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ABSTRACT

This study investigated the effects of an interdisciplinary course in inquiry on the self-perceptions of preservice teachers. Sample populations included an experimental group enrolled in an interdisciplinary inquiry course. Control groups comprised students enrolled only in a philosophy course in inquiry, students not enrolled in either course, and inservice teachers not enrolled in either course. A testing instrument rated the concepts of "myself as an inquirer" and "myself as a teacher in the conduct of inquiry" and opinion on the nature of inquiry. A summary of the findings concluded that the experimental inquiry group perceived (1) their inquiry teaching selves as more open to and pleased by the social stimulation of the inquiry mode of teaching, (2) themselves less comfortable as inquirers than did students in the philosophy of inquiry course, (3) the nature of inquiry as more truthful and perfect than did any of the other groups, and (4) the nature of inquiry as less structured and more responsive than the other control groups. Under the assumption that behavior follows perception, instruction of this nature is valuable for teaching any inquiry oriented discipline. (Author/DE)

A COMPARATIVE STUDY OF THE EFFECTS OF AN INTERDISCIPLINARY COURSE IN INQUIRY ON THE PERCEPTIONS OF PRESERVICE TEACHERS

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A review of the social studies literature supports the contention that didactic teaching does not meet today's challenges and that what is needed is a teaching attitude which "promotes the spirit and mood of inquiry, critical skepticism, inventiveness, imagination, and enthusiasm for "learning" (Tucker, 1970). This position is advanced in curricula guidelines for social studies educators, yet the social studies classroom, typically, is not characterized by inquiry-supportive teacher behaviors.

Despite the need for facilitating the autonomous probing of the learner (Suchman, 1965), indirectiveness (Massialas, 1970) and supportiveness of the teacher (Merwin, 1970); Feely (1972) noted that social studies educators often inquire in a restricted manner, which results in teacher dominance instead of student autonomy. He concluded that this reflects the teacher's insecurity about what they perceive their role to be, if they are not directing each activity.

One would expect that "the classroom teacher who would institute a program of inquiry must himself be an inquirer" (Goldmark, 1968, p. 156), yet teachers, characteristically, do not perceive themselves as inquirers. Butts (1965) found that problem-solving behaviors were not characteristic of students in science methods, either. Similarly, Gray and Youngs (1971) and Keller (1970) concur that there is difficulty in getting prospective teachers to build models of inquiry. In light of these non-inquiry behaviors and confused role expectations, it is not surprising that prospective teachers have been found to be preoccupied, primarily, with student behaviors which are socially desirable, rather than inquiry-related (Herrin, 1971).

The phenomenological attitude of teachers, as it influences classroom climate, academic achievement, and student self-concept, has been documented

(Rosenthal and Jacobson, 1968; Rogers, 1961; Combs, 1965; Purkey, 1973). These studies concur that teachers with psychologically sound self-perceptions tend to demonstrate more facilitative behaviors than those who have unhealthy perceptions. Combs goes on to state that "whether an individual will be an effective teacher depends upon the nature of his private world of perceptions" (Combs, p. 19).

This phenomenological dimension has a direct bearing on the inquiry process. It was Dewey who noted that inquiry must be concerned, fundamentally, with the development of attitudes which are conducive to productive thinking (Doll, 1973). Similarly, VanScotter and Hass (1972) advance the theory that as inquiry becomes more reflective, affective behaviors become more crucial.

In addition to the teacher's perceptions about the nature of inquiry and his/her role within it, there is a need for teachers to be able to perceive the interrelatedness of the content areas; i.e., the natural and social sciences. This is especially important since there is a tendency for these content areas to be integrated in the elementary curriculum (Blackwood, 1965; Powell, 1969). Despite this fact, it has been noted that there are few science methods courses which develop an interdisciplinary perspective (Banks, 1965).

The effects of interdisciplinary teaching were reported by Kermode (1972), who reported that there was marked improvement in the learner's self-concept, as well as increased independence, assertiveness, self-motivation, enthusiasm, and interest. In addition, he found that students employed more varied problem-solving approaches while making better use of available resources. Kalla (1972) concluded that an interdisciplinary approach to an elementary education program resulted in attitude changes regarding preservice teachers' perceptions of the nature of the learning experience, the learning environment, and student-teacher relationships.

The effects of inquiry training for teachers has been under study for some time; however, the vast majority of these studies dwell upon measuring the student's ability to conduct inquiry as a result of some training program, i.e., improving questioning strategies (Bass, 1972; Knight & Wayne, 1970; Olsen, 1972; Pate, 1969).

There are no studies which address themselves to the assessment of an interdisciplinary approach to inquiry teaching on the perceptions of prospective teachers. This absence of empirical data exists, yet there is evidence that the use of inquiry strategies does modify teacher attitudes, which in turn have been found to effect teacher behaviors. This study will attempt to provide some of the necessary data on the perceptions of prospective teachers as they relate to inquiry and inquiry teaching.

PROBLEM

The major problem investigated in this study was to determine the effects of an interdisciplinary course in inquiry on the perceptions of preservice teachers.

Sub-problems investigated are as follows:

A. To determine differences in the perceptions of self as teacher in the conduct of inquiry, self as inquirer, and the nature of inquiry between preservice teachers who have completed an interdisciplinary course in inquiry for prospective teachers, preservice teachers who have completed all requirements for teacher certification, and inservice teachers.

B. To determine changes in the perceptions of self as inquirer, and self as teacher in the conduct of inquiry of preservice teachers as a result of the experiences in an interdisciplinary course in inquiry for prospective teachers.

C. To determine differences in the perceptions of self as inquirer, and the nature of inquiry between students who have taken an interdisciplinary course in inquiry for prospective teachers and college students who have completed a philosophy course in inquiry.

METHOD

Subjects

Students who had completed their teacher preparation through student teaching and who were enrolled in an interdisciplinary course in inquiry represent the major treatment group on this study (N=18). A reference group of students enrolled in a philosophy course in inquiry make up the second experimental group (N=34). A third group was obtained by random selection of 50 students from the available population of students who had completed all requirements for teacher certification (N=42). The fourth group was made up of inservice teachers who were enrolled in a variety of extension courses offered by the college. A sample of 90 teachers were randomly selected from a total population of 283 for this group. Seven persons were dropped from this sample because of insufficient data, hence the N for this sample is 83.

Instrument

The instrument used to assess the variable self-perception is a semantic differential. Seven point semantic differential scales were used to rate the concepts: Myself as an inquirer - referred to as Inquiring Self and designated IQS, and Myself as a teacher in the conduct of inquiry - referred to as Inquiry Teacher Self and designated ITS, on 21 polar adjective pairs. The pairs (administered as indicated in Table A) were developed by Lewis (1971) and used by Monge (1973) in a study of self-concept. The adjective pairs were administered as indicated in Table B.

A special set of adjective pairs, developed by the investigators was used to measure perceptions of the concept Nature of Inquiry (NI). The following procedure was employed to establish a content validity for these pairs of adjectives. A panel of judges whose field of study includes investigation of the nature of inquiry or inquiry teaching participated in the selection of the adjectives. Four persons on campus, in addition to the investigators, were chosen for this panel. The composition of the panel was as follows: four social studies educators, two science educators, and one philosopher. Each person was asked to submit adjectives which describe the nature of inquiry, some 54 separate adjectives were obtained. Next, every member of the panel ranked the 54 adjectives on a forced choice Q-sort. The 21 adjectives receiving the most votes were used. The decision to use 21 pairs was rather arbitrary in that the rationale for this decision was mainly to provide consistence of format and convenience in analyzing the data. However, there was some experimental rationale. A-priori assessment of the adjectives using a thesarus method revealed not more than seven factors with three adjectives per factor. This is acceptable in terms of the guidelines established by Osgood, Suci, and Tannenbaum (1957), and although the a-priori method was not used in the determination of factors, it seemed reasonable that not more than seven factors would be found in the factor analysis. The adjective pairs were administered as indicated in Table I.

The concepts for the instruments were selected by the investigators and accepted on the grounds that there was a direct relationship between the objectives for the interdisciplinary course in inquiry and the concepts.

Design

The major questions asked in this study are:

(1) Are there differences in the perceptions of self as teacher in the conduct of inquiry, self as inquirer and the nature of inquiry between preservice teachers who have completed an interdisciplinary course in inquiry for prospective teachers, preservice teachers who have completed all requirements for teacher certification, and inservice teachers?

(2) Does an interdisciplinary course in inquiry for prospective teachers effect changes in preservice teachers' perception of himself as an inquirer, himself as a teacher in the conduct of inquiry, and the nature of inquiry?

(3) Are there differences in the perceptions of self as inquirer and the nature of inquiry between students who have taken an interdisciplinary course in inquiry for prospective teachers and college students who have completed a philosophy course in inquiry?

A variation of the Solomon Four Group design was used to answer these questions.

Using the notation of Campbell and Stanley (1963), the design may be represented as follows:

R_1^*	O_1	X_1	O_3
R_2	O_2	X_2	O_4
R_3			O_5
R_4			O_6

Where: R represents random selection of a sample from a population.

R* indicates intact groups. (The use of intact classrooms for these groups was necessary since it was impossible to select these classrooms or students at random when the experimental treatment was the

course taught in these classrooms.)

O_1, O_2 indicate the administration of pretest measures.

O_3, O_4, O_5, O_6 indicate the administration of posttest measures.

X_1 indicates an experimental treatment - in this case an interdisciplinary course in inquiry for prospective teachers.

X_2 indicates a different experimental treatment - here this represents a course in philosophy on the nature of inquiry.

Observations 1 through 4 will be used to answer the third question listed on page 6. Observations 3 through 6 will be used to answer the second question on page 6. Changes in perception for the experimental group will be determined using observations 1 and 2. Each of these questions will be dealt with separately and in the order given on page 6.

General Statistical Procedures

Factor Analysis:

Principal components were extracted as the first step in each analysis. Vectors with eigen values greater than or equal to one were then rotated to the verimax criterion (Kaiser, 1959). Orthogonal verimax rotation was selected on the basis of Smith's (1962) findings that this method "provided the most satisfactory factor structure for interpretation (p. 333)."

Rotated components are referred to in this paper as factors.

Factor Similarity:

The degree of factor similarity was determined by means of the coefficient of congruence devised by Tucker (1951) and reported in Harmon (1967, p. 270). Significant factor similarity exists, according to Tucker (1951), when the coefficient of congruence is greater than .459 or less than -.459. Factor similarity between groups is desirable in order to pool the groups for statistical comparison.

RESULTS

Three separate analyses were used to answer the questions asked on page 6. Results of these analyses are presented in the same order in which the questions are asked.

Analysis #1

The three groups involved in this analysis are: the experimental group of preservice teachers enrolled in the interdisciplinary course in inquiry for prospective teachers (designated EI), preservice teachers who have completed all requirements for certification (designated PST), and teachers inservice (designated IT).

The general statistical procedures described on page 7 were employed for the concepts; Self as Teacher in the Conduct of Inquiry, Self as Inquirer, and the Nature of Inquiry. Coefficients of congruence were determined for each factor of each concept. Sufficient congruence was observed for pooling the data for all concepts and all groups. Specific coefficients are not reported in this paper but are available from the investigators. The decision not to list these coefficients was made because of convenience and to save paper, since they are nct essential to discuss the results.

Concept #1 Myself as a teacher in the conduct of inquiry (ITS).

Pooled Verimax Analysis

Three orthogonal factors were extracted from the pooled data. Table A presents the factors with the adjective pairs used to name the factors listed under each factor. The pairs of adjectives are listed in order of their loadings, largest to smallest.

TABLE A

FACTORS FOR SELF AS TEACHER IN THE CONDUCT OF INQUIRY

I. Achievement/Adjustment

Confident - Unsure
Superior - Inferior
Steady - Shaky
Success - Failure
Stable - Unstable
Strong - Weak
Sharp - Dull
Satisfied - Dissatisfied
Good - Bad
Relaxed - Nervous
Smart - Dumb
Leader - Follower
Valuable - Worthless
Refreshed - Tired

II. Congeniality/Sociability

Kind - Cruel
Nice - Awful
Friendly - Unfriendly
Happy - Sad
Healthy - Sick

III. Masculinity/Feminity

Hard - Soft
Rugged - Delicate

Interpretation of Factors

The findings of Monge (1973) and DeMarte and Sorgman (1973) were used as referents to name the factors in this study since they employed the same instrument to measure self-perceptions.

Factor I, Achievement/Adjustment seems to be a merger of DeMarte and Sorgman's factors I and II and Monge's factors I and III of the same names. The combination of factors is not an uncommon event in factor analysis. It does, however, make interpretation slightly more difficult. Positive adjectives for this factor convey the picture of a capable, independent, front running individual who is generally in a state of equilibrium with his environment. Negative poles for these adjectives, on the other hand, project the image of incompetent, dependent, loser who is in a state of flux with his environment.

Factor II, Congeniality/Sociability is very similar to Monge's factor II in that the adjective pair healthy-sick replaces good-bad. Monge interprets

the positive adjectives to be indicative of a person perceiving himself as open to and pleased by social stimulation. We accept the name congeniality/sociability and add the dimension of a specific self perception, that is of self as teacher in the conduct of inquiry.

Factor III, Masculinity/Feminity is so named because it so clearly distinguished male and female responses in Monge's study. As Monge points out, the male pole is defined by rugged and hard and the female pole by delicate and soft, traits which Rosenkrantz et al. (1968) identified as male-valued and female-valued, respectively.

Table B presents the verimax loadings for the 21 adjective pairs and other statistics of interest for the factor analysis performed on the pooled data for the concept, Self as Teacher in the Conduct of Inquiry.

TABLE B

VERIMAX FACTORS FOR THE CONCEPT: SELF AS TEACHER IN THE CONDUCT OF INQUIRY

Variable[a]	Factor Loadings[b]			Communalities
	I	II	III	
1. *Confident*-Unsure	-.847			.743
15. Superior-*Inferior*	-.809			.706
5. Steady-*Shaky*	-.795			.698
6. *Success*-Failure	-.794			.718
17. *Stable*-Unstable	-.785			.727
3. *Strong*-Weak	-.767			.672
9. *Sharp*-Dull	-.732			.634
2. Good-*Bad*	-.720			.669
19. Satisfied-*Dissatisfied*	-.720	.357		.655
20. *Smart*-Dumb	-.637	.347		.546
4. Leader-*Follower*	-.622			.562
12. Valuable-*Worthless*	-.576	.468		.553
16. Relaxed-*Nervous*	-.639			.538
21. Refreshed-*Tired*	-.468			.402
13. *Kind*-Cruel		.809		.681
7. *Nice*-Awful		.762		.676
18. *Friendly*-Unfriendly	-.324	.745		.660
11. *Happy*-Sad	-.512	.551		.571
10. Healthy-*Sick*		.379		.296
14. *Hard*-Soft			-.632	.460
8. Rugged-*Delicate*			-.630	.429
% of Variance	36.8	16.7	6.5	60.0

[a]Numbered in order administered, italicized pole was left most on instrument.

[b]Loadings less than .30 in magnitude omitted.

Analysis of Factor Scores

In order to obtain a statistic for each subject which represents his measurement on each of the three factors, the following procedure was employed. Each subject's rating on each scale was transformed into standard score form. This results in a vector of standard scores for each subject. This vector was then premultiplied by the matrix product $(B' B)^{-1} B'$, in which B was the 21 (Variables) X 3 (Factors) verimax pattern matrix (Harman, 1967, sec. 16.3). The result is three "factor scores" which represent the subject's measurement on each factor. Factor scores so derived are in standard score form, distributed with a mean of zero and variance of one, and the vectors are orthogonal.

The next step was to run a one-way analysis of variance on the factor scores to determine differences between these three groups. Results of this analysis are presented in Table C.

TABLE C

SUMMARY ANALYSIS OF VARIANCE FOR CONCEPT: SELF AS TEACHER IN THE CONDUCT OF INQUIRY

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. ACHIEVEMENT/ ADJUSTMENT	EI	-.05	.83	.41 (Between)	2	.20	.21	.81
	PST	.03	1.16					
	IT	-.09	.93	138.58 (Within)	140	.99		
II. CONGENIALITY/ SOCIABILITY	EI	.63	.85	8.11 (Between)	2	4.06	4.47	.01
	PST	-.11	.95					
	IT	-.07	.97	126.88 (Within)	140	.91		
III. MASCULINITY/ FEMINITY	EI	.16	.81	6.08 (Between)	2	3.04	2.90	.06
	PST	.26	.79					
	IT	-.18	1.16	146.62 (Within)	140	1.05		

Results of this analysis indicate that for this concept a significant difference is evidenced for factor II, Congeniality/Sociability. Since the most interesting question one could ask about this difference is; does the Experimental Inquiry group differ significantly from the other two groups? A planned orthogonal comparison of means was employed as the post hoc procedure to answer this question. This contrast of means was found to be significant at the .002 level. Further analysis using the Scheffe method reveals a significance for this contrast beyond the .01 level. This is rather strong statistical evidence for/to indicate that the Experimental Inquiry group's perception of themselves as teachers in the conduct of inquiry was significantly more positive regarding the congeniality/sociability factor.

a treatment effect. This seems

Concept #2 Myself as an Inquirer

Pooled Verimax Analysis

Three orthogonal factors were extracted from the pooled data. Table D presents the factors with the adjective pairs used to name the factors listed under each factor. The adjective pairs are listed in order of their loadings, largest to smallest.

TABLE D

FACTORS FOR CONCEPT: SELF AS INQUIRER

I. Achievement/Leadership	II. Congeniality/Sociability
Strong-Weak	Kind-Cruel
Sharp-Dull	Friendly-Unfriendly
Success-Failure	Nice-Awful
Good-Bad	Soft-Hard
Superior-Inferior	Happy-Sad
Confident-Unsure	
Smart-Dumb	III. Adjustment
Leader-Follower	
Steady-Shaky	Refreshed-Tired
Valuable-Worthless	Healthy-Sick
	Relaxed-Nervous
	Rugged-Delicate
	Stable-Unstable
	Satisfied-Dissatisfied

Interpretation of Factors

Factor I. Achievement/Leadership is clearly Monge's (1973) Factor I of the same name. Positive poles of the adjectives for this factor convey the perception of self as an inquirer to be a capable, intelligent person who would be at the "head of the pack." The other pole presents the image of incompetence, dejection, and an all around "loser."

Factor III. Adjustment was so named by Monge (1973) in that "the positive pole conveys a picture of need satisfaction and homeostatic balance versus an image at the negative pole of helpless frustration. The person who has attained a comfortable balance with his environment, adjusted to its rhythms of ebb and flow, and built a comfortable niche in life would apply the positive adjectives to himself."

Factor II. Congeniality/Sociability is identical to factor II described on page 9.

Table E presents the verimax loadings for the 21 adjective pairs and other statistics of interest for the factor analysis performed on the pooled data for this concept.

TABLE E

VERIMAX FACTORS FOR THE CONCEPT: SELF AS INQUIRER

Variable[a]	Factor Loadings[b]					Communalities
	I	II	III	IV	V	
1. *Confident*-Unsure	.717					.578
2. *Good*-Bad	.724					.608
3. *Strong*-Weak	.788					.660
4. Leader-*Follower*	.672					.549
5. Steady-*Shaky*	.663		-.443			.637
6. *Success*-Failure	.752					.657
9. *Sharp*-Dull	.773					.618
12. Valuable-*Worthless*	.633	-.427				.616
15. Superior-*Inferior*	.723					.557
20. *Smart*-Dumb	.704					.546
13. *Kind*-Cruel		-.828				.689
18. *Friendly*-Unfriendly		-.770				.635
3. *Nice*-Awful		-.719				.614
14. *Hard*-Soft		.632				.588
11. *Happy*-Sad		-.642	-.376			.617
19. Satisfied-*Dissatisfied*		-.531	-.398			.543
21. Refreshed-*Tired*			-.731			.613
10. Healthy-*Sick*		-.385	-.597			.514
16. Relaxed-*Nervous*	.476		-.506			.484
8. Rugged-*Delicate*		.363	-.471			.426
17. *Stable*-Unstable	.384		-.456			.402
% of Variance	28.3	17.0	12.6			57.9

[a]Numbered in order administered, italicized pole was left most on instrument.

[b]Loadings less than .30 in magnitude omitted.

Analysis of Factor Scores

The procedure described on page 12 was used to generate factor scores. Again, one way analysis of variance was used to determine between group differences. Results of this analysis are given in Table F.

TABLE F

SUMMARY ANALYSIS OF VARIANCE FOR CONCEPT: SELF AS AN INQUIRER

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. ACHIEVEMENT/ LEADERSHIP	EI	.27	.61	3.45 (Between)	2	1.73	1.82	.17
	PST	-.25	1.17					
	IT	-.09	.93	136.31 (Within)	140	.95		
II. CONGENIALITY/ SOCIABILITY	EI	-.55	.72	1.58 (Between)	2	.79	1.06	.35
	PST	-.24	.86					
	IT	-.22	.89	103.90 (Within)	140	.74		
III. ADJUSTMENT	EI	-.40	.65	4.19 (Between)	2	2.10	1.96	.14
	PST	.08	.97					
	IT	-.26	1.12	149.39 (Within)	140	1.07		

These results indicate no statistically significant difference between these groups in terms of perceptions of themselves as inquirers.

Concept #3 Nature of Inquiry

Pooled Verimax Analysis

Six orthogonal factors were extracted from the pooled data. Table G presents the factors with the adjective pairs used to name them listed under each factor. The adjective pairs are listed in order of their loadings, largest to smallest.

TABLE G

FACTORS FOR CONCEPT: NATURE OF INQUIRY

I. TRUTH/PERFECTION

Certain-Uncertain
Definite-Indefinite
Straightforward-Obscure
Absolute-Doubtful
Sure-Unsure

II. IMPACT/SIGNIFICANCE

Static-Dynamic
Uninfluential-Influential
Simple-Complex

III. STRUCTURE/RESPONSIVENESS

Systematic-Random
Stylized-Spontaneous
Slow-Fast
Reflective-Impulsive
Delayed-Immediate

IV. CONFIDENCE/PROTECTION

Dangerous-Safe
Difficult-Easy
Bewildering-Reassuring
Insecure-Secure

V. EXTRINSIC/INTRINSIC

Extrinsic-Intrinsic

VI. POTENCY/LIMITATION

Strong-Weak
Infinite-Finite
Unrelenting-Yielding

Interpretation of Factors

Factor I. Truth/Perfection, was defined on the left most pole by the adjectives certain, definite, straightforward, absolute, and sure. Collectively these adjectives connote the truth seeking nature of inquiry. Also, implied is a perception of the ultimate perfection of this truth seeking procedure. Adjectives on the opposite pole conger an image of vagueness and invalidity.

Factor II. Impact/Significance, defined on one pole with the adjectives static, uninfluential, and simple gives the impression for this concept as something unable to provoke or induce change. Adjectives on the rightmost pole dynamic, influential, and complex imply something in motion with the capability to create change.

Factor III. Structure/Responsiveness, was defined on the leftmost pole by the adjectives systematic, stylized, slow, reflective, and delayed. Together these adjectives indicate a time dimension for the process of inquiry and imply a structure or framework for the process. On this side of the scale the structure of inquiry would be perceived as present and responding in a gradual fashion. The opposite pole, defined by the adjectives random, spontaneous, fast, impulsive, and immediate, would connote a structureless, rapidly changing process for the nature of inquiry.

Factor IV. Confidence/Protection, defined at the leftmost pole as dangerous, difficult, bewildering, and insecure, implies a lack of confidence and a large degree of skepticism in the nature of inquiry. Adjectives at the rightmost pole give the opposite impression.

Factor V. Extrinsic/Intrinsic, was defined by one adjective pair, hence a certain measure of confidence is not possible when one attempts to describe any perception relative to this one pair. However, we can speculate that this relates to perception of the personal value of the nature of inquiry as intrinsic or extrinsic.

Factor VI. Potency/Limitation, was defined at the leftmost pole by the adjectives strong, infinite, and unrelenting. Taken collectively, these adjectives conjure an image of a powerful, continuous, and unending entity for the nature of inquiry. The adjectives weak, finite, and yielding define the rightmost pole and give the impression of frailty, termination, and compliance.

TABLE H

VERIMAX FACTORS FOR THE CONCEPT: NATURE OF INQUIRY

Variable[a]	Factor Loadings[b]						Communalities
	I	II	III	IV	V	VI	
				.370			
9. Absolute-*Doubtful*	-.647						.558
2. Sure-*Unsure*	-.541						.540
14. *Delayed*-Immediate	-.499						.540
18. *Certain*-Uncertain	-.741						.684
19. *Definite*-Complex	-.740						.630
21. Straightforward-*Obscure*	-.682						.530
3. Static-*Dynamic*		-.773					.651
10. Influential-*Uninfluential*		.666					.479
20. *Complex*-Simple		.580				.325	.576
5. *Systematic*-Random			.716				.689
6. Reflective-*Impulsive*			.533				.501
8. *Stylized*-Spontaneous			.652				.548
16. Slow-*Fast*			.600			-.399	.628
4. *Dangerous*-Safe				-.756			.597
7. *Difficult*-Easy			.388	-.623			.617
12. *Unrelenting*-Yielding				.433		.416	.513
13. Secure-*Insecure*	-.495			.505			.656
15. Reassuring-*Bewildering*				.543			.543
11. Extrinsic-*Intrinsic*					-.837		.727
1. *Finite*-Infinite		-.394				-.404	.410
17. *Strong*-Weak						.758	.673
% of Variance	15.8	10.0	9.8	9.8	5.6	7.5	58.5

[a]Numbered in order administered, italicized pole was left most on instrument.

[b]Loadings less than .30 in magnitude omitted.

Analysis of Factor Scores

Factor scores for these three groups, derived using the procedure described on page 12, were subject to one-way analysis of variance to determine the differences in perception for the concept, Nature of Inquiry. Results of this analysis are presented in Table I.

TABLE I

SUMMARY ANALYSIS OF VARIANCE FOR CONCEPT: NATURE OF INQUIRY

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. TRUTH/ PERFECTION	EI	.76	.90	17.09 (Between)	2	8.54	9.33	.0001
	PST	-.04	.81					
	IT	-.31	1.04	145.34 (Within)	140	.92		
II. IMPACT/ SIGNIFICANCE	EI	.50	.78	9.36 (Between)	2	4.68	4.37	.01
	PST	.33	1.07					
	IT	.06	1.06	149.81 (Within)	140	1.07		
III. STRUCTURE/ RESPONSIVENESS	EI	-.33	.78	3.78 (Between)	2	1.89	2.00	.14
	PST	-.37	.89					
	IT	-.03	1.05	132.58 (Within)	140	.95		
IV. CONFIDENCE/ PROTECTION	EI	.22	1.23	.34 (Between)	2	.17	.16	.84
	PST	.17	1.10					
	IT	.09	.91	143.42 (Within)	140			
V. EXTRINSIC/ INTRINSIC	EI	-.38	1.00	8.38 (Between)	2	4.19	3.57	.03
	PST	-.16	1.09					
	IT	.25	1.10	164.23 (Within)	140	1.17		
VI. POTENCY/ LIMITATION	EI	.37	.86	5.83 (Between)	2	2.92	2.92	.06
	PST	.07	1.02					
	IT	-.21	1.01	139.81 (Within)	140			

Statistically significant differences were found for factors I. (Truth/Perfection), II. (Impact/Significance) and V. (Extrinsic/Intrinsic). This raised the question of whether this difference exists between the Experimental Inquiry group and the two control groups. Planned orthogonal comparison of means was used to answer this question. Results of this analysis indicate a statistically significant difference between the Experimental Inquiry group and the control groups for factors I and II. Further analysis using the Scheffe method reveals significance beyond the .01 level for these contrasts. A glimpse of the means for factor V posed another question; is there a significant difference between the preservice teachers and inservice teachers for this factor? Again, planned orthogonal comparison of these means indicates a significant difference beyond the .05 level of alpha.

Analysis #2

The following analysis was made to determine the changes in perception of self as teacher in the conduct of inquiry, self as inquirer, and the nature of inquiry for preservice teachers as the result of taking an interdisciplinary course in inquiry for prospective teachers.

Factor scores, derived using the procedure outlined on page 12, for the experimental inquiry group's pre and post test observations were used in this analysis. One way analysis of variance was performed on the factor scores for the previously stated concepts to determine the changes in perception. Results of the ANOVA are given in Tables J through L.

TABLE J

SUMMARY ANALYSIS OF VARIANCE FOR THE CONCEPT: SELF AS TEACHER IN THE CONDUCT OF INQUIRY

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. ACHIEVEMENT/ ADJUSTMENT	EI(pre)	.42	1.04	1.98	1	1.98	2.22	.14
	EI(post)	-.05	.83	30.33	34	.89		
II. CONGENIALITY/ SOCIABILITY	EI(pre)	-.05	1.23	(B 4.24 (Between)	1	4.24	3.79	.06
	EI(post)	.633	.85	38.12 (Within)	34	1.12		
III. MASCULINITY/ FEMININITY	EI(pre)	.07	.69	.07 (Between)	1	.07	.12	.73
	EI(post)	.16	.80	19.13 (Within)	34	.56		

While no statistically significant difference is observed for the changes in perceptions of self as teacher in the conduct of inquiry for the experimental inquiry group, the alpha of .06 for factor II (Congeniality/Sociability) does approach significance. Since the decision rule of .05 level for alpha is arbitrary we can accept this as a significant change in perception.

TABLE K

SUMMARY ANALYSIS OF VARIANCE FOR THE CONCEPT: SELF AS INQUIRER

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. ACHIEVEMENT/ LEADERSHIP	EI(pre)	-.30	.96	2.94 (Between)	1	2.94	4.51	.04
	EI(post)	.27	.61	22.16 (Within)	34	.65		
II. CONGENIALITY/ SOCIABILITY	EI(pre)	-.32	.83	.44 (Between)	1	.44	.73	.40
	EI(post)	-.55	.72	20.62 (Within)	34	.06		
III. ADJUSTMENT	EI(pre)	-.01	.75	1.38 (Between)	1	1.38	2.79	.10
	EI(post)	-.40	.65	16.88 (Within)	34	.50		

For the concept self as inquirer, factor I (Achievement/Leadership) is observed to have been perceived significantly different by the Experimental Inquiry group from the beginning to the end of the course. The means indicate a positive change in perception.

TABLE L

SUMMARY ANALYSIS OF VARIANCE FOR CONCEPT: NATURE OF INQUIRY

FACTOR	GROUP	$\bar{X}$	SIGMA	SUM OF SQUARES	DF	MEAN SQUARE	F RATIO	P<
I. TRUTH/ PERFECTION	EI(pre)	.05	.80	4.52 (Between)	1	4.52	6.27	.02
	EI(post)	.76	.89	24.50 (Within)	34	.72		
II. IMPACT/ SIGNIFICANCE	EI(pre)	.36	.69	.18 (Between)	1	.18	.32	.57
	EI(post)	.50	.78	18.33 (Within	34	.54		
III. STRUCTURE/ RESPONSIVENESS	EI(pre)	-.14	.76	.35 (Between)	1	.35	.59	.45
	EI(post)	-.33	.78	20.04 (Within)	34	.59		
IV. CONFIDENCE/ PROTECTION	EI(pre)	.23	1.18	.002 (Between)	1	.002	.002	.95
	EI(post)	.21	1.23	49.34 (Within)	34	1.45		
V. EXTRINSIC/ INTRINSIC	EI (pre)	-.18	.73	.36 (Between)	1	.36	.47	.50
	EI(post)	-.38	1.00	26.10 (Within)	34	.77		
VI. POTENCY/ LIMITATION	EI(pre)	-.03	.89	1.46 (Between)	1	1.46	1.91	.18
	EI(post)	.37	.86	26.10 (Within	34	.77		

Of the six factors for the concept nature of inquiry, only factor I (Truth/ Perfection) is observed to have changed significantly from the beginning to the end of the experimental course. The pre and posttest means for this factor indicate a positive change in perception.

Analysis #3

This analysis was undertaken to answer the question; are there differences in the perceptions of self as inquirer and the nature of inquiry between students who have taken an experimental interdisciplinary course in inquiry for prospective teachers and college students who have completed a philosophy course in inquiry?

The philosophy course was titled Theory and Evidence and dealt primarily with the nature of inquiry. This course was of interest as a reference group in that the entire course was about inquiry and none of the students enrolled were education majors or intended to become teachers. This group is designated (TE).

The preliminary analysis to determine factors for the concepts Self as Inquirer and Nature of Inquiry was reported in Analysis #1. Since both of these groups were pretested one-way analysis of covariance was used to determine differences between these groups. Tables M and N contain results of the covariant analysis.

TABLE M

SUMMARY ANALYSIS OF COVARIANCE FOR THE CONCEPT: SELF AS INQUIRER

FACTOR	GROUP	PRETEST $\bar{X}$	POSTTEST $\bar{X}$	ADJUSTED CRITERION $\bar{X}$	DF	MEAN SQUARE	F	P<
I. ACHIEVEMENT/ LEADERSHIP	EI TE	-.30 .26	.27 .27	.51 .15	1 49	1.39 .42	3.31	.08
II. CONGENIALITY/ SOCIABILITY	EI TE	-.32 .60	-.55 .70	-.27 .56	1 49	6.93 .42	16.46	.001
III. ADJUSTMENT	EI TE	-.01 .35	-.40 .41	-.30 .36	1 49	4.96 .42	11.88	.01

These results clearly indicate a statistically significant difference for factors II (Congeniality/Sociability) and III (Adjustment). A positive difference in means in favor of the Theory and Evidence group is noted for both of these factors.

TABLE N

SUMMARY ANALYSIS OF COVARIANCE FOR N CONCEPT: NATURE OF INQUIRY

FACTOR	GROUP	PRETEST $\bar{X}$	POSTTEST $\bar{X}$	ADJUSTED CRITERION $\bar{X}$	DF	MEAN SQUARE	F	P<
I. TRUTH/ PERFECTION	EI	.05	.76	.79	1	4.60	6.28	.01
	TE	.21	.19	.17	49	.73		
II. IMPACT/ SIGNIFICANCE	EI	.36	.51	.35	1	.86	1.23	.25
	TE	-.19	-.01	.07	49	.70		
III. STRUCTURE/ RESPONSIVENESS	EI	-.14	-.33	-.19	1	4.47	7.07	.01
	TE	.27	.51	.44	49	.63		
IV. CONFIDENCE/ PROTECTION	EI	.23	.21	.04	1	1.85	2.98	.10
	TE	-.21	-.46	-.36	49	.62		
V. EXTRINSIC/ INTRINSIC	EI	-.18	-.38	-.37	1	1.87	2.94	.10
	TE	-.14	.03	.02	49	.64		
VI. POTENCY/ LIMITATION	EI	-.03	.37	.42	1	2.63	3.48	.07
	TE	.26	-.02	-.05	49	.76		

A statistically significant difference was determined for only two of the six factors defining the concept nature of inquiry. Factor I (Truth/Perfection), was observed more positively by the Experimental Inquiry group. Conversely, factor III (Structure/ Responsiveness), was observed more positively by the Theory and Evidence group.

DISCUSSION

Analysis #1

The purpose of this analysis was to determine differences in perceptions of self as teacher in the conduct of inquiry, self as inquirer, and the nature of inquiry between the Experimental Inquiry group and the two control groups: preservice teachers and inservice teachers. Examination of results for the self scales reveals a significant difference for factor II, Congeniality/ Sociability within the concept self as teacher in the conduct of inquiry. The post hoc analysis implies a treatment effect by attributing this difference in perception to the experimental group and not the control groups. Additional support for a treatment effect is found in analysis #2 where a significant change in perception for the same factor and concept is observed.

It is impossible to specify exactly what element(s) of the experimental treatment produced this effect. We might speculate that since much of the course dealt with the teacher's role in inquiry teaching, something in the role definition presented to these students was the contributing factor. Two key characteristics of the teaching role were openness and acceptance. The adjectives kind, friendly, nice, happy, and healthy, which describe this factor can be interpreted to convey the qualities of openness and acceptance. Therefore, it seems as though the experimental group views their inquiry teaching self as more open to and pleased by the social stimulation of the inquiry mode of teaching than either preservice or inservice teachers.

The lack of significant results for the factor Achievement/Adjustment is interesting, in that apparently all of these groups perceive themselves as capable of conducting inquiry teaching and well adjusted to this mode of instruction. Given that this may be the case, the question then becomes; do

they actually use this mode in the classroom?

Results of the analysis for the concept self as inquirer clearly indicate no difference between these three groups.

Of the six factors for the concept, nature of inquiry, a significant difference is observed for factors I, Truth/Perfection; II, Impact/Significance; and V, Extrinsic/Intrinsic. Again, the post hoc finding that the Experimental Inquiry group differed from the other two gives credence to a possible treatment effect. Results from analysis #2 confirm a treatment effect for factor I but not factors II and V. It would seem then, that the observed differences for factors II and V are artifacts of the sampling. Implications of this finding are discussed in the next section.

Analyses #2 and #3

These results are discussed together because both groups involved received an experimental treatment.

A significant change in perception of self as inquirer was observed in factor I, Achievement/Leadership for the Experimental Inquiry group. This was a positive change in perception. It appears that this group saw themselves as more capable inquirers at the completion of the course. Although this change is observed, it is most likely a sampling artifact since it is not supported in analysis #1. It is reasonable to assume that such a change would probably be recorded for similar groups of students, but not generally.

Regarding differences between the Experimental Inquiry group and the Theory and Evidence group for this concept, significant differences were observed for factors II, Congeniality/Sociability and III, Adjustment. Thedirection of the difference is positive and in favor of the Theory and Evidence group. Therefore, this group saw themselves as being more comfortable as

inquirers. Since the course they took dealt with the topic of inquiry for a longer period of time, forty-five hours as opposed to sixteen hours, it seems that they were better able to accommodate or resolve the discomfort associated with personal involvement in inquiry.

The treatment effect observed for the factor Truth/Perfection within the concept nature of inquiry is given additional verification by the difference found between the two experimental groups. If one assumes that subjects responded to this concept in terms of the nature of inquiry as a process, it is possible that the Experimental Inquiry group would have perceived this process as source of ultimate truth since their exposure to inquiry as a subject was significantly less than that of the Theory and Evidence class. On the other hand, the TE group dealt with inquiry as a subject as well as a process. Hence, they could possibly perceive that while the process seeks ultimate truth, there remains many subjects of inquiry for which there may not be an absolute determination of truth.

Another difference between the experimental groups was observed for the factor Structure/Responsiveness. Here the EI class viewed the nature of inquiry as being more quick to respond and having less structure. Once again, it would seem that the amount of exposure to inquiry as a process and a subject might account for this difference. Although it has not been empirically demonstrated how philosophers would perceive the nature of inquiry. The philosopher involved with this course agreed that there exists a definite structure for inquiry and that the process of inquiry is slow and deliberate in responding to the search for truth. Given that this may be so, it is likely that if the students in the EI class were given more exposure to inquiry a greater congruence of perception would be observed.

LIMITATIONS AND IMPLICATIONS

Some severe limitations in this study lead the investigators to caution any generalization of these data beyond the experimental groups involved. These restrictions are as follows:

(1) Small sample sizes - N = 18 for the Experimental Inquiry group.

(2) Use of intact groups for the experimental treatment.

(3) Uniqueness of the instruction - impossible to randomly assign teachers to students.

A summary of the findings includes:

(1) The Experimental Inquiry group perceived their inquiry teaching selves as more open to and pleased by the social stimulation of the inquiry mode of teaching than did the preservice or inservice teachers.

(2) The Experimental Inquiry subjects perceived themselves less comfortable as inquirers than did students in the Theory and Evidence class.

(3) The Experimental Inquiry class perceived the nature of inquiry as more truthful and perfect than did either the TE class or the control groups of preservice and inservice teachers.

(4) The Experimental Inquiry students perceived the nature of inquiry as less structured and more responsive than did the students in the Theory and Evidence class.

It is safe to conclude that for students in this course self-perceptions, as they relate to teaching with inquiry methods, are effected by interdisciplinary instruction in the nature of inquiry and inquiry teaching. Given the limitations of the instrument used to assess self-perceptions it seems the only true effect relates to self-perceptions of the role of teacher in the conduct of inquiry. If there is any validity to the assumption that behavior follows perception it does seem that instruction of this nature is valuable for teachers of any discipline where inquiry methods are deemed important.

The findings with regard to differences between the two experimental groups indicates that more exposure to inquiry for the Experimental Inquiry class would be necessary to develop a greater congruence between the perceptions of the two groups. Such congruence does appear to be a worthwhile goal since the courses like this would be interested in communicating the "true" nature of inquiry.

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