Use of Problem Solving Teaching Among Secondary Agriculture Teachers in Illinois

Edward W. Osborne, Associate Professor
Ramlah Hamzah, Graduate Student
University of Illinois

The problem solving approach to teaching has long been promoted as the most effective method for teaching agriculture in the secondary schools. However, according to Crunkilton (1988), the problem solving approach to teaching agriculture has diminished in popularity in recent years. As a result, some agricultural educators have expressed concern about the quality of teaching in secondary agriculture programs. Lee (1980) described this concern with the following statement:

> Some of the pedagogical practices now being carried out in vocational agriculture are disturbing. There appears to have been an increase in the use of instructional methodologies which allow students to assume a passive rather than an active role in the learning activities of the classroom/laboratory (p. 5).

While some agricultural educators have questioned the value and usefulness of problem solving teaching in today's secondary agricultural program (Moore & Moore, 1984), many agricultural educators have still strongly supported the use of problem solving as the primary teaching method for vocational agriculture (Binkley & Hammond, 1970; Henderson, 1983; Krebs, 1982; Lee, 1980; Newcomb, McCracken, & Warmbrod, 1986). In his AATEA Distinguished Lecture Crunkilton (1987) stated "...problem solving, both as a method of teaching and as a skill that students need, is more critical today than it was years ago" (p. 8).

A widely recognized model for the study of classroom teaching was developed by Mitzel and published by Dunkin and Biddle (1974). In this model the teaching/learning process is explained by the interaction of several groups of variables. These include presage variables (those associated with the teacher), context variables (those associated with students and environmental conditions), process variables (those associated with teacher and student behavior in the classroom), and product variables (those associated with the outcomes or effects of teaching). As indicated by this model, teacher behavior in the classroom, including teaching methods and techniques used, plays a significant role in the teaching/learning process and represents a critical area of research into the teaching process.

While the Mitzel model and other theories of the teaching/learning process highlight the importance of teaching methods in formal education, very little research has been done to describe the use and effectiveness of problem solving as a teaching approach in agriculture. In a recent study conducted by Flowers and Osborne (1988) secondary agricultural students were taught using a subject matter approach or a problem solving approach. The results showed that student achievement and attitudes toward the teaching method were essentially the same in the two groups. However, students taught using the problem solving approach had significantly less achievement loss. This study by Flowers and Osborne was the only research found that directly addressed the effectiveness of problem solving teaching in agriculture, as measured by student achievement.

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Current reform efforts in education have demanded that more attention be given to the development of problem solving, critical thinking, and decision making skills in students. As Phipps and Osborne (1988) and many other agricultural educators have suggested, problem solving teaching in agriculture develops students' thinking ability, stimulates student interest, and helps students evaluate, draw inferences, and make decisions. The recent empirical evidence reported by Flowers and Osborne (1988), the continuing promotion of problem solving teaching by the profession, and the declining use of problem solving teaching by agricultural teachers described by Crunkilton (1988) and others suggested the need to examine problem solving as a teaching method used by Illinois agricultural teachers. No studies have been completed that sought to describe the extent to which Illinois agricultural teachers used the problem solving approach to teaching.

Purpose and Objectives

The purpose was to examine the use of problem solving teaching by Illinois secondary agriculture teachers. Specific research questions developed to provide focus for the study included:

1. To what extend did agriculture teachers use the problem solving approach to teach their high school classes?

2. To what extent were various components of problem solving teaching used by Illinois agriculture teachers?

3. What factors influenced teachers' decisions not to use problem solving teaching?

4. What was the relationship between teachers' use of the problem solving approach and selected demographic variables?

The research design implemented was classified as descriptive correlational. The target population included all full-time Illinois agricultural production and agribusiness teachers in 1987-88 (N = 316). The LOTUS 1-2-3 spreadsheet program was used to select a simple random sample of 80 teachers, or 25% of the population. The sample size was determined using a formula suggested by Scheaffer, Mendenhall, & Ott (1979). A confidence level of 90% was used, and the population proportion was assumed to be .50 to overestimate the needed sample size. Data were collected by use of a mailed questionnaire. Field testing and pilot testing resulted in several modifications of the survey instrument. A panel of experts consisting of four faculty members in agricultural education verified the content validity of the instrument. Twelve secondary agricultural teachers who were not selected to participate in the study provided pilot test data. Cronbach's Alpha reliability coefficients of r = .80 and r = .75, respectively, were calculated for the scales describing the use of components of problem solving teaching and the factors for not using problem solving teaching. Part III of the instrument contained 20 items describing teachers' attitudes toward the problem solving approach to teaching. However, the results from this portion of the study are not presented in detail in this report. A Cronbach's Alpha reliability coefficient of r = .79 was calculated for the teacher attitude scale.

After the initial mailing and two follow-up mailings, a total of 61 responses (76%) had been received. However, two of the returned

questionnaires were incomplete, resulting in a 74% usable return. All returns received one week or later after the first follow-up mailing were classified as late respondents. Research has shown that late respondents are similar to nonrespondents, and a comparison of early and late respondents can be performed to allow generalization of the findings to the target population (Miller and Smith, 1983). The 45 early respondents were compared with the 14 late respondents on the dependent variable, use of problem solving teaching. The t-test indicated no significant difference between the two groups. Thus, the results of the study were generalized to the target population under examination.

Analysis of Data

Descriptive statistics were used to summarize and analyze the data. Possible relationships were examined using Pearson correlation coefficients. The SAS backward elimination regression procedure was used to determine the amount of variance in the dependent variable that could be explained by the linear combination of independent variables. All hypotheses were tested at the .05 level.

Results

Teacher and School Characteristics: The number of years of teaching experience reported by teachers ranged from zero to 36, with a mean of 13.12 years. Four of every five teachers (81.4%) had taken vocational agriculture in high school, and 84.8% of the teachers had completed four years of agriculture as a high school student. Nearly all teachers (89.9%) earned their undergraduate degree in agricultural education, and an equal percentage (89.1%) completed their undergraduate degree at one of the four universities in Illinois that have an agricultural teacher preparation program. The percentage of teachers holding a master's degree was 45.8%. Only 23.7% of the teachers had completed course work or inservice workshops on problem solving teaching since they first began teaching.

Teachers were also asked to report the approximate percentage of their students that conducted a SOE program in each grade level. The percentage of teachers reporting that 81-100% of their students participated in SOE was as follows: 9th grade - 64.4%, 10th grade - 62.7%, 11th grade - 52.5%, and 12th grade - 45.8%.

Teachers were asked several Likert-type questions dealing with the emphasis given to problem solving teaching during various stages of their teacher preparation and experiences in high school agriculture. These questions contained a five item response scale, ranging from (1) none at all to (5) exclusively. About one-third (38.6%) of the teachers reported that problem solving teaching received "very much" to "exclusive" emphasis in their undergraduate program ($\bar{X} = 3.28$, SD = 1.11). In addition, 35.6% of the teachers indicated that problem solving teaching received similar emphasis from their cooperating teachers during student teaching ($\bar{X} = 2.92$, SD = 1.13). Finally, 50.8% of the teachers reported that problem solving teaching received "very much" to "exclusive" emphasis by their university supervisor during student teaching ($\bar{X} = 3.32$, SD = 1.24).

Teacher Use of Problem Solving Teaching in General: Using a similar five point Likert-type scale, teachers were asked to indicate the extent to which they used problem solving teaching a student teacher. The results showed that 40.6% of the teachers reported using problem solving "very

much" to "exclusively" during student teaching (X = 3.2, SD = 1.2). Teachers also reported medium levels of confidence in using problem solving teaching when they first began to teach (X = 3.08, SD = 1.03), compared to high levels of confidence in using problem solving teaching now (X = 3.69, SD = 0.94). Both of these questions used a five point Likert-type scale (1 = very low, 5 = very high). Finally, teachers were asked to compare their use of problem solving teaching now with when they first began teaching (see Table 1).

Table 1
Use of Problem Solving Teaching Now Compared to When Teachers First Began Teaching

Use	Freq.	%
I use problem solving less now (1)	18	30.5
I use problem solving about the same (2)	30	50.8
I use problem solving more now (3)	11	18.6

Note. X = 1.88, SD = .69.

The mean percentage of lessons taught using problem solving teaching was found to be 39.0%. However, the percentage of lessons organized on a problem area basis was reported to be 62.7%. A significant, low relationship was found between these two variables (r = .28, p < .05).

Extent to Which Teachers Used Specific Components of Problem Solving Teaching: Using a five point Likert-type scale ranging from (1) almost never or never to (5) almost always, teachers reported their use of

Table 2
Use of Specific Components of Problem Solving Teaching Reported by Vocational Agriculture Teachers

Components	X	SD
-Teacher discussion of solutions to problems & concerns while providing time for student inquiry & self-study	3.71	1.02
-Interest approach presented by the teacher at the beginning of problem area	3.66	1.17
-Summary of solutions to individual problems and concerns	3.53	1.07
-Discussion of approved practices and general principles as a summary for the entire problem area	3.31	1.10
-Problems and concerns identified by students	3.08	1.04
-Student inquiry & self-study to discover possible solutions to problems and concerns	2.93	1.08
-Lec-discussion to present problem solutions to students	2.92	1.00
-Devel. of plans to practice or application by individual students	2.86	1.01
-Group objectives identified by students	2.86	1.17
-Trial discussion of problems and concerns	2.85	1.00

Note. 1 = almost never or never; 2 = sometimes; 3 = often; 4 = usually; 5 = almost always or always.

specific components of the problem solving process. One item, pertaining to the use of lecture-discussion, was included that did not represent problem solving teaching, but was perceived to be used to a considerable extent by teachers. As shown in Table 2, teachers reported that they usually provided discussion of solutions to problems and concerns while providing time for student inquiry and self-study (X = 3.71). Teachers also indicated that they usually presented interest approaches at the beginning of a problem area (X = 3.66) and summarized problem solutions (X = 3.53). Other listed components were reportedly used often by the teachers. Lecture-discussion to present problem solutions to students (X = 2.92) was also often used by teachers as a teaching strategy.

Reasons for Not Using Problem Solving Teaching: For lessons not taught using problem solving, teachers were asked to cite their reasons for this decision (see Table 3). For each of the 14 possible factors listed,

Table 3
Reasons Reported by Teachers for Not Using Problem Solving Teaching

Factors	Mean	SD
-Topics not well suited to problem solving teaching	2.68	0.99
-Lack of good reference materials for my students to use during problem solution	2.51	1.00
-Lack of instructional time	2.26	1.05
-Lack of sufficient understanding of problem solving by my students	2.18	0.98
-Lack of teacher planning time	2.16	1.02
-Negative student responses to problem solving teaching	2.09	0.99
-Reluctance to allow students to determine instruct. focus	2.03	0.95
-Extra work required to plan problem solving lessons	1.91	0.81
-Complexity of prob. solving as teaching & learning process	1.88	0.75
-Inability of my students to learn through problem solving approach	1.81	0.79
-Loss of teacher control over lesson content	1.79	0.93
-Lack of teacher confidence in the problem solving approach itself	1.75	0.87
-Lack of suff. understand. of problem solving by teacher	1.54	0.71
-Lack of confidence in my ability to effectively use problem solving	1.51	0.68

Note. 1 = no influence; 2 = slight influence; 3 = considerable influence; 4 = heavy influence.

teachers indicated the amount of influence each factor had on their decision not to use problem solving. Two reasons were cited by teachers as having considerable influence on their decision not to use problem solving. These included "topics not well suited to problem solving" (X = 2.68) and "lack of good reference materials for my students to use during problem solution" (X = 2.51). The remaining 12 factors were rated by teachers as having only slight influence in their decision not to use problem solving for certain lessons.

Relationships Between Teachers' Use of Problem Solving Teaching and Selected Independent Variables: Table 4 contains the Pearson correlation coefficients describing the relationships between teachers' use of problem

Table 4
Pearson Correlation of Teacher Use of Problem Solving Teaching with Selected Demographic Variables

Variable	r
Teacher use of prob. solving teaching(PST) during stud. teaching	.46***
Emphasis on PST by cooperating teacher during stud. teaching	.42***
Emphasis on PST by university supervisor during stud. teaching	.38**
Current level of confidence in using PST	.37*
Emphasis on PST by high school agriculture teacher	.31*
Percentage of students having a SOE program	.29*
Years of agriculture completed as a high school student	.23
Years of teaching experience	.23
Level of confid. in using PST when teachers first began teaching	.16
Emphasis on PST during the undergraduate Ag Ed program	.12

Note. * $p < .05$; ** $p < .01$; *** $p < .001$.

solving teaching and pertinent independent variables. The dependent variable "use of problem solving teaching" was defined as the percentage of lessons taught using the problem solving approach. Using the convention suggested by Davis (1971), results showed moderate, significant relationships between teachers' use of problem solving and (1) use of problem solving during student teaching; (2) emphasis placed on problem solving teaching by the cooperating teacher, university supervisor, and high school agriculture teacher; and (3) current level of confidence in using problem solving teaching. A significant, low relationship was found between use of problem solving teaching and percentage of students having SOE programs.

Multiple regression analysis was performed to determine the amount of variance in the dependent variable, use of problem solving teaching, that could be explained by the linear combination of independent variables (see Table 5). Results showed that four variables explained 60% of the variance in teachers' use of problem solving teaching. These included teachers' attitude toward problem solving as a teaching approach, percentage of students with SOE programs, the use of problem solving teaching during student teaching, and teachers' confidence in their ability to use problem solving teaching when they first began teaching.

Table 5
Regression of Use of Problem Solving Teaching on Selected Independent Variables

Independent Variable	R	R^2	b	t	p
Attitude toward PST	.69	.48	.56	5.43	.0001
Percentage of students with SOE programs	.72	.52	.21	2.13	.04
Use of PST during student teaching	.73	.54	.34	-2.66	.01
Confidence in using PST when teachers began to teach	.77	.60	-.30	2.94	.005

Note. $F = 18.23$; $p < .0001$.

Conclusions and Recommendations

Although teachers organize a majority of their lessons on a problem area basis, a much lower percentage of lessons is usually taught using a problem solving approach. Teachers do not appear to follow through their problem based organization of instruction to actual problem solving teaching.

Generally accepted components of problem solving teaching are being used by Illinois agriculture teachers. However, lecture-discussion is also often used by teachers to present problem solutions or answers to students. Preservice and inservice programs should focus on specific strategies for effectively using problem solving, while emphasizing the major themes inherent in this approach.

A wide variation exists in the perceived emphasis placed on problem solving teaching during the teacher preparation program and by cooperating teachers. Teachers tend to use problem solving more if it is used during student teaching and its use is encouraged throughout the teacher preparation program. University supervisors place considerable emphasis on problem solving teaching as they work with student teachers. Teacher educators and cooperating teachers should provide consistent support and encouragement to teacher candidates in their efforts to use problem solving.

As teachers gain more teaching experience, they tend to become more confident in their ability to use problem solving teaching, and in turn, tend to use problem solving more. A perception that teaching topics are not well suited to problem solving and a lack of appropriate reference materials are the two major reasons teachers do not use problem solving in more of their classes. Teacher educators should work with teacher candidates in the undergraduate program to help them adapt the problem solving teaching process to current and emerging instructional topics in agriculture.

Teachers' use of problem solving teaching can be explained to a substantial degree by their attitudes toward the method, their confidence in using problem solving as a beginning teacher, their use of problem solving as a student teacher, and the percentage of their students with SOE programs. Therefore, teacher educators and state supervisors should do as much as possible to enhance these teacher characteristics via preservice and inservice programs.

The following areas of further study area also recommended: (a) examination of ways to increase teachers' confidence in and attitudes toward problem solving teaching; (b) testing of the effectiveness of adaptations of the problem solving approach with new and emerging topics in agriculture; and (c) development of effective models of problem solving teaching for use in undergraduate and inservice programs.

References

Binkley, H.R., & Hammond, C. (1970). Experience programs for learning vocations in agriculture. Danville, IL: The Interstate Printers and Publishers, Inc.

Crunkilton, J.R. (1988). Thinking out loud about this process we call teaching. Journal AATEA, 29(1):, 2-10.

David, J.A. (1971). Elementary survey analysis. Englewood Cliff, New Jersey: Prentice Hall, Inc.

Dunkin, M., & Biddle, B. (1974). The study of teaching. New York: Holt, Rinehart, and Winston.

Flowers, J.L., & Osborne, E.W. (1988). The problem solving and subject matter approaches to teaching vocational agriculture: effects on student achievement and retention. The Journal of the American Association of Teacher Educators in Agriculture, 29(10:, 20-26, 52.

Henderson, J. (1983). Professional commitment to cognitive skill development. The Journal of the American Association of Teacher Educators in Agriculture, 24(3), 71-75.

Krebs, A.H. (1982). Critical points in problem solving. The Agricultural Education Magazine, 54(10), 5-7.

Lee, J.S. (1980). Time to take inventory in agricultural education. The Journal of the American Association of Teacher Educators in Agriculture 22(1), 2-12.

Moore, G.E., & Moore, B.A. (1984). The problem solving approach to teaching: Has it outlived its usefulness? The Journal of the American Association of Teacher Educators in Agriculture, 25(2), 3-10.

Miller, L.E., & Smith, K.L. (1983). Handling nonresponse issues. Journal of Extension, 21, 45-50.

Newcomb, L.H., McCracken, J.D., & Warmbrod, J.R. (1986). Methods of teaching agriculture. Danville, IL: The Interstate Printers and Publishers, Inc.

Phipps, L.J., & Osborne, E.W. (1988). Handbook on agricultural education in public schools. Danville, IL: The Interstate Printers and Publishers, Inc.

Scheaffer, R.L., Mendenhall, W., & Ott, L. (1979). Elementary survey sampling. Belmont, CA: Wadsworth Publication Co., Inc.