Journal of Agricultural Education
Volume 32, Number 1, pp.35-40
DOI: 10.5032/jae.1991.01035

STUDENT/TEACHER PARTICIPATORY INTERACTION, MOTIVATION, AND SATISFACTION DURING GROUP PROBLEM SOLVING

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Problem solving is perceived as an important teaching strategy, method, or approach in agricultural education (Archer, 1976). Yet, there is insufficient research to determine the educational outcomes of this strategy in the classroom (Flowers, 1988; Moore & Moore, 1984); especially for group problem solving.

Many of the problems facing agriculture today are more appropriately solved by groups than individuals, making group problem solving a valuable skill to learn in the agricultural education classroom. The Center for Vocational Education (1977) inferred that an ideal classroom learning environment during group problem solving is realized when there is equal or transactional student/teacher participatory interaction:

> The use of the problem-solving techniques in group situations can also encourage active participation by students and can develop effective student-teacher interaction processes...Cooperative group discussion, with students relating to the teacher as a co-member in the group, can assist students in attaining and retaining knowledge as a result of their active participation in formulating and discussion solutions to problems. (p. 7)

Similar positive outcomes of transactional student/teacher participatory interaction during group problem solving learning activities have been substantiated without empirical evidence (Dewey, 1916; Friere, 1970; Krebs, 1982; Warmbrod, 1969).

A theoretical base for this study was borrowed from development communication. The relationship between rural target group members and development communicator(s) is intuitively similar to a student/teacher relationship in terms of information and technology transfer. Transactional participatory interaction in development communication is depicted by Nair and White (1987) as a constant give and take between rural group members and development communicator(s). They identified five important areas of transactional participatory interaction: shared decision making, shared discussion, shared leadership, agreements reached by consensus, and mutual respect.

Among realistically achievable participatory interaction models in development communication, transactional participatory interaction between rural target group members and development communicator(s) has been theorized to most highly motivate target group members to participate in group problem solving relating to their acceptance of new ideology and/or technology (Cohen & Uphoff, 1980; Nair & White, 1987).

Maslow (1970) defined human satisfaction as motive (or need) gratification. Perhaps student satisfaction with group problem solving is related to level of student/teacher participatory interaction. Motivation/transactional participatory interaction (Cohen & Uphoff, 1980; Nair & White, 1987) and motivation/satisfaction (Maslow, 1970) theories seem to support this assumption.

This study explores these satisfaction and motivation theories in relation to secondary school students and teachers of agricultural education.

Purpose and Objectives

The purpose was to investigate the relationships between student/teacher participatory interaction (STPI), and both student motivation to participate (SMP) and student satisfaction (SS) during group problem solving for secondary school agricultural education. Specific objectives were:

1. To describe the relationship between STPI and SMP during group problem solving.
2. To describe the relationship between STPI and SS during group problem solving.

3. To describe relationships between selected variables (i.e., class size and student age, gender, and Grade Point Average) and SMP and SS during group problem solving.

Methods

Design: A correlational and replicated case study design was employed in naturalistic classroom settings. Multiple methods of data collection and quantitative and qualitative data analysis techniques were employed. The independent variable was student/teacher participatory interaction (STPI). The two dependent variables were student motivation to participate (SMP) in group problem solving and student satisfaction (SS) with group problem solving. Class size and student age, gender, and Grade Point Average (GPA) were control variables. Another variable, predominant student/teacher transactions (PSTT), was a qualitative indicator of STPI.

Sample: Twenty-seven secondary school agricultural education programs in New York State approved as student teacher placement centers by the State Department of Education and the Program Area of Agricultural and Occupational Education at Cornell University provided the basis for sample selection. Four agricultural education programs, representative of the 27 programs with respect to placement center selection criteria, were chosen because of: 1) Driving distance for the researchers; 2) Sufficient teacher experience in problem solving teaching; 3) Teacher agreement to participate; 4) The availability of a Basic Agricultural Skills (BAS) class which had not yet undertaken a problem solving instructional unit that is part of the state curriculum.

The sample included 61 students (58 questionnaires with usable data). For some analysis procedures, the four teachers and four intact classes were considered experimental units, while four other students were clustered across classes and schools on the basis of predesigned research criteria.

Procedures: A six-stage problem solving model, adapted from the state curriculum, guided group problem solving activities during the research: Stage 1 - Define the problem:; Stage 2 -Identify possible solutions; Stage 3 - Gather information; Stage 4 - Analyze information and choose an alternative; Stage 5 - Implement an alternative; Stage 6 - Evaluate the outcome and modify the alternative.

The four teachers were contacted by mail and phone. A researcher visited each school to prepare teachers, students, and administrators for the study. As a pretreatment procedure, each class participated in the problem solving instructional unit from the state curriculum. They then participated in a group problem solving lesson on land resource stewardship. The purpose of the pretreatment was to develop group problem solving understanding, skills, and social dynamics prior to solving a group problem during the treatment. Five 40 minute classes were allotted to solving the pretreatment group problem.

For a treatment procedure, each class solved another group problem on land resource stewardship. At each stage of group problem solving, students recorded their impressions on a standardized form. Classes were allotted seven periods to solve the treatment problem. Since videotaping was part of data collection, a video camera was set up in each class on three occasions during group problem solving activities to reduce the Hawthorne effect.

Instrumentation: Instruments were developed by the researchers based on a review of related literature. STPI, SMP, and SS were measured for each stage and the overall treatment group problem solving activity using Likert-type scales. STPI was measured by a seven-point scale ranging from participation Highly Dominated by the Teacher to Highly Dominated by the Students. Equal (or transactional) Participation by the Students and the Teacher represented the midpoint for this scale. SMP was measured by a four-point scale ranging from Not to Highly motivated to participate. SS was measured by a five-point scale ranging from Highly Dissatisfied to Highly Satisfied.

Student and teacher questionnaires were found to be content and face valid by a panel of experts. Readability of student and teacher questionnaires were assessed by the students and teacher from a fifth program of agricultural education among the student teacher placement centers. A class of BAS students from a sixth center was used for piloting instructional materials and procedures, and for determining instrument reliability. Cronbach's alpha reliability coefficients for STPI, SMP, and SS scales were .85, .92, and .97 respectively.

Data Collection and Analysis: Teachers audiotaped Stage 1 through Stage 5 activities. A researcher videotaped Stage 6 activities. Immediately following the group problem solving treatment, students

and teachers were subjected to a reflective process involving verbal signposts (identified by a researcher from a review of audiotapes and videotapes for that class), and a reading of standardized review forms. Observations of the treatment were recorded on questionnaires in a stage by stage manner.

Data were analyzed with descriptive statistics and a regression model. Audiotapes and videotapes were analyzed qualitatively for evidence of predominant student/teacher transactions (PSTT). Shared decision making, shared discussion, shared leadership, agreements reached by consensus, and mutual respect were the PSTT categories. A PSTT was scored when it was observed in operation more than 50% of the time during a stage of group problem solving.

Results

Objective 1: A significant correlation ($p < .05$) was found between student/teacher participatory interaction (STPI) and student motivation to participate (SMP). STPI was not significantly correlated to any of the control variables: student age, gender, GPA, and class size (Table 1). The relationship between STPI and SMP is further analyzed in Table 2 using a regression model. The relationship between STPI and SMP remained significant even after partial regression between STPI and GPA. The prediction equation for SMP using STPI as a predictor was: SMP (predicted) = 1.355 + 0.261 (STPI). STPI predicted approximately 9% of the variance in SMP. No students observed STPI to be highly dominated by the teacher or students and only one student observed STPI to be moderately dominated by the teacher. Because very high or very low STPI scale values were not observed, the prediction model is limited.

Table 1
Correlations Between STPI or Selected Variables and SMP, SS, and STPI ($N = 58$)

Variable	Dependent Variables		Ind. Variable
	SMP	SS	STPI
STPI	.296*	.130	1.000
Age	-.138	-.253	-.249
Class Size	-.167	.097	-.043
Gender	.121	.101	.165
GPA	.269*	.233	.107

Note. *$p < .05$.

To check for the possibility of a stronger nonlinear relationship between STPI and SMP, a scattergram was visually analyzed and SMP was regressed on STPI after STPI data were effect coded. These analyses did not support a stronger nonlinear relationship between STPI and SMP [the relationship between STPI (effect coded) and SMP was insignificant ($p = .257$)].

Correlational and regression analysis of student data most strongly support a linear model to predict SMP from STPI and a theory that slight to moderate student domination of participation during group problem solving is linked to peak levels of SMP. Conversely, descriptive and qualitative results suggest a non-linear relationship between STPI and SMP and that transactional to slightly student-dominated student/teacher participatory interaction is linked to peak levels of SMP during group problem solving.

Limited teacher observations of STPI and SMP during group problem solving are reported in Table 3. Predominant student/teacher transactions (PSTT) observed on audiotapes and videotapes during group problem solving for each class are reported in Table 4. Teachers from Classes 1 and 4 had STPI values closest to the transactional midpoint of 4 on the scale (STPI = 4.75 and 4.42 respectively). These classes had the highest frequencies of PSTT during group problem solving as shown in Table 4 ($F = 19$ and 18 respectively). The teachers from these more "transactional" classes observed the highest SMP values (SMP = 3.17 and 2.83 respectively) among teachers.

Table 2
Regression on SMP in Group Problem Solving

Source	df	SS	MS	F	p	Rsq
STPI						
Regression	1	2.9470	2.9470	5.37	.024*	.088
Error	56	30.7175	0.5484			
Total	57	33.6644				
Predictor		Coef.	SD	t-ratio	p	
Constant		1.3554	0.5198	2.61	.012	
STPI		0.2605	0.1124	2.32	.024*	
GPA						
Regression	1	2.4408	2.4408	4.38	.041*	.073
Error	56	31.2236	0.5576			
Total	57	33.6644				
STPI and GPA +						
Regression	2	4.8708	2.4654	4.65	.014	.145
Error	55	28.7936	0.5235			
Total	57	33.6644				
Predictor		Coef.	SD	t-ratio	p	
Constant		-0.2754	0.9908	0.28	.782	
STPI		0.2754	0.1104	2.15	.036*	
GPA		0.0236	0.0123	1.92	.060	

Note. *$p < .05$.
+ Regression of SMP on STPI, GPA, and the interaction term (STPI x GPA) produced an insignificant interaction term ($p < .232$). Therefore the interaction term was deleted from the model.

Conversely, the Class 2 teacher observed the lowest level of STPI (2.33) and SMP (2.25), among teachers. Only four PSTT were observed during five stages of group problem solving in Class 2. The Class 3 teacher observed the highest level of STPI (5.09) and second lowest SMP (2.75). The 14 PSTT observed in Class 3 was the second lowest frequency among classes.

Table 3
Interaction Model for Teachers ($N = 4$)

Teacher	STPI	SMP	SS
Class 1 Observations	4.75	3.17	4.17
Class 2 Observations	2.33	2.25	3.75
Class 3 Observations	5.09	2.75	3.59
Class 4 Observations	4.42	2.83	3.83
Totals	4.15	2.75	3.84

Objective 2: There was no significant relationship between STPI and student satisfaction (SS) (Table 5). To check for the possibility of a nonlinear relationship between STPI and SS, a scattergram was visually analyzed and SS was regressed on STPI after STPI data were effect coded. These analyses did not support a nonlinear relationship between STPI and SS [the relationship between STPI (effect coded) and SS was insignificant ($p = .913$)].

Table 4
Frequencies of Predominant Student/Teacher Transactions (PSTT) Observed From Audiotapes and Videotapes of all Stages of Group Problem Solving (22 total stages observed*)

Transactions	Class 1	Class 2	Class 3	Class 4	Totals
Shared Decision Making	3	-	-	3	6
Shared Discussion	5	1	5	6	17
Shared Leadership	3	1	3	3	10
Agreements by Consensus	3	-	-	-	3
Mutual Respect	5	2	6	6	19
Totals	19	4	14	18	55

Note. *Tapes from only five out of six stages of group problem solving were available for analysis from Classes 1 and 2.

Table 5
Regression on SS During Group Problem Solving

Source	df	SS	MS	F	p	Rsq
STPI						
Regression	1	0.4945	0.4945	0.96	.332	.017
Error	56	28.9643	0.5172			
Total	57	29.4588				

However, descriptive and qualitative results suggest a non-linear relationship between STPI and SS and that transactional to slightly student-dominated student/teacher participatory interaction is linked to peak levels of SS during group problem solving. Data in Tables 3 and 4 show that the teachers from the more "transactional" classes (Classes 1 and 4) observed the highest SS values (SS = 4.17 and 3.83 respectively) among teachers. Conversely, the Class 2 teacher observed the second lowest SS (3.75) and the Class 3 teacher observed the lowest SS (SS = 3.59) among teachers.

Objective 3: A significant correlation ($p < .05$) was found between SMP and GPA (Table 1). This relationship is further analyzed in Table 2 using a regression model. When SMP was regressed on both STPI and GPA, GPA became insignificant ($p > .05$) and was dropped from the model. Other correlations between SMP or SS and the control variables were insignificant.

Discussion

Objective 1: Using student data, student/teacher participatory interaction (STPI) was positively related to student motivation to participate (SMP) in group problem solving. Insufficient evidence exists to support relationships between STPI and the control variables student age, gender, GPA, and class size. That STPI remained related to SMP after partial regression with GPA was further evidence for a relationship. A linear model best described the relationship between STPI and SMP during group problem solving using student data; however, teacher data and data from audiotapes and videotapes for each stage of group problem solving suggested a non-linear relationship between STPI and SMP. Specifically, peak values of teacher-observed SMP corresponded to observations of transactional to slightly student-dominated student/teacher participatory interactions. As mentioned, transactional participatory interaction during adult group problem solving situations in development communication has been recommended (Cohen & Uphoff, 1980; Nair & White, 1987) to maximize participant motivation. Similarly, results from this study indicate a relationship between STPI and SMP and support a transactional to slightly student dominated participatory interaction model.

Teacher educators in agricultural education who instruct their students during preservice or inservice on problem solving teaching should highlight the importance of establishing a student/teacher participatory interaction during group problem solving that maximizes student motivation to

participate. Transactional to slightly student-dominated participatory interaction is recommended in which students and teachers share responsibilities and demonstrate mutual respect.

Measures of STPI should be included in related studies that attempt to construct a model for predicting SMP in group problem solving.

Objective 2: Using student data, there was insufficient evidence to support a relationship between STPI and student satisfaction (SS) with group problem solving. However, teacher data and data from audiotapes and videotapes for each stage of group problem solving suggested a non-linear relationship between STPI and SS. Specifically, peak values of teacher-observed SS corresponded to observations of transactional or slightly student-dominated student/teacher participatory interactions.

Pending further empirical evidence, transactional to slightly student-dominated participatory interaction is recommended for maximizing student satisfaction with group problem solving.

Objective 3: Of the control variables, only GPA was positively related to SMP. When SMP was regressed on both GPA and STPI, GPA was dropped from the prediction equation.

Teachers of agricultural education using a group problem solving teaching strategy should consider motivational strategies that take advantage of a possible positive relationship between student achievement and SMP in group problem solving. Pairing high with average or low achievers during small group activities would be one such strategy. Measures of student achievement other than GPA should be included in related studies that attempt to construct a model for predicting SMP in group problem solving.

Since results and conclusions are limited to the sample, their contributions to theory are still tentative. Replicating the study in other settings and random sampling of agricultural education programs would increase generalizability. Further qualification of the nature of student motivation to participate, student satisfaction, and student/teacher participatory interaction during group problem solving is needed.

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