Problem Solving and the Questioning Strategies of Student Teachers of Vocational Agriculture

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Research findings have indicated that much of the questioning behavior displayed by classroom teachers is neither effective nor productive (Hunkins, 1972), while at the same time teacher questioning has been recognized as one of the most common methods of encouraging inquiry and critical thought on the part of students (Hyman, 1979; Sanders, 1966). More specifically, evidence has suggested that teachers tend to ask many questions requiring recall and few questions prompting critical thought (Adams, 1964; Clements, 1964; Davis & Tinsley, 1967; Floyd, 1960). Regardless of the subject matter taught or the general discipline of the teacher, findings reported in the literature have suggested that teacher questioning most often have involved the lower levels of thinking.

The problem solving approach to teaching is recommended for use by teachers of vocational agriculture. "Problem solving aids students in learning a systematic approach to the recognition, analysis, and solution of problems" (Warmbrod, 1969:232). Furthermore, "it stimulates interest; developes thinking ability; and helps students to evaluate, draw inferences from, and make decisions essential to the solution of, a problem" (Phipps, 1980:48). Warmbrod (1969), summarized primary premises fundamental to the problem solving approach as follows:

> Instruction is student-centered rather than subject-centered; instruction aims at the development of and change of behavior of individuals rather than "covering" subject matter; content is organized such that it is psychologically meaningful to students rather than a completely teacher-dominated process; students are capable of and will share in planning, conducting, and evaluating what is taught and how it is taught; learning is an active rather than passive process; and learning is improved when students "inquire into" (discovery or inductive approach to learning) rather than being "instructed in" subject matter. (p. 231)

Thus, if the problem solving approach is used properly, its use potentially can enhance the higher level cognitive functions of pupils such as analysis, application, synthesis, and evaluation.

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The review of related literature presented evidence that teachers of today are similar to those of some 50 years ago in terms of their tendency to repeatedly use lower level cognitive functions (Adams, 1964; Davis et al., 1969; Floyd, 1960; Gall, 1970). "Set against this type of evidence, the frustration of half a century's rhetoric about problem solving and critical thinking is obvious, and, perhaps, monstrous" (Davis et al., 1969, p. 711).

There is a need to describe the effectiveness of the problem solving approach in affecting students' critical thought. An analysis of questioning strategies is one method of describing cognitive functions occurring in the classroom. If a goal of teacher education is to promote effective teaching, and if, as Hunkins (1972) suggested, questioning strategies influence the quality, significance, and accuracy of pupil's conclusions, then it behooves teacher educators to know the characteristics of the questioning strategies being employed in the classroom by their student teachers.

Purpose

The purpose of the study was to ascertain the effect which classroom experience using the problem solving approach had on the questioning strategies of student teachers of vocational agriculture. Research questions related to those questioning strategies of student teachers of vocational agriculture which were associated with (a) varying levels of classroom experience using the problem solving approach, (b) proficiency using the problem solving approach, (c) final grades assigned for student teaching, and (d) the cognitive level of questioning strategies used by teachers and student teachers of other disciplines.

Methodology

The population of the study included students presently and subsequently enrolled in F299--Student Teaching in Agricultural Education and F303--The Teaching of Agriculture at the University of Missouri-Columbia as long as the professors teaching these courses remain the same. The sample used in this study consisted of 19 student teachers enrolled for the fall semester of 1980.

The Questioning Strategies Observation System (QSOS), developed by Morse and Davis (1970), served as the instrument used for measuring the seven dependent variables: question quantity, cognitive quantity, cognitive quality, tactical versatility, question success, reaction quality, and cognitive versatility. The Observation Guide for Student Teachers, an instrument developed by the Agricultural Education Staff at the University of Missouri-Columbia, was used to rate proficiency in using the problem solving approach. The student teachers audiotaped lessons representing no experience (a videotaped mini-lesson), one week of experience, and four weeks of experience using the problem solving approach. Audiotapes of 14 (74%) student

teachers were used in the final analysis. The scores of the other five student teachers were deleted from statistical analysis because a complete set of three scores was not available.

The principal investigator was responsible for all scoring. For the QSOS, the reliability coefficients for the seven derived measures established before the study ranged from .81 to .97 and the coefficients established during the study ranged from .74 to .93. The reliability for the Observation Guide for Student Teachers was .93. All of the coefficients of stability were above .70 and, therefore, were considered adequate for the purposes of this study (Ary, Jacobs, & Razavich, 1972). Scoring was not initiated until all of the audiotapes had been returned so they could be mixed and scored without knowledge of which experience level was represented.

A repeated-measures design was utilized and data were analyzed using univariate analysis of variance. Posteriori contrasts were performed on the least squares means for experience when the variable was significant at the .05 alpha level to isolate the source of the significant difference.

Findings and Conclusions

Questioning strategies remained relatively stable except for cognitive quantity and reaction quality for the student teachers of vocational agriculture with three levels of classroom experience using the problem solving approach as shown in Table 1. Thus, questioning strategies displayed during the videotaped mini-lesson, representing no classroom experience using the problem solving approach, were indicative of questioning strategies subsequently used by the student teachers during student teaching.

Questioning strategies were not different for student teachers of vocational agriculture grouped by proficiency using the problem solving approach. Therefore, it was concluded that experience using the problem solving approach did not alter the questioning strategies of the student teachers of vocational agriculture.

Questioning strategies were not different for student teachers of vocational agriculture grouped by their final grade for student teaching except for cognitive quantity scores which were higher for student teachers who received a B for student teaching than those who received an A. Therefore, it appeared that final grades for student teaching were not a function of questioning strategies.

As shown in Table 2, student teachers of vocational agriculture using the problem solving approach asked more higher level questions, more lower level questions, and fewer procedural questions than teachers and student teachers not using the problem solving approach as depicted in the related literature. Therefore, questioning strategies used with the problem solving approach involved the use of more cognitive questions, including an emphasis on more challenging cognitive questions.

Table 1

Analysis of Variance of Questioning Strategies Considering the Effect of Classroom Experience Using the Problem Solving Approach[1]

Questioning strategy	F	p
Question quantity	1.45	.2536
Cognitive quantity	6.28	.0060**
Cognitive quality	1.57	.2270
Tactical versatility	1.68	.2051
Question success	0.49	.6199
Reaction quality	3.45	.0467*
Cognitive versatility	2.66	.0892

[1]df = 2 and 13.
*Significant at the .01 alpha level ($p<.01$).
**Significant at the .05 alpha level ($p<.05$).

Implications

The phrase, higher scores, is quantitative not qualitative; it reflects the relative juxtaposition of a numerical score and is not intended to serve as an indicator of quality. Findings of this study and previous studies concerning questioning strategies have not defined precisely what the qualitative parameters of various measures of questioning strategies should be in order to promote the intellectual growth of students (Lamb, 1976). Additional investigation in this area appears warranted. Qualitatively, higher scores for student teachers who received a B were not interpreted to mean that those who received a B used questioning strategies in a more superior manner than those who received an A. Perhaps if the independent variable, grade, had been more discriminating between levels, a stu-

Table 2

Cognitive Level of Questions Asked by Student Teachers of Vocational Agriculture Using the Problem Solving Approach

Cognitive level	Percent of total questions
Knowledge, comprehension	67.34
Application, analysis, synthesis, evaluation	25.16
Procedural	7.40
Affective	0.10

dy of grades as a function of questioning strategies would have been more meaningful. With only two levels for grades and a small sample size, the analysis of data more accurately identified general trends rather than precise findings.

Questioning strategies displayed during the videotaped mini-lesson, representing no previous classroom experience using the problem solving approach, were indicative of questioning strategies subsequently used during student teaching. Therefore, it appears feasible to use the QSOS to evaluate questioning strategies of student teachers of vocational agriculture during the videotaped mini-lesson before they encounter the actual student teaching experience. Those student teachers who apparently needed improvement could receive appropriate instruction.

The lack of a significant relationship between questioning strategies and the use of the problem solving approach was unexpected. Perhaps the distinction between a question and a problem as explained by Phipps (1980) is more actual than philosophical; or, perhaps a more precise measure of proficiency using the problem solving approach would provide more discrimination among individual differences, thus yielding more definitive data describing the relationship.

It was not surprising that student teachers of vocational agriculture using the problem solving approach asked more lower level questions, more higher level questions, and fewer procedural questions than teachers and student teachers not using the problem solving approach as depicted in the related literature. Because of the specific structure of the approach, a routine for conducting class is developed. Apparently, the student teachers of vocational agricul-

ture asked fewer procedural questions because the students were familiar with the class routine, thus allowing more time for the student teachers to ask more challenging cognitive questions. The fact that the student teachers asked more lower level questions was not viewed as a weakness, even though there were more lower level questions asked than Sanders (1966) suggested. The higher percentage of lower level questions was probably used to form a foundation upon which to subsequently build the higher education questions as discussed by Zohorik (1980).

The findings of this study revealed that affective questions accounted for only 0.10% of the questions asked by the student teachers of vocational agriculture using the problem solving approach. This finding was more extreme than noted by Hevener (1973) in which he described the portion of class time devoted to discussing cognitive questions as five times that devoted to affective questions. The almost total absence of affective questions appeared to be a substantial weakness in the questioning strategies of the student teachers of vocational agriculture participating in this study. Perhaps the curricula in agricultural education should include more emphasis on stimulating affective thought.

In light of these observations, the problem solving approach as used by student teachers of vocational agriculture is more nearly satisfying the basic theoretical postulates of the approach than has been evident from other studies (Davis et al., 1969; Harris, 1969). Therefore, the problem solving approach should continue to be highly recommended and widely utilized for the teaching of agriculture.

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