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ABSTRACT

The purpose of this study was to explore the utility of the Theory of Planned Behavior for predicting the behavioral intentions of teachers enrolled in the Institute in Physical Science. The study investigated three determinants of teachers' behavioral intentions set forth in the theory of planned behavior, namely attitude toward the behavior, subjective norm, and perceived behavioral control. The behavior of interest in this study was the intention of teachers in grades 5/6 and 9/10 who were enrolled in the institute to use half of the activities and investigations completed in the program with students they would teach during the next school year. Data were collected from 50 elementary and secondary teachers. Results of this study indicated that attitude, subjective norm, and perceived behavioral control made significant contributions to the prediction of behavioral intention. Examination of the data block on external variable revealed attitude toward the behavior to be the single most important predictor of behavioral intention. Intent to perform the behavior appears to be totally under the control of most teachers, with little need for social support and with ample resources and sufficient opportunities available to perform the behavior. (MVL)

Intentions of Science Teachers to Use Investigative Teaching Methods: A Test of the Theory of Planned Behavior

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Abstract

The purpose of this study was to explore the utility of the Theory of Planned Behavior for predicting the behavioral intentions of teachers enrolled in the Institute in Physical Science, an EESA, Title II program funded by the Texas Higher Education Coordinating Board. In particular, the study investigated three determinants of teachers' behavioral intentions (BI) set forth in the theory of planned behavior, namely attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control (PBC). The behavior of interest in this study was the intention of teachers in grades 5/6 or 9/10 who were enrolled in the Institute to use of 50% of the activities and investigations completed in the program with students they would teach during the next school year.

Data were collected from fifty elementary and secondary teachers. Simple and hierarchical regression analyses were used to determine the relative contributions of attitude, subjective norm, and perceived behavioral control (and their interactions) to the prediction of behavioral intention.

Results of this study indicated that attitude, subjective norm, and perceived behavioral control made significant contributions to the prediction of behavioral intention. Examination of the data blocked on external variables revealed attitude toward the behavior to be the single most important predictor of behavioral intention. Intent to perform the behavior appears to be totally under the control of most teachers, with little need for social support and with ample resources and sufficient opportunities available to perform the behavior.

Purpose

The purpose of this study was to explore the utility of the Theory of Planned Behavior for predicting the intentions of teachers to use investigative teaching methods. In particular, the study investigated three determinants of teachers' behavioral intentions (BI) set forth in the theory of planned behavior, namely attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control (PBC). More specifically the study sought to predict teachers' intentions to use 50% of the activities and investigations completed in the Institute in Physical Science with students the teachers would teach during the next school year.

Theoretical Base

The empirical link between attitude and behavior has long eluded social psychologists. As early as 1934 LaPiere reported an inconsistency between the actual behaviors of restaurant or hotel proprietors, serving a Chinese couple, and the behaviors predicted from a knowledge of the proprietors' attitude toward Chinese people. With the introduction of the theory of reasoned action in 1975 (Fishbein & Ajzen), empirical and theoretical evidence was presented linking attitude and social support to behavior, through the mediating variable behavioral intention, provided that the behavior in question is volitional and attitude and behavior are measured at the same level of specificity as defined by four components — action, target, context, and time. Behavior (B), behavioral intention (BI), attitude toward the behavior (AB), and subjective norm (SN) are linked through the equation (referred to as the simple model),

$$B \sim BI \sim (AB + SN) = w_1AB + w_2SN \quad \text{(Eq 1)}$$

where w_1 and w_2 are the relative contributions of attitude and subjective norm to the prediction of behavioral intention and subsequent behavior. The relative contributions of attitude and subjective norm (i.e., the regression weights, w_1 and w_2) have been shown to be dependent upon external variables, i.e., specific characteristics of the target group such as sex, ethnicity, general and specific abilities (Crawley & Coe, in press).

The theory of reasoned action has been found to be extremely successful in explaining such diverse human behaviors as drinking, dieting, choosing a career, planning a family, voting, and

consumer purchasing behavior (Ajzen & Fishbein, 1980). In education, the theory has been used successfully to understand and predict grade 8 students' intentions to enroll in a high school science course and girls' intentions to enroll in at least one physical science course in high school (Koballa, Crawley, & Shrigley, 1987).

The predictive value of the theory of reasoned action rests upon the assumption that the behavior of interest is volitional, i.e., the individual can decide at will whether to perform the behavior. Some instructional behaviors of interest to science educators and teachers are most likely truly volitional, e.g., use of 3-5 seconds wait time. Other instructional behaviors, however, may not be completely under the teacher's control (e.g., use of inquiry investigations in science teaching). For one reason or another there may be insufficient opportunities and resources available to perform a target behavior. Knowledge of the personal and social motivational bases of behavior (i.e., attitude toward the behavior and subjective norm), therefore, is insufficient to insure accurate prediction of behavior or behavioral intention for situations in which teachers have only partial control.

The theory of planned behavior (Ajzen & Madden, 1986) extends the theory of reasoned action and allows accurate prediction of behavioral intention and behavior for situations in which individuals have incomplete control, for example weight loss (Schifter and Ajzen, 1985). The beliefs individuals hold about the availability of resources and opportunities to perform a behavior directly affect their perceived control over the behavior. The theory of planned behavior proposes a direct causal effect of perceived behavioral control on behavioral intention, separate from the individual contributions of attitude and subjective norm. Behavior (B), behavioral intention (BI), attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control (PBC) are linked through the equation (simple model),

$$B \sim BI \sim (AB + SN + PBC) = w_1AB + w_2SN + w_3PBC \quad (Eq\ 2)$$

where w_1, w_2, and w_3 are the relative weights of attitude, subjective norm, and perceived behavioral control in the prediction of behavioral intention and behavior.

Recent studies (Ajzen & Madden, 1986; Schifter and Ajzen, 1985) have examined the improved prediction of behavioral intention using multiple regression techniques with simple (e.g., Eq's 1 and 2) and hierarchical model equations. The hierarchical models include predictor variables as well as their interactions. The hierarchical model for the theory of reasoned action includes the interaction of attitude toward the behavior (AB) with subjective norm (SN), and is described by the equation (hierarchical model):

$$B \sim BI = w_1AB + w_2SN + w_3(ABxSN) \quad \text{(Eq. 3)}$$

The hierarchical model for the theory of planned behavior includes the three predictor variables of Equation 3 and four interaction terms, and is described by the equation (hierarchical model):

$$B \sim BI = (\text{Eq } 2) + w_4(ABxSN) + W_5(ABxPBC) + W_6(SNxPBC) + W_7(ABxSNxPBC) \quad \text{(Eq. 4)}$$

Design and Procedures

Fifty elementary (grades 5 & 6) and secondary school (grades 9 & 10) teachers of physical science participated in the Institute in Physical Science, an Education for Economic Security Act, Title II, program funded by the Texas Higher Education Coordinating Board. The objectives of the Institute in Physical Science were to improve teachers' understanding of basic concepts in physics and chemistry, to enhance their awareness of research and development activities related to physical science taking place within the local community, and to develop their skill in the use of activities and investigations to teach basic concepts and concept applications to students enrolled in their classes.

Four courses were developed and offered to participants in the five-week, Institute in Physical Science program. Teachers in grades 5 and 6 enrolled in one or two courses: Concepts in Physical Science and Frontiers in Physical Science. Teachers in grades 9 and 10 enrolled in as many as two of three courses: Concepts in Chemistry, Concepts in Physics, and Frontiers in Physical Science. The physics, chemistry, and physical science classes met three days a week, and the "frontiers" course met two days each week.

Investigations developed for use in each course followed identical formats and stressed the teaching of physical science concepts through active use of the subject specific process skills,

identified as Essential Elements by the Texas Education Agency. Investigations followed the learning cycle approach by first introducing concepts through the use of free exploration, followed by conceptual invention, and expansion of the concept to new situations (Renner, Abraham, & Birnie, 1988). Inexpensive, commonly available equipment and materials were utilized in each investigation.

Toward the end of the first week of class teachers responded to an open-ended questionnaire. On this questionnaire teachers identified their beliefs about factors that might help and factors that might prevent their "use of 50% of the activities and investigations completed in the Institute with the students they would teach during the next school year", the target behavior of interest in this study. Next, beliefs were content analyzed to arrive at modal salient beliefs, accounting for 90% of the beliefs identified on the open-ended questionnaire. Thirteen personal beliefs about the consequences of and six beliefs about social support for engaging in the target behavior were identified during the Institute in Physical Science, Summer, 1987, and previously reported (Crawley, 1988). Beliefs about personal consequences, social support, and perceived behavioral control formed the basis of a subsequent questionnaire designed to assess behavioral intention, attitude toward the behavior, subjective norm, and perceived behavioral control.

Regression analyses were used to determine the relative contributions of attitude, subjective norm, perceived behavioral control and their interactions to the prediction of behavioral intention by testing the significance of model equations 1-4 and the significance of the incremental variance explained by equations 2-4.

Results

Thirteen salient beliefs and six personal referents constituted the items included on the AB and SN scales, respectively. Ten "facilitating" factors were identified by teachers and formed the basis of the belief statements included on the final questionnaire, and indirect measure of perceived behavioral control (PBC). Five statements constituted the direct measure of perceived behavioral control. The ten facilitating factors included the availability of materials, class time, class size, preparation time, compatibility with curriculum guides, personal knowledge, facilities, the

ability levels of students, and the principal's expectations. Data were collected from all teachers attending the Institute (n = 50).

Test of Simple and Hierarchical Model Equations

Intercorrelations were computed for the four components of the theory of planned behavior, namely behavioral intention (BI), attitude toward the behavior (AB), subjective norm (SN), and perceived behavioral control (PBC). Correlations were found to be significant ($p < .05$) between BI and AB, BI and SN, AB and SN, and AB and PBC scales. Non-significant correlations were obtained between BI and PBC and SN and PBC scales (see Table 1).

Insert Table 1 about here

Intentions were predicted from AB and SN scale data (theory of reasoned action) and AB, SN, and PBC scale data (theory of planned behavior) using simple and hierarchical regression analyses. The contributions of AB and SN to the prediction of BI proved to be significant ($R = .52$, $p = .0009$), as did the contributions of AB, SN, and PBC ($R = .57$, $p = .0007$). Hierarchical regression analyses were conducted to determine the contributions of the AB, SN, PBC and their interaction terms to the prediction of BI. The prediction of BI from AB, SN, and the AB/SN interaction was found to be significant ($R = .54$, $p = .0017$), as was the prediction of BI from AB, SN, PBC, and the AB/SN/PBC interactions ($R = .60$, $p = .0130$).

Insert Table 2 about here

The significance of the explained variance increment (Eq's 2-4) was determined for contributions beyond that accounted for in the theory of reasoned action (Eq. 1). First to be tested was the contribution of the additional variable, perceived behavioral control (Eq. 2), to improved prediction of behavioral intention. The addition of perceived behavioral control improved the prediction of behavioral intention by 4%, a non-significant increase in the explained variance.

The contributions of the interaction terms (Eq's 3 and 4) were tested and found not to improve the prediction of behavioral intention in the theory of reasoned action (Eq. 3) and to reduce the explained variance in behavioral intention by 4% in the theory of planned behavior (Eq. 4).

Insert Table 3 about here

Previous research (Crawley & Coe, in press) has shown that external variables indirectly influence behavioral intention through a determination of the value of the relative combining weights (i.e., the w's in Equations 1-4). External variables represent unique characteristics of the target group under study and are used as blocking variables in subsequent analyses. The external variables characteristic of the teachers participating in this study included sex, age, school level, and level of perceived behavioral control (PBC). Results of the SN/PBC intercorrelation indicated that PBC may indirectly influence the prediction of BI. Moreover, the non-significant contribution of PBC to the prediction of behavioral intention (BI) indicated that the theory of reasoned action sufficiently accounted for the variation in BI without direct contribution from PBC. Scores on PBC were coded from continuous to categorical data (high vs low PBC) Age also was coded, and three age categories were formed – Group 1 ($24 \leq G_1 < 34$), Group 2 ($34 \leq G_2 < 44$), and Group 3 ($44 \leq G_3 < 54$). Data were disaggregated by categories of each of the four external variables (EV_{1-4}), and separate regression analyses were conducted for each category of the four external variables to determine whether partitioning the total variance in BI by categories of each external variable would improve the prediction of BI, a test of the indirect effects model using Equation 1. The indirect effects model is represented by equation 5, namely:

$$B \sim BI \sim (AB + SN) = w_1(EV_{1-4})AB + w_2(EV_{1-4})SN \quad \text{(Eq. 5)}$$

Predictions were further examined to determine the relative contributions of the predictor variables to the determination of behavioral intention for each category of external variable.

The results of the test of the "indirect effects" model proved to be of mixed significance. In four of the nine tests the explained variance was increased (beyond that explained by model

Equation 1, namely $R^2_{adj} = .24$) by partitioning the variance according to categories of the external variables. Improvements were made in the prediction of behavioral intention for female teachers ($R^2_{adj} = .35$), elementary teachers ($R^2_{adj} = .31$), age group 1($R^2_{adj} = .42$), and for teachers whose PBC scores were high ($R^2_{adj} = .45$). Five of the tests resulted in a reduction in the explained variance. Reductions were identified for male teachers ($R^2_{adj} = .02$), secondary teachers ($R^2_{adj} = .16$), teachers in age groups 2 ($R^2_{adj} = .03$) and 3($R^2_{adj} = -.10$), and teachers whose PBC scores were low ($R^2_{adj} = .12$). Results of the tests of the "indirect effects" models are found in Table 4.

Insert Table 4 about here

The relative contributions of attitude toward the behavior and subjective norm were computed for each of the nine model equations. Attitude was found to be the sole predictor of behavioral intention among female teachers ($w_{AB} = .57$, $p \leq .01$ and $w_{SN} = .13$, ns), elementary ($w_{AB} = .57$, $p \leq .05$ and $w_{SN} = .13$, ns) and secondary ($w_{AB} = .39$, $p \leq .05$ and $w_{SN} = .16$, ns) school teachers, teachers in the age range 24-33 ($w_{AB} = .67$, $p \leq .01$ and $w_{SN} = .11$, ns), and among teachers whose PBC scores were low ($w_{AB} = .44$, $p \leq .05$ and $w_{SN} = .05$, ns). Attitude and subjective norm both proved to be significant predictors of intention for teachers whose PBC scores were high ($w_{AB} = .42$, $p \leq .05$ and $w_{SN} = .42$, $p \leq .05$). Neither attitude nor subjective norm predicted intention among male teachers or teachers whose ages ranged from 34-43 or 44-53. In none of the nine model equations did subjective norm prove to be the sole predictor of behavioral intention. The relative contributions of attitude and subjective norm to the prediction of the behavioral intentions of teacher groups formed on the basis of membership in one of the categories of each of the external variables are presented in Table 5.

Insert Table 5 about here

Belief Determinants of Group Differences

Results of the test of model equation 5 implied that different behavioral beliefs, outcome evaluations, or the product of the two may underlie the determination of attitude for different teacher groups formed on the basis of their sex, school level, age, and degree of perceived behavioral control. From Table 5 it is seen that different normative beliefs, motivations to comply, or the product of the two may underlie the determination of subjective norm for teachers, depending on the degree to which they perceive that there are adequate resources and opportunities available (perceived behavioral control) to them to use investigative teaching methods, i.e., the target behavior of interest.

The correlation between the direct measure of attitude (AB) and its belief determinants ($\Sigma_i b_i e_i$) was computed and found to be significant ($r = .49$, $p = .0004$). Follow-up tests were conducted to identify salient beliefs (viz., belief strength, outcome evaluation, and the product of the two) that serve as bases for differences in attitude, and thus the prediction of intention, for groups of teachers formed on the basis of their sex, school level, age, and level of perceived behavioral control (PBC). Two outcomes were valued more highly by female than male teachers. Female more than male teachers valued helping students understand physical science ($p = .0239$) and giving students experience using physical science equipment ($p = .0112$). Eight of thirteen outcomes were valued more by elementary teachers than by secondary teachers. Compared with their secondary counterparts elementary teachers more highly valued getting students actively involved in learning physical science ($p = .0023$), giving students experience using physical science equipment ($p = .0065$), developing vocabulary ($p = .0024$), helping students develop critical thinking and problem solving skills ($p = .0059$), teaching physical science to students of varying abilities/interests ($p = .0001$), clarifying concepts and principles ($p = .0237$), providing opportunities for students to interact with one another ($p = .0500$), and making physical science more interesting ($p = .0181$). Five consequences of engaging in the target behavior (i.e., using 50% of the activities and investigations with students to be taught the next school year) distinguished elementary from secondary teachers. Elementary more than secondary

teachers believed that using the physical science investigations would get students more actively involved in learning physical science ($p = 0112$), would help them develop in students critical thinking and problem solving skills ($p = .0205$), would enable them to teach physical science to students of differing interests and abilities ($p = .0006$), would clarify physical science concepts and principles ($p = .0472$), and would make physical science more interesting and fun ($p = .0143$). The younger groups of teachers ($24 \leq G_1 < 34$ and $34 \leq G_2 < 44$) attending the Institute in Physical Science valued giving students experience using physical science equipment more than did older ($44 \leq G_3 < 54$) teachers ($p = .0010$). Teachers recording high (PBC_H) rather than low (PBC_L) scores on perceived behavioral control believed the supply and accessibility of materials and equipment to support use of the investigations to be adequate ($p = .0427$), and they believed students possessed the ability and interest needed for them to use the investigations ($p = .0452$). Salient beliefs about engaging in the target behavior are presented in Table 6.

Insert Table 6 about here

The correlation between the direct measure of subjective norm (SN) and its belief determinants ($\Sigma_j nb_j mc_j$) was computed and found to be significant ($r = .56$, $p = .0001$). Follow-up tests were conducted to identify salient normative beliefs that serve as the bases for differences in subjective norm among teacher groups formed on the basis of their level of perceived behavioral control. Non-significant differences were found between high and low PBC groups on normative beliefs, motivation to comply, and the product of the two.

Conclusions

Results of this study indicate that attitude, subjective norm, and perceived behavioral control provide significant, linear contributions to the prediction of behavioral intention. Examination of the beta coefficients in the regression equations reveal the relative contributions of each variable to the prediction of behavioral intention ($w_1 = .46$, $w_2 = .25$, and $w_3 = -.04$, respectively). With but one exception attitude toward the behavior proved to be the single most important

predictor of the behavioral intention in question, which in this study is use 50% of the activities and investigations completed in the Institute in Physical Science with students that teachers would teach during the next school year. Performance of this behavior appears to be totally under the control of teachers, with iittle need for social support. Beliefs alone are not sufficient, however, to predict the intentions of teachers who believe that they have ample resources and opportunities. Social support is important, as is seen in Table 5, but it is not clear who the significant person(s) or groups are. No single person or group (superintendent, parents, students, principal, other science teachers, or the department chairperson) discriminates between teachers having adequate resources and opportunities to use the activities and investigations and teachers who lack them.

Not all of the fifty teachers participating in the Institute in Physical Science completed all information on the questionnaire designed for this study. For any test the sample size is reduced, which necessitated formation of fewer categories on external variables for which continuous data were available. Results, therefore, are tentative due to the small sample size. An examination of the results reveals the explained variance to be appreciable but not significant in several analyses, viz., among male teachers, teachers older than 34, and teachers who scored low on perceived behavioral control. Additional information is needed before conclusions can be reached about the theory of planned behavior or its use with teachers to explain their intentions to alter instructional practices. Considered as a single group one conclusion is inviting. Teachers most intent on engaging in the target behavior are female, teach in elementary school, are less than 34 years of age, and believe change is within their control.

Alternative explanations of the results are also suggested. Teachers who perceive that they lack the resources and opportunities may truly be unable to use the activities and investigations produced in the Institute in Physical Science. These persons may believe that the decision to engage in the behavior is completely out of their hands. Regardless of these teachers' beliefs about available social support or the consequences of engaging in the behavior, circumstances appear to prevent them from doing so. On the other hand, it is teachers' perceptions of reality that the theory of planned behavior taps, not circumstances as they may actually exist. The theory of

reasoned action and the theory of planned behavior are predicated on personal involvement and logical decision making. Both theories may be inappropriate to use to understand the behavior of teachers who perceive that they have no control of their daily practices and that decisions regarding instructional changes are made not by them but by other people.

Table 1

Intercorrelation Matrix for Behavioral Intention (BI), Attitude Toward the Behavior (AB), Subjective Norm (SN) and Perceived Behavioral Control (PBC)

	AB	SN	PBC
Behavioral Intention (BI)	.49***	.32*	.16
Attitude Toward Behavior (AB)		.35*	.34*
Subjective Norm (SN)			.22

*p < .05. **p < .01. ***p < .001.

Table 2

Regression of Predictor Variables on Behavioral Intentions

Model	Source	SS	df	MS	F	p	R^2(adj)
Reasoned Action							
Simple	Regression	31.38	2	15.69	8.28	.0009	.24
	Residual	85.29	45	1.89			
Hierarchical	Regression	33.58	3	11.19	5.93	.0017	.24
	Residual	83.09	44	1.89			
Planned Behavior							
Simple	Regression	38.17	3	12.72	6.86	.0007	.28
	Residual	77.94	42	1.86			
Hierarchical	Regression	41.36	7	5.91	3.00	.0130	.24
	Residual	74.75	38	1.97			

Table 3

Increment in Explained Variance

Additive Terms	Source	SS	df	MS	F	p	R^2(adj)
Perc. Beh. Control	Hypothesis	4.59	1	6.79	3.65	<.10	+.04
(PBC)	Error	77.94	42	1.86			
Interaction	Hypothesis	2.20	1	2.20	1.16	ns	.00
(AB/SN)	Error	83.09	44	1.89			
Interactions	Hypothesis	3.19	4	0.80	0.41	ns	-.04
(AB/SN/PBC)	Error	74.52	38	1.97			

Table 4

Significance Tests of Regression Effects-Indirect Effects Model

External Variable		Source	SS	df	MS	F	p	R^2(adj)
Sex	Female	Regression	29.61	2	14.81	8.18	.0018	.35
		Residual	45.24	25	1.81			
	Male	Regression	5.49	2	2.74	1.23	.3181	.02
		Residual	35.67	16	2.23			
School Level	Elementary	Regression	11.16	2	5.58	4.37	.0353	.31
		Residual	16.59	13	1.28			
	Secondary	Regression	18.86	2	9.43	4.02	.0288	.16
		Residual	68.01	29	2.34			
Age	Group 1	Regression	16.54	2	8.27	5.75	.0195	.42
	$(24 \leq G_1 < 34)$	Residual	15.82	11	1.44			
	Group 2	Regression	5.99	2	2.99	1.23	.3198	.03
	$(34 \leq G_2 < 44)$	Residual	36.51	15	2.43			
	Group 3	Regression	2.82	2	1.41	0.57	.5875	-.10
	$(44 \leq G_3 < 54)$	Residual	17.18	7	2.45			
PBC	Low	Regression	11.87	2	5.93	2.39	.1201	.12
		Residual	44.70	18	2.48			
	High	Regression	28.80	2	14.40	10.76	.0005	.45
		Residual	29.43	22	1.34			

Table 5

Correlations, Regression Coefficients, and Multiple Correlations of Intentions on Attitude (AB) and Subjective Norm (SN)-Indirect Effects Model

External Variable		Correlation Coefficients		Regression Coefficients		Multiple Correlation
		$r_{AB \cdot I}$	$r_{SN \cdot I}$	w_{AB}	w_{SN}	R
Sex	Female	.62***	.32	.57**	.13	.63**
	Male	.28	.31	.20	.24	.36
School Level	Elementary	.62**	.38	.57*	.13	.63*
	Secondary	.44**	.28	.39*	.16	.47*
Age	Group 1	.68**	.31	.67**	.11	.71*
	Group 2	.31	.26	.28	.21	.38
	Group 3	.18	.37	-.03	.39	.37
PBC	Low	.45*	.13	.44*	.05	.46
	High	.58**	.58**	.42*	.42*	.70***

*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

Table 6

Summary of Salient Beliefs by External Variable

Use of the investigations with students next year will...	Belief Strength	Outcome Evaluation	Product
create more interest in physical science.	———	———	———
help students understand physical science.	$PBC_H > PBC_L$	Females>Males	———
help me cover more required topics.	———	———	———
boost the interest of other teachers.	———	———	———
help students see applications.	———	———	———
get students actively involved.	———	Elem>Sec	Elem>Sec
give students experience using equipment.	———	Females>Males Elem>Sec G_1 & G_2 > G_3	———
develop physical science vocabulary.	———	Elem>Sec	———
develop critical thinking and problem solving skills	———	Elem>Sec	Elem>Sec
teach students of differing abilities and interests.	———	Elem>Sec	Elem>Sec
clarify concepts and principles.	$PBC_H > PBC_L$	Elem>Sec	Elem>Sec
allow time for students to interact.	———	Elem>Sec	———
make physical science more interesting and fun.	———	Elem>Sec	Elem>Sec

Note. All differences are significant at or beyond .05.

References

Ajzen, I & Madden, T. J. (1986). Prediction of goal-directed behavior: Attitudes, intentions, and perceived behavioral control. Journal of Experimental Social Psychology, 22, 453-474.

Ajzen, I. & Fishbein, M. (1980). Understanding Attitude and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice-Hall.

Crawley, F. E. (1988). Determinants of physical science teachers' intentions to use investigative teaching methods: A test of the theory of reasoned action. (ERIC Document Reproduction Service No. ED 292 675)

Crawley, F.E., & Coe, A. S. (in press). Determinants of middle school students' intention to enroll in a high school science course: An application of the theory of reasoned action. Journal of Research in Science Teaching.

Fishbein, M. & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Menlo Park CA: Addison-Wesley.

Koballa, T. R., Crawley, F. E. & Shrigley, R. L. (1987). The theory of reasoned action: Can it be used to predict and understand the behavior of science teachers and students? Abstracts of Presented Papers - National Association for Research in Science Teaching. Columbus OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

LaPiere, R. T. (1934). Attitudes vs. action. Social Forces, 13, 230-237.

Renner, J. W., Abraham, M. R., & Birnie, H. H. (1988). The necessity of each phase of the learning cycle in teaching high school physics. Journal of Research in Science Teaching, 25(1), 39-58.

Schifter, D. E., & Ajzen, I. (1985). Intention, perceived behavioral control, and weight loss: An application of the theory of planned behavior. Journal of Personality and Social Psychology, 49, 843-51.