Developing Critical Thinking Skills of Tech Prep Students Using Applied Communications

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Introduction and Theoretical Base

Employers and educators are generally in agreement that students need to increase their problem solving and critical thinking skills. One goal for improved educational outcomes have pointed out that American students should perform at a higher level in these areas (National Education Goals Panel, 1994). Improved problem solving and critical thinking skill experiences have been included in tech prep initiatives which have tended to focus on activities designed to better prepare students for the world of work (Custer, Ruhland, & Stewart, 1997). However, little evidence was found that tech prep initiatives, and especially applied communications activities, addressed the improvement of problem solving and critical thinking abilities of students.

The theoretical base for this study was formed from cognitive and behavioral learning theories and theories of self-efficacy as applied to problem solving and critical thinking. These learning theories fall into two broad areas. The first area deals with the nature of problem solving and critical thinking. The second considers whether problem solving and critical thinking can be taught.

The ability to think critically and to solve problems has been a concern of philosophers, educators, and psychologists for many centuries. Sternberg (1986) attributed the modern-day critical thinking movement to John Dewey. Dewey (1933) was concerned with the nature and value of thinking. He considered thinking to be the process by which individuals find meaning in the world in which they live. The ability to think critically is a prerequisite for problem solving and as such is of significant value. Dewey believed that the ability to think critically and reflectively was a function of one's experience as well as one's intellect.

The basis for the second area of learning theory, that which deals with methods for developing cognitive abilities, can be traced to Bloom, Englehart, Furst, Hill, and Krathwohl (1956), who developed a taxonomy of cognitive levels of learning. Each level requires a different mental activity or way of thinking. Lower levels of learning are prerequisites for higher levels, where higher levels are often referred to as requiring higher order thinking skills. Bloom stated that higher order thinking skills are built on the ability of students to identify concepts and analyze and integrate multiple concepts to solve problems. Therefore, problem solving requires higher order thinking, which Bloom stated can be taught. A number of authors have proposed methods for teaching thinking and problem solving. For example, Bruner, Goodnow, and Austin (1956), Gallagher (1993), Halpern (1984), and Ruggiero (1988) have described various aspects of thinking, learning, and problem solving and methods for developing problem solving skills. The methods they proposed are based upon both cognitive and behavioral learning theories.

Bandura (1986) defined self-efficacy as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p. 408). Greenburg and Baron (1993) stated that self-efficacy develops "partly through direct experiences, in which individuals perform various tasks and receive feedback on their success, and partly through vicarious experiences, in which they observe others performing various tasks and attaining varying levels of success at them" (p. 208). They further stated that, regardless of how it develops, "the stronger individuals' beliefs that they can perform successfully, the higher their performance actually tends to be" (p. 208).

Problem solving is one of the foundation skills needed for high-skill, high-wage employment (Daggett, 1992; U.S. Department of Labor, 1992). Life in technologically oriented countries, such as the United States, is characterized by rapid change. This rapid change complicates life and makes it necessary for students to learn how to be effective problem solvers. It is particularly desirable that students learn to be effective problem solvers in the context of actual work situations. In order to keep up with international competition and the faster pace of technological change, employers in the United States are demanding that the public schools be responsible for developing students' critical thinking and problem solving skills. In response to this demand, goals have been defined at the national level for developing students' problem solving skills. The fifth objective of National Education Goal 6 states: "The proportion of college graduates who demonstrate an advanced ability to think critically, communicate effectively, and solve problems will increase substantially" (National Education Goals Panel, 1994, p. 10).

About the Study

The primary purpose of this study was to examine the effect of participation in a tech prep program and specifically an applied communications course on the problem solving self-appraisal and selected aspects of critical thinking skills of secondary students. A secondary purpose was to examine the effects of a traditional English course and an honors English course on these factors. Three null hypotheses were formulated to test for differences among performance of students in three types of English courses.

What We Did

A pretest-posttest nonequivalent control group design was used for the study. Demographic information and two instruments were used to collect data.

The Problem Solving Inventory (PSI) Form B (Heppner, 1988) was used to measure an individual's self-appraisal of problem solving self-efficacy. The PSI contains 35 items and uses a 1 to 6 Likert-type scale with 1 representing strong agreement and 6 strong disagreement with the statement. Reliability for the PSI was reported to be $r = .89$ for test-retest reliability and $r = .90$ for internal consistency. The Watson-Glaser Critical Thinking Appraisal (WGCTA) Form B (Watson & Glaser, 1980) was used to measure selected aspects of the students' critical thinking abilities. It consists of 80 items divided into five subscales of 16 items each and includes exercises that are purported to be examples of problems, statements, and interpretations of data that are regularly encountered at work or school. The split-half reliability estimates for 11th grade students was reported to be $r = .79$. The maximum raw score for the WGCTA is 80.

The purposive sample consisted of the students enrolled in four sections of each of three different English courses: an applied communications course, a traditional English course, and an honors English course. When there were more than four sections of a course, sections were randomly selected for this study. At the time of the pretest, 254 students were enrolled in the 12 sections studied. The number of students increased to 279 by the time of the posttest. Complete data on pretest and posttest measurements for the PSI and WGCTA were obtained for 136 students, including 53 Honors English III students, 43 English III students, and 40 English IIIC applied communications students. All students were in the 11th grade, except one 10th-grade student who was in English III and three 12th-grade students who were in English IIIC applied communications.

The Statistical Analysis System (SAS, 1990) was used to calculate a multivariate analysis of variance (MANOVA) value using the general linear model adaptation for a two-factor repeated measures experiment or a Pearson product-moment correlation, as appropriate. The null hypotheses were rejected if the F value was significant at equal to or less than the .05 alpha level.

The Data

The mean pretest and posttest scores (see Table 1) on the PSI for the honors English students were 83.7 and 79.0; for the English III students, 92.4 and 90.8; and for the English IIIC applied communications students, 93.2 and 95.7. The mean pretest and posttest scores on the WGCTA for the honors English students were 57.5 and 59.1; for the English III students, 48.5 and 45.6; and for the English IIIC applied communication students, 43.1 and 42.6.

The multivariate analysis of variance procedure showed a significant difference for course ($F = 43.3$; $p = .0001$) and interaction ($F = 3.5$; $p = .0088$) as reported in Table 2. There was not a significant difference found for time of administration of the instruments.

The first hypothesis proposed that there is no statistically significant difference in the mean total scores from the PSI and WGCTA by type of English course assignment. The hypothesis was not supported at the .05 level of significance. Table 3 data show a significant difference on the PSI ($F = 7.82$; $p = .0006$) and the WGCTA ($F = 75.67$; $p =. 0001$) in mean total scores of students by English course assignment. Students assigned to the honors English III course had mean total scores

Table 1. Mean Pretest and Posttest Scores for the PSI and WGCTA

Variable	M	n	SD	Variance	SE
Course 1-Honors English III					
Pretest PSI	83.736	53	17.811	317.237	2.447
Posttest PSI	79.000	53	19.104	364.962	2.624
Pretest WGCTA	57.453	53	6.256	39.137	.859
Posttest WGCTA	59.151	53	7.140	50.977	.981
Course 2-English III					
Pretest PSI	92.419	43	14.945	223.344	2.279
Posttest PSI	90.791	43	18.809	353.788	2.868
Pretest WGCTA	48.488	43	7.830	61.303	1.194
Posttest WGCTA	45.628	43	8.449	71.382	1.288
Course 3-English III C					
Pretest PSI	93.225	40	19.453	378.435	3.076
Posttest PSI	95.725	40	21.664	469.333	3.425
Pretest WGCTA	43.100	40	7.063	49.887	1.117
Posttest WGCTA	42.575	40	6.898	47.584	1.091

Table 2. Pillai's Trace Test for Multivariate Analysis

Value	Source	F	NDF	DDF	PR>F
Course	.78878902	43.3075	4	266	.0001*
Time	.01707687	1.1467	2	132	.3208
Interaction	.09904930	3.4650	4	266	.0088*

* Significant

(PSI = 81.4; WG = 58.3) that were significantly more positive than the mean total scores of students assigned to English III (PSI = 91.6; WG = 47.1). The mean total scores of English III students were, in turn, significantly more positive than the mean total score of English IIIC applied communication students (PSI = 94.5; WG = 42.8).

The second hypothesis suggested no statistically significant difference in the mean total scores from the PSI and WGCTA by time of administration of the test instruments. The hypothesis was supported at the .05 level of significance. Table 2 shows no significant difference (F = 1.1; p = .321) between the pretest and posttest mean total scores from the

Table 3. ANOVA for PSI and WGCTA

PSI	DF	SS	MS	F	PR>F
Course	2	9076.396	4538.198	7.82	.0006*
Error	133	77163.659	580.177		
Time	1	111.202	111.202	.95	.3322
Interaction	2	596.763	298.381	2.54	.0825
Error	133	15613.174	117.392		
R^2=.847					
WGCTA	**DF**	**SS**	**MS**	**F**	**PR>F**
Course	2	12143.342	6071.671	75.67	.0001*
Error	133	10671.936	80.240		
Time	1	21.208	21.208	.83	.3632
Interaction	2	247.125	123.562	4.85	.0093*
Error	133	3388.153	25.474		
R^2 = .871					

* Significant

PSI and WGCTA, for any class of students.

Results were also examined for interactions. An analysis of variance procedure (see Table 3) revealed that there was a significant interaction (F = 4.85; p = .0093) between the mean WGCTA scores by the type of English course assignment and time. A post hoc test (see Table 4) was used to isolate source of the differences between the interaction of course and time. The mean pretest and posttest WGCTA test scores of honors English III students were significantly higher than the mean pretest and posttest WGCTA scores of English III and English IIIC applied communications students. English III students' pretest and posttest scores were significantly higher than the pretest and posttest scores of English IIIC applied communications students.

The third hypothesis asserted that the correlation between the students' scores from the PSI and from the WGCTA would not be statistically different from zero. The results from the Pearson product-moment calculation showed that the correlation of .41 for the students' posttest scores from the PSI and WGCTA was significantly different than zero and the hypothesis was not supported.

Implications from the Data

The results of this study do not support a conclusion that the critical thinking skills of any of the three groups of subjects of this study were significantly changed during the course of the school year. Therefore, it cannot be concluded that the applied communications course significantly changed students' critical thinking skills. Also it cannot be concluded that the honors English III or the traditional English III courses significantly changed students' critical thinking skills.

These results may support a belief that critical thinking skills and problem solving skills cannot be developed in a short period of time. This explanation is consistent with a conclusion reached by Langholz and Smaldino

Table 4. Least Square Mean, Least Square Standard Error, and Least Significant Difference Test for Dependent Variables PSI and WGCTA by Course

Course	n	M	SE		LSD Test 2	LSD Test 3
Dependent Variable = PSI						
Honors English III	106	81.367	1.052	1	.0001*	.0001*
English III	86	91.604	1.168	2	.0904	
English IIIC	80	94.475	1.211	3		
Dependent Variable = WGCTA						
Honors English III	106	58.301	.490	1	.0001*	.0001*
English III	86	47.058	.544	2		.0001*
English IIIC	80	42.837	.564	3		

* Significant

(1989). They pointed out that there is not much evidence to support the conclusion that critical thinking and problem solving can be developed in a short period of time.

There is some literature that supports the idea that training can develop a more positive self-appraisal of an individual's problem solving abilities. Gallagher (1993) pointed out that the PSI has been used as an outcome measure for problem solving seminars. In a study of an eclectic approach to training paraprofessionals in counseling, Gallagher administered the PSI both pre and posttest and found that the PSI scores of trainees decreased significantly, indicating that the trainees' self-appraisal of their problem solving was more positive after training. Interestingly, the self-appraisal of their problem solving abilities by the subjects in the study reported in this article did not significantly change over the time of the study. In addition, the pretest-posttest comparisons found no statistically significant evidence indicating that the spread between the self-appraisal of Honors English III students as compared to the self-appraisal of English IIIC applied communications students increased over time.

Although the change was not statistically significant, the posttest mean PSI scores of Honors English III and English III students were lower than their pretest mean scores. This could indicate that a slightly more positive self-appraisal of their problem solving abilities was developed. By way of contrast, the posttest mean PSI score (95.73) of the English IIIC applied communications students was higher than their pretest mean score (93.23). A possible explanation for this slightly less positive self-appraisal might be that their understanding of problem solving increased and the posttest score provided a more realistic awareness of their problem solving abilities.

Students' grade point averages and PLAN test scores were also examined to provide additional background information for the study. An examination of the data revealed that both the grade point average (3.5 vs. 2.2) and PLAN test scores (23.1 vs. 14.2) of the honors English students were higher than for English IIIC applied communication students. Students' scores from the PLAN test, which requires higher order thinking skills, were significantly related to their PSI and WGCTA scores. This indicates that the students assigned to the different courses had different characteristics that likely influenced their performance on the test instruments.

The tech prep curriculum for the applied communications course should incorporate specific objectives to improve the critical thinking skills of students and to develop a more positive perception of their ability to solve unstructured problems of the type encountered at home and at work. To achieve these objectives, instruction specifically designed to develop inductive and deductive reasoning skills and to develop the ability to draw inferences should be incorporated into the tech prep applied communications curriculum.

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