, entering attitude toward economics, negative feelings after failure, behavioral response to failure), we used the General Linear Model module in the SYSTAT 8 data analysis program. Unit-specific content knowledge and general economics knowledge were the dependent variables. Treatment was entered as an independent variable, then each of the student characteristic variables were entered first by themselves and then crossed with treatment. Thus, separate statistical tests were conducted with unit-specific content knowledge as the

**Table 4.—Means of Student Characteristics Variables Across Treatments**

Variable	PBL (n = 148)	Lecture/ discussion (n = 38)	t
Academic ability	32.45	34.68	2.87*
Entering attitude toward economics	3.50	3.50	0.00
Negative feelings after failure	2.50	2.37	-1.19
Behavioral response to failure	3.36	3.44	0.86*

Note. PBL = problem-based learning.  
\*p < .01.

dependent variable, and then with change in general economics knowledge as the dependent variable. We did not examine student characteristics in combination.

For Teacher A, there were no significant interactions between treatment and the four student characteristics variables after the student characteristics variables had been entered separately. That finding occurred when either unit-specific content knowledge or change in general economics knowledge was used as the dependent variable.

For Teacher C, there was one significant interaction,  $F(1, 34) = 4.10, p = .05$ , between treatment and students' entering attitude toward economics when change in general economics knowledge was used as the dependent variable. Further correlational analyses indicated that within the lecture/discussion classes there was a statistically significant relationship ( $r = .46, p = .09$ ) between entering attitude toward economics and change in general economic content knowledge. That finding means that students in lecture/discussion classes with more positive attitudes toward economics at the beginning of the semester tended to have higher change scores in general economics knowledge at the end of the semester.

#### *Pooled Analyses*

*Content knowledge.* There was no treatment effect when either the combined content test or change in general economic knowledge was used as the dependent measure.

*Attitude toward economics.* With all teachers combined, there was no difference between the PBL and traditional lecture/discussion class in changes in students' attitude toward economics.

*Student characteristics covariates.* As in the analyses by teacher, several student attributes were associated significantly with combined post-unit content knowledge. Those attributes included academic ability,  $F(1, 183) = 23.92, p = .001$ , attitude toward economics,  $F(1, 183) = 3.41, p = .07$ , negative feelings after failure,  $F(1, 183) = 11.24, p = .001$ , and behavioral response to failure,  $F(1, 183) = 2.66, p = .10$ . There were no statistical associations between student characteristics covariates and changes in general economics knowledge.

*Aptitude-treatment interactions.* As in the above analyses, we tested for aptitude-treatment interactions by first entering treatment as an independent variable and then entering each of the student characteristics variables first by themselves and then crossed with treatment. When changes in general economics knowledge was the dependent variable, there was a statistically significant interaction,  $F(1, 182) = 3.89, p = .05$ , between treatment and behavioral response to failure. Correlational analysis shows that there was a significant negative relationship ( $r = -.28, p = .09$ ) within the lecture/discussion classes between willingness to take action and change in general economic knowledge as well as a nonsignificant trend in the opposite direction for PBL classes ( $r = .13, p = .11$ ). That finding suggests that in

the lecture/discussion classes, students who reported willingness to take action after failure tended to have lower positive change scores in general economics knowledge, whereas the reverse was the case in the PBL classes.

#### **Discussion**

Using a quasi-experimental design, we investigated whether traditional and problem-based learning instructional approaches made a difference in students' attainment of economic knowledge and principles and affected their attitudes toward the study of economics. On the basis of medical education literature, we expected that students in the PBL classes would score lower on knowledge measures than would students in the lecture/discussion classes. We also expected that attitude toward economics would increase more for students in the PBL classes than for students in the lecture/discussion classes. Finally, we expected that student characteristics would be related to student success in the PBL and lecture/discussion treatments. However, our findings are more complicated than we expected.

Although analyses conducted by teachers and across teachers found no differences between the unit-specific content knowledge scores of students in the lecture/discussion and PBL classes, analyses by teachers showed a significant treatment effect on the test of general economic knowledge: Students in the traditional, lecture/discussion classes showed greater positive prechange/postchange compared with students in the PBL classes. It is tempting to call this finding a fluke, except that it occurred with 2 different teachers teaching two different PBL units. Taking this finding at its face value, it appears that participating in the PBL units was a barrier to the acquisition of general economic knowledge—a conclusion that would be in line with the findings of the medical school research cited in our study. We question, however, whether the relatively short treatment (a maximum of 3 weeks within an 18-week semester) could be responsible for the difference in students' general economics knowledge scores. It seems highly unlikely; therefore, we question the validity of that result.

A second interpretation of our finding turns the previous explanation (invalid result) on its head and questions our study's methodology regarding the assessment of knowledge outcomes. There were three separate assessments of students learning: two unit-specific content tests (President's Dilemma and High School Food Court) and one test of general economics knowledge. In our desire to intrude as little as possible on the instructional process, we designed the unit-specific content tests to be administered only at the conclusion of each unit (e.g., posttest only). In contrast, the general economics knowledge test was administered at the beginning and end of the semester, and change scores were used in the analyses (pre-/posttest). The logic of our quasi-experimental design led us to use two student characteristics measures (academic ability and attitude toward economics) to account for differences in students' entering characteris-

tics; but these measures are only proxies for unit-specific entering economic knowledge (that we did not measure). Of the two student characteristics, academic ability was the strongest predictor of unit-specific content scores, yet it showed only moderate correlations with each unit-specific content test score ( $r = .36$ ). That result leaves substantial room for error. Perhaps our methodology has camouflaged a negative relationship between treatment and unit-specific content scores. In the future, researchers will need to collect both pre- and postdata to counter this possibility.

A final possible explanation of our results is that the items on the test of general economics knowledge and the unit-specific content tests tapped different domains of knowledge and skill. The general economic knowledge test was designed to assess knowledge of the concepts of scarcity, trade-offs, and opportunity costs. Although those concepts are implicitly threaded throughout both PBL units, they were never explicitly explained during the PBL units nor were their definitions essential to helping solve the problem. Instead, both units were designed to have students understand and apply the concepts through debate, discussion, and presentations. Without explicit, didactic attention to the general concepts, students may not be able to transfer their understanding to a multiple-choice test.

Although medical students report more positive attitudes toward the PBL learning experience than toward traditional instruction, we did not find that instructional treatment affected student attitudes toward economics. A semester-long economics class lasts for approximately 90 days and students in the PBL condition experienced problem-based learning for only 5–10 of those days. It is difficult to determine, therefore, how such a short treatment—even if intellectually provocative and enjoyable—could outweigh the impact of the other days in the semester, which were all devoted to learning economics through lecture and discussion.

A second major focus of this study was whether individual differences in student characteristics were related to differences in student learning. Here the answer is unambiguous. We found differences in academic ability, attitude toward economics, intensity of negative feelings after academic failure, and predisposition to take action after failure to solve academic problems to be more consistently, and often more strongly, related to student learning than the treatment condition. Students who are typical achievers, that is, those who (a) have high verbal ability, (b) like their subjects, (c) are not demoralized by academic setbacks, and (d) try to set things right if they make mistakes do well in both PBL and traditional instructional environments.

Although it is often suggested that PBL is the instructional treatment of choice for students not fully engaged with school-based learning, that was not borne out in our data. PBL was neither more nor less efficacious than traditional instructional approaches for students with limited academic ability, at least as measured by a verbal ability assessment.

Finally, we did find two aptitude-treatment interactions,

although given the small sample size and the number of statistical tests performed, these relationships may well be spurious. They are, however, intriguing and may give PBL advocates a taste of the empirical validation they hope to find. After pooling the data, we found a negative relationship in lecture/discussion classes between taking action after failure and positive general economics change scores. That finding may suggest that the relatively passive student learning role accompanying lecture/discussion instruction jeopardizes the learning of students who want to grapple more actively with conjectures and ideas. If so, one would expect that such students would find PBL a better match for their predispositions; some empirical support for this proposition is available. Considering only PBL classes, we found a borderline significant positive relationship between taking action after failure and positive change scores on the test of general economics knowledge ( $r = .13$ ,  $p = .11$ ). Although the PBL treatment was of short duration, advocates might argue that it had an energizing effect on students. We await further empirical confirmation before making such claims.

A second aptitude-treatment interaction occurred during the by-teacher analyses in the lecture/discussion classes of Teacher C: students with a more positive attitude toward economics tended to have higher positive change scores on the general economics knowledge test. In the PBL classes, there was not a statistically significant relationship between general economics knowledge change scores and entering attitudes toward economics, although we found a trend in the opposite direction ( $r = -.29$ ,  $p = .17$ ). Students with a less positive attitude toward economics tended to have higher positive change scores on the test of general economics knowledge. That result may suggest that students already positively predisposed toward economics were more receptive to the lecture-centric teaching approach and thus were encouraged to achieve, whereas the achievement of students initially less interested in economics was encouraged in the PBL classes.

Both of the aptitude/treatment interactions in our data involved *affective* (attitude toward economics) and *dispositional* (taking action after failure) student characteristics as opposed to academic ability. PBL advocates often argue that PBL classes spark student interest in the subject studied and teach students to learn from their mistakes and become problem solvers. Although our data provide weak empirical confirmation of those sentiments, the findings are strong enough to stimulate more rigorously designed research with a larger population.

We want to be circumspect regarding the generalizations that can be made from this type of pilot study. We perceive that its greatest value is to encourage others (and ourselves) to examine possible differences in the impact of PBL and traditional instructional practices using more rigorous methodological designs. We hope this initial work will lead to further examination of the immediate and long-term impact of problem-based and traditional instructional prac-



tices and more focused examinations of whether PBL leads students to gain additional skills (i.e., critical thinking, problem solving, and oral presentations). Some researchers have argued that PBL instructional approaches create cognitive apprenticeships (Bransford et al., 1990) in which students learn problem-solving routines (Jones et al., 1996) that prepare them to confront future ill-structured diagnostic dilemmas (Regehr & Norman, 1996). This study measured student learning by multiple-choice tests, albeit tests that demanded application and problem solving as well as recall. There are other assessment approaches such as content mapping and performance tasks that can be used to measure problem solving and the other additional skills that PBL instruction supposedly engenders. Within the subject area of economics, future research should examine the impact of PBL and traditional instructional strategies on the ability to conceptualize economic problems and to think like an economist.

To conclude, we note our current misgivings with the assumption that PBL is the instructional treatment of choice for students who do not ordinarily excel in school. Although our study provides some shreds of evidence for that position, such conclusions are extremely speculative. Although PBL is an alluring instructional approach and continues to expand its franchise among educators (Association for Supervision and Curriculum Development, 1998), we urge caution toward this instructional methodology until more is known about its impact on student learning. Further study in additional subject areas with larger samples, more teachers per unit, and more units per semester will be needed to determine the representativeness of our results. More sophisticated measures of student learning need to be employed, and more attention needs to be focused on the cognitive strategies and social/behavioral learning predicted by PBL advocates. Researchers should consider semester-long PBL implementations and compare their effects with traditional instructional approaches. Our research suggests that PBL is neither an instructional panacea nor salvation, and pronouncements of its efficacy with students who have lesser academic ability and those who do not typically achieve in school should be viewed skeptically.

#### NOTE

\* Twenty-eight of the same studies appeared in the two meta-analyses. Those common studies consisted of 53% of the articles cited by Vernon and Blake (1993) and 26% of the articles cited by Albanese and Mitchell (1993).

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