PREPARING TEACHERS OF AGRICULTURE TO SOLVE COMPLEX STUDENT SUPERVISION PROBLEMS THROUGH PROBLEM-BASED LEARNING

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Introduction and Theoretical Framework

Beginning teachers face many ill-structured, complex problems. Among their many needs, novice teachers of agriculture have problems managing and advising FFA activities (Edwards & Briers, 1999; Garton & Chung, 1996; Layfield & Dobbins, 2000; Mundt, 1991; Mundt & Connors, 1999; Talbert, Camp, & Heath-Camp, 1994) and disciplining students (Joerger & Boettcher, 2000; Mundt, 1991; Mundt & Connors, 1999; Nesbitt & Mundt, 1993; Talbert et al., 1994). Because teacher educators play a significant role in developing teachers (American Council on Education, 1999; McGhee & Cheek, 1990) and shaping the future of agricultural education (Anderson, 1977), preparing preservice teachers through problem-based learning may help them survive and grow through the complex, ill-structured problems they may face in their initial years of teaching.

Conceptually, teacher thinking and problem-solving are not new to agricultural education. Problem-solving approaches to teaching have been a standard method in agricultural education programs (Brown, 1998), and have changed very little from the early days of agricultural education (Straquadine & Egelund, 1992). One of the basic tenants of traditional problem-solving methods is the existence of a clearly defined problem (Hedges, 1996; Newcomb, McCracken, & Warmbrod, 1993; Stewart, 1950; Sutherland, 1948). Yet, researchers and practitioners alike would agree that the profession of teaching requires educators to make decisions about and act upon problems that are often complex and ill-structured. Schön (1983) noted that teaching as a profession commands the skill of inquiring into and reflecting upon complex problems, often in very ill-structured, demanding contexts.

Research comparing novices to experts in their cognitive processing abilities (Sweller, 1988) reveals that experts have more well-developed schemas or mechanisms for structuring and recognizing problems. Novices as such, must refer to more rudimentary and generic mechanisms for approaching problem situations. Furthermore, research on the practice of expert vs. novice teachers indicates that expert teachers have more efficient mechanisms for thinking about and solving the problems of practice, with student development as the central outcome (Fuller, 1970). While advanced cognitive processing abilities such as critical and creative thinking, analytical thinking, higher-order thinking, and metacognition have long been espoused as the aims of an educational system, research regarding the widening gap between theory and practice in professional education indicates that few preservice teachers leave higher education with the ability to think, process, and solve the ill-structured problems of practice.

The theoretical framework for the study is derived from Jonnassen’s (2000) meta-theory of problem-solving. One of the basic tenents of this theory (Jonnassen, 2000) is that there are critical differences between well-structured and ill-structured problems, and that ability to solve well-structured problems does not translate to ability to solve complex, ill-structured problems.
As opposed to well-structured problems, ill-structured problems are authentic or emergent, have unpredictable solutions, appear ill-structured because one or more of the elements are unknown, possess multiple solutions or solution paths, possess multiple criteria for evaluating solutions, and require learners to make judgments or are dependent upon learners’ epistemological beliefs (Jonnassen, 1997).

The use of authentic, problem-based cases is one method of creating a learning environment more similar to the types of problems encountered in professional contexts (Jonnassen, 1997). Such problems tend to be highly bound by context, thus, preservice teachers of agriculture who learn how to manage, supervise, and discipline students related in the role of an FFA advisor through ill-structured problems would feel more prepared to handle difficult student problems in the future. The utilization of ill-structured problem-based cases has been determined to develop students’ abilities to think and process at higher cognitive levels (Hernandez-Serrano, & Jonassen, in press). Further, problem-based case methods have been established as sound pedagogical tools for preservice teacher education (Silverman, Welty, & Lyon, 2000). Yet, a paucity of research exists regarding the outcomes of utilizing ill-structured problems, as a pedagogical tool for the preparation of preservice teachers of agriculture for the problems unique to the context of their practice. Research is needed to determine the outcomes of utilizing problem-based cases in agricultural education. The findings of such research could serve as a mechanism for helping developing teachers in solving the ill-structured and complex problems related to the practice of supervising FFA activities.

**Purpose and Objectives**

The purpose of this study was to determine the outcomes of using problem-based learning cases by preservice teachers to learn how to manage difficult student problems related to FFA supervision. The objectives of the study were to: (1) ascertain the level of problem-solving of preservice teachers based on the problem-based learning method; (2) identify the common themes of preservice teachers’ learning outcomes about FFA supervision that prepared them to deal with ill-structured student problems as future teachers; and, (3) identify common themes of difficulties preservice teachers’ faced when making decisions related to the ill-structured problems.

**Methods and Procedures**

This descriptive survey sought to explore and describe the population of a cohort group of preservice teachers in agricultural education in at a land-grant university in a Midwestern state. The target population that the researchers sought to generalize to consisted of a census of preservice teachers in a teacher education seminar. The seminar was conducted one semester before the student teaching internship. The students were randomly assigned ill-structured problems designed to prepare future agriculture teachers to solve difficult student problems related to the supervision of the FFA chapter. The ill-structured problems were written by the researchers based on authentic cases and involved: (1) theft on a field trip; (2) sexual activity in a motel room; (3) drug and alcohol use on a camping trip; (4) violation of good conduct policy; (5)
academic ineligibility of the FFA chapter president; and, (6) horseplay on the school bus at a
convention. Three to four preservice teachers were randomly assigned the same ill-structured
problems and the groups discussed how to solve the problems using the satisficing or
administrative decision-making model (Hoy & Miskel, 2001). The preservice teachers were
couraged to discuss their strategies in groups, but were asked to turn in assignments that were
completed independently. The students were given three weeks to work on the assignment,
which included three 50-minute sessions of in-class instruction: (a) establishing expectations; (b)
making decisions using the administrative, satisficing model; and, (c) writing a “bad news”
letter.

Preservice teachers identified the short-term and long-term problems, analyzed the difficulties,
defined a set of criteria for a satisfactory solution, outlined 17 alternatives and consequences, and
explained a plan of action for each ill-structured problem. Then, preservice teachers were taught
how to write a “bad news” or indirect letter to a parent of one of the students involved in the ill-
structured problems. The preservice teachers were provided scaffolding and examples of how to
complete the major steps of the satisficing model and “bad news” letter. Students completed a
self-reflection in the seminar on problem-based learning on the day that they turned in their
completed assignments. All of the preservice teachers (N = 22) completed the reflection
activity—questionnaire.

The instrument used to collect the data of this study was a questionnaire containing nine items.
The researchers created the instrument based on Jonassen’s (2000) meta-theory of ill-structured
problems. Five summated rating scale items (see Table 1) were included in the questionnaire to
assess preservice teachers’ beliefs of problem-based learning. The scale was: (1) strongly
disagree; (2) moderately disagree; (3) slightly disagree; (4) slightly agree; (5) moderately agree;
and, (6) strongly agree. Four open-ended questions were used to ascertain the teachers’ thoughts
about the use of ill-structured problems related to FFA supervision in agricultural education.
Two questions addressed Objective 2: Learning Outcomes: What do you know now about FFA
supervision that you didn’t know before you completed this assignment? How did this case
study prepare you to deal with student problems as an agriculture teacher? Two questions
addressed Objective 3: Difficulties: What was the most difficult aspect of trying to make a
decision regarding your case? As a future agriculture teacher, how will you approach making
difficult decisions related to supervising students? A panel of teacher education experts in the
agricultural education department established content validity. Graduate students in agricultural
education established face validity through a field test. Post hoc reliability tests were conducted
to establish reliability. Cronbach’s (1951) alpha coefficient was 0.79 for the problem-solving
domain.

Descriptive statistics were used to analyze the numerical data for Objective 1. The data set was
analyzed using SPSS. The ordinal-level data from the five summated rating scale items were
reported as frequencies. These five items were summed as the problem-solving domain and was
reported as a population mean and standard deviation. For Objectives 2 and 3, the researchers’
collected and interpreted the data using qualitative methods from a post-positivist
epistemological stance (Lincoln & Denzin, 2000). Paper, pencils, and highlighter markers were
used to help create organizers to code and summarize the qualitative data. Coding was used to
analyze the qualitative data from the open-ended questions. The researchers created a coding
scheme of the major concepts, central ideas, or related responses (Glesne, 1999). Trustworthiness and believability was established through the use of peer debriefing, member checks, an audit trail, and a reflexive journal (Donmoyer, 2001; Lincoln & Guba, 1985).

Results and Findings

For Objective 1, the mean of the problem-solving domain was $\mu = 4.89$ ($\sigma = .70$, $N = 22$). Table 1 reports the frequencies as percentages ($N$ in parentheses) of the five items that comprised the problem-solving domain. Approximately 90% of the preservice teachers agreed that they learned how to make decisions. Approximately 86% of the preservice teachers agreed that they were more prepared to deal with student problems after the problem-based learning experience. Approximately 95% of the preservice teachers agreed that the problem-based learning experience engaged them to think reflectively. Approximately 95% of the preservice teachers reported that the ill-structured problems helped prepare them for similar situations they would face as agriculture teachers. All of the preservice teachers agreed that the ill-structured problems engaged them to think of creative alternatives.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Frequencies Reported as Percentage of Preservice Teachers’ Perceptions of Learning Outcomes as a Result of a Problem-Based Learning Experience ($N = 22$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>I learned how to make decisions about resolving difficult student problems through this case study</td>
<td>0 (0)</td>
</tr>
<tr>
<td>I am more prepared to deal with student problems as an FFA advisor than I was before I studied this case</td>
<td>0 (0)</td>
</tr>
<tr>
<td>This case study engaged me to think reflectively</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Completing this assignment helped me prepare for similar situations that I will face as an FFA advisor</td>
<td>0 (0)</td>
</tr>
<tr>
<td>This case study engaged me to think of creative alternatives</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Scale: 1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Moderately Agree, 6 = Strongly Agree

For Objective 2, eight themes emerged from the preservice teachers’ learning outcomes about FFA supervision that prepared them to deal with ill-structured student problems as future
Decision-Making Process: The first theme centered on aspects of engaging in the decision-making process. Preservice teachers discussed this outcome more than double the amount of comments that were many regarding the other themes. The preservice teachers emphasized that the process of generating 17 alternatives caused them to think creatively. Preservice teachers also stressed that they considered many factors when outlining the consequences for each alternative. They also stated that they learned to reflect upon the implications of the consequences for the students, parents, and the school community. A representative response from a preservice teacher was, “There are many ways to think of solutions. Many will work, but some are more right than others.”

Awareness of Problems: The second theme dealt with preservice teachers developing a greater awareness of student problems than they had before participating in this problem-based learning experience. Preservice teachers indicated that they were somewhat naïve in relation to the wide variety of problems that they may have to address in the future. An example of a frequent response from preservice teachers stated, “It brought to life some real problems that we may think will never happen to us.” Preservice teachers also stated that they are now aware of the stress that may occur when dealing with complex student problems as agriculture teachers.

Communicating Bad News: The third theme focused on what preservice teachers learned about communication when dealing with ill-structured student problems. Preservice teachers stated that they learned how to write an effective “bad news” letter to the parents of the students involved in the ill-structured problem. Preservice teachers responded with comments such as, “I feel that I will be more prepared to address the parents if the need arises.”

Legal Issues, Liability Concerns, and School Policies: The fourth theme focused on preservice teachers’ learning to consider legal issues, liability concerns, and school policies when faced with complex student problems. Preservice teachers realized the necessity of knowing the proper procedures to follow when students are involved in illegal activity. Preservice teachers also stated that they learned the importance of being informed about the policies contained within the school handbook. A preservice teacher stated, “Now, I realize that I must be aware of all school policies and guidelines, and consider them each time I have to deal with a problem.” Furthermore, preservice teachers also stressed that the criteria for establishing a solution should try to limit personal liability.

Teacher Comfort: The fifth theme to emerge was finding a decision that the preservice teachers felt comfortable in making and implementing. Preservice teachers commented that their decisions must consider “…how I feel comfortable handling the situation.”

Dealing with the Individual: The sixth theme focused on dealing with ill-structured student problems on an individual basis. Preservice teachers responded with comments such as, “I will always meet individually with the students.” Preservice teachers also considered it was important to involve the individuals’ parents in determining the consequences for the students.
Career Preparation: The seventh theme to emerge was preservice teachers feeling more prepared to deal with ill-structured student problems. Preservice teachers indicated that they believed they were better equipped to deal with these difficult situations as a result of engaging in the decision-making process. One preservice teacher commented, “It showed me the procedure to follow when faced with a similar situation.”

Reaction Time: The eighth theme centered on preservice teachers’ realization that they would need to reach a decision in a shorter amount of time in the real-world. Preservice teachers felt that their reaction time should be faster than this assignment required it to be. A preservice teacher commented, “In the real world we won’t have 3 weeks to react. We will have 3 seconds.” Although this was an accurate observation, only a small proportion of preservice teachers mentioned this particular learning outcome.

For Objective 3, the preservice teachers discussed six common aspects that made their decision-making process difficult regarding the ill-structured problems. Although there were some similarities between learning outcomes and difficulties, the difficulties were reported separately from the learning outcomes because they represented a different aspect of the problem-solving process. The following themes are also discussed the order of frequency in which the preservice teachers discussed them.

Deciding upon a Solution: The first theme to emerge identified the difficulties involved in deciding upon a solution to the ill-structured problem. Preservice teachers stated that the solution must be fair, relevant, appropriate, and effective. Preservice teachers frequently commented on difficulties they faced in “…deciding which action was best” and “…finding a solution that met all criteria.”

Teacher Reputation: The second theme focused on the need to protect the teacher’s reputation. Preservice teachers found it difficult to determine a solution that was acceptable, yet maintained their authority and promoted respect among the students, parents, school, and community. A selected comment made a preservice student illustrated this concern, “The consequence had to help the program and my respect as an instructor.”

Keeping Other’s Interests in Mind: The third theme was that of considering others when making a decision. A typical response stated that it was difficult to “find a solution that is in the best interests of everyone involved.” The preservice teachers were concerned about the effects of their decision on students, parents, and the school community as a whole. Keeping other’s interests in mind seemed to reciprocate in the minds of the preservice teachers related to their consideration of the teacher’s reputation and authority.

Developing Alternatives: The fourth theme to emerge was the difficulty preservice teachers faced in developing 17 different alternatives for the situation. The preservice teachers stated that this activity challenged them to think of creative alternatives. One preservice teacher commented, “It was hard to think of 17 different alternatives that weren’t completely off-the-wall.” Although a few commented that they thought 17 different alternatives appeared to be a bit too much to do at first, several commented that it made them be more creative in thinking of possible alternatives.
Legal Actions: The fifth theme concerned issues pertaining to legal actions. Preservice teachers stated that they faced several complications in making decisions that would require them to take legal action against their students. One preservice teacher commented, “You don’t want to call the cops on your own kids, but that may be the legal thing to do.”

Teacher Comfort: The sixth and final theme of difficulties focused on finding a decision that was best for the teacher. In relation to evaluating the alternatives, a preservice teacher stated that it was difficult to “…figure out which ones would work best for me.” Preservice teachers said they felt compelled to arrive at a decision that made them comfortable.

Conclusions, Recommendations, and Implications

Problem-based learning engaged preservice teachers to be creative and reflective problem-solvers in making decisions related to ill-structured student problems. This is consistent with Schön’s (1983) assertions of teachers as practitioners who must be reflective both in and about action. The preservice teachers learned how to creatively generate alternatives, become informed of personal interest, school policies, and liability concerns, determine potential consequences for each alternative, consider possible implications of the consequences, and make decisions in a more reasonable period of time. Furthermore, preservice teachers reflected on several factors in making decisions through the use of ill-structured problems. The preservice teachers reflected on their own level of comfort in making the decision and limiting liability concerns. They also considered students as individuals and including their parents in reaching a decision or understanding the actions taken. Moreover, preservice teachers reflected school policies, liability concerns, and possible legal implications.

Problem-based learning prepared preservice teachers to solve similar ill-structured problems related to FFA supervision that they may face as future agriculture teachers. Anticipation and preparation are important variables to solving student problems (Hedges, 1997). Therefore, preservice teachers felt that engaging in solving the ill-structured problems exposed them to a variety of situations that they did not consider before the problem-based learning experience. Preservice teachers also learned how to apply the satisficing decision-making process to real-life problems and communicate their decisions to parents through a “bad news” letter. Research in solving ill-structured problems similarly indicates that students must experience ill-structured problems for those problem-solving skills to transfer to other ill-structured problems of everyday practice (Jonassen, 2000).

Preservice teachers faced difficulties in making decisions regarding the ill-structured problems. This finding is consistent with research in ill-structured problem solving practices in that students faced difficulties with the challenge of processing at higher cognitive levels, and processing cases that have multiple solution paths (Hernandez-Serrano & Jonassen, in press). They expressed how challenging it was to think of creative alternatives, consider the interests of others, and take legal action if necessary in reaching solutions that were fair, relevant,
appropriate, and effective. The preservice teachers felt that the solution should support their authority and reputation as a teacher and be one that they felt comfortable implementing.

Several recommendations emerged from the findings and conclusions. Teacher educators seek to prepare preservice teachers for the challenges that they will face in the future as agriculture teachers. A problem-based learning experience with the same nature as the one described in this study may help prepare preservice teachers to address ill-structured student problems. Teacher educators should reconceptualize the nature of the problems and approaches they use to teach preservice teachers to solve authentic, real-world problems. Further, the satisficing decision-making model should be considered as an appropriate strategy to teach preservice teachers to make decisions regarding complex student problems. Teacher educators should challenge preservice teachers with ill-structured problems based on their own, and others, real-life experiences and problems faced in the field of teaching. Agricultural teachers at the secondary education level often incorporate problem-solving techniques into classroom instruction and activities. These teachers may benefit from using ill-structured problems with their students. Activities and assignments that require students to derive solutions for ill-structured problems help to instill problem-solving skills within students. Students will be challenged to think creatively and reflectively about the problem.

This study was an initial look at the learning outcomes and difficulties of problem-based learning in a teacher education seminar. This study appears promising for further investigation and should be replicated with more participants for greater generalization and transferability. Moreover, further investigation should use quasi-experimental or experimental designs to determine if problem-based learning is more effective than other teaching methods. The ill-structured problems should be compared to determine if they result in different learning outcomes. Follow-up studies should be conducted to determine if the problem-based learning experiences helped preservice teachers solve real problems they faced in the field.

References


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Authentic learning and authentic assessment are important topics in Career and Technical Education today. The use of ill-structured problems with preservice teachers in agricultural education should better prepare them to solve real-world problems in the teaching profession. Knobloch, Ball, and Settle conducted a well-designed study to determine the outcomes of using problem-based learning cases with preservice teachers the semester before the student teaching internship. It is encouraging when teacher educators use current research to guide their practice in the classroom.

Although this descriptive study used a cohort group at one university, it contributes to the body of knowledge and expands understanding in this area. I agree with the authors’ recommendations that their study should be replicated and investigated using more powerful research designs. It will also be interesting to see if, as the authors correctly note, experiencing problem-based learning cases at the preservice phase makes a positive difference in the ability to solve real-world problems as practicing teachers. I would encourage these researchers to conduct a follow-up at the end of the student teaching internship and again at the end of the first year of teaching to better gauge the effectiveness of the problem-based learning cases.

The conceptual and theoretical frameworks seem to well-support the study. The methods used appear appropriate; however, one concern is noted in the reporting of the data. If, as the Cronbach’s alpha indicates, the five items measure one domain of problem-solving, then caution should be used in reporting and interpreting the individual items. As this study is replicated and expanded, a “problem-solving” scale should be the focus rather than the individual items in the scale.

This paper raises some questions for discussion:

Are our agricultural education teacher preparation programs adequately training preservice teachers to analyze ill-structured problems and develop satisfactory solutions?

In agricultural education, does the use of authentic learning and assessments at the preservice phase translate to better performance in the classroom?

Can, as the authors suggest, the use of ill-structured problems be utilized in secondary agricultural education? If so, it seems that preservice teachers would need to be trained in using this teaching methodology for it to be successful.