INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.
TEACHERS' THINKING ABOUT THE USE OF GLOBAL ENVIRONMENTAL ISSUES IN SECONDARY SCIENCE CLASSES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Carol E. Landis, B.S., M.A.

* * * * *

The Ohio State University

1995

Dissertation Committee:

David L. Haury
Ellen Mosley-Thompson
R. Paul Vellom

Approved by:

Adviser
College of Education
ACKNOWLEDGMENTS

I truly appreciate the assistance of my adviser, Dr. David L. Haury, who provided me with an enriched environment in which to "go and grow" and whose insightfulness and willingness to "think with me" have been most helpful. I would also like to thank Dr. Ellen Mosley-Thompson and Dr. R. Paul Vellom for their advice, professional support, and precious time. Particular thanks are owed to the teachers who unselfishly shared their thoughts and concerns and who persisted with me throughout the study. Special thanks go to Dr. Garry D. McKenzie, who assisted my research in many ways.

I would also like to thank my friends, Dr. Carmen E. Trisler and Leslie S. Jones, for their support and constructive criticism in their helpful reviews of the draft documents. Thanks also, to my friends and fellow graduate students, Tony Murphy, Tung-Guang Hsueh, Teresa Schretter, Dr. Richard Jurin, Carmen, and Sandy, whose tacit knowing and presence have provided comraderie and much laughter over the years. Special thanks go to Niqui, Eric, and the others who have helped me with all the details.

My enduring gratitude and love go to my husband, Dave, who has unselfishly maintained both house and home. His unwaivering support, unending patience, and deep friendship are lessons in life. To our children, Kyle, Andra, and Marina, thanks for understanding my mental and physical absences. I am especially grateful to my parents for encouraging me to pursue my education even when it was inconvenient, and for teaching me to value it above other things. Special thanks and love go to Dick and Dottie, who are kind, loving, and selfless people.
VITA

May 2, 1952
Born--Shell Lake, WI

1974
B.S., University of WI-Superior
Superior, WI

1975-1992
Science teacher, Jackson Local
Schools, Massillon, OH

1982
M.A., Kent State University,
Kent, OH

1989-1990
Content Specialist, Discover World,
McKinley Museum, Canton, OH

1992-1995
Graduate Research Associate,
The Ohio State University

PUBLICATIONS


FIELDS OF STUDY

Major Fields: Education  
Science Education  
Global Systems Science
TABLE OF CONTENTS

ACKNOWLEDGMENTS ................................................................. ii
VITA ............................................................................................ iii
LIST OF TABLES ........................................................................ vii
LIST OF FIGURES ....................................................................... viii

CHAPTER

I. INTRODUCTION ........................................................................... 1
   Introduction ................................................................................ 1
   Problem Statement/Conceptualization .................................... 3
   Background ................................................................................ 9
   Research Questions .................................................................. 15
   Pertinent Definitions ............................................................. 15

II. REVIEW OF LITERATURE ....................................................... 17
   Terminology ............................................................................ 17
   Conclusion ............................................................................... 30
   Justification ............................................................................ 33

III. METHODOLOGY ...................................................................... 34
   Overview of the Chapter ....................................................... 34
   Context ................................................................................... 36
   Preparation and the Sample ................................................. 39
   Information Gathering ........................................................ 40
   Data Analysis .......................................................................... 61
   Trustworthiness ................................................................... 64
   Researcher Subjectivity ....................................................... 66
IV. DATA AND INTERPRETATION ................................................................. 70

Presentation of the Data ............................................................... 70
The Teachers ................................................................................. 73
Research Question 1--Concerns ................................................ 76
Research Question 2--Anxiety ................................................... 95
Research Question 3--Insights .................................................. 107
Research Question 4--Skill-Builders ....................................... 113
Research Question 5--Science Literacy ................................. 114

V. DISCUSSION ...................................................................................... 116

Controversial Issues ................................................................. 116
Limitations ................................................................................... 117
Review of the Findings ............................................................. 119
The Model ..................................................................................... 122
Summary ........................................................................................ 128
Implications ..................................................................................... 131

APPENDICES

A. Protocol to Obtain Consent and Consent Form ......................... 136
B. Characterizations of the Panel of Experts and Peer-Reviewers... 139
C. Forms Used to Gather Information About the Teachers .......... 141
D. Interview Schedules ................................................................. 147
E. Code Notes and Code Book Used with Delphi ......................... 150
F. Scripts Used to Introduce ST STPI Administrations ................. 154
G. Open-Ended Survey Used with the Delphi Technique ............ 157
H. Delphi-Round 4 ........................................................................... 159
I. Group Data for ST STPI ............................................................. 161
J. Individual Data for ST STPI ........................................................ 164

LIST OF REFERENCES ............................................................................. 166
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Description</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CBAM Correlations</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Weekly Record of Teachers' Input</td>
<td>41</td>
</tr>
<tr>
<td>3</td>
<td>Summary of the ST STPI Administrations</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>Teacher Characteristics</td>
<td>74</td>
</tr>
<tr>
<td>5</td>
<td>Categorization of Delphi-Round 2</td>
<td>79</td>
</tr>
<tr>
<td>6</td>
<td>Categorization of Delphi-Round 3</td>
<td>84</td>
</tr>
<tr>
<td>7</td>
<td>Comparison of Top Three Concerns from Delphi-Round 2 and Delphi-Round 3</td>
<td>86</td>
</tr>
<tr>
<td>8</td>
<td>Group Means and Standard Deviations for Trait Anxiety Scores</td>
<td>162</td>
</tr>
<tr>
<td>9</td>
<td>Group Means and Standard Deviations for State Anxiety Scores</td>
<td>163</td>
</tr>
<tr>
<td>10</td>
<td>Individual ST STPI Data with Ranges and Means</td>
<td>165</td>
</tr>
<tr>
<td>FIGURE</td>
<td>PAGE</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Graphic Model of Teacher Thinking Related to Issues-Based Instruction</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>Frequency of Responses in the Top Three Concerns from D2 and D3</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>Distribution of Individual S-Anxiety and T-Anxiety Mean Scores</td>
<td>99</td>
</tr>
<tr>
<td>4</td>
<td>Group Means for S-Anxiety and T-Anxiety per ST STPI Administration</td>
<td>101</td>
</tr>
<tr>
<td>5</td>
<td>Revised Model of Teacher Thinking Related to Issues-Based Instruction</td>
<td>125</td>
</tr>
</tbody>
</table>
CHAPTER I
INTRODUCTION

Science education should provide future generations not only with a general understanding of science as such, but most of all, with the capacity to appreciate those aspects of science which affect the future of man [sic]—the impact of science on public affairs, on the fate of our own nation and of mankind [sic] as a whole. This means that science should be taught not as a separate body of technical facts, or an autonomous system of ideas, but in relation to other disciplines that traditionally mould the attitude of growing generations toward the society and the world they will live in; history, political science, sociology . . .

Eugene Rabinowitch, 1958

(Agin & Pella, 1972, 321)

Introduction

Ongoing discussion of the need for science literacy and the ways in which it can be fostered (AAAS, 1993; NAS, 1994) focus attention on the training and practices of science teachers in the United States. Incongruence between the typical high school curriculum and the expressed goal of achieving science literacy has been documented since the late 1970s through a series of research efforts, most notably Project Synthesis (Harms & Yager, 1981). The standard curriculum at the secondary level is discipline-based, hierarchical, and often presented in preparation for the next level of education. Within what is often referred to as a “layer cake” approach to curriculum development, the extent of integration of the subject matter and the relevance of course work to the 1990s and beyond are often left to the discretion of the individual classroom teacher. Committed, energetic, and innovative science teachers
enrich their adopted curricula by including local situations and current issues in their instruction.

Issues-based instruction in science can provide one means of achieving several goals of current science education reform efforts. It can be used to integrate the subject matter of the biological, physical, and social environment within which society operates, and it can provide a systems perspective and contextual base that reflects the social construction of knowledge. It can also contribute to active citizenship by enabling students to critically examine controversial issues and work collaboratively in their investigations. An issues-based approach can be applied toward the resolution of local problems, thereby modeling the societal mechanisms through which changes in practice occur and documenting the interaction of scientific investigation with the students' lives.

Teacher thinking regarding the use of issues as organizers for secondary-level science instruction is pertinent to current discussions of reform in science education. Little research has been published in the area of secondary teachers' thinking and even less exists regarding science teachers' ideas. Given the national attention to science education reform, formal analysis of teacher thinking can provide insights into the implementation of intended curriculum revisions at the practitioner level. Examinations of teachers' thinking as they consider issues-based instruction for their classroom and setting was the focus of this study. Particular attention was given to degrees of concern that affect decision-making of teachers as they overtly consider the impact and ramifications of their professional judgments.

There is a well-documented history of persuasion regarding the use of issues-based instruction involving a Science, Technology, and Society (STS) framework (Aikenhead, 1988; Bybee, 1987; Hofstein & Yager, 1982; Hurd, 1958, 1993, 1994; Yager, 1993). Likewise, there has been opposition to use of STS issues as a focus
of instruction (Good, Herron, Lawson, & Renner, 1985; Kromhout & Good, 1983). Bybee (1987) described the debate and outlined a conceptual scheme that can be used as a heuristic device for conceptualizing issues-related curriculum development. The ultimate decisions regarding the actual, implemented instructional environment, however, rest with teachers, who select or write the resource materials to be used, allot the time, guide and manage the discussions, and structure and administer assessments. This study focuses on teachers' thinking relative to their curriculum.

**Problem Statement/Conceptualization**

Teachers are not autonomous in their professional decision making. Their work may be influenced by the beliefs and actions of all the stakeholders in the education of youth in the United States today: the students, the students' parents, the teacher's own and other teachers' goals, building and district administrators, county and state level authorities and legislators, the interests of business and industry, as well as national and international standards and goals (Ladwig & King, 1991; Onosko, 1991). In the complex and dynamic environment of the classroom, teachers must remain ever cognizant of the multiple goals and interests of all stakeholders as they plan and provide educational opportunities.

Recently, reform efforts in science education have emphasized the importance of a scientifically-literate citizenry (Hurd, 1993; Miller, 1987; Rutherford & Ahlgren, 1990; Yager, 1993) and have described various means by which educators must strive toward attainment of that goal (Shymansky & Kyle, 1992). Educators in the United States are challenged to assist with the development of citizens who are capable of understanding and making informed choices about the increasingly complex, diverse, technological, and increasingly globally-oriented society in which we live.

Several proposals for the improvement of science education in the United States have been forwarded. For example, some posit that students must consider the impacts
of science and technology within society (Aikenhead, 1988; Rosenthal, 1990; Yager, 1980, 1983, 1993), and others emphasize the necessity of understanding the global impact of human existence (Brown, et al., 1994; Luterbacher, 1992). In 1988, Aikenhead offered a guide with strategies for implementation of the proposed new science curriculum for Saskatchewan, Canada, using Science, Technology, Society, and Environment (STSE) as an educational focus, while environmental educators in the United States continue to look for evidence of environmental education within formal science education (Berberet, 1988; Disinger, 1985b). Others maintain that students must have opportunities to explore the Earth as a system (Fortner & Mayer, 1992). Consideration of the social processes of interaction among humans within biological and physical environments (Consortium for International Earth Science Information Network, 1992) seems to be a logical extension of that position. Likewise, global education has been suggested as a means of establishing connections between global studies and civic awareness and responsibility (Merryfield, 1994; O’Neil, 1989). The examination of controversial issues concerning the global environment provides a basis for accommodating the central features of all of these proposals by facilitating a better understanding of the Earth system within the social process of interaction (Luterbacher, 1992).

Global environmental awareness has been conceptually embraced as an educational goal in the Benchmarks for Science Literacy developed within Project 2061 (AAAS, 1993). Details of this position are provided in Chapter 2 with references to specific Benchmarks components. A panel report, “Social and Behavioral Sciences” (Appley & Maher, 1989), from which Science for All Americans (Rutherford & Ahlgren, 1990) was produced emphasized the importance of increased social responsibility. Social responsibility was an important component of the panel’s
recommendations toward achieving the goal of scientific literacy. One might logically ask where this emphasis can be found in science curricula in our schools today.

Issues-based instruction in science can be used to integrate subject matter relating the biological, physical, and social environments within which society operates. It can help to establish a systems perspective, and it can illustrate the social construction of knowledge and the contributions made by the sciences. A curriculum enriched by issues-based instruction can evolve and can contribute significantly to the development of a scientifically-literate citizenry capable of dealing with the pressures that increasing human population and continued development are believed to exert on the planet (Brown, et al., 1994). When implemented with classroom management techniques that maintain the integrity of human values from diverse viewpoints (Nelson, in Crow, 1989), it can build self-esteem and meaningful interpersonal communication skills that enrich the lives of students and prepare them to contribute toward the resolution of issues within their personal and public endeavors. It also enables teachers to meet the educational objectives of national reform efforts such as the National Science Education Standards (NAS, 1994) and Project 2061 (AAAS, 1993), as well as local and state initiatives and interests. Lastly, social and critical thinking skills that allow students to work constructively toward the resolution of societal issues and concerns, and to relate information and ideas, can be developed through use of issues-based instruction (Nelson, 1989; Risinger, 1992).

Several of the national science education reform efforts stress citizenship and societal awareness as important components of scientific literacy. Similarly, C. Frederick Risinger listed the same components for social studies education in Trends in K-12 Social Studies. He listed “attention to contemporary and controversial issues” and “covering issues in depth” as two of the ten trends derived from contemporary research literature, recently-developed curriculum guides, and blue-ribbon reports.
He cited the avoidance of controversial issues as a “barrier to the development of critical thinking and decision making necessary for effective participation in a democratic society” (1992, p.4). He also stated that covering issues in depth allows students the opportunity to develop “perspective and thoughtful judgment,” which requires time for sufficient exploration of the topic, analysis of a variety of source materials, and discussion of issue-oriented questions with other students and the teacher/s (plural added).

Social studies teachers are encouraged and empowered by virtue of their subject matter¹ to address issues in the classroom (Risinger, 1992). The National Council for the Social Studies (NCSS) presented guidelines for teaching science-related social issues that included a position statement adopted in November, 1982 (Otto, et al., 1983). Presuming that issues are in fact being taught in social studies classes, is it a case of intellectual snobbery to inquire about the substance of the science being investigated in a social-studies approach? While some might argue that issues-based instruction in the social studies will enable students to develop a satisfactory understanding of the issues for citizenship, other implications exist, namely, that the scientific thinking included in science-related social issues is unattainable or is “reified . . . as superior to everyday thinking” (Brickhouse, Stanley, & Whitson, 1993, 363). Even if those implications are not well documented at this time, Appley and Maher reported that pre-college students rarely are involved in the scientific comparative study of “societies, cultures, and social forms and institutions . . . and their influence on behavior” (1989, xi), all of which are interactive components of global environmental issues.

¹Merryfield, M. (1994, August 1). Dr. Merryfield's response to my electronic message regarding social studies teachers' preparation for issues-based lessons, (as opposed to my perception that science teachers are not well-prepared to address issues as the basis of instruction) was: “Very interesting thoughts! I think that social studies teachers think issues come with the territory. We have lots of publications, materials, etc. on issues-centered education and, of course, global ed really focuses on issues.”
Science teachers, unlike social studies teachers, tend to self-impose limitations on their teaching of these matters. It has been my observation that many science teachers are reticent to address issues in the classroom. This may be a reflection of their disciplinary training, or other sources of influence. Fundamental disagreements are inherent to the advancement of scientific knowledge, therefore limiting discussion and exploration of dissimilar views denies the enactment of scientific inquiry in the classroom. Do teachers' perceptions of the importance of maintaining objectivity virtually exclude value-laden social concerns from the purview of science instruction?

The reluctance of some science teachers to address controversial issues in their classrooms may be the result of the perceived influence of the multiple stakeholders in public education today. What might some of these influences be? Do some teachers feel that they are relatively uninformed regarding the specific details or recent developments surrounding a current issue and, therefore, feel unprepared to present this issue to their class? Do they feel anxious about exposing their uninformed perceptions or the possibility of potential criticism from segments of the community in which they teach? Perhaps teachers have been socialized to believe that they should be knowledgeable about content before attempting to instruct others about a topic (Westerback, 1984; Westerback & Long, 1990).

Or, is prioritization of class time and effort a primary consideration that influences teachers' decision making? Some teachers may believe or feel pressure to accept one of their primary goals as that of "covering the content." That is, they believe that the students ought to learn the content of the textbook (Tobin & Ulerick LaMaster, 1992) or that they are expected to survey the breadth of basic knowledge in the discipline at this time (De Boer, 1991). Perhaps in the case where teachers consciously teach for understanding, there is still a limitation inherent in the content
structures that are in place, or the value that is placed on the examination of issues within the discipline.

Are the teachers making an assessment of personal or public risk in their decision to use or avoid issues-based instruction? Judgments of increased personal vulnerability, or jeopardy of loss, might be related to the possibility of making a mistake or seeming ignorant, which could affect their self esteem (Westerback, 1982). What about liability? Do personal liability concerns inhibit issues use in secondary science classrooms? Teachers find themselves in an increasingly litigious environment and may be justified as they exercise caution regarding the use of controversial issues, in view of the actions of vocal and demonstrative special interest groups (Merrow, 1994). As another type of liability, do thoughts about the possibility of jeopardizing a working relationship with peers or supervisors influence teachers’ decision making?

Do teachers experience increased anxiety regarding classroom management and the potential conflict over the issue? According to Pedersen (1992), Dececco and Richards reported the suppression and avoidance of controversies in 1974, acknowledging concerns about student responses and interaction in response to controversy, including the divisive nature of issues use and its potential for generation of dislike and resentment among students.

In addition to the possibilities suggested above, there may be other factors that influence teachers’ decision making about the use or nonuse of issues-based instruction that have not been verbalized or recognized without sincere reflection on practice. Other questions also arise when considering issues-based science instruction. For example: Does the absence of discussion of societal issues carry implications toward the authority afforded to scientific research and advancement (Gaskell, 1992; Hurd, 1994)? This evokes the notion of the “null curriculum” and
suggests the unintended effects of what is not taught (Eisner, 1979). Are there related implications then about student participation or inclusion in the scientific endeavor (Brickhouse, et al., 1993)? Are questions and challenges to ideas fundamental components of scientific inquiry, and as such, should they be included as important components within science education (Silverman, 1992)? Can preservice training and experiences assist teachers with teaching thinking skills (Kurfiss, 1985; and Nelson, 1989) and modeling new emphases and orientations (Zoller, 1991)?

While these questions warrant further investigation, it seems reasonable to begin by inquiring about teachers' thinking when they elect to use global environmental issues-based science instruction. Are science teachers being influenced by external forces, by past experiences, by peer pressure, by an older paradigm of the role of scientists, or by some combination of these and other factors? Or, have science teachers already acknowledged a role in the preparation of students for active and informed citizenship; and in doing so, have they begun to use issues-based instruction to accommodate the goals of Project 2061 in their classrooms?

Background

Global environmental change issues are of particular interest to me. Many scientists believe that increasing human population (coupled with the continued use of unsustainable practices) is propelling humanity toward or beyond the carrying capacity of the Earth, so they have signed the "Scientists' Warning to Humanity" imploring caution as we proceed toward the 21st century (Brown, et al., 1994). It seems possible, then, that the global community will, of necessity, increasingly be required to "think globally, and act locally" in the next decade and century. In any case, a more global understanding of the potential for human occupation of the planet will be required. As has been the case throughout recent history, the United States must be prepared to cooperate and to provide capital resources (both physical and
human) to enable this evolution of thought and adaptation to change. This statement urges both cooperation and leadership.

The stance taken here is notably different from the competitive one posed in the National Science Teachers Association Lead Paper on Science and Technology Education for the 21st Century, where statements such as: “Our nation must have enough qualified scientists, engineers, teachers, and related professionals to compete successfully worldwide in science and technology” (1990, 1) clearly maintain the dominant theory of U.S. hegemony. Following that statement, a position is taken on science literacy in general: “Our nation must have a citizenry that is prepared to understand and deal rationally with the issues and opportunities of a scientific and technological world.” That statement still implies an imperative that is national in scope, as opposed to a global conceptualization that is more aligned with the Earth systems approach being adopted in our national research initiatives (NOAA, 1990). In the global society of the 21st century, citizens will be asked to contribute knowledge and expertise along with human and physical resources toward global sustainable development, agreed upon at both the recent United Nations Conference on the Environment and Development, commonly known as the “Earth Summit” that was held in Rio De Janeiro (UNESCO, 1994) and the United Nations International Conference on Population and Development held in Cairo, in September, 1994 (EarthAction, 1994).

Science education must help to prepare students for these expected and other unforeseen changes (Hurd, 1994) by enabling them to critically examine the issues and by modeling and providing guided practice in collaborative effort toward their resolution. Global environmental issues-based secondary science instruction can be used to enhance science literacy and to promote the effective and informed participation of citizens within our society. Several federally- and privately-funded curriculum developers utilize these principles in the organization of their materials
and procedures. As examples, the GLOBE program (Educational Horizons, 1994); National Geographic Kids' Network (Julyan, 1989); TERC Global Laboratory (Ruopp, 1993); STS (Rosenthal, 1990); and Project GREEN (Lewis, 1992) strongly encourage student investigation of local and regional issues and collaborative effort in promoting environmental awareness.

It is my intention to be persuasive as a science teacher-educator, to encourage the incorporation of global environmental and sustainability issues into the development and implementation of secondary science curricula. In order to do this, teachers must be convinced of the appropriateness of their inclusion. They must agree that they are in concert with both current science education reform efforts and our understanding of cognitive and intellectual development.

Issues-based instruction can provide a framework within which specific methods are employed to improve the quality of instruction, the relevance of the lessons, and the voluntary participation and productivity of the students in science classes at the secondary level. Specific pedagogical methods can be used to enhance both the scientific understanding (Anderson & Roth, 1989) and the interpersonal, problem-solving, and communication skills (Narode, Heiman, Lochhead, & Slomianko, 1987; Pedersen, 1992) that are required of citizens, all of which contribute to science literacy. While assessments toward these ends are not the focus of this preliminary investigation, it would seem that issues-based instruction can serve as one means by which the goal of a scientifically-literate citizenry might be more readily achieved. Furthermore, issues-based instruction may promote environmentally-responsible behavior through the development of critical thinking skills and through active engagement of the learner in practical reasoning (Brickhouse, et al., 1993). If understanding global environmental issues is valued as a component of science literacy, then it is important to identify and describe factors that impact the decision making of teachers while
implementing a curriculum that includes issues. Likewise, the science education community can provide awareness of, and experiences in, issues-based curriculum development and implementation both for preservice and inservice science teachers.

Researchers have concluded that students tend to be apolitical (Miller, 1983; Risinger, 1992) and my own observations over seventeen years as a high school science teacher have led me to conclude that students tend to be generally apathetic toward their education. My students tended to be disinterested in guarding the quality of their education, and passively followed the path of least resistance, accepting a socially prescribed curriculum that was encumbered by logistics and expediency as an immutable reality that would adequately accommodate their future needs. One way in which this student apathy manifests itself is illustrated by decreasing enrollment in science courses (when offered as electives) as students move through the upper grades. "Why should I take more than one year of science if it's all that's required to graduate and go to college?" they would ask. Their notion of gain was a credential, not improved understanding.

Dwindling enrollment in the upper level science courses has been described as a "leak in the pipeline" (Oakes, 1990), when referring to women, minorities and other under-represented populations such as disabled persons. If science educators are genuinely interested in science for all (Rutherford & Ahlgren, 1990), then we must learn to accommodate and encourage participation of all students throughout their tenure in the upper grades. This will require a conscientious effort to develop a "curriculum that can be lived and which has cultural as well as scientific validity" (Hurd, 1994, 111). Global environmental awareness fostered through an issues-based science curriculum may be one means of reducing student apathy and encouraging democratic participation.
It has been my observation that most teachers are interested in both their students' acquisition of knowledge and their continued social development and acceptance of responsibility. Some teachers are more successful than others at implementing their perceived multiple roles as an educator (Tobin & Ulerick LaMaster, 1992). Some roles that teachers describe for themselves include being a facilitator, a manager, and an assessor. The enactment of these roles may be influenced by a wide variety of factors, as described above. The prioritization of teachers' effort is based upon teachers' personal practical theories of teaching (Ross, Cornett, & McCutcheon, 1992) including their implicit theories about students and learning. The relationship between teachers' personal theories and beliefs and their effects on praxis regarding choices about curriculum development and implementation is not clearly understood.

The authors of the third chapter of the *Handbook of Research on Teaching* identified a need for further investigation of teacher thinking at the secondary level. "Most of the research on teachers' thought processes has been done with teachers of elementary school, and there is a conspicuous absence of attention to the thought processes of secondary school teachers" (Clark & Peterson, 1986, 292). This statement can be emphatically reiterated regarding secondary science teachers! Is the curriculum so prescribed that there is little consideration given to additional topics that might be selected for inclusion in the scope and sequence of a district's curriculum? Or, is there sufficient latitude in the district's definition of "professional judgment" that there are few concerns regarding issues implementation at the secondary level, if an individual teacher chooses to do so? What considerations are acknowledged by reflective practitioners in science education as they reveal their thoughts in the selection, adoption, and implementation of issues-based instruction at the secondary level?
A tremendous amount of wisdom exists in the collective experience of the countless teachers whose voices have not been heard. What can be learned from those who have not been asked to participate in formal research or whose expression was limited by the systematic and controlled studies where methodology prohibited the open-ended inquiry and reflection on practice that would have elicited intuitive, tacit knowing and insightful observations? The art and essence of teaching science are not easily captured, regardless of how the questions are framed. Gardner (1991) and others believe that the “best science teaching stresses thoughtfulness” (Brandwein & Glass, 1991, 36). This study encourages and examines this thoughtfulness on the part of secondary science teachers as they contemplate and implement global environmental issues-based instruction. It will be necessary to structure and monitor the study carefully to maintain “empathic neutrality” (Patton, 1992, 41) as data collection and analysis occur. This challenge is especially intriguing to me as a researcher.

The purposes of this research are to: a) describe elements in their decision making regarding the use of issues-based science instruction (delimited to global environmental issues), and b) describe secondary science teachers’ levels of anxiety toward teaching science-related social issues. Teachers who already incorporate issues-based instruction in their secondary science classes are of particular interest.
Research Questions

Research questions that were investigated are as follows:

1) What considerations, if any, are part of teacher thinking regarding their use or avoidance of global environmental issues as organizers for instruction?

2) What levels of anxiety are expressed by secondary science teachers as they consider the use of specific topics for issues-based instruction?

3) What insights can teachers who use issues-based instruction provide to others that might foster the use of this approach?

4) What effects do these teachers suggest that the use of issues-based instruction has on student communication, interpersonal, and critical-thinking skills?

5) To what extent do teachers suggest that science literacy is fostered through the examination and use of global environmental issues as the basis for secondary-level science instruction?

Pertinent Definitions

For the purposes of this study, the following definitions will be used:

Academic freedom: from Black’s Law Dictionary, “Right to teach as one sees fit, but not necessarily the right to teach evil. The term encompasses much more than teaching-related speech rights of teachers” (Nolan & Nolan-Haley, 1991, 6).

Curriculum: “What students have the opportunity to learn in schools” (Cornett, 1987, 8)

Global environmental issues: Those topics over which disagreement between and among scientists and policymakers exists about the condition, maintenance, or use of the physical and biological components of the Earth’s systems on a global scale, such as air, water, land, space, organisms, and ecosystems. For this study, issues will be delimited to those that were discussed at the United Nations Conference on Economic Development (UNCED—the “Rio Summit”) toward which recommendations were made in Agenda 21 (UNESCO, 1994), and those that were on the agenda of the United Nations International Conference on Population and Development, held in Cairo, in September, 1994 (EarthAction, 1994). (See Appendix C, p. 145.)

Instruction: “The process of arranging human, material, and temporal resources with the intention of facilitating...the learning of others” (Hough & Duncan, 1980, in Cornett, 1987, 8).
Issues-based instruction: Structuring a learning environment or event that is designed to incorporate the global environmental issues defined above as the basis (or core) of the lesson or event. Lessons with superficial mention or reference to global environmental issues do not qualify as issues-based instruction for the purposes of this study.

Professional judgment: The judgment of one who acts within the bounds of their profession, defined as that "which can be practiced only by those who have satisfied an examining body that they have followed an approved course of training and reached a satisfactory level of competence" (Hudson, 1983, in Barrow & Milburn, 1990, 250).

Secondary-level science classes: Any class offered for science credit for grades seven through twelve
CHAPTER II
REVIEW OF LITERATURE

Terminology

Several search terms in the ERIC database have been productive of literature related to the proposed study. Among them are: scientific literacy, science-related social issues (SRSI), controversial issues, scientific controversy, issues approach, and science and society (U.S. Department of Education—USDE, 1993). These and other search terms are used as an organizer in this chapter to present recent research, followed by a summary statement describing the need for further research.

Scientific literacy:

Scientific literacy, a primary element in the proposed study, is described in the scope notes of the Thesaurus of ERIC Descriptors as “comprehension of scientific concepts, processes, values, and ethics, and their relation to technology and society” (USDE, 378). Among the pre-eminent source materials in science education literature on issues of scientific literacy would be the historic analysis of the concept of science literacy (Pella, O’Hearn, & Gale, 1966) and the more recent documents produced in conjunction with Project 2061 of the American Association for the Advancement of Science (AAAS).

Pella et al. reported findings based upon interviews with scientists, educators, members of the military, and others regarding their perceptions of the need for knowledge “in and of science” by the citizenry. The term science literacy was introduced in science education literature as early as 1952, and has revisited the
literature almost continuously since then, primarily as a debate founded upon the
general goals of science education. The debate has continued to occupy the thoughts of
science educators since that time, as capsulized in Bybee's discussion (1987), where
he asserted that two primary positions exist for the location of science-technology-
society (STS) subjects within the discipline. Either these topics are considered to be
acceptable as the focus of, or organizers for, the curriculum (Hofstein & Yager,
1982) or they provide a motivation for the "coherent study of fundamental science"
which he interprets to mean "educating students about the structure and methods of
science" (Bybee, 1987, 670). The debate about the inclusion of the science,
technology, and society theme has been resolved to some extent through the thematic
inclusion of these principles in the preparation and development of the materials that
support and guide Project 2061.

Throughout its development, the evolution of Project 2061 has included the
contributions of panels of scientists, educators, mathematicians, and engineers,
particularly in the description of adult literacy goals in Science for All Americans
(SFAA) (Rutherford & Ahlgren, 1989). Subsequently, Project 2061's Benchmarks
for Science Literacy (1993) has been released as a guide to curriculum development
for grades K-12. Continued development of project initiatives include the production
of Designs for Science Literacy, in which the curricular blocks that can be used to
assemble a curriculum will be described and a range of alternatives will be offered as
illustrations (AAAS, 1993). Following that, Blueprints for Reform will address the
changes that will be required throughout the educational system to accommodate
holistic restructuring and reform that would complement the curricular reform that
is underway (AAAS, 1993). Project 2061 goals are in close agreement with the
National Standards 1994 Draft document; both emphasize science literacy as a
primary goal of science education as we approach the 21st century.
As has been described, collaborative effort and substantial research were utilized in the production of the Project 2061 publications. Therefore, multilateral support of the components are recognized in their production, from the panel reports through SFAA and the subsequent Benchmarks. Specifically, Benchmarks includes brief summaries of quality research reports that are relevant to the topics listed for consideration. In light of these facts, separate citations are not recorded here. Instead, specific components that lend credence to the emphasis of this study are listed below and referenced to AAAS.

The description of science literacy offered in Chapter 14 “Issues and Language” of Benchmarks states that:

> scientifically-literate people are able, however, to use the habits of mind and knowledge of science, mathematics, and technology they have acquired to think about and make sense of many of the ideas, claims, and events that they encounter in everyday life. Accordingly, science literacy enhances the ability of a person to observe events perceptively, reflect on them thoughtfully, and comprehend explanations offered for them. In addition, those internal perceptions and reflections can provide the person with a basis for making decisions and taking action.” [emphasis added, p. 322].

The chapter concludes with a statement of the underlying premise of the importance of Project 2061— that quality of life in the future will depend upon the education that this and succeeding generations of children will receive, enabling them to “participate intellectually and emotionally in science . . . and to become responsible and productive members of society. Education must prepare them for an uncertain future and it must include understanding and habits of mind that can serve as tools for thinking throughout life” (AAAS, 1993, 325).

These statements point to a need for a societal understanding that goes beyond the technological emphasis that is commonplace within the STS framework, but they don’t explicitly state the need for a global environmental aspect of citizenship, which is of
importance to me, personally. It is implicit within the “quality of life” and “uncertain future” statements, however. Therefore, support for issues-based instruction, and in particular, the use of global environmental issues, is deduced from the titles of the chapters, namely: The Human Organism; Human Society; The Designed World; The Living Environment; The Physical Setting; Historical Perspectives; and the sections of Common Themes, which include systems, models, constancy and change, and scale. Each of these topics encompasses ideas that are central to issues facing humanity as the 21st century arrives. Human population and health issues, societal concerns regarding development and technology and their existing inequities, cultural effects on behavior, political and economic systems, social conflict, global interdependence, energy use, agriculture, materials and manufacturing, biodiversity, and reasoning are included as components of Benchmarks for Science Literacy. As such they are described as the “common core of learning that contributes to the science literacy of all students” (p. XIII). Each of these issues then, provides an opportunity to address science literacy in the science curriculum, with suggestions for appropriate levels of understanding at each grade level category (K-2, 3-5, 6-8, and 9-12) used throughout the document.

Science and society/STS:

The inclusion of issues has been examined within science education research literature using the related search terms science-related social issues (SRSI), controversial issues, scientific controversy, issues approach, and science and society (which is a broader term than science, technology and society, or STS) (USDE, 1993, 378). Many articles were identified using the search term science and society, which includes the STS theme.

Research related to STS curricula tends to focus on the nature of the issues included in science curricula and the rationale for their inclusion, both of which are
very well established (Aikenhead & Ryan, 1992; Bybee, 1987; Bybee & Bonnstetter, 1987; Chiang-Soong & Yager, 1993; Hamm, 1991; Hamm & Adams, 1989; Yager, 1990, 1993). Likewise, pedagogical methods employed in the utilization of STS issues have been explored (Bonnstetter & Pedersen, 1993; Disinger, 1985a; Geddis, 1991; Kellerman, 1993; Pedersen, 1992; Ramsey, Hungerford & Volk, 1990). Surveys have begun to establish perceptions of the importance of SRSI issues (which specifically include STS issues), both among science teachers (Bybee & Bonnstetter, 1986; Simpson, McLaughlin, Volk, & Hungerford, 1989) and among college students (Bybee & Nejafi, 1986), internationally among science educators (Bybee & Mau, 1986), and among scientists and engineers (Bybee, 1984).

However, only one reference could be found that examined teacher concerns in the utilization of controversial or STS issues. Vey (1992) explored participating teachers' perceptions and concerns regarding the implementation of a proposed STS course for secondary schools in Newfoundland and Labrador. The teachers' concerns were described as being related to the nature of the proposed course, resource materials associated with it, teacher inservice, and evaluation strategies that would be employed. Vey's thesis considered a course adoption, a macro-level adaptation of curriculum, and not the individual action of the classroom practitioner that results from professional judgment which is of interest to this researcher.

Attitudes/Values:

Also of interest, and remaining unanswered, are the questions posed by Disinger (1985b) inquiring where the "E" (environmental issues) could be found in STS. Primary objections to the presence of environmental issues in the science curriculum often relate to concerns about indoctrination versus education, especially when such education is expected to affect the attitudinal positions of students resulting in changes in behavior or responsible actions based on decisions (Zoller, Donn, Wild, & Beckett,
Others have advocated the inclusion of practical reasoning "based on values about what ought to be done in specific situations" as being relevant, not only to STS issues but also to fundamental scientific problems (Brickhouse, et al., 1993, 365).

Herein arise the values questions that have been the source of much controversy in science education. While the values clarification efforts of the 1970s and early 1980s (Morrill, 1980) and moral education ideals (Zeidler, 1984) have been somewhat subdued for a period of time, the paradigm shift that has evolved regarding the kinds of questions that can be legitimately raised in science and, therefore, in science education, has prompted a renewed analysis of claims of objectivity and "value-free" science (Longino, 1990). Cordero (1992) and others (Allchin, 1991; Caduto, 1983; Koballa, 1992; Kormondy, 1990; Laudan, 1984; Stevenson, 1993; Zeidler, 1990) have examined the philosophical questions inherent in the fact/value dichotomy and the role that values should play in science education. The concept of values is introduced at this point only to postulate that it represents a plausible reason for reluctance on the part of science teachers to broach value-laden subjects that carry ethical and social responsibility implications in their classrooms. Can the consideration of values and the possibility of imposing them result in anxiety for teachers and partially explain a reluctance to teach about certain issues?

Anxiety:

If anxiety is included among teachers' conscious considerations about issues-based instruction, then what other factors might play a role in increasing or decreasing that anxiety? If the use of controversial issues does indeed change classroom dynamics, to what extent does this alter a teacher's disposition to include them? Anxiety measures have been frequently applied to science anxiety, particularly toward student perceptions which are not part of this study; to that of preservice
elementary teachers (Westerback, 1984); and to science teaching; in relation to
preservice and inservice elementary teachers (Westerback, 1982; Westerback &

A summary of science teaching anxiety research using the State-Trait Anxiety
Inventory (STAI) was outlined in Spielberger and Butcher (1988). The STAI is a 40-
item, self-report, Likert-type instrument. State-anxiety measures (as determined
from the first 20 items) are used to describe anxiety that is subject to conditions and
contextual situations. This type of anxiety varies over time and can be influenced by
training. Trait-anxiety, the fairly consistent personal characteristic of the individual
regarding anxiety proneness, is measured by the second 20 items (Westerback & Long,
1990). This instrument was modified and tested for validity and reliability for
assessing science teaching anxiety and when used with modified headings for this
purpose was renamed the “Science Teaching State-Trait Anxiety Inventory” or,
Science Teaching STAI (Westerback & Primavera, 1988). No reports of the use of
this instrument in measuring anxiety toward issues use and science teaching were
found.

Subsequent development and use of the State-Trait Personality Inventory (STPI)
(Spielberger, et al., no date) allowed consideration of other factors that may affect
found significant relationships between problem-solving appraisal and state-trait
factors of anxiety, anger, and curiosity. Likewise, Coorough (1991) reported
significant reductions of state anxiety across randomized treatments in a study of
computer-assisted instruction investigating locus of instructional control strategies.
Locus of control elements may be related to this investigation, and may be related to
state anxiety in the teaching of social issues in science class. In another study using
the STPI, perceived social support was reported relative to state anxiety and anger
among urban adolescent girls (Procidano, Guinta, & Buglione, 1988). Since perceived social support may influence teacher thinking, state anxiety measurements may illuminate the decision making of science teachers relative to issues use in their classrooms.

The STPI was recommended for use in the present study by the developer and by an acknowledged expert in the use of the instrument (personal communication, October 24, 1994). Teacher anxiety toward teaching science subjects, or toward specific topics in science courses, has been measured with this instrument.

Two recent dissertations focus on anxiety about teaching science. Loftin's dissertation research (1993) examined whether there were predictive effects of anxiety toward teaching and attitude toward teaching on the academic achievement and specific socio-demographic variables of the preservice secondary teachers in his study. The results indicate that anxiety and attitude toward science teaching were not predictors of academic achievement, while age and type of degree pursued were reliable predictors. Wicker (1993) demonstrated that predictor variables of age, GPA, science content knowledge, and ACT scores exerted a significant effect on locus of control and also on state anxiety regarding science teaching. Wicker's results lend credence to the argument that science teachers' state anxiety regarding science teaching is affected by science content knowledge. Is this true of their knowledge of science-related social issues, as well?

Teacher personal theorizing:

Another area of educational research that is directly applicable to this study is that of teacher personal theorizing as applied to teaching and curricula. Ross, et al., (1992) provided an overview and theoretical grounding of an aspect of educational research that has evolved in the past decade which examines the relationship between teacher cognition and teacher behavior. As was described earlier, this relationship is
not clearly defined. It is clearly affected by the values, beliefs, attitudes, knowledge, and skills of the teachers. The reasoning involved in teachers’ curricular choices and implementation warrants further investigation and is the basis for this study.

Merryfield documented teacher acknowledgment that “students often dramatically influenced what was taught and learned” (1994, 234). Although she investigated the teaching of global content and multiculturalism among social studies teachers, the profiles of personal theories of teaching that evolved from the study revealed contextual factors such as teacher beliefs and experiences, mandated curricula, the impact of administrators, and instructional materials, all of which contoured the landscape of the conceptual problem space for the teachers (Shulman, 1980) regarding implementation.

In previous research, Merryfield had identified three categories of teachers’ reasons for introducing the Gulf War, a current event and social issue, into their social studies classrooms. The first was “concern over students’ understanding of today’s world in relation to the content of world history and geography courses” and the second, “perceived opportunities to take advantage of student interests, concerns, and questions.” The third reason was attributed to “the belief that current events are important topics for study” (1991, 38).

Again, no study was found that investigated secondary science teachers’ personal practical theorizing, or elements and factors that influence selection and implementation of issues-based instruction, yet some of the factors described above were expected to be cited by science teachers when asked to explain their thinking about curricular implementation.

Teacher decision making:

Duschl and Wright (1989) examined teacher decision making models for planning and teaching science, reporting several discrepancies between the models that
Shavelson and Stern reported in 1981 and those exposed through their own ethnographic study. They described teacher decisions as being based on pedagogical considerations related to student development, curriculum guide objectives, and "appeasement of pressures of accountability" (Duschl & Wright, 1989, 496) and suggested that institutional constraints affect teachers' decision making, in consideration of both the nature of the learning environment and the nature of the subject matter. Their research was described primarily as being relative to the nature and role of scientific theories in teacher decision making. The research questions posed in this study enabled the investigation of similar topics in an open-ended frame, exposing multiple factors and elements that influence teachers' thinking as they consider issues-based instruction.

Teacher concerns:

In a study that longitudinally examined the evolution of preservice teachers through their micro-teaching and student-teaching experiences, Lederman and Gess-Newsome (1991) categorized participant concerns as being related to self or students. Eleven of the 17 concerns were "concerns for students" and included such descriptors as: "student involvement, instructional sequencing, concrete and relevant instruction, management, motivation, depth and breadth of the material, and time requirements for learning" (1991, 448). The remaining 6 concerns for self that may be relevant to this study included: "expression and confidence," and "work load" (ibid., 447-448). These concerns for self are among the factors that are delineated in the model for teacher thinking that is proposed in this study. The dominance of concern for students seems noteworthy.

Using a case study format, Rossi (1993) examined the practice of in-depth study in secondary social studies classrooms. He concluded that the changed roles for both the teacher and the students raise challenges that require re-examination of both
their practices and responsibilities. In-depth study could be used in the examination and treatment of global environmental issues and represents another pedagogical approach for science teachers to consider.

Engel (1993) surveyed social studies and English teachers' attitudes toward the use of controversial issues in another midwestern state. His analysis showed that 75% of the respondents reported using up to 25% of class time for the examination and treatment of controversial issues. He found that sanction reasons such as parental criticism, administrative disapproval, and community pressure groups were cited to explain the absence of certain issues in the respondents' classrooms. Low percentages of the participants in that study knew whether or not their district had a controversial issues policy; and religion, school policy, and abuse were among the issues that teachers would not discuss with students.

Concerns-Based Adoption Model (CBAM):

It has been generally shown that professional and personal considerations are interwoven in teacher decision making, and comprise the two major sources of illumination on the implementation of issues-based instruction in science classes in the model proposed here. Therefore, secondary science teachers' personal and professional concerns regarding the use of issues-based instruction might be expected to cluster as described in the Concerns-Based Adoption Model, or CBAM. This model is based on six assumptions about change in educational systems in which change is described as a process accomplished by individuals, and as a highly personal experience that involves developmental growth. The assumptions also include the ideas that change is best understood in operational terms, and is facilitated by ultimately focusing on three components: 1) individuals, 2) the innovation under consideration (in this case, teaching about issues), and 3) the context in which the innovation occurs (Hall, Wallace, & Dossett, 1973).
CBAM is not appropriate for this study, except as a referent, because no policy or innovation is being unilaterally applied. It serves only as a comparison for stages of concern that may be identified from the data as the participating teachers reflect upon their practice and decision making regarding issues-based instruction in secondary science classes.

There are three diagnostic dimensions in CBAM that are characterized as: Stages of Concern (SoC), Levels of Use (LoU), and Innovation Configurations (IC). The Stages of Concern describe the nature of the concerns as individuals accommodate an innovation. For example, initially the teachers may be unaware of the innovation or its potential and would be categorized at SoC 0—Awareness. All of the stages of concern are analyzed progressively throughout the period of implementation of the innovation. As the individuals become more familiar with the innovation, they often seek information about it, represented as SoC 1—Informational. The dominance of the individual's concern at any stage progresses through shifting patterns of relative importance. Dominant areas of concern may vary between the stages of personal concerns, and concerns about management of the innovation, consequences of its implementation, collaboration with others in its use, and eventually in refocusing their efforts after acceptance and implementation of the innovation. Patterns that describe a particular individual's profile can be developed and are useful in prescribing interventions that may foster the use of the innovation.

Data gathered in this study were expected to relate to the stages of concern and levels of use as postulated in CBAM and displayed in the table on the next page. As was mentioned above, the initial awareness of the individual with the innovation under consideration places that individual at Stage 0, the Awareness stage, which would indicate that the individual is a non-user. As the individual seeks more information about the innovation, their stage of concern has shifted to Stage 1, the Informational
stage, and the individual might be described as gaining an orientation to the use of the innovation. So, their LoU would be "Orientation." By the time the individual is concerned with management strategies, she or he is at a level of use that could range from mechanical use to routine use.
Table 1

CBAM correlations

<table>
<thead>
<tr>
<th>Stages of Concern (SoC)</th>
<th>to</th>
<th>Levels of Use (LoU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0  Awareness</td>
<td></td>
<td>Non-use</td>
</tr>
<tr>
<td>1  Informational</td>
<td></td>
<td>Orientation</td>
</tr>
<tr>
<td>2  Personal</td>
<td></td>
<td>Preparation</td>
</tr>
<tr>
<td>3  Management</td>
<td></td>
<td>Mechanical Use/Routine</td>
</tr>
<tr>
<td>4  Consequences</td>
<td></td>
<td>Refinement</td>
</tr>
<tr>
<td>5  Collaboration</td>
<td></td>
<td>Integration</td>
</tr>
<tr>
<td>6  Refocusing</td>
<td></td>
<td>Renewal</td>
</tr>
</tbody>
</table>

The concerns outlined in CBAM might be related to the expressed concerns and considerations of secondary science teachers as they select, adopt, and implement issues-based instruction in their classes.

Conclusion

"Since post-modern science is already embedded in social and cultural contexts, the selection of subject matter for school science courses is a task of choosing concepts that are rational and relevant to the life affairs of students, social progress, and the 'common good' " (Hurd, 1994, 112). Acknowledging that teachers are the arbiters of classroom structure and function, and as such can be the agents of educational change and societal improvement as described by Fullan (1993), the logical question becomes, "What considerations impact teachers' decision making as they carry out this responsibility?"

In line with the thinking of Lipsky's Street-Level Bureaucracy (1980, 3), the model that is proposed on page 32 maintains the primacy of the role of teachers in curricular decision making. While policies and external influences are part of the
environment within which teachers operate, and as such filter the options at a teacher’s disposal, it is the teacher who directly interacts with the students. Student preferences, interests, motivation, and experience also provide focus. Teachers are on the front lines of interaction; it is teachers who carry out curricular revision. Repeated investigation into the intended versus the implemented curriculum (or a variety of other terms, including “adopted” or “espoused” versus “actual” or “active” curricula) have shown the importance of teachers in curriculum development. Furthermore, according to G. McCutcheon, the dynamics of the classroom demands that teachers make “preactive, interactive, and postactive” decisions while instruction is being planned, carried out, and revised (personal communication, November 4, 1994).

Based on the research and experiences noted above, a graphic representation or model (Fig. 1) has been developed that relates the factors that are involved in teachers’ selection of topics and in their use of issues-based instruction. The spectrum of influence emanating from a teacher’s personal and professional background (portrayed as lights in the graphic) illuminate the stage of instructional opportunities that teachers construct as they select, plan, and implement their curriculum. These professional judgments are filtered by the externalities of institutional constraints, shown as a lens through which the light passes. Consideration of students, another lens, focuses the implemented curriculum. This representation may be illustrative of the influences on teacher thinking regarding the use of issues in any discipline, and may more generally describe the process of teacher contributions to curricular development in any content area. This research study was conducted to identify, describe, and categorize considerations that impact secondary science teachers’ curricular choices and their implementation, and the refined model is discussed further and displayed in Chapter 5.
TEACHER CHARACTERISTICS

PROFESSIONAL
- EVALUATIONS/STATUS
- TRAINING/EXPERIENCE
- PROFESSIONAL DEVELOPMENT LEVEL
- CONCEPTIONS OF COMMUNITY ROLES(S)

PERSONAL
- CULTURAL HISTORY
- CONCEPTIONS OF ROLE(S)
- PERSONALITY DIMENSIONS
- ATTITUDES/VALUES/BELIEFS
- PSYCHO-SOCIAL PREFERENCES

STUDENTS
- LEVELS OF COGNITIVE DEVELOPMENT
- SOCIAL SKILLS
- EQUITY AWARENESS
- PRIOR KNOWLEDGE/EXPOSURE TO CONCEPTS/IDEAS
- INTEREST/MOTIVATION/PARTICIPATION

INSTITUTIONAL CONSIDERATIONS
- PHILOSOPHY/POSITION STATEMENT RE: INQUIRY
- TEXTBOOK ADOPTION COMMITMENT
- SCOPE & SEQUENCE OF CURRICULUM
- FACILITIES AND EQUIPMENT
- TEACHING ASSIGNMENTS/CONFIGURATION
- ACCOUNTABILITY MECHANISMS
- DEGREE OF COLLABORATION

PEDAGOGICAL DECISIONS
- APPROPRIATENESS TO CURRICULUM
- CLASS TIME ALLOCATED
- IMPLEMENTATION
- LEARNING STYLES
- TEACHER/STUDENT CENTERED
- EQUITY ISSUES

TOPIC/ISSUE
- RELATIVE IMPORTANCE (STUDENT, CURRICULUM, SOCIETY)
- PREPAREDNESS (MATERIALS, KNOWLEDGE, INFLUENCE ON THE)
- CONSEQUENCES (PROF'L, LEGAL, PUBLIC, PERSONAL, ACADEMIC)
- BIAS/Balance?

Fig. 1
Model of Teacher Thinking Related to Issues-Based Instruction
To summarize, research investigating secondary science teachers' thinking about the choice and implementation of global environmental issues as curricular topics is absent from the research literature. Some factors that influence teachers' thinking have been investigated however, through studies of teacher anxiety (often with regard to elementary teachers or specific knowledge bases). Surveys have also been used to identify and describe teacher perceptions of the role and scope of STS/controversial issues in the classroom. Teacher thinking, particularly in regard to curricular issues, is a relatively recent area of educational research, that as yet has not been reported to explicitly address secondary science teachers.

This study extends the knowledge base by investigating the linkages that some secondary science teachers perceive to be important as they plan and implement issues-based instruction, delimited to global environmental issues. It also illuminates the considerations that are involved as teachers make decisions about appropriate topics, materials, time allocation, and methods used for secondary science instruction.

Justification

The major national science reform efforts and independent initiatives have two common themes relevant to my interests: 1) the call for improvement of science education for all students, and 2) the acknowledged role of teacher development and teacher involvement in the success of curriculum revision, restructuring, or reform. This study contributes teacher perceptions about the use of global environmental issues as an elemental component of secondary-level science instruction to the body of knowledge upon which curriculum and policy decisions are based. Therefore, it helps to resolve questions about global environmental issues-based science instruction, and places environmental education as a visible and deliberate component within secondary science curricula.
CHAPTER III

METHODOLOGY

Learn to talk so they will listen, learn to listen so they will talk.
(in Wallace, 1994, 207)

Overview of the Chapter

This study is grounded in the declared considerations of the participants (hereafter referred to as the teachers) as they assess the appropriateness of issues-based instruction in their science classrooms. The primary goal of this research was to make explicit the concerns of this group of secondary science teachers as they decide whether or not to include issues-based instruction in their implemented curriculum, and to describe the teachers' anxiety in this regard. A secondary goal was to provide "catalytic validity" (Lather, 1991) whereby discussion and reflection on the use of issues-based instruction by the teachers might positively influence their thinking and subsequently, their teaching.

Grounded theory (Strauss & Corbin, 1990) provided the structure for the emergent design of this study. A grounded theory approach uses inductive analysis to develop theory that emerges from "close involvement and direct contact with the empirical world" (Patton, 1992, 153). Inductive analysis occurs when patterns are recognized from specific observations, although deductive reasoning and testing of ideas also occur as findings and patterns are explored and confirmed. The inductive process is reiterated when unanticipated information or the awareness of a negative case or rival theory stimulates re-analysis. This alternation between
deductive and inductive reasoning, coupled with concurrent gathering and analysis of information often results in an emergent design.

Information was gathered through questionnaires, individual and focus group interviews, repeated measures of anxiety levels using a validated instrument, non-participant observations, teacher self-reports of issues-use history and autobiographical information, and researcher field notes over a six-month period. Triangulation among methods, data sources, and researchers contributes to the trustworthiness of this study. A basic assumption underlying the methods selected is that teachers’ responses to direct questions, when “sampled to redundancy” (Lincoln & Guba, 1985) can be categorized by the researcher and later confirmed by the teachers as being representative of their thoughts. Conscious attention has been given to representation of the Other, and no claims of transferability are made. This is, therefore, a descriptive study that reveals some of the thinking of a self-selected group of secondary science teachers.

Methodologically, it is important to establish the context of the study and to describe the gathering, identification, and inclusion of data. The first section of this chapter situates the study theoretically and contextually. Next, the procedures used to prepare for the study and the sample are described. The next section describes chronologically the procedures used to collect information, from which data were selected. This is intended to offer better understanding of emergent design. The units of analysis and the procedures that were followed in selecting data from the available information are outlined next. Finally, a description of mechanisms used to establish trustworthiness and an acknowledgment of my subjectivities are presented.
Context

According to Clark (1988), there are three categories within the research on teacher thinking that can help teacher educators in the preparation of future teachers. These categories are Preconceptions and Implicit Theories, Planning and Reflection, and Dilemmas and Uncertainty. For example, teachers may have preconceptions and implicit theories about students and learning, about the subject matter they teach, and about their roles and responsibilities as teachers. The category of planning and reflection includes the thinking that occurs both preactively or prior to implementation of the curriculum, and interactively, or during its implementation. A previous distinction of postactive, and later evaluative, thinking has since been incorporated into preactive thinking, since reflection is part of the revision process and is therefore considered to be preparation for another lesson. Dilemmas and uncertainty represent conditions that exist throughout the planning and implementation phases of instruction. These categories are relevant to this research study.

The interface between the areas of Preconceptions and Implicit Theories, and Planning and Reflection, is specifically pertinent to this study. The research questions focus on the interactions between science teachers' underlying theories and their intentions or plans to use issues-based instruction in science. Each of the areas named above contributes to the private universe within which individual teachers operate, and which remains private unless it is probed and/or voluntarily revealed. Because this individual problem space is not usually available for public scrutiny, its exposure might be perceived as posing some personal risk to the individual.
An ethical question arises as to whether or not this study is warranted in view of the indeterminable costs and benefits to the participants in the study. Specifically, these teachers were asked to reveal information about their personal history regarding both their family life and intellectual development as well as their academic and professional preparation, and their perceptions of anxiety relative to various scenarios presented throughout the study period. Additionally, they were asked about their personal experience with teaching about issues, and asked to reflect upon specific things that might make them anxious about teaching certain issues. They were then probed about teaching strategies that they might use to reduce their anxiety. Confidentiality was assured and maintained, but considerations of personal and professional risks that were mentioned in Chapter 2 interact in the process of self-report. This acknowledged limitation is discussed further in Chapter 5.

The conduct and formulation of this research is directly related to my background and sustained interest in teacher thinking. Hrdy refers to “conscious partiality” through which the notion that all research is subjective, given its derivation from the perceptions and interests of the researcher, is conveyed and posits that “a politically-motivated approach is preferable to the illusion of impartial research” (1986, 141). As was stated above, the stimulus of questions posed and the resulting reflection upon practice are intended to have affected the teachers, providing catalytic validity to this study. Conscious processing by the teachers of their perhaps unarticulated understandings may have provided a forum for restructuring their priorities and/or their self-defined roles as science teachers.

Having taught Earth science and biology, and later Earth Systems, for 17 years in a public high school in Ohio, my experiential, emic perspective, or the
insider's view, is clearly part of this study. Formal training in research methods as part of the doctoral program at a large midwestern university stressed the importance of maintaining the formal etic perspective, or outsider's view, which is more traditional in science education research. "Empathic neutrality" (Patton, 1992) was maintained throughout the research period. The etic perspective was gained by probing the teachers for their thoughts, interpreting their reflections on their experiences using a constant-comparative method (Glaser & Strauss, 1967), and soliciting member checks (Lincoln & Guba, 1985) whereby the teachers confirm and/or improve the interpretations offered by the researcher. The interesting juxtaposition of my formal, etic perspective and experiential, emic perspective are presented in the last section of this chapter.

As was postulated in Chapter 2, preconceptions and implicit theories may contribute to secondary science teachers' decision making as they assess the appropriateness of issues-based instruction and plan their implemented curriculum within their specific teaching situation. Teachers whose implicit theories enable issues-based instruction in their classrooms were deliberately sought to participate in this study. The selection of a graduate-level course that focused on issues provided a purposeful sample and the entry that was critical to the success of this research. The course selected for use in this study addressed the interactions of the human population within the Earth system. Teachers' enrollment and participation in this course were interpreted as evidence of the teachers' willingness to become more knowledgeable about the interrelationships of human population and Earth's resources, at least some of which could be considered to be controversial, and which clearly fall within the description of global environmental issues as listed in Chapter 2. In addition to providing entry and a purposeful sample, the graduate-level course
provided the basis for discussions and interviews that dealt with specific topics and situations rather than generalities about issues-use by secondary science teachers.

**Preparation and the Sample**

Specific steps that enable the systematic progression of research initiated this study. A panel of experts (Appendix B) reviewed the interview schedules and data source documents that were to be used, and suggestions for revisions were accommodated prior to submission for formal review by the Human Subjects Review Board at the university. An abbreviated version of the proposal including all questionnaires, interview schedules, and other data source documents was presented, and exemption from full review was granted. University guidelines for educational research were followed. Permission was obtained from Dr. Charles Spielberger to use the State-Trait Personality Inventory (STPI)\(^1\) for this study. Likewise, permission was granted to modify the headings to produce the Science Teaching STPI (ST STPI) for this study (telephone conversation, October 27, 1994). The study was planned in conjunction with an issues-based graduate-level course, and the full cooperation and support of the professor of that course provided access and entry to the sample.

**The Sample**

Twenty-five graduate students were enrolled for credit in the issues-based course. The course met on Wednesday evenings during winter quarter of the 1994-95 academic year, and of the 25 students enrolled, 22 were educators. The educators

---

\(^1\) The STPI is not included in this document. Please contact Dr. Spielberger, Director of the Center for Research in Behavioral Medicine and Health Psychology, Department of Psychology, at the University of South Florida, Tampa, FL, for more information regarding this instrument.
secondary science teachers, 2 were elementary teachers, and 2 were environmental educators, not involved in formal education. In addition, although not enrolled for credit, a doctoral student with 14 years of experience as a high school science teacher participated in the course and in the research. Three of the teachers with secondary science experience or training declined to participate in the research due to personal time constraints. One of the elementary teachers withdrew after the first week, expressing doubt that her experience was applicable to the study. The other elementary teacher’s responses have been analyzed as relevant anecdotal information that are not comparable to the other teachers’ input and therefore, are not included in the presentation of the data. Both of the environmental educators declined to participate in the study; both offered personal time constraints and lack of public school experience as reasons for nonparticipation. Information reported in this study was therefore obtained from 16 secondary science educators representing experiences in 11 different school districts. These 16 educators participated throughout the quarter and provided input throughout the analysis and interpretation phases of the study.

**Information Gathering**

The teachers provided information over a six-month period beginning in winter quarter and continuing into summer quarter. The data source documents that were distributed or gathered in association with the class are displayed in the Appendices and described below in chronological order to provide a sense of the emergent design of the study. Table 2 on the following page shows the distribution of the primary input that was associated with the class during winter quarter.
Table 2

Weekly Record of Teachers' Input

<table>
<thead>
<tr>
<th>Type</th>
<th>W</th>
<th>E</th>
<th>F</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delphi Survey</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>ST STPI</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Autobiography</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Issue Use</td>
<td></td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Interview</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Focus Group</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

The First Class Session

Consent and Biographical Data:

Data source documents were presented to the teachers in a pre-defined sequence and will be described in chronological order. In addition to specific data sources described below, all class sessions were audio-recorded to supplement the audit trail. Class discussions were analyzed for teachers' expressions of anxiety or concern regarding issues-use at their levels of instruction, and were recorded into the field notes.

During the first class session, the professor provided the course information such as department name, course number, and credit hours, and then following brief self-introductions, allowed time for the introduction of the study including formal consent to participate (see Appendix A). The methods of data collection were listed
briefly and an estimate of the time that might be required for full participation were offered in the introductory remarks.

The consent forms had been distributed in a manila envelope, along with four other data source documents. The teachers were asked to generate a four-digit code on their consent form that would be used to identify all future submissions for this research study. The teachers were instructed to place the completed consent form in the envelope and to remove the second page from the envelope which was a biographical data sheet (see Appendix C). The teachers were asked to complete the biographical data sheets and to return them to their envelopes when that was completed.

*Open Delphi:*

After completing the biographical data sheets, the teachers were asked to locate the next page, which was a questionnaire (see Appendix G) that would be administered using a modified Delphi technique. The Delphi technique is a “method for the systematic collection of informed judgments on a particular topic” (Udinsky, Osterlind, & Lynch, 1981, 34). The Delphi technique traditionally provides for iterations of a questionnaire whereby the participants are informed about the rest of the group’s responses and are then asked to respond again. This allows each individual to respond differently after considering the collective position of the group. Topics that lend themselves well to the Delphi technique include those for which there is no “right answer” and on which a panel of experts may disagree. In this case, the panel of experts are the people who have “a perspective on education that will yield useful information” (p. 35). In the first administration of this questionnaire (hereafter referred to as the Open Delphi) the teachers were asked to brainstorm (jot random responses) as they reflected on the following open-ended
statement: "When I am deciding whether or not to use a particular issue in class, I think about:" (see Appendix G).

Because the group might have become sensitized to concerns specifically related to issues-use as the course progressed, The Open Delphi was administered as early as possible in the first class session, immediately after obtaining informed consent and the biographical data from the teachers. This data collection strategy allowed the teachers to record their thoughts about issues-use prior to any substantive discussion of the subject matter of the course, and prior to any interactions that might focus attention on the related aspects of teaching that subject matter. The teachers were instructed to use their four-digit identification code on the Open Delphi and were asked to respond as a classroom teacher who was responsible for curriculum implementation using, as a referent, their most recent secondary classroom teaching experience.

While the teachers completed the Open Delphi, a second manila envelope was distributed to each participant. The second envelope would enable them to carry their data source documents to and from class, and would facilitate the confidential transfer of documents in class throughout the quarter. The teachers were instructed to write their names on the labels on the envelopes, place the completed documents in the first envelope, and to remove the next page, which was the Science Teaching State-Trait Personality Inventory (ST STPI).

Science Teaching State-Trait Personality Inventory:

The Science Teaching State-Trait Personality Inventory mentioned above was modified by adding a question at the top of the page. None of the individual items were altered in any way. The modified form is subsequently referred to as the Science-Teaching STPI (ST STPI) after Westerback & Primavera (1988).
The ST STPI was initiated by reading the script for General Issues Use (see Appendix F). The teachers were asked to consider that scenario while responding to each of the items. The ST STPI provided a measure of one contributing factor (anxiety) in the full context within which issues-based instruction is used (or is not used) by secondary science teachers.

The ST STPI was administered six times during the quarter: on the first and last days of class, and in conjunction with each of two major topics that were addressed in the course. Specifically, the teachers responded to scenarios of teaching with issues related to population stabilization and land resource use. The self-reports taken during the first and last class sessions were intended to ascertain the teachers' anxiety levels relative to using issues throughout the year, which is referred to as "general issues-use."

The script for the first report of the teachers' state anxiety (S-anxiety) referred to a hypothetical decision to infuse issues-based lessons into each unit taught by the teacher that year. The teachers were asked to respond to each item, reporting their feelings about that situation, a state anxiety measure. The reverse side addressed the teacher's trait anxiety level (T-anxiety), or their feelings about life in general. The instructions were read and the teachers were allowed sufficient time to complete the T-anxiety report. The first administration of this instrument took ten minutes.

This administration is hereafter referred to as G1, indicating the general issues use scenario, first administration. The second measure of this scenario, G2, occurred on the last day of class. Subsequent administrations of the ST STPI occurred up to four weeks apart and in conjunction with content material that may have influenced the teachers' anxiety levels about teaching specific issues (i.e. population
stabilization plans, land use and zoning changes). See Table 3 below for a summary of the ST STPI administrations.

Table 3
Summary of ST STPI Administrations

<table>
<thead>
<tr>
<th>Administration of ST STPI</th>
<th>Issue Considered</th>
<th>Week during Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 &amp; G2</td>
<td>General Issues-Use throughout the year</td>
<td>Week 1 &amp; Week 10</td>
</tr>
<tr>
<td>P1 &amp; P2</td>
<td>Population Stabilization (e.g. family planning)</td>
<td>Week 2 &amp; Week 3</td>
</tr>
<tr>
<td>RU1 &amp; RU2</td>
<td>Resource Use (land-use zoning change)</td>
<td>Week 5 &amp; Week 9</td>
</tr>
</tbody>
</table>

The teachers were asked to place all the completed data source documents into their envelopes, and to pass them forward. They were instructed to retain the second envelope and the remaining two data source documents, the Autobiographical Sketch and Experience with Global Environmental Issues in the Classroom, hereafter referred to as “issues-use history” or IUH (see Appendix C). It was stated that these latter documents (described in class as “take-home assignments” for the research study) were to be completed as time permitted, but should be submitted within two week’s time, if at all possible.

Delphi-Round 2:

While instruction continued on the first evening, the responses to the Open Delphi were open-coded, tallied, and broadly categorized. Immediately prior to the dismissal of class, the questionnaire was administered a second time (hereafter referred to as Delphi-Round 2). Broad categories that had been developed from the group’s earlier responses were listed on the blackboard and I presented them orally.
The teachers were asked to reconsider the statement on the questionnaire and to respond again, this time prioritizing their responses in terms of their perceived relative importance (listing their first priority in the first position, etc.). They were told that they were not required to use the categories listed on the blackboard, and could write full statements elaborating their answers if they wished. This procedure allowed them to incorporate ideas presented from the group’s prior responses, including some that they may not have initially considered but which, upon reflection, seemed important enough to prioritize among their selections this time. The teachers were reminded to use their four-digit code to identify their responses on the blank questionnaire, since their initial response sheet was not returned to them. While the teachers completed Delphi-Round 2, their envelopes were redistributed to allow confidential submission of this document. The envelopes were collected as they finished.

An additional record of events, interactions, and analysis was produced through maintenance of a research log throughout the study. A record in the log notes that one of the original participants (an elementary teacher) withdrew from the research during the first week. The teacher expressed doubt that the elementary perspective would be useful in the study as it had been described. The request was discussed in a telephone conversation during the ensuing week and the teacher agreed to provide a written withdrawal statement at the next class meeting.

The Second Class Session

Another participant (a middle school science teacher) officially withdrew from the study at the beginning of the second session. Personal time constraints were
offered as a reason for withdrawal. The withdrawal was submitted in writing, dated and signed. The previously mentioned withdrawal was also officially completed at the beginning of class through receipt of a written statement.

First ST STPI on Population Stabilization:

The ST STPI was administered in the second half of this class, immediately following the break. The teachers were asked to respond to the items while considering the question at the top of the page that asked: "How do you feel about using population stabilization as an issue in science class?" (See Appendix F). This provided input about their state anxiety levels about using that issue in class.

The following statement was included in the directions:

You are asked to respond to the question at the top of the page. In doing so, I want you to consider the school district that you teach in, the building and district administration there, your fellow teachers, and the students and community that you serve.

The directions for completion of the form were read verbatim. The following statement was used to help the teachers distinguish population stabilization from a basic demography lesson:

Please remember to consider the situation that you teach in, and to recognize that population stabilization indicates some sort of policy regarding population growth (i.e. population control, family planning, etc.). What does this mean to you as a science teacher?

There were no questions. I circulated among the teachers to provide assistance as they completed the S-anxiety report, and then read the instructions for completing the T-anxiety report found on the reverse side. Together, the S- and T-anxiety reports constitute the first ST STPI administration and are subsequently referred to as P1. The teachers were asked to put the completed form into their envelope, along
with their autobiographical sketches and their issues-use histories if they had remembered to bring them to class. Class resumed immediately.

*Individual Interviews:*

The teachers had been informed during the introduction of the study on the first night of class that a short semi-structured interview (10-15 minutes) would be used to more fully capture their ideas about topics and pedagogy used when teaching from an issues perspective. A semi-structured interview was planned, and had been approved by my dissertation committee (see Appendix D). Because use of class time to collect data was already somewhat intrusive, and in consideration of the teachers' time on a school night, it was agreed that those who would like to participate in that aspect of the research could plan to meet with me at their convenience. No one was available to stay after class for an interview that evening. A sign-up sheet was circulated during the break to arrange interviews before and after class or by appointment during the remainder of the quarter.

This was a deviation from the proposed data collection plan, in which interviews were intended to be more spontaneous, but meeting at a pre-arranged time was now thought to be more conducive to voluntary interview participation. It allowed the teachers to check their personal schedules and to devote an additional 10 to 15 minutes to this study when it was more convenient for them. The interview schedule was not altered. This was the first manifestation of emergent design in this study.

*Autobiographical sketches and Issues-Use Histories:*

The teachers were reminded to complete their autobiographies and issues-use histories and to bring them to class, or leave them at my office during the week if
that was more convenient for them. Five teachers submitted these documents at this
class session.

The Third Class Session

Second ST STPI on Population Stabilization:

The administration of P2 was carried out by following the instructions and the
routine that had been established. There were no variations from the routine;
however, one teacher had to leave class early and had arranged to provide input at
another time. Envelopes were used for the distribution and collection of the
instruments.

Interviews:

At the class break, the sign-up sheet for interviews was circulated again for
adjustments and additions. Twelve of the sixteen participants volunteered their time
for this purpose.

Autobiographical sketches and Issues-Use Histories:

The teachers were again reminded to complete and return their autobiographies
and issues-use histories as soon as possible. Seven teachers submitted these
documents at this class meeting.

The Fourth Class Session

Interviews:

Two of the teachers had volunteered to be interviewed on this evening. These
interviews were conducted prior to and following the class session. The interviews
were conducted in a separate room and were audio-recorded for transcription.
Permissions were obtained at the outset and recorded on tape. Field notes were recorded during the interviews. Immediately following the closure of the interview, the teachers were asked if they would read the transcript, when it was completed, to verify and evaluate their responses. They were also reminded again that they could provide additional input at that time or afterward, if reflection on the questions generated additional thoughts. After each teacher's departure, additional field notes were added. The interviews were fully transcribed within three days.

Peer-review (see Appendix B) of the interview transcripts was sought at this point to confirm the development of the category descriptions and for advice on data management strategies. Minor modifications were made as a result: only the four-digit codes were left on the transcripts for identification, since information about the date of the interview might be used to identify the interviewee.

The Fifth Class Session

First ST STPI on Resource Use:

The first administration of the ST STPI referring to resource use (hereafter referred to as RU1) was conducted prior to any instruction. The scenario used to stimulate state anxiety (see Appendix F) described a situation where opinions about land-use and zoning plans within the school district were strongly divided. A proposed activity that would allow students to interview local residents about their position on the controversial change in zoning for land use was provided to the teachers. The established routine was followed. Four teachers were absent; two of them had provided prior notification of absence and had made arrangements to provide this input at a later date.
Interviews:

The interview scheduled to be conducted after class was canceled due to illness. An alternative plan was proposed, to conduct the interview at the teacher's school sometime during this week. Plans were later made by telephone to meet at the teacher's school on the teacher's preparation period during the following week.

Autobiographical sketches and Issues-Use Histories:

No submissions of these documents occurred at this session, and the teachers were reminded yet again to provide this information when they could. Acknowledging that the time commitment was problematic for some teachers during the school year, accommodation of the teachers' personal circumstances was made. Little concern about timeliness regarding submission of the autobiographies and IUH reports existed since they were not expected to vary significantly over the ten week period of initial data collection.

Emergent Design:

In response to the data analysis at this point, several options were considered to focus the study on themes of interest that were emerging from the analysis of the Delphi and interview data. One option was to revisit the Delphi technique as planned, providing the teachers with the latest category descriptions. Telephone interviews were considered, but dismissed because they seemed unlikely to be successful, given the partial participation with interviews so far. Another option was to add focus group interviews based upon the results of the interviews and the Delphi series at the end of the data collection period. I scheduled an appointment with my adviser to consider the analysis of the data stream to date, and to obtain approval of a modification.
The Sixth Class Session

Make up of First ST STPI on Resource Use:

Three of the teachers who missed the administration of RU1 agreed to meet before this class to complete the instrument. The established routine was followed, and they finished well before class was scheduled to begin. The other teacher who had missed RU1 completed it while listening to the audio tape of that class meeting at her home, and submitted it prior to this class session.

Interviews:

Individual interviews were conducted prior to and after class as scheduled. They were audio recorded for later transcription and field notes supplemented the data collection. In both cases, the teachers were reminded that they could modify their responses when reviewing the transcript or if other ideas were generated as a result of reflection on the interview, and that the additions or modifications would be welcomed at any point in time.

Peer review of the data analysis was sought again at this point to confirm category descriptions and data processing strategies. No changes were made to methods, categories, or descriptions as a result of this consultation.

Emergent Design:

The rationale for a design change was provided in writing to each of the members of the dissertation committee, and responses were invited. In consultation with the adviser and the committee, I planned Delphi-Round 3, which was expected to serve as a springboard for focus group interviews later in the quarter. The first two administrations of the Delphi were re-examined, and the refined categories that resulted were prepared for display in Round 3. The Code Notes (see Appendix E) included categories, subheaded with keywords used to describe previous responses
from Round 2, with tally marks indicating the frequency with which the keywords had been indicated. Delphi-Round 3 would be conducted during the next class session.

The Seventh Class Session

Delphi-Round 3:

At the end of the second half of class, the teachers were asked to revisit the Delphi component of the study. The first and second rounds were described to refresh the teachers' memories about the development of the series and as an explanation of the origin of the Code Notes and data source documents that were being distributed. The teachers were given two sheets of paper. Delphi Round-3 (see Appendix G) was familiar to them and asked them to list the things they think about when considering issues-use in their classrooms. The Code Notes page had been distributed and was also being projected on the wall screen to facilitate the explanation of the tally marks and letter codes. After this explanation, the teachers were asked once more to list and prioritize their considerations regarding issues-use. They were instructed that they could use the categories or subheadings on the Code Notes if they wished, or provide their own statements to more fully explain their thoughts about issues-use. They were reminded to prioritize their responses. It was emphasized that this was an important part of completing this document.

After they had prioritized their responses, they were instructed to turn to the reverse side of the page and to respond to the situations posed there (see Appendix H). This document is subsequently referred to as Delphi-Round 4, because it is grounded in and provides supplemental evidence of consistency with prior responses to the Delphi series. The ambiguous nature of the situation posed in number one was purposeful. It was anticipated that those who have had negative
experiences with their principal/s and/or school board/s would respond to the situation defensively. This strategy was expected to provide corroboration of data analysis from other sources, such as the interviews, anxiety measures, prioritized considerations, etc. Upon completion, the teachers submitted documents in their envelopes and were free to leave.

Interviews:

Two individual interviews were conducted after class. Permissions were obtained and recorded, and procedural details about the transcripts were outlined. The first interview was unremarkable. The second interview became a conversation that lasted for more than two hours. No pertinent information was lost when the available audio tapes were exhausted. By that time, the conversation had evolved to become a discussion of present course work and questions about processes for graduate students, neither of which were relevant to this study. Again, transcripts were provided to the interviewees at the next class session for review and revision. No changes were suggested.

Autobiographies and Issues-Use Histories:

The teachers were prompted again to submit their autobiographical sketches and issues-use histories. None were collected at this class meeting.
The Eighth Class Session

Interviews:

No individual interviews were conducted on this evening. However, one of the teachers suggested that a telephone interview would be most convenient, so I made arrangements to call on a specific evening. This interview was conducted as arranged, from my home. Telephone recording equipment had been purchased and tested prior to the study and was retested at the beginning of the phone call. Once the teacher's permission had been recorded, and verified, the rest of the interview was very similar to the others that had been conducted in person. There were no interruptions in either household, and the audio quality of the recorded conversation was very good.

One disadvantage of this mode of communication is the lack of nonverbal input. However, this teacher had a record of being verbal, perhaps even outspoken, in discussions throughout the quarter. In addition, the teacher had been instrumental in developing an innovative course of study and was willing to share insights and experiences that resulted from that opportunity. At the end of the conversation, the member check protocol was explained. A transcript was provided to the teacher at the next class meeting for suggested changes and revisions. None were offered.

Focus Group Interviews:

Data analysis had provided some themes that could be productively examined in a group setting. In addition, the teachers could themselves be grouped according to the nature and length of their classroom experience. The idea of focus group interviews was first proposed to the dissertation committee during the fifth week of the quarter.
Focus group interviews are often conducted in a series with different individuals participating in each, who respond to similar topics and questions (Marshall & Rossman, 1995). The notion of a group interview is based on the assumption that attitudes and beliefs are not formed independently of other people. Marshall and Rossman extend that assumption: “People often need to listen to others’ opinions and understandings in order to form their own” (1995, 84). Careful, systematic analysis by the researcher of the trends in perceptions and opinions expressed in the series of interviews can provide improved understanding of the relationships and phenomena being explored.

There are advantages and disadvantages to this method (Marshall & Rossman, 1995, 84-85). Advantages include the nature of focus group interviews as being socially-oriented, allowing the facilitator some flexibility to develop unanticipated avenues of discussion. In addition, they maximize the data-gathering potential of the researcher because they allow concurrent interviewing of several people. They also reduce the strain and artificiality of one-on-one interviewing and provide a “reciprocally educative” atmosphere (P. Lather, class notes, Feb. 21, 1995) that can stimulate thought, whether expressed or not. On the other hand, the facilitator has less control over the discussion and the data may be more difficult to analyze, since they require contextualization to make the comments more understandable. Variations in the characteristics of the group can make analysis more difficult, as well, and the assembly of groups of people can be difficult to arrange.

The professor of the issues-based course participated in the development and conduct of the focus group interviews. The idea was posed to the class as a focus group “session” which would provide input from experienced people that could be used to develop suggestions for future teachers or others who might consider issues-
use in their classrooms. It was necessary to obtain the teachers' voluntary participation in this endeavor and to schedule a suitable time and location. The group agreed that before and after class were the most acceptable times, and plans were made accordingly. Therefore, the focus group "sessions" were scheduled before and after class for the next two weeks.

The teachers were grouped according to their teaching experience by both longevity and the nature of their teaching assignment. There were 2 larger groups and 2 smaller groups. Some of the teachers were employed in districts where environmental and innovative science programs were in place. Others were employed in districts with more traditional approaches to teaching science. The teachers were grouped according to the following scheme:

- Group 1—7 teachers with more than 10 years of classroom experience,
- Group 2—4 teachers with experience in nontraditional programs,
- Group 3—5 teachers with less than 5 years of classroom experience, and
- Group 4—10 class members who were nonparticipants in the research study.

The professor's active participation in arranging, structuring, and facilitating the focus group interviews was essential to their success.

A semi-structured interview schedule had been devised in consultation with the dissertation adviser and with the participating professor (see Appendix D). The discussion revolved around five main questions which are listed below. These questions were intended to provide ideational scaffolding as the interview progressed. Notes have been added to explain the intent of the questions. All five questions were addressed in each of the focus group interviews, including the session that was comprised of class members who were not participating in the study, some of whom were not teachers.
The focus group sessions were developed through examination of these five questions:

1) "Do you think that issues-based lessons give students a better understanding of the issues, as opposed to an introduction, a 'hook' or interest-motivator, which is then discarded to pursue the science which is the basis of the lesson? Why or why not?" (*This question allowed the teachers to consider the nature of issues-based instruction.)

2) "Do you think people make different decisions on the basis of these understandings?" (*This was a knowledge-to-action question which probed the teachers' philosophies of education.)

3) "If understanding and/or knowledge are not enough (to effect action), then what things can be done in the classroom to promote environmentally-responsible decision-making?" (*This question was intended to be catalytic.)

4) "Decision-making basically means taking a stance, and implies that action may result. (Consider the Senate vote that has been delayed.) Advocacy for one decision or the other is clearly at work in our democratic form of government. What role, if any, do you think advocacy should play when issues-based lessons are being used in the classroom?"

5) "Several people have mentioned that there might be 'a parent call.' What does that mean to you? Who would they call? What process is set in motion when this happens?"

**The Ninth Class Session**

*Focus Group Interviews:*

One focus group met before class. The group assembled in a small conference room with comfortable chairs surrounding a square table space. The class had used this room earlier in the quarter to examine resource materials, so the participants were familiar with the room. Pizzas were delivered and beverages provided to the participants in consideration of the dinner hour and their willingness to commit additional time to the study. The opening discussion was friendly as the group assembled, and the pizza provided an atmosphere of casual conversation. It was
important that all voices were heard, both literally and figuratively, so two audio
tape recorders were poised in opposite directions on the table. The group was
accustomed to the operation of the tape recorders throughout the quarter, since each
class meeting had been audio-recorded, as well. Acting as the primary facilitator, I
provided the introductory remarks and made notes of who spoke, in turn, as the
discussion ensued. As a courtesy to the participants, my note-taking was explained
as a means of assuring correct attribution of comments to individuals when the tapes
were transcribed.

The first focus group session broke up in time to allow the group to report to
class in a neighboring room, with a few minutes for a break. The class had been
scheduled to meet 15 minutes later than usual, and would be dismissed 15 minutes
earlier than usual, as further compensation of the additional time required for these
sessions, and to accommodate the completion of the later focus group session at a
reasonable hour on a school night.

Another focus group met in the small conference room after class. Again the
active participation of the professor and the size of the group provided good
discussion. A second delivery of pizza provided a casual atmosphere. The two tape
recorders were operating in full view of everyone at the table, and full participation
was observed throughout the session. Although it was a smaller group and one of the
teachers was absent, there was one point where I purposefully directed the
conversation to include a teacher who had indicated a willingness to speak on a few
occasions but had not been afforded the opportunity within the group dynamics.

Because the focus groups met for an hour and involved several individuals, the
transcription of the focus group sessions was very time-consuming. The
participants were not offered an opportunity to critique the transcripts but were provided an opportunity to assist with analysis through member checks.

**Second ST SPI on Resource Use:**

The administration of RU2 occurred just prior to dismissal of the class meeting. Circumstances in the structure and coverage of course content had prevented it from being scheduled at an earlier date. The teachers were familiar with the procedure and completed both sides of the instrument in accordance with the directions. No unusual circumstances occurred during the administration of RU2.

**The Tenth Class Session**

**Focus Group Interviews:**

Again, delivery of pizza and familiarity with the surroundings, coupled with a small group sharing a common background, provided the basis for comfortable, casual discussion. The presence of two recorders and the visible note-taking did not deter conversation, which flowed smoothly from my introductory remarks through the five primary questions noted earlier. The active participation and obvious interest of the professor provided a basis for detailed explanations of the teachers' shared experience. One of the teachers had observed science instruction in the district in which the others were employed, and was familiar with that district's program. This teacher also provided a basis for comparison, speaking from experience that had been gained in another district.

Arrangements for a delayed start of the night class and its early dismissal were the same as for the previous class session. The focus group interview lasted about an hour and was dismissed in time to allow for a short break before the beginning of class.
Second ST STPI about General Issues-Use:

The second administration of the ST STPI regarding general issues-use, relating to G1 which was administered on the first night of class, occurred during this last class meeting (see Appendix F). It was conducted at the end of the class session, following the familiar routine established in prior administrations. There were no variations in procedure or in the completion of this document, hereafter referred to as G2.

Data Analysis

Phrases, key words, and single sentences offered in response to the Open Delphi were identified and selected as data. Broad concepts that related the teachers’ responses were developed as category names for data analysis. In this way, elements in the declared thinking of these secondary science teachers toward issues-use were identified and selected as data. Additional data were subsequently identified and selected from statements made in interviews and other interactions and considered in relation to these initial categories.

The data were broadly categorized using a form of “open coding” (Strauss & Corbin, 1990). Examples of the teachers’ statements that contributed to the category Materials and Information are listed below. The teachers’ statements are identified by their four-digit codes.

Reliability of info. on that issue (0728)

Where am I going to find unbiased materials or balanced materials? (2626)

Will students be able to find information easily? (8479)
Amount & type of resources available to students to use (9613)

Analysis of the textual data was used to establish dense categories using the constant-comparative method (Glaser & Strauss, 1967). Code memos that described the data categories were developed and revised periodically as a basis for reflection through ongoing analysis. This constant analysis and comparison of the information within and among the categories resulted in ongoing refinement of the categories and reassessment of the data. Awareness of gaps, or what hadn’t been said, was noted in my log, and intensified my active listening. Alternative or rival theories were also postulated in the log, and provided a “reality check” against my own implicit theories.

Modifying a process described in Strauss and Corbin (1990, 70-73), the categories were dimensionalized. To do this, the key words or phrases that had so far described the categories were incorporated into a series of questions that could individually be answered along a continuum. (See Appendix E.) For example, the properties and dimensions for the category Appropriateness, were stated in three questions.

Does this lesson/topic support skill development that is important when studying science?

Does this lesson/topic fit with my curriculum, or course of study?

Is this lesson/topic related to this science subject area (i.e. biology)?

Because a continuum allows an infinite number of possibilities, any teachers' concerns could, theoretically, be processed. This scheme was devised to accommodate a response of “no concern.” In other words, it enabled the response of a teacher who considered a concept to be inconsequential to be processed along with responses where the same concept had been prioritized as a major concern.
Concerns referred to as "negative cases" in the research log were those that had been anticipated but had not yet been mentioned by the teachers. The negative cases were "missing," and I wondered why. A conscious choice was made not to probe for them. Both patience and impatience were problematic in this situation. It was difficult to judge when to push the teachers for more information without giving the impression of dissatisfaction with their answers. Even when "a very interesting answer" initiated a probe, the response was usually a reiteration of the teacher's original statement rather than exposition beyond that thought. Sometimes the teachers even asked a question in return... which was noted as a typical "teacher behavior." Conscious of the danger of "leading the witness," perhaps too much latitude was given and excessive patience was a problem. At the time, it seemed to be important that the missing concepts should emerge out of the natural vocabulary of the teachers, and that they should be verbalized without prompting. Perhaps the negative cases seemed all the more important because of my awareness that they were "missing" and if so, then impatience was a problem. Upon reflection, it was decided not to probe for them, but rather to note their absence until the individual interviews were completed.

Data analysis and data gathering were contemporaneous and grounded the study in the repeated responses of the teachers throughout the period of investigation. Therefore, the emergent design reported earlier was a response to my ongoing assessment of the data stream throughout the quarter.

Data analysis was assisted by the use of software programs. One program enabled sorting and transfer of coded textual information. This enhanced capability both for separation and synthesis of textual data assisted in the analysis. A spreadsheet program was used to provide descriptive statistics for the ST STPI data.
Triangulation of the ST STPI data with textual data was employed to alert me to any contradictory expressions of anxiety from the teachers.

To summarize the data and their analyses, the textual data sources included field notes and the research log (records of nonparticipant observations), transcripts of individual and focus group interviews, autobiographical information, biographical data sheets, a personal issues-use history, and three rounds of a survey using a modified Delphi technique. Audio taped recordings of class sessions provided additional documentation of the interaction among the teachers.

Using constant-comparative analysis of these data sources, the teachers' reflections on issues-use were selected, coded, and entered into a database. Data selection and synthesis were employed to identify and describe those elements that enable and/or constrain issues-based science instruction at the secondary level. Anxiety measures provided an additional expression of concern, and were analyzed as an indicator of the teachers' comfort levels with issues-based instruction. Teachers' perceptions of factors inherent in the appropriateness and utility of issues-based instruction were analyzed.

**Trustworthiness**

The preliminary manual for the State-Trait Personality Inventory (STPI) documents the psychometric data that establish the reliability and construct validity of the STPI instrument. Face validity was determined by the professor offering the graduate-level course associated with this study and by the members of the dissertation committee. A panel of experts (Appendix B) reviewed and approved the introductory script and the modified headings in the creation of the ST STPI.
Repeated administrations of the ST STPI provide a basis for comparison that is internal to the study, for several reasons. See the Limitations section in Chapter 5.

Using Patton's (1992) suggestions for establishing trustworthiness of the interpretive data and analyses, triangulation of data, method, and researchers was employed. Data triangulation involved textual analysis from an array of data source documents coupled with the use of quantitative anxiety measures. Audio tape recordings and transcriptions of individual and focus group interviews, along with data selected from autobiographical sketches and issues-use history reports, provide an audit trail for the investigation. I will maintain sole possession of the original documents. Interview transcripts were processed to include line numbers for reference. Identification codes were added to textual data to facilitate their re-examination. The existence of negative cases and rival explanations was explored throughout data analysis.

Two other graduate students who are familiar with interpretive inquiry and educational issues related to the environment, respectively, provided peer review of the definitions and the categories that were established from the data. Member checks, asking for participant verification of the description and analysis of the textual data, empowered the teachers as co-researchers in analysis of the data. Further triangulation of researchers involved adviser and expert panel assessment of face and construct validity throughout the period of data collection.

Use of terminology and wording of questions for potential reactive effects was constantly monitored and recorded. Participants were fully informed regarding the nature of the research and the ways in which this information may be used. Participant identities were protected through use of interchangeable pronouns and identification codes to ensure confidentiality. Their voluntary participation was
documented with consent forms obtained prior to the onset of data collection. All physical documentation pertinent to this study is held solely in my possession and will be maintained until this research is completed.

Researcher Subjectivity

The juxtaposition of the etic and emic perspectives required my conscious attention. Instances in which personal resonance with selected comments or expressed positions was strong, prompted conscious attention to other teachers whose comments were not as closely aligned with my experience. The teachers were frequently probed to elaborate, and often related situations or experiences that substantiated or clarified their more-succinct original statements. This strategy helped to assure that the teachers' comments were reflections of their own experiences rather than an expression of alliance with my interests.

Negative cases regarding specific concerns that had been anticipated were noted and were consciously monitored. Cases in which minimal concern was expressed were explored as interesting. In an attempt to better understand lower levels of concern, I asked the teachers to explain and to share their perceptions of other teachers' concerns. Their responses represented one end of the dimensionalization of the phenomena under study, and I could at least verify their awareness of others' concerns. This indicated that the teacher was not unaware of potential causes for concern.

My teaching experience had been expected to provide an overtly empathic interaction with the teachers, but this was not found to be the case. Very few of the teachers expressed collegiality by referring to or including me as a teacher. Instead,
their sense of comraderie seemed to be related to a common interest in the topic of research or was expressed as a function of our common association with the university. At times, I used the collective "we" to frame the teacher's thinking in the shared experience of having taught science at the secondary level. This strategy had little, if any, noticeable effect on the responses offered.

So, while the emic and etic perspectives are indeed represented in my approach to and analysis of this study, the teachers' responses were almost exclusively exposed to me as an outsider. Awareness of my subjectivity is an artifact inherent in the study, which was expressed in the design of the study and in the gathering, analysis, and reporting of the data. Peshkin (1988) maintains that a researcher's subjectivity is virtuous because it provides a distinctive contribution to the profession.

It is important therefore, to identify and to describe the "subjective I's" (Peshkin, 1988) that were present simply because the researcher acts as the primary instrument for gathering, analyzing, and reporting the data. In doing so, I have acknowledged my preferences and my need to examine the data more closely for exceptions and divergence of thought. The subjectivities that I acknowledge begin with Peshkin's "Social-Meliorist I," which is adapted and expanded to include the "Pedagogical-Meliorist I." Then, my personal characteristics and values are described within the "Curious I," the "Farmer's Daughter I," and "The Mom I," each of which is explained below.

First and foremost, I am a teacher. Therefore, the Social-Meliorist I, as a teacher, holds standards and aspirations that are probably naive and unrealistic. My grandmother maintained that teachers must display very high standards of personal conduct as well as goals for lifelong learning as necessary evidence for the rest of
society. Her influence on my concept of teaching as a profession is immeasurable, and significant. I smiled inside as teachers revealed their perceived roles.

The Pedagogical-Meliorist I, perhaps only an extension of the first, wants to believe that reflection in action and conscientious attention to the societal importance of understanding the world through scientific thinking can improve the practice of science education. This "subjective I" hopes to motivate teachers to greater awareness of the need for more interactive instruction that fosters both thoughtful engagement with science as a way of knowing and a desire to understand human choices, rather than fascination with the seemingly-endless breadth of scientific information to which students can be exposed. Again, I was aware of resonance with some of the teachers' preferred pedagogical methods and with their stated priority of including citizenship skills as goals for science instruction.

There is a Curious I who resists routines and numb acceptance of institutionalized procedures. Within a tolerable limit of risk, it is important to step out of bounds and to experience the freedom of self-determination. My Curious I wanted to see evidence of reasonable and defensible chances taken within the scope of the teachers' positions as educators that might enable students to explore the world outside of their immediate circumstances. This "subjective I" does not accept the "existing curriculum" as a limit, but instead sees potential in what it can become, and values field experiences and human interaction as educational opportunities. Discipline of the Curious I was required when external controls were reported by the teachers as an immutable reality.

Then, there is the Farmer's Daughter I, who was often the most difficult to manage and discipline. As a society, we are becoming generations removed from awareness of our agricultural base. My children have endured "farm stories" and
understand the hardships that are endured as an individual works within the system to predict and to manage the productivity of a small part of the Earth for human consumption. Deep appreciation for the power of "nature" and the intricacies of the Earth's interacting subsystems is not gained without deliberation. This appreciation can be reinforced by personal experience. This "subjective I" recognizes the necessity of adopting sustainable practices for the future of humankind, and therefore, strives to place environmental education and critical thinking as visible components that are prioritized in the implemented science curriculum. The Farmer's Daughter I winced at the "coverage" notion for teaching the breadth of the disciplines in science.

Lastly, but certainly not least of all, is The Mom I. This "subjective I" is so intricately folded in on itself that it is difficult to describe. There is a generational component to each of the "subjective I's" mentioned so far, and The Mom I makes that awareness explicit. My upbringing, rooted in a rural, lower-middle class, extended-family culture, still prompts concerns for the young and the old; friend, neighbor, and stranger. My nurturing and preparing self, my caretaking nature, and even my identity concerns seem intertwined in the hopes for a better world that are part of the Social-Meliorist I. But The Mom I takes responsibility, expressed as a need to act. This complicated urge to lead and to push, to demonstrate and to test, to speak out and to listen is rooted in accountability. Who is that child's parent, teacher, neighbor, friend; and where were they when they were needed?

This study is steeped in the essence of the subjectivities based in the totality of my life's experience. Subjectivity shaped the study, gave it form and direction; yet acknowledging its presence yields an opportunity to confront it, to step aside and analyze it, as well.
CHAPTER IV
DATA AND INTERPRETATION

"Think Display"
(Miles & Huberman, 1984, 21)

Presentation of the Data

So far, I have remained relatively "disembodied," predominantly maintaining a
passive voice, removed from the text. However, the introduction to the study revealed
the contributions of my career to my sustained interest in the topic of science
teachers' thinking regarding issues-use. The selection of related terms and pertinent
arguments in the review of literature provide further evidence of my thinking in the
"uncountable strategic choices and active constructions" (Van Maanen, 1988, 73)
inherent in this study. Therefore, the first two chapters were written more formally,
yet the "subjective I's" were present in both.

Likewise, the "re-presentation" of the data is an interpretation of the data, my
interpretation of the data. Where those strategic choices are not obvious, they are
explained. There are several ways that the data, indeed the entire story, can be
related. Van Maanen (1988) described three distinctly different ways of writing
ethnography, the realist, impressionist, and confessional tales. While the
predominantly realist tale is related here as a "compressed reality" (Van Maanen,
1988, 9) in presenting the data to the reader, my awareness of subjectivity was
presented in the interest of intellectual honesty and as an acknowledgment of conscious
partiality.

70
As Van Maanen described, I consciously structured this report to reflect the perspectives and to some extent the practices of a particular culture (1988, 50), but in that statement, I once again acknowledge my presence. The order of presentation of the teachers' concerns was examined and schemata that served to tame my biases included alphabetical listing and consistently ordering from top to bottom. Ongoing effort has been expended to manage and to discipline the "subjective I's" throughout the study. Confidence in the member checks, peer review process, and committee involvement offers some assurance that given the same information, others would reasonably ascribe similar meanings to the data offered here.

In an effort to assist the reader in making sense of the information presented in this chapter, it is organized to be consistent with the order of the research questions. The data are organized specifically in reference to the individual questions, and presented alphabetically when possible. Then, through the consideration of negative cases and rival theories, I examine my interpretations, and finally, compare them to the graphic model that was displayed on page 32.

Offered as a reminder, the research questions were:

1) What considerations, if any, are part of teacher thinking regarding their use or avoidance of global environmental issues as organizers for instruction?

2) What levels of anxiety are expressed by secondary science teachers as they consider the use of specific topics for issues-based instruction?

3) What insights can teachers who use issues-based instruction provide to others that might foster the use of this approach?

4) What effects do these teachers suggest that the use of issues-based instruction has on student communication, interpersonal, and critical-thinking skills?

5) To what extent do teachers suggest that science literacy is fostered through the examination and use of global environmental issues as the basis for secondary-level science instruction?
Recall that the methods used to address the questions relied upon a variety of repeated probes of the teachers' thinking about their use of issues-based instruction in science class, and their self-assessment of anxiety while reflecting upon hypothetical teaching situations. The data were primarily selected from individual and focus group interviews, anxiety measures, and open-ended questionnaires. This strategy offered the teachers several opportunities to consider their statements, to respond verbally and in writing to open-ended questions about potential sources of their anxiety, and to relate the importance of their concerns.

Concern is defined as follows in Merriam-Webster's Collegiate Dictionary: "n. 1 a: marked interest or regard usually arising through a personal tie or relationship, b: an uneasy state of blended interest, uncertainty, and apprehension; 2: something that relates or belongs to one: affair; 3: matter for consideration” (Mish, 1994, 238). The concerns of the teachers may be matters of interest of a practical nature. Or, they may represent some degree of uncertainty and apprehension, as well as basic interest. Offered in direct response to the questions posed in this study, the expressed concerns of the teachers were recorded and analyzed.

Purposeful sampling was used in the design of this study to gain input from secondary science teachers who are interested in science-related social issues. When asked to explain why they chose to use issues-based lessons, the teachers offered a variety of reasons:

My rationale for spending time on such issues relates to the students' personal experiences and concerns, as well as, those current events discussed in the news. (0728)

1. They 'fit' the curriculum.
2. It is important for the students to have some exposure to these issues
3. The students see practical importance of this information. (2726)
I use global environmental issues in order to help explain to my students the whole picture of earth systems education. They need to understand that earth is unique and that we have certain responsibilities to maintain that uniqueness. Also, most of the issues discussed will affect my students during their lifetime and class work will better prepare them to deal with these issues. The goal is to prepare them to be lifelong learners. (3456)

Global environmental issues are 'what I am teaching' and are more interesting than just memorizing or reading from a textbook. (4665)

The Teachers

While the comments listed above serve as an introduction to the teachers' thinking, this group of teachers should be described for the reader. The teachers included 10 women and 6 men enrolled in an evening course offered during the school year through a science department at a university. Fifteen of the 16 referred to their previous or current experience at the high school level. One teacher referred to previous middle school experience. Twelve of the teachers were currently employed inservice science teachers and 5 had prior experience in science classrooms but were not employed as school teachers at the time of the study. Two of the teachers referred to their private school teaching experience and the rest referred to their experience teaching in public schools. Five of the teachers were currently enrolled as PhD students in science education at the university and 6 others were enrolled in the Master of Arts degree program in science education at the university. Seven of the teachers were between 23 and 32 years old, and the remaining 9 teachers were 33 years of age or older. Eight of the teachers had 6 or fewer years of teaching experience and 8 had 7 or more years of experience. Five of the teachers in the latter group had 13 or more years of classroom experience. Refer to Table 4 on the next page for another representation of this information.
Table 4
Teacher Characteristics

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Age Range</th>
<th>Gender</th>
<th>Level Taught</th>
<th>Service</th>
<th>Private (Pr) or Public (Pub) School Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A = 23-32</td>
<td>F / M</td>
<td>HS / MS</td>
<td>I = Inservice</td>
<td>P = Preservice</td>
</tr>
<tr>
<td></td>
<td>B = 33 &amp; up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5 - 6 yrs.</td>
<td>7</td>
<td>1 B</td>
<td>6 F</td>
<td>2 M</td>
<td>8 HS</td>
</tr>
<tr>
<td></td>
<td>7-12</td>
<td>3 B</td>
<td>1 F</td>
<td>2 M</td>
<td>2 HS 1 MS</td>
</tr>
<tr>
<td></td>
<td>13-18</td>
<td>3 B</td>
<td>2 F</td>
<td>1 M</td>
<td>3 HS</td>
</tr>
<tr>
<td></td>
<td>19-24</td>
<td>1 B</td>
<td>1 M</td>
<td>1 HS</td>
<td>1 I</td>
</tr>
<tr>
<td>25-30</td>
<td>1 B</td>
<td>1 F</td>
<td>1 HS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The courses taught by these teachers during this academic year included those typical of the full range of a traditional high school science curriculum: life science, general science, or physical science; biology, chemistry, physics, and earth science. Other courses being taught by this group included: anatomy, STS, natural resources, science inquiry, environmental science, marine science, geology, microbiology, and a required two-year sequence of integrated science.

An open-ended statement on the Issues Use History form inquired about the percentage of class time that the teachers felt should be spent on issues in the courses that they taught. This is offered as another indication of this group’s thinking related to issues-use. Some of the responses were endorsements:

About 75% of the instructional time in any subject area because all we do is tied into society and the environment. I have always tried to fit environmental issues into the curriculum as a way of focusing science. I truly believe that this is a good way to integrate the science disciplines. (0928)

Biology: 100% because these are the concepts that will make my students most prepared for the world they inhabit. (2726)

One of the teachers responded with two-part answers: “ideally” a higher percentage, but “practically” a lower percentage, for various reasons.
Calc-based Physics: Ideally this group will be future scientists & engineers, or in some science-related field. These people need to be knowledgeable about the issues... Therefore, about 25-30% of the time. However, ... I also feel I need to devote a tremendous amount of time developing the concepts and the mathematics—this is where students struggle the most in college physics. From this viewpoint, probably only 5-10% of time can be devoted. Five percent is truly more reasonable. [emphasis in the original] (6534)

Other teachers expressed similar concerns. Note the contrast between the responses given by one teacher (2726) for time given to issues-use in biology, above, as compared to the percentage of time given in chemistry, below:

Chemistry 5% because these issues make chemistry more meaningful, but take less time to comprehend than alot of other topics in the course. (2726)

About 5% in Earth Science because there is a core of other material which must be learned in addition to this aspect. (4665)

Physics: .5% --book-driven; environmental issues rarely come up (8479)

About 25-35% of the time in biology (depends on what topics you are discussing) (3535)

About 10% of the geology class time because it would give more significant meaning of the importance of knowing how earth processes operate as they affect man's [sic] quality of life and economic well-being. It would also be a valid way to incorporate critical thinking skills into the classroom work as students debated the implications of man's [sic] actions on the earth systems. (9613)

These responses reveal some of the teachers' preconceptions about teaching and learning. The explanations offered here acknowledge basic skill development (specifically mathematics) and content knowledge as priorities for their teaching, as well as the stated or implicit expectations of the community regarding the students' next level of education. The relative importance of issues as a component of science instruction is one expression of each teacher's personal philosophy. Yet the realistic assessment of the time actually given to issues-use reveals the perceived importance
of achievement indicators and their own accountability to the expectations of the community.

Alternatively, it could be postulated that the teachers can satisfy their reasons for using issues in less time than would be indicated by their relative importance. Or, put another way, given other considerations that require attention, teachers allot the time that is required to meet their own objectives for using the issue in class. There are externalities that are very real and that impinge upon curricular implementation. Awareness of these externalities recalls the model displayed in Chapter 2.

The model was displayed as a graphic representation of a metaphor: teacher as director or designer. It now provides an opportunity for data analysis. Can the categories that emerged from the teachers' expressed considerations fit the graphic model? And, how does reflection on the input from this group of teachers result in its refinement? The graphic model will be fully addressed in Chapter 5 and is used as a referent in the following interpretation and discussion of the data.

Research Question 1: What considerations, if any, are part of teacher thinking regarding their use or avoidance of global environmental issues as organizers for instruction?

This group of teachers was generally interested in using issues in class. Therefore, their responses tended to be about their use of the issues. Later, through probing, some issues were identified that individual teachers would avoid. Those issues and the reasons given for the avoidance will be discussed later.

Because it was important for the concerns to develop through the teachers' responses to prompts, the initial request was open-ended. The Open Delphi was the teachers' first opportunity to identify the types of "things" that they consider when deciding about issues-use in their classrooms. The categories that emerged and representative responses for each begin on the next page.
**Appropriateness to students (maturity, skills, etc.)**
Are the students mature enough to have a productive discussion on the issue? (8371)

**Bias or sensitivity to “both sides”**
Where am I going to find unbiased materials or balanced materials? Am I providing students with both sides of the issue? (2626)

**Class response**
Possibility for conflict/students attacking one another, etc. (5671)

Will it bring about healthy classroom discussion or will it be one-sided? (6534)

**Community response**
Reflect on the mood-attitude of the community (9613)

Political responses (administrative, personal, religious, cultural) (2491)

**Course of study**
The relevance of the issue to other topics covered in the current course (0728)

Whether it relates directly or indirectly to the subject at hand and if I can integrate it with other courses (such as English or History, etc.) (9221)

**Impact on the future**
Importance to the students when they are out of school (1234)

Impacts the issues would have on the audience, community, and globally (0928)

**Resources available to students and teacher**
Will the students be able to decipher the information they find into useful and meaningful material? (8479)

Availability of materials to use in promoting discussion (2726)

**Student and teacher interest**
Is it ‘engaging’ or just sensationalism? (2626)

How will it enable the students to learn science better? (4665)

**Support available to the teacher**
Is it going to raise flags when students talk to parents? (3535)

Will administration support me? (2298)
Teacher knowledge or background/Teaching concerns
My knowledge/interest of material (5678)

How will this project be evaluated? (8479)

Ability to incorporate appropriate lab activities (9613)

Time to spend (class preparation)
Is this issue important enough to take up class time? (8371)

Can I find enough time to prepare it adequately? (4665)

Timeliness or relevance
Does it tie in a societal/global look at real-life issues & concerns that students should be aware of today? (6534)

The comments offered in response to the Open Delphi can be grouped in a variety of ways, and the initial categories were refined after each round and again in the final analysis.

By presenting the categorized responses of the group to the teachers, in keeping with the Delphi technique, they were informed of the others' viewpoints and were offered an opportunity to adjust their position as a result of that awareness. Recall that prioritizing the teachers' concerns was an important outcome of this round. Some teachers chose to use the categories as listed on the blackboard and prioritized them according to their assessment of importance. Others used the category names, again prioritizing them independently, but supplemented their list with explanations. Still others responded in their own words. There were as few as 3 items listed in Round 2 (by 1 teacher) and 7 teachers prioritized 10 considerations in Round 2. See Table 5 on page 79 for a categorical display of the teachers' prioritized responses from Delphi-Round 2.
### Table 5

Categorization of Delphi-Round 2

Prioritized Items by Category

<table>
<thead>
<tr>
<th>Teacher</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
</tr>
</thead>
<tbody>
<tr>
<td>0104</td>
<td>stu</td>
<td>implic</td>
<td>commun</td>
<td>natissue</td>
<td>mat/info</td>
<td>tchreb</td>
<td>approp</td>
<td>clas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0728</td>
<td>stu</td>
<td>implic</td>
<td>tim</td>
<td>tchreb</td>
<td>approp</td>
<td>tchreb</td>
<td>natissue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0928</td>
<td>tchrrp</td>
<td>approp</td>
<td>natissue</td>
<td>tchrrp</td>
<td>stu</td>
<td>natissue</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1234</td>
<td>approp</td>
<td>stu</td>
<td>tchreb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2491</td>
<td>implic</td>
<td>stu</td>
<td>mat/info</td>
<td>tchrrp</td>
<td>tim</td>
<td>commun</td>
<td>commun</td>
<td>mat/info</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2626</td>
<td>approp</td>
<td>mat/info</td>
<td>approp</td>
<td>tchreb</td>
<td>stu</td>
<td>commun</td>
<td>mat/info</td>
<td>tim</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2726</td>
<td>stu</td>
<td>implic</td>
<td>tim</td>
<td>approp</td>
<td>mat/info</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3456</td>
<td>stu</td>
<td>implic</td>
<td>natissue</td>
<td>approp</td>
<td>mat/info</td>
<td>natissue</td>
<td>tchreb</td>
<td>tim</td>
<td>commun</td>
<td>mat/info</td>
</tr>
<tr>
<td>3535</td>
<td>stu</td>
<td>approp</td>
<td>tchreb</td>
<td>natissue</td>
<td>implic</td>
<td>natissue</td>
<td>tim</td>
<td>commun</td>
<td>mat/info</td>
<td>tchreb</td>
</tr>
<tr>
<td>4665</td>
<td>stu</td>
<td>implic</td>
<td>approp</td>
<td>tim</td>
<td>natissue</td>
<td>commun</td>
<td>tchreb</td>
<td>mat/info</td>
<td>mat/info</td>
<td>natissue</td>
</tr>
<tr>
<td>5678</td>
<td>natissue</td>
<td>stu</td>
<td>implic</td>
<td>mat/info</td>
<td>tim</td>
<td>approp</td>
<td>mat/info</td>
<td>tchreb</td>
<td>tchreb</td>
<td>natissue</td>
</tr>
<tr>
<td>6534</td>
<td>stu</td>
<td>approp</td>
<td>implic</td>
<td>tchreb</td>
<td>mat/info</td>
<td>tchreb</td>
<td>clas</td>
<td>commun</td>
<td>natissue</td>
<td>tim</td>
</tr>
<tr>
<td>8371</td>
<td>stu</td>
<td>tchreb</td>
<td>natissue</td>
<td>approp</td>
<td>tim</td>
<td>mat/info</td>
<td>implic</td>
<td>commun</td>
<td>tim</td>
<td>commun</td>
</tr>
<tr>
<td>8479</td>
<td>stu</td>
<td>implic</td>
<td>approp</td>
<td>natissue</td>
<td>mat/info</td>
<td>tim</td>
<td>stu</td>
<td>mat/info</td>
<td>commun</td>
<td></td>
</tr>
<tr>
<td>9221</td>
<td>stu</td>
<td>tchreb</td>
<td>mat/info</td>
<td>mat/info</td>
<td>approp</td>
<td>approp</td>
<td>commun</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9613</td>
<td>stu</td>
<td>commun</td>
<td>approp</td>
<td>mat/info</td>
<td>natissue</td>
<td>implic</td>
<td>tchreb</td>
<td>tchreb</td>
<td>mat/info</td>
<td></td>
</tr>
</tbody>
</table>

- `approp` = Appropriateness
- `clas` = Classroom
- `commun` = Community
- `implic` = Implications
- `mat/info` = Materials/Information
- `natissue` = Nature of the Issue
- `stu` = Student Concern
- `tchreb` = Teacher Experience & Background
- `tchrrp` = Teacher Role & Philosophy
- `tim` = Time
It seemed odd that not one of these teachers mentioned the *Benchmarks* document as a consideration when using issues, although one teacher wrote, "current concerns in science education" in the Open Delphi (OD, 9, 0728). Another teacher offered "students' learning styles" as one of the aspects that was considered (OD, 2, 2626). No one explicitly mentioned gender-related concerns such as preferences for group work and the placement and valuing of discussion earlier in the learning event, both of which can be easily incorporated into issues-based instruction. Likewise, "racial/multicultural issues/considerations" (OD, 1, 2626) were mentioned by one teacher. The interviews were expected to provide other opportunities for these ideas to arise, so they were not probed.

Slight modifications were made to the initial categories because upon reflection, some other linkages could be inferred. It was expected that the next round of the Delphi and the completion of the interviews would clarify the teachers' intended meanings. The revised list of categories provided a framework for the study which was further refined as input from interviews was processed.

A Code Book was developed that named the categories and listed some of the key words or phrases used by the teachers to describe them (Strauss & Corbin, 1990). From this point forward, the category names are capitalized and italicized to distinguish them from normal usage. The initial Code Book that emerged from Round 2 is listed below:

*Appropriateness*—to the curriculum and to the students

*Classroom* considerations—management of behavior/discussion, money available to implement this topic, student safety, vandalism, interpretations of the lesson

*Community* response—parents, administrators, political and religious factors

*Implications*—of the topic to the students' present and future

(renamed "Importance" in the final analysis)
Materials/Information—availability, pedagogical methods
described, "hands on" or fun, levels of difficulty, reliability of
information, accommodates different learning styles

Nature of the Issue—current, sensitive, substantive, inherent bias,
controversial

Teacher—knowledge, background, methods, interest, purpose, feelings

Time—teacher preparation, use of class time, time to adequately
present or approach the topic.

The teachers' expressed concerns about issues-use from the Open Delphi and
Round 2 were coded using the category descriptions in the Code Book. For example, the
statements that follow were all categorized as a Materials/Information concern:

Reliability of info. on that issue (0728)

Where am I going to find unbiased materials or balanced
materials? (2626)

Availability of resources to teacher on topic, including education,
lab ideas, discussions, readings (2491)

Money for materials? (2726)

Amount of resources available. As excited as one may be to study
and apply an issue—it won’t be possible if there are no (or
limited) resources available (9221)

Although these comments indicate different concerns, they can be categorized as a
general concern about having materials and information with which to develop or
implement an instructional event or lesson.

The teachers' responses were usually quite brief, which might have been
expected under the circumstances of using an in-class questionnaire. Because of their
brevity, the analyses were tentative. I wondered about the basis of some of the
concerns, since there were many that could be rationalized to fit into several
categories. For example, "current relevance to students and to curriculum (current
topic?)" (2726) might be categorized as a concern for student interest and
Appropriateness, as well as a concern about Appropriateness to the existing
curriculum, and also a *Nature of the Issue* concern related to the timeliness of this topic. Some of the statements defy solitary categorization, and the rhizomatic nature of the concepts prompts me to suggest concept maps as a format to represent the data, but those too, are personal interpretations of the data. The "uneasy feeling" still exists that these categories are too broad and too disjoined, and yet too interrelated to be discrete (Van Maanen, 1988, 8), but with descriptions available to improve their utility, they served as a tool for analysis. For the production of this document, I chose to assign multiple category names to such statements in the database, but named them to one primary category for the production of the tables. Another strategic choice is made transparent.

The Code Book was indispensable because without it, each teacher's interpretation of the category names could have held different meanings, which would have made their prioritization of concerns less useful to the study. Allowing the teachers to consult the Code Book to frame their responses in Delphi-Round 3 assisted with the analysis and provided information for the interviews that followed.

The Delphi was administered a third time during the seventh week of the quarter. The teachers were provided a copy of the tallied results from Round 2 (see Appendix E) and were asked to respond once again, prioritizing the list of things that they think about when considering issues-use. Even though the tally sheet did not separate the category of *Appropriateness* into two separate components at that point in time, the teachers' responses made a clear distinction. *Appropriateness* comments were applicable either to students or to the curriculum. Therefore, a separate category was developed to accommodate appropriateness for students, a *Student* concern (Stu), as being distinct from *Appropriateness* to the curriculum or course of study (Approp).
The Teacher concerns were also split into different categories, *Teacher Experience and Background* (tchreb) and *Role or Philosophy* of teaching (tchrrp). This separation was established to accommodate considerations that referred to a particular event or situation as opposed to those that were goal-oriented or that related to the teacher's values and beliefs.
### Table 6

Categorization of Delphi-Round 3

Prioritized Items by Category

<table>
<thead>
<tr>
<th>Teacher</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
</tr>
</thead>
<tbody>
<tr>
<td>0104</td>
<td>stu</td>
<td>natissue</td>
<td>tchreb</td>
<td>clas</td>
<td>commun</td>
<td></td>
<td>clas</td>
<td>stu</td>
<td>implic</td>
<td>tchreb</td>
</tr>
<tr>
<td>0728</td>
<td>implic</td>
<td>stu</td>
<td>mat/info</td>
<td>tim</td>
<td>natissue</td>
<td></td>
<td>appropri</td>
<td>implic</td>
<td>tchreb</td>
<td>stu</td>
</tr>
<tr>
<td>0928</td>
<td>implic</td>
<td>natissue</td>
<td>approp</td>
<td>commun</td>
<td>mat/info</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1234</td>
<td>natissue</td>
<td>mat/info</td>
<td>commun</td>
<td>stu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2491</td>
<td>implic</td>
<td>approp</td>
<td>tchreb</td>
<td>mat/info</td>
<td>tim</td>
<td>tim</td>
<td>commun</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2626</td>
<td>mat/info</td>
<td>approp</td>
<td>implic</td>
<td>tchrhp</td>
<td>natissue</td>
<td>natissue</td>
<td>mat/info</td>
<td>implic</td>
<td>appropri</td>
<td>commun</td>
</tr>
<tr>
<td>2726</td>
<td>approp</td>
<td>stu</td>
<td>tim</td>
<td>mat/info</td>
<td>mat/info</td>
<td>stu</td>
<td>approp</td>
<td>commun</td>
<td>implic</td>
<td>appropri</td>
</tr>
<tr>
<td>3456</td>
<td>implic</td>
<td>approp</td>
<td>natissue</td>
<td>mat/info</td>
<td>tim</td>
<td>implic</td>
<td>stu</td>
<td>tchrhp</td>
<td>tchrhp</td>
<td>stu</td>
</tr>
<tr>
<td>3535</td>
<td>approp</td>
<td>tchreb</td>
<td>implic</td>
<td>commun</td>
<td>mat/info</td>
<td>tim</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4665</td>
<td>natissue</td>
<td>approp</td>
<td>stu</td>
<td>clas</td>
<td>tchreb</td>
<td>tchrhp</td>
<td>tim</td>
<td>tchreb</td>
<td>implic</td>
<td>commun</td>
</tr>
<tr>
<td>5678</td>
<td>approp</td>
<td>approp</td>
<td>clas</td>
<td>mat/info</td>
<td>clas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6534</td>
<td>approp</td>
<td>implic</td>
<td>implic</td>
<td>natissue</td>
<td>commun</td>
<td>tchreb</td>
<td>natissue</td>
<td>tim</td>
<td>implic</td>
<td>stu</td>
</tr>
<tr>
<td>8371</td>
<td>stu</td>
<td>commun</td>
<td>natissue</td>
<td>approp</td>
<td>implic</td>
<td>tchrhp</td>
<td>tim</td>
<td>natissue</td>
<td>tchreb</td>
<td>tchreb</td>
</tr>
<tr>
<td>8479</td>
<td>implic</td>
<td>natissue</td>
<td>mat/info</td>
<td>stu</td>
<td>tim</td>
<td>tchreb</td>
<td>clas</td>
<td>mat/info</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9221</td>
<td>tchreb</td>
<td>tim</td>
<td>commun</td>
<td>approp</td>
<td>commun</td>
<td>mat/info</td>
<td>stu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9613</td>
<td>stu</td>
<td>commun</td>
<td>tchreb</td>
<td>mat/info</td>
<td>tim</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

approp = Appropriateness  
clas = Classroom  
commun = Community  
implic = Implications  
mat/info = Materials/Information  
natissue = Nature of the Issue  
stu = Student Concern  
tchreb = Teacher Experience & Background  
tchrhp = Teacher Role & Philosophy  
tim = Time
In the final analysis, *Teacher* (tchr) was left as a single category encompassing both their personal and professional experiences, and their philosophy regarding their roles as teachers including their reasons for using issues in the classroom. Any reference to a concern that was related to pedagogy or to teacher characteristics was placed in this category.

Although the teachers had been asked to prioritize all their responses in Rounds 2 and 3, it was felt that their top three concerns were truly meaningful rankings. A final comparison of the first three items listed by the teachers in Rounds 2 and 3 is shown in Table 7, on the next page, and compared in the form of a histogram on the following page. (See Fig. 2).

It is interesting to note that the *Student* concerns category shifts in priority and in frequency between Round 2 and Round 3. Bear in mind that a student concern may have been a consideration of the maturity or the interest level or the skill development or the emotional state of the students. These are not presented as distinct concerns but are categorized here to indicate a general concern for the students’ state of being.
Table 7

Comparison of Top Three Concerns from Delphi-Round 2 and Delphi-Round 3

<table>
<thead>
<tr>
<th>Delphi-Round 2</th>
<th>Delphi-Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher 1st 2nd 3rd</td>
<td>Teacher 1st 2nd 3rd</td>
</tr>
<tr>
<td>0104</td>
<td>stu</td>
</tr>
<tr>
<td>0728</td>
<td>stu</td>
</tr>
<tr>
<td>0928</td>
<td>tchr</td>
</tr>
<tr>
<td>1234</td>
<td>approp</td>
</tr>
<tr>
<td>2491</td>
<td>imp</td>
</tr>
<tr>
<td>2626</td>
<td>approp</td>
</tr>
<tr>
<td>2726</td>
<td>stu</td>
</tr>
<tr>
<td>3456</td>
<td>stu</td>
</tr>
<tr>
<td>3535</td>
<td>stu</td>
</tr>
<tr>
<td>4665</td>
<td>stu</td>
</tr>
<tr>
<td>5678</td>
<td>natissue</td>
</tr>
<tr>
<td>6534</td>
<td>stu</td>
</tr>
<tr>
<td>8371</td>
<td>stu</td>
</tr>
<tr>
<td>8479</td>
<td>stu</td>
</tr>
<tr>
<td>9221</td>
<td>stu</td>
</tr>
<tr>
<td>9613</td>
<td>stu</td>
</tr>
</tbody>
</table>

approp = Appropriateness  
clas = Classroom  
commun = Community  
imp = Importance (formerly Implications)  
mat/info = Materials/Information  
natissue = Nature of the Issue  
stu = Student Concern  
tchr = Teacher Experience & Background & Teacher Role & Philosophy  
tim = Time
Fig. 2

Frequency of responses in the top three concerns from D2 and D3.
As a rival theory, concern for students might also be described as a politically-correct choice. Teachers are socialized to express concern for their students. While this concern may be inherent in a teacher's personal and professional roles, more complex thinking about the use of issues in science class may have affected the outcome in Round 3. Through the member checks, the teachers confirmed and even elaborated their concern for students, frequently assigning some importance of knowledge of this topic to their students' lives and even to the future of society.

Is the issue something that my students 'need' to know? (3456)
Will it help my students prepare for the future? (4665)
And eventually, it will lead them to make responsible decisions. (0728)
It must be of use and concern to the student and world (1234)
Will it have an effect on the child's decisions and process of learning in life--student appropriateness & interest! (9221)

Considering what's going to happen with some of these issues, like population, in the next 30 or 40 years, with the growth and the effect on the environment, that it's going to brutally affect everybody's life. And I think that it's important for them to understand it, because the more educated you are, the more you can do about it. (0104)

Comments such as these bring the model to mind. The teachers' personal and professional characteristics are demonstrated here to influence their judgment about what is important for the students to learn. A teacher's view of our common future, then, influences the amount of class time that is given to a topic.

It should be noted that each of the concerns mentioned by the teachers could result in implicit or explicit actions that would affect the implementation of the lessons. The range of possible actions relative to any particular concern includes removing it from consideration (e.g. "Not to act, is to act"), to some degree of modification of the
lesson to accommodate the concern. Concerns that resulted in explicit and declared accommodation strategies were of particular interest and provided focus for the study.

Through a variety of remarks, it became apparent that there were potentially negative effects of an issues-based lesson for the students, their parents, the school administrators, the local citizens or the teachers themselves. Comments and responses revealed an awareness of potentially negative situations:

You know, they don't give me a problem, but I've heard them giving some other people some real, some real problems. [emphasis in original] (8479)

Administrative support for sensitive topics--very related to conservative/liberal community (2491)

How will the students react to this? (If a negative response results--will there be staff and district support if it's an important concept?) (9221)

As these concerns surfaced, the teachers were probed to offer an explanation of the effects the concerns had on their lessons. The teachers presented a variety of strategies that could minimize the negative aspect/s of an issues-based lesson, and the consequences that were possible:

Well, there are things that I might do to reduce the chances of getting yelled at by an irate community member (4665).

One strategy used by four of the teachers included presenting the lesson very factually:

I introduce it based on the factual information that I've been able to gather from journals, articles, and things like that. (5678)

Others used time-out and conflict resolution strategies to reduce the emotionalism or discord:

You've raised some questions; you've raised some questions. Let's try to resolve those before we go on . . . if they are resolvable. (0928)
Still others chose to make the lesson less personal, at least initially:

Ordinarily, when I would start things, I would try to get it as close to their own personal thing to start with, but in this case, to avoid that hassle and that conflict at the initial stage, I would start far out, with somebody else. (9613)

A common approach was to provide “balance,” to offer information that would explain “both sides” of a controversy. Twelve of the 16 teachers reported use of this strategy. In 5 of these cases, the stated goal was to “Let the kids make their own decisions” (8371).

Throughout the interviews, teachers referred to the possibility of “a parent call.” After a few of the interviews had been conducted, I decided to probe what that reference really meant to these teachers. A question was added to subsequent individual interviews and the final questions posed in the focus group interviews were, “What does it mean when a parent calls? Who do they call? What process is set in motion when that happens?”

As might have been expected from teachers employed by 11 districts, a variety of situations was described. Most of the teachers felt that display of the materials or prior announcement of the lesson or unit was most useful when communicating with parents.

And, have any materials open for them to read at any time. . . . The more supportive you are to the parent, the more supportive they’re going to be back (to you). (0104)

Others indicated that a miscommunication may have prompted the parent telephone call, and that presenting the situation so that the parent would “understand” would adequately address the parent’s concern.

Sometimes if there’s a problem when the parent calls in, it’s because they don’t understand what went on, and it’s not that they’re objecting that much, but they just don’t know. (9613)
Situations where dissatisfied parents were concerned about a factor that was beyond a teacher's ability to respond were generally considered to be within the domain of another level of district operation, such as the guidance counselors' role, or the building principal, or district superintendent. In the cases of continued parent dissatisfaction, one teacher reported gathering supporting evidence from other teachers in the building.

In one case, an official policy was described that specified which district personnel could respond to parent concerns. Other teachers in the room nodded and murmured approval of that district's approach to this situation.

Our school has an official written policy that if they [parents] call the principal, the board, or whatever, they're to be referred directly to the teacher. The principal and so on is not supposed to talk to them. They talk with the teacher, and if they're not satisfied, then they can request a conference with the principal and the teacher, and kind of move up. (2726)

During the individual interviews, some of the teachers were asked if there were topics or issues that they would not use in their classrooms. Four teachers responded that issues related to human sexuality would not be considered for their classroom use. Their reasons varied, but were related to classroom management concerns, personal uneasiness in presenting the topic, and the potential responses of parents. For example,

I think that the issue about birth control . . . which is really very very important . . . could end up being very sensitive. And I would hesitate approaching that, and I'm not quite sure how I would handle it. I think it ought to be brought up, but I'm not sure I have the skills to do that, you know, in a sensitive situation. (9613)

Further investigation of the implementation of issues-based lessons may provide more evidence of a relationship between teachers' levels of concern or anxiety and the implementation of lessons about specific issues.
To summarize, the data tables (Tables 5-7) showing the categorized responses of the teachers display the areas of concern that were reported as they consider issues-use in their secondary science classrooms. The types of “things” that these teachers consider include:

- **Appropriateness** to the curriculum;
- **Classroom** concerns about management and student behavior;
- **Community** concerns relative to the parents, administration, and residents of the district;
- **Importance** of this topic to their perceptions of the students' and society's future;
- **Materials and Information** concerns about availability, quality, reliability, etc.;
- **the Nature of the Issue** and its substance, biases, and relevancy;
- **Student** levels of maturity, skill development, awareness of emotional state, and experiences;
- **Teacher** knowledge, experience, and professional concerns; and
- **Time** required to present the topic adequately, and to prepare the lesson/s.

These categories support the graphic model displayed on page 32. The categories named above can be logically placed within one or more of the components of the model. Again, the category names given to the teachers' concerns will be capitalized and italicized. The components of the model will be capitalized, only. Each of the primary components of the graphic model are compared below with the concerns expressed by the teachers.

For example, the personal and professional characteristics of the teacher, shown as the lights illuminating the scene, represent the **Teacher** category that emerged from these data. Representation as two separate light sources expresses the contributions of both personal and professional backgrounds, and yet they have a combined effect. As
might have been anticipated, it was difficult to separate professional considerations
from the influence of a teacher's personal background and so the categories collapsed
under analysis.

Student concerns seem to constitute a primary filter for teacher thinking, as was
shown in the model. Repeatedly, the teachers expressed concerns for their students'
Levels of Cognitive Development and Social Skills that would be required to approach
the sometimes controversial and personal nature of the selected topics. Concerns about
their students' Interest, Motivation, and probable Participation along with Prior
Knowledge and Exposure to Concepts/Ideas address the teachers' perceptions of student
readiness for a topic or issue. These concerns can be linked to the teachers' attitudes,
values, and beliefs and are likely expressions of the teachers' implicit theories about
students and learning. The expressed goals of five of the teachers were to foster
improved decision-making skills for their students' future and lifelong learning.

The Institutional Considerations filter in the model accommodates the
Appropriateness concerns for the curriculum or course of study. The concerns about
"fit" with the existing curriculum and congruence with coverage in the textbook that
were mentioned repeatedly by the teachers provide evidence of this. Some of the
teachers mentioned Equipment and safety considerations, which could be interpreted as
Facilities and Equipment concerns. And lastly, support from the department chair and
mention of other colleagues who use issues were mentioned by five of the teachers, and
could be placed in the Accountability Mechanisms and Degree of Collaboration items
under Institutional Considerations in the model.

The Pedagogical Decisions area was well-represented in the teachers' comments.
Appropriateness as seen in the model could, in retrospect, include both Student
calms and Appropriateness to the curriculum, since both affect the teachers'
implementation choices. *Time* became a separate category in this investigation, although it is a universal factor that permeates the personal space of Teacher Characteristics, the Institutional Considerations, and the Pedagogical Decisions and Topic/Issue areas, as well.

Questions of assessment and evaluation were mentioned by three teachers. Several teachers posed questions related to implementation. “How do I present this issue?” (2298) or “Can the students decipher the information?” (8479) and ideas about student projects and student investigation surfaced repeatedly. These questions and statements acknowledged the teachers' Pedagogical Decisions about teacher-directed and student-centered options for implementation. As has been mentioned before, Learning Styles and Equity Issues were both mentioned specifically by one teacher, without further elaboration.

The Topic/Issue area of the model was the most frequently addressed by this group of teachers, but their remarks were often coupled with Pedagogical Decisions concerns, confirming their complementary nature. The Relative *Importance* of the topic to their students' learning and development and to society at large was a primary consideration of these teachers. Likewise, the Teacher's Knowledge and *Time* to prepare the lesson were mentioned repeatedly. *Materials/Information* were also a primary concern for these teachers, particularly in relation to their appropriateness to their students' interests and levels of skill or awareness, availability to both teacher and students, the balanced presentation of the topic in the materials, and the reliability of the information. One teacher expressed concern about multicultural sensitivity and accommodation of learning styles in reference to materials, as well.

The Consequences of using a Topic/Issue were expressed most often in terms of anticipated responses of the parents and the district administrators. None of the
teachers explicitly considered legal ramifications of using an issues-based lesson. Use of the topic or issue was sometimes couched in terms of appropriateness to the course of study and therefore, represents an Academic concern that I have interpreted as a Professional judgment.

As the concerns were identified, a logical question that arose was: Were the concerns of these teachers sufficient to arouse anxiety about using issues-based lessons? An assumption underlies this question. I thought that teacher anxiety related to use of a particular issue in class might result in less attention to issues-use in general or avoidance of particular issues-based lessons. This assumption was based in part on a generalization from research conducted with elementary teachers who reported a reduction in anxiety in relation to increased knowledge of the topic after completion of a science content course (Westerback & Long, 1987). Their findings suggest that increased confidence in content knowledge was associated with a reduction in the elementary teachers' anxiety about teaching a particular topic. So, what levels of anxiety about issues-use, if any, were acknowledged by this group of secondary science teachers?

Research Question 2: What levels of anxiety are expressed by secondary science teachers as they consider the use of specific topics for issues-based instruction?

Levels of Anxiety and the ST STPI:

To answer this question, the teachers reported their anxiety levels about hypothetical teaching scenarios that involved issues-use, using the ST STPI. This instrument required responses to Likert-type items that asked about their levels of anxiety in relation to a particular teaching scenario as a report of their state-anxiety, and about their levels of anxiety about life in general, which was a report of their trait-anxiety. The ST STPI was administered six times during the ten-week quarter
(see Table 3, page 45). Each of the issues-use topics was presented twice. The items that were part of the State and Trait Anxiety subscales of the ST STPI were analyzed in response to this research question after completion of the series.

Recall that state anxiety (S-anxiety) indicates teacher responses to test items in reference to a hypothetical teaching situation that was read to them during the administration of the ST STPI (see Appendix F). The teachers responded to the items on the S-anxiety report and then continued on the reverse side of the instrument to report their trait anxiety (T-anxiety), or how they felt about life in general.

The questions that began “How do you feel about . . . ” were posed to the teachers in a pencil-and-paper format so that they could privately rate their levels of anxiety. Because they could submit their responses in a confidential manner for examination at a later time, the responses may have been more representative of their true feelings than those expressed in the interviews. This approach documented the teachers’ assessment of their anxiety over the ten-week period of the class.

Mean state and trait anxiety scores were calculated for each teacher to reflect their overall assessment of their anxiety related to issues-use and to life in general. (See Appendix I). These means are interpreted to be average representations of the teacher’s levels of anxiety since they are the mean score of the six administrations of the ST STPI at particular times over a period of ten weeks.

It is postulated that anxiety about life in general on any given day might vary somewhat depending on the particular situation or circumstances. Consider as an analogy that each person’s body temperature and blood pressure vary somewhat throughout the day and from day to day. Therefore, most individuals have a range of values that would be normal for them for each of these phenomena, and these variations would cluster around a mean value for that phenomenon for that person. Likewise, it
is plausible that a variety of factors contribute to a person's levels of trait anxiety on a daily basis and that an anxiety score might be expected to vary throughout the day and from day to day, as well. If this is true, then, over the period of ten weeks and six administrations of the ST STPI, it is within reason that each teacher's scores might vary somewhat, but would cluster around a mean score that would be typical or representative of that person's level of trait anxiety.

Each teacher's S-anxiety score was analyzed relative to the group means for unusual levels of anxiety regarding a particular issue or topic. One teacher (4665) reported anxiety levels that were slightly greater than two standard deviations from the group means on the population stabilization issue scenario used for the S-anxiety measure. Another teacher (8479) reported a level of anxiety that was greater than two standard deviations from the group mean regarding the resource use scenario on the first administration. In both cases, these data complement the teachers' descriptions of their teaching situations and their personal histories. Given the number of administrations and the range of individual scores, these three scores were noted as extreme but were not invalidated.

Each administration was analyzed separately using descriptive statistics (see Appendix I) as well as in relation to the interview data that were also gathered from thirteen of the sixteen participants about anxiety and issues-use. The data were visually scanned for completeness each week and entered into a data analysis program, but the descriptive statistics were not calculated until after the entire series was completed.

Because of the purposeful sampling and the restricted sample size, no general statements are made about secondary science teachers on the basis of this study. Comparison with the psychometric data reported for the STPI and the nearly random
distribution of the teachers' individual mean scores for state and trait anxiety would indicate that this group of teachers reported low to moderate levels of anxiety, both in relation to issues-use and about life in general. There was no discernible pattern among the data for the group. (See Fig. 3, on page 99).
Fig. 3

Distribution of Individual S-Anxiety and T-Anxiety Mean Scores
The group means for S- and T-anxiety were plotted relative to each other for the six administrations and within the time frame during which they occurred. For example, the General Issues-Use report was taken for the first time during Week 1. This administration is referred to as G1. The group mean for S-anxiety for the first administration is designated as G1-s. The group mean for T-anxiety for the same administration is labeled G1-t on the graph that follows. Each of the topics was addressed twice, so the same labeling procedure was used for the second administration. Therefore, G2-s and G2-t represent the S-Anxiety and T-Anxiety group means for the second administration of the General Issues-Use report, G2, which was obtained during Week 10.

In most cases, this group of teachers reported lower state anxiety regarding issues-use than they reported about life in general. (See Fig. 4, page 101). Plotting the group means revealed a variation in the pattern regarding the population stabilization issue. The pattern is distinctive, but all the group means fall within a relatively narrow range of 3.6 points. There may have been a reactive effect to the clarification of the term “population stabilization” in the introduction for this administration. Another possibility may lie in the nature of the topic itself. The population stabilization issue is arguably the most politically and personally sensitive of the issues presented to the group for S-anxiety reports, and as such may indicate that consideration of some issues may increase teachers' anxiety about using an issues-based lesson in science class.
Fig. 4

Group Means for S-Anxiety and T-Anxiety per ST STPI Administration
To summarize this discussion of the teachers' anxiety levels, it can only be said that this group of teachers showed a fairly random distribution of both state and trait anxiety levels. Some were considerably more anxious about life in general than they were about issues-use in their classrooms. Others reported low anxiety levels about both life and issues-use. Still others reported feeling fairly anxious about both. And some reported low anxiety about life in general, but higher than average anxiety about issues-use compared to the rest of the group.

The ST STPI results compared favorably with my assessments of these teachers' anxiety levels. By discussing specific issues with the teachers individually, and hearing about their school setting and the other teachers with whom they work, I have a sense of their concerns, much like a teacher's supervisor would have. One teacher's S-Anxiety mean seemed to be high relative to my perception from the interviews and Delphi responses. I reconsidered and re-read my information, and acknowledged that this teacher was coping with personal anxiety by use of a series of strategies. This was confirmed through a member-check. She acknowledged that she had learned how to reduce her stress related to issues-use and that she felt that discussion of the issues was important.

Sources of potential anxiety:

In addition to reporting their levels of anxiety, the teachers were asked about the potential sources of anxiety related to issues-use. One question in the individual interview elicited comments about the potential sources of concern or anxiety about using issues-based lessons to teach science. This question was posed in reference to a specific topic. Thirteen of the 16 teachers participated in individual interviews and responded to that question.
The question was, "What aspects of today's topic or lesson about [a specific issue] might make you anxious about teaching it at your level?" (See Appendix D). Because the interview questions asked about sources of anxiety, degrees or levels of anxiety could only be inferred by the intensity of the teacher's remarks, and by the use of adverbs such as "very" or "not very." Some teachers shrugged and made other dismissing gestures, or facial expressions that indicated little concern. Self-report may have been unreliable when face-to-face with a teacher/researcher who is interested in issues-use. So, triangulation of data provides a checks-and-balances approach to the anxiety question.

If no anxiety was expressed, then a probe was used: "What might make other teachers anxious about using [the issues-based lesson]?" Any response to that question is admittedly hearsay, but it provides an indication of the teachers' thinking about anxiety in relation to issues-use. Observational notes about the teachers' expressions were used to assess the relative degree to which anxiety was present. My observation notes included descriptions of the teachers as being "somewhat anxious," having "little anxiety," or "considerable anxiety," often described in relation to a particular situation or topic. These interview and log data were also examined in relation to the teachers' anxiety self-assessment of anxiety obtained through the repeated administrations of the ST STPI.

"My own lack of knowledge" (2491) of the topic was named as a potential source of anxiety by three of the teachers. "Being adequately prepared and keeping up with new knowledge" (0728) is a potential source of anxiety that has implications other than knowledge, since it is also a reflection of teachers' available time.

Another potential source of anxiety was the reception of the issues-based lesson by the students. Four teachers made statements that the lessons might "relate right
back to their families" (2726) or “might impact my students at their home” (9613). As they explained that students rarely have any level of self-determination, those concerns about the perceived impact of the lesson on the student's home life reinforced the importance for these teachers of a lesson that was “very factual” (4665) and that was “not judgmental” (2726).

Once the teachers had decided to use an issues-based lesson and its implementation was being considered, then the parents and the community were explicitly mentioned as potential sources of anxiety. One teacher referred to the administration, saying that “There might be societal types of things that might serve as pressure and might make one anxious” (0928), and in the same commentary pointed out how “positive publicity” had always worked in that teacher's favor, but acknowledged that “There might be some sensitive issues.”

I have interpreted the Student and Community concerns as being interrelated, but acknowledge that they appeared to be considered at different stages of the planning process. Concern about the impact of the lesson on the students' lives, in their homes and neighborhoods, is linked to the concern for Community. In one case, it could be argued that the teachers are sensitive to the students' condition of having inherited through their family, a place, lifestyle, or both, that they did not choose for themselves. The teachers acknowledged some constraints in relation to the students' receptivity to other perspectives.

As long as it's an issue that doesn't directly affect how their parents think or how their parents have been teaching them and things like that. ... Then they can be excited about those and be objective and see the whole picture. ... But, I think that the more sensitive the issue gets, the older a student has to be, to be objective. (5678)
A similar concern for students and their home situations regarding parental influence was addressed by another teacher in response to a different question later in the study:

Be sensitive to the opinions of students that disagree and also be aware that students do not always have a choice in some of these issues. They must for now, act as their parents dictate. (2726)

Alternatively, the concern for student perceptions of a lesson could be construed as being a manifestation of the Community concern. Concern for the Student is more immediate and has more direct influence on teachers’ daily interactions, so again the relationship between these concerns seems to be important.

An awareness of the potential conflict with various religious orientations was noted, and 3 of the 13 teachers who were interviewed pointed out that belief systems had directly influenced their science instruction in the past. These teachers were responding to three different sets of circumstances and different groups of people regarding a science lesson or unit. One teacher spoke about a parent removing their student from the introduction to a health unit, because modern medical treatment was not acceptable to their family because of their faith. The second teacher encountered disagreement among the teachers in her science department regarding the presentation of evolutionary theory:

There are a few things in there that... some of the teachers that are very religious objected to. That brought up some issues... and I think that is one of the biggest problems we have up here... as far as science goes... is the religion thing... evolution doesn’t get hit real hard here. Some teachers do it more than others. (B479)

The third teacher was responding to a student’s concern about a population stabilization issue presented to the class. Each of these teachers then went on to discuss the strategies that they used to address the scientific bases for these lessons. A separate section about strategies used by the teachers to address these concerns is
developed under Research Question 3 which asks about the insights that these teachers might offer others.

In the negative cases, where five of the teachers reported having low anxiety about using issues in science class, implicit authorization seemed to reduce the teacher’s potential for anxiety. Four of these teachers supported their use of issues in science class via a relationship to the textbook or to the course of study, or by virtue of their training as a science teacher. Offering an explanation for having little anxiety about issues-use, one said:

It’s a board-approved course. I mean, if you’re not going to talk about issues in an environmental science class, where are you going to talk about them? (0104).

Two of the teachers described what I refer to as “professional judgment” by explaining more fully in two separate focus group sessions what had been alluded to in their individual interviews:

A certain amount of professionalism is endowed upon you, when you receive a degree, in the eyes of society . . . and I think with that is granted, to some degree, a little bit of freedom to use your best judgment as to what you want to try to get across in your classroom. (5678)

This teacher followed that statement with an acknowledgment that this privilege has been and is being abused, but that the use of professional judgment should have legitimacy. He also described a supportive administration, and considerable experience with local issues in his classroom. The other teacher has experienced the proactive stance taken by a small group of parents who have voiced disapproval about their district’s science curriculum:

It’s an issue of respect, also. I mean, can they (parents) respect us as educators having the training to develop a curriculum that best benefits their children, just like they respect their doctor, and the decisions their doctor makes for their child’s health? Same issue. (2491)
In both of these cases, these teachers have been socialized to take responsibility for implementation decisions based on their professional training.

Another teacher who reported a considerable amount of anxiety about both life in general and issues-use, used the textbook as a justification for his use of class time. If he could tie the lesson to the topics identified in the textbook, he felt more comfortable with the issue.

I do use the textbook. It was adopted by our school district textbook selection committee, and I feel pretty comfortable with, if they say that's what science teachers should be using, then I feel pretty good about using that. (4665)

None of the teachers indicated a direct concern for any effect/s on the student-teacher relationship, or their working relationships with their colleagues. It could be argued that concern for students' lives and perceptions of the importance and delivery of the lessons is also a concern for the student-teacher relationship.

In answer to this research question, a variety of levels of anxiety were reported, both regarding issues-use and life in general. Some topics may be more likely to generate anxiety than others for science teachers, subject to the context within which the teachers work. Regarding sources of potential anxiety, the teachers' assessments of their students' situations, the perspectives held by various members of the local community, and their personal philosophy including their role as a science teacher were reported to contribute to their personal anxieties about curricular implementation.

Research Question 3: What insights can teachers who use issues-based instruction provide to others that might foster the use of this approach?

At the time of the member checks, the teachers were asked if they would offer three or four pieces of advice to a beginning teacher who was considering issues-use.
Eight teachers responded to this Quick Question: "If you were asked to offer advice to a new teacher about the use of issues in the classroom, what things would you say?"

Several responded with numbered lists. Others had already mentioned suggestions or tips during their interview or focus group session. Prior to the presentation of this question, those remarks had been tagged with a code for "strategy" which was not categorized as a type of concern. The strategy designation represents a planned response by the teacher to an expressed concern. Comparisons were made with the responding teacher's interview statements to see if their ideas about issues-use had changed.

The alphabetical listing of categories that were represented in their responses to this question include the following:

- **Appropriateness** (to the curriculum),
- **Community** (parents, administrators, district residents),
- **Importance** (of the topic),
- **Materials/Information** (availability, types, reliability),
- **Nature of the Issue** (current, substantive, emotional)
- **Teacher** (knowledge, background, interest)
- **Student** (readiness, maturity, interest, participation).

Many of the same concerns that had been revealed in the earlier probes were enumerated. As always, these comments can be cross-referenced. There are implications and complexities that lie within such succinct answers, but these responses provided evidence of "theoretical saturation" (Strauss & Corbin, 1990, 188). I was repeatedly reading and hearing the same concepts from this group.

What issues are locally relevant? (0928)

Make certain the students are interested in the issue--they must see some importance in it (2726)
Talk to the other teachers in the department to get a feel for the community and the school. What type of parents and kids are they dealing with? (To help them plan the approach they will take). 

Do you know enough about the issue, or can you find enough information to inform yourself as the teacher? (so that you have some expertise to teach, or explore the issue with, your students). 

Know your community. . . . Know what the majority thinks or accepts. Choose your battles. 

Ensure the lesson does not offer biased opinions. 

Strategies for Issues-Use: 

The following section presents a summary of the strategies that were offered by these teachers as ways to incorporate issues-based lessons more easily into their classroom settings. As has already been stated, presenting the pros and cons, or allowing discussion of different viewpoints was considered to be very important by a majority of these teachers. Removing their bias and keeping their opinions to themselves was also important to several of these teachers. Presenting "both sides" was used as a strategy to accommodate that concern. I question the use of that strategy, which will be discussed again in Chapter 5. Another reason for this strategy was offered: 

I also like the idea of using issues to look at the scientific process. You have both sides of an issue: which arguments are most scientifically-sound or scientifically-accurate? Who's producing these documents? 

Allowing the students to investigate and design their own studies also enabled the issues-based lessons for these teachers. This is not a risk-free situation, however, and professional judgment is called upon throughout the unit: 

Stepping out of the limelight for the first time--it is difficult. . . sometimes, I have some dilemmas as to where do I let go, and let them run. And how many mistakes do I allow them to make before I step in and say, 'Let me guide you.' And that's the big
before I step in and say, 'Let me guide you.' And that's the big issue that I feel is one of the dilemmas, one of the anxieties, I guess. (2491)

One teacher expressed another control-based source of anxiety related to the proposed student-conducted survey of local residents used in the administration of RU1 and 2:

I probably would want to have an idea of what their questions are, before they go out. An idea of... exactly who are they going to target to talk to... are we talking about homeowners... or apartment dwellers... exactly where are they going to stop and talk to people? (3535)

Is the nature of this concern the type of information that the students will gather, or is it the possible perceptions of that teacher by the community? He felt accountable for his students' actions and didn't want the nature of the lesson to be misconstrued by the community or by his immediate supervisors. When planning an issues-based lesson, another teacher said:

And students get to pick the issues... that they are most concerned about... to investigate further, and learn more about. (0104)

Another believes that student interest and motivation is improved by making it personal for them.

I think the bigger impact is when you do apply it to their daily lives, and they can see how their decisions, how decisions of the community, whatever, impact their daily lives. [emphasis in original] (2626)

Delaying the personalization of the issue until after the students had considered a similar situation farther from home was also proposed:

I would try to make it more generalized, so that it wouldn't, (in the initial stages) and then, ... after they felt comfortable with that, then I would say, 'Now, what about your area? What about your neighborhood, how would you feel?' (9613)

One teacher summarized his use of issues-based instruction this way:

You really have to integrate it with... the content-based education that you're required to get across, as put forth in the curriculum. So, if you can get that content across and allow them
to form their own opinions and be objective about other viewpoints, then, that's ideally what you're looking for. (5678)

The preservice teachers proposed sending home prior notification of the lesson to allay parental concern. Another young teacher mentioned this as a possible strategy as well, but said that she'd had no problems, so hadn't used this strategy herself.

For parents' reactions, you could notify them ahead of time that you're discussing a certain topic in the classroom. If they have a problem, have it all laid out so they can see how you're going to teach it. (8371)

Another strategy was to use conflict resolution as a part of the lesson. Three of the teachers used this strategy to encourage respectful tolerance of others' views.

And I think in terms of arguments between classmates, or whatever . . . that it's just a matter of establishing respect and establishing tolerance and saying, 'It's OK if you believe that, you're entitled to your position. Let's see . . . Can you see why, maybe, this person thinks this?' (2626)

Saying, 'Maybe we need to pull away from this and take the long view for a time period.' It could be just a short time-out if it was not real heated. It could be 'Let's go back and dig some more.' (0928)

Then, I usually try to be pretty patient, and say, 'OK, I don't always agree with everything you say. Many of the other people in the class may not agree with you, but I think you need to have a chance to at least politely . . . express what your opinion is . . . and then we can recognize that it's one person's opinion and we can discuss that.' (4665)

Several teachers expressed the importance of these types of lessons and their plans to revisit and to model the concepts. A one-shot lesson was acknowledged as being less than effective in fostering student understanding of the issues.

Because to the learner, you're not spending much time on it, so neither should they . . . It's almost like the time on task idea, you know. If you just bring it up at the end of your lesson, then you must not be that concerned about it. It's the same idea. (6534)

I think that you have to present it again and again, this information, and talk about it and internalize it in some way. And
eventually, it will lead them to make responsible decisions. And, you have to model it too. (0728)

It has to be a consistent exposure to the topics, not necessarily a daily thing, but over the course of a grade school, or middle school, or high school career. I think those issues need to be touched on at some point, consistently each year. (5678)

Likewise, the potentially-negative impact of some of the issues was explicitly addressed. Three of the teachers commented about fighting the apathy and pessimism that can develop when some of the more complex issues are discussed.

I think it is important to bring in examples of communities that have made a difference. (2626)

I probed some of the teachers, asking them to consider what they would do next if an objection occurred, or if their strategy didn’t work. Depending on their commitment to the topic or issue, there were different responses, but most indicated that they would persist, with some modification.

If it’s an easy fix, you know, that can be . . . ‘We’re going to give them the rest of this.’ . . . It could be a whole range of things. (8479)

If I did have parents that had some serious concerns about what I was planning on doing, I would hear them, and maybe even make some changes in what I was originally going to do to satisfy them, as well as satisfy my own goals and objectives. (2626)

One way is to change your methods of teaching, or change the curriculum if that’s necessary. (0728)

Because this group of teachers uses issues-based lessons, their strategies have helped them to feel more successful in their implementation. A list of these strategies would include: providing balance and removing bias, using the lessons to build tolerance and respect for others' ideas, evaluating the science concepts and the bases of arguments presented in the popular press, enabling and guiding student investigation of topics of interest, and using positive approaches and revisiting the issues to combat the pessimism and futility that can accompany the investigation of some issues.
Research Question 4: What effects do these teachers suggest that the use of issues-based instruction has on student communication, interpersonal, and critical-thinking skills?

One teacher specifically mentioned "critical thinking" as an important part of her teaching, and the notions of providing experiences and social interactions related to citizenship and future decision-making arose several times. Three members of the group discussed their roles as science teachers in helping to develop an informed citizenry, capable of making "educated" or "responsible" decisions:

Part of an education is preparing kids for citizenry... And I think that it's your role as a science teacher, to present the global issue, and the global perspective, and the links, and to tie those things back into your backyard, your home. (2626)

Others stated it somewhat differently, but clearly had personal goals of contributing to their students' development, or helping them to become more capable of making informed decisions.

Eventually, it will lead them to make responsible decisions. (0728)

How will it help them in their future life and decisions that they may have to make someday? (8479)

Will it help my students make more educated decisions? (0104)

Improving citizenship skills or thinking skills were mentioned, but concerns were also expressed that there could be negative effects of using issues as the basis for science lessons. The potential for increased pessimism and apathy in response to the global nature of some of the issues, or to the alarmist positions taken by some media sources and teachers was also a concern.

I want to teach them to make decisions... I want them to be able to weigh pros and cons and come out with their best guess as to what the right thing is for them to do. But... how do you combat that pessimism in the classroom... because a lot of times pessimism fosters apathy, and, and how do you prevent that from happening? (2626)
And, I'm afraid that a lot of times when you talk about issues, the perspective that teachers, or presenters happen to take is very alarmist. And, I think we need to try to avoid that, in education especially. (2491)

Even so, one of those teachers suggested that experience in addressing the conflicts that are often a part of issues-based instruction would help students to acknowledge how difficult it can be to achieve consensus.

Well, I think that there's an educational value in conflict, too, because you're just extending what that classroom experience is. I mean, there's a community experience which is based on the same sorts of conflict... so that they can... knowing how hard it is to address conflict in a classroom, they can get an appreciation of how hard it is to address issues on a city-, community-wide, versus nationwide, versus global level. (2626)

This teacher seemed to be committed to issues-use, but was simply acknowledging her concerns about the possibilities of unintended effects of some topics and the controversy that accompanies them.

In answer to the research question, interpersonal and communication skills were not mentioned specifically by these teachers. But the value of consensus-building and conflict resolution were mentioned as potentially useful components of issues-based lessons. Critical thinking was stated as one reason for using issues-based lessons and it was implicitly supported by several of the teachers' comments about improving students' decision-making capabilities.

Research Question 5: To what extent do teachers suggest that science literacy is fostered through the examination and use of global environmental issues as the basis for secondary-level science instruction?

The evolving and somewhat nebulous definition of science literacy over a period of about forty years makes this question difficult to answer in the absence of the explicit use of the phrase "science literacy." Not one of these teachers used those words in their discussions or comments.
The definition for science literacy selected for this investigation from *Benchmarks for Science Literacy* (AAAS, 1993, 322) states that:

scientifically-literate people "are able, however, to use the habits of mind and knowledge of science, mathematics, and technology they have acquired to think about and make sense of many of the ideas, claims, and events that they encounter in everyday life. Accordingly, science literacy enhances the ability of a person to observe events perceptively, reflect on them thoughtfully, and comprehend explanations offered for them. In addition, those internal perceptions and reflections can provide the person with a basis for making decisions and taking action."

[emphasis added, p. 322].

This definition includes habits of mind and critical thinking skills which are important to informed decision-making, each of which have been expressed in various ways by these teachers, as shown by the statements selected for inclusion in this chapter. Some expressed the importance of these ideas as personal goals for their teaching, others stressed the students' understanding and ability to cope with and influence the future. Still others stressed the importance of investigating these issues as a citizenship skill. There is evidence of a science literacy component that was not specifically named.

The fact that these "issues-minded" teachers do not feel empowered to teach explicitly toward science literacy provided a reflective moment for me as a science educator. Local and personal influences were mentioned to the virtual exclusion of state and national goals, which provided only "background noise" in this investigation. It seems that the national efforts will suffer reduced potential to influence local curricula until a forum for discussion about implementation and assessment is also provided. These teachers were motivated by their own senses of purpose and accountability. If these teachers, who personally embrace science literacy as a goal for instruction, have not been motivated to refocus their instructional priorities away from traditional content themes, how will other teachers respond to state and national initiatives? This concern is addressed in the Implications section in Chapter 5.
CHAPTER V

DISCUSSION

Controversial Issues

The Board of Education believes that the consideration of controversial issues has a legitimate place in the instructional program of the schools. Properly introduced and conducted, the consideration of such issues can help students learn to identify important issues, explore fully and fairly all sides of an issue, weight carefully the values and factors involved, and develop techniques for formulating and evaluating positions.¹

The resolution quoted above is a reminder that teachers’ use of professional judgment and academic freedom to implement issues within their curriculum are subject to policies adopted by Boards of Education and upheld by district and building administrators. This position statement supporting classroom use of controversial issues includes the phrase “properly introduced and conducted” to define the context within which the issues may be used. It leads quite nicely into the discussion of this study.

¹ This resolution was adopted by the Board of Education for the Jackson Local Schools, Massillon, Ohio, on November 21, 1988. For more information, see page 171.
Limitations

It should be noted that this study is based on self-reports made by secondary science teachers who are interested in issues-use. The teachers agreed to be interviewed and to provide personal histories and self-reports of their concerns and anxiety regarding issues-use. Because purposeful sampling was used and a small number of teachers participated in this study, no generalizations can be made to other secondary science teachers. Likewise, no assumptions are made about the transferability of the teachers' beliefs, feelings, and opinions as stated in this document to their actual practice, since no documentary analyses or classroom observations were made.

The genre of teacher thinking research has its own inherent limitations. Thinking is difficult to reproduce, to describe, and to document. For example, researchers frequently use stimulated-recall techniques such as the use of video recordings or other opportunities for reflection. Or they sometimes record teachers' verbalizations as the teachers process information and make decisions in an attempt to capture the teachers' thought processes. The information-gathering methods used in teacher thinking research, and the analyses of that information, are often constrained by classroom dynamics and the limited opportunities for teachers to openly respond to inquiries made by researchers. This is especially true of decision-making that occurs while in the process of teaching, the interactive component of teacher thinking research. It is also acknowledged that even when the teachers' thinking can be elucidated, inconsistencies may exist between thought and action, purpose and practice. These limitations are recognized.
Another limitation has been the partial participation of some of the teachers. The busy lives of teachers during the school year and summer resulted in sporadic submission of documents and delays in receiving member check information. Three of the teachers did not submit all of the data source documents, even though they were given additional time, were sent reminders, and were given additional copies of the documents. The option of a telephone call, rather than a written report, was offered and yet repeated requests were unproductive. Likewise, those three teachers did not complete member checks on the analysis of their data.

No generalizability or broad application of the ST STPI information can be made from this study. Purposeful sampling and the variations that occurred in the timing of the administrations prevent generalization of these findings to other groups of teachers. The ST STPI instrument was reproduced for improved legibility and the headings on the trait anxiety scale were inadvertently altered in the process. The column headings corresponding to the Likert-type responses of 1 through 4 respectively on Form X-1 (the measure of state anxiety, curiosity, and anger) read as follows: Not at all, Somewhat, Moderately so, and Very much so. These column headings were copied to Form X-2 (the measure of trait anxiety, curiosity, and anger) found on the reverse side of the instrument, and in the process of doing so replaced the following headings: Almost never, Sometimes, Often, and Almost always. Therefore, this instrument is not directly comparable to other versions of the STPI. However, the six administrations of the instrument internal to this study were performed consistently, and the teachers' reports of anxiety levels are comparable within this setting.
Because of the interpretive nature of the study, it is descriptive of this group of teachers. The transferability of this study to other contexts is dependent on the “fit” (Lincoln & Guba, 1985) and is left to the reader’s interpretation.

Review of the Findings

The teachers’ self-report of their concerns regarding their use of issues-based instruction in secondary science classes was obtained through three administrations of an open-ended survey and through individual and focus group interviews. The following categories of concerns emerged from the analysis of the teachers’ statements:

- Appropriateness (to the curriculum)
- Classroom (management and implementation)
- Community (external stakeholders)
- Importance (of the issue)
- Materials/Information (available on the topic)
- Nature of the Issue (substantive, emotional, etc.)
- Student Concerns
- Teacher Concerns
- Time (teacher and class time)

Comparison of the top three concerns from Delphi-Round 2 (D2) and Delphi-Round 3 (D3) offers food for thought (see Table 7, page 86). Four concerns dominated the others when frequencies were counted. In both D2 and D3, the top four concerns were: Student Concerns, Appropriateness to the curriculum, Importance of the issue to the future, and the Nature of the Issue. Figure 2 on page 87 presents the frequency data
for Table 7 as a histogram. These teachers exercised their professional judgment in considering the relevance of the topics to their students' lives and acknowledged their roles as science teachers in the selection of the topics that would be used in their classes.

Analysis of the teachers' self-reports of anxiety showed that this group of teachers was almost randomly-distributed within a low to moderate range of anxiety about both using issues-based instruction in science class and about life in general. The teachers' individual means for S-anxiety and T-anxiety were found to be widely distributed over a normal range, and no pattern was discernible. (See Figure 3, p. 99.)

Group means were analyzed for each administration of the ST STPI on the three topics of general issues-use, population stabilization, and resource use issues. These teachers, as a group, reported less anxiety about general issues-use and resource issues used in science class than about life in general. This may have been expected from a group of teachers who have expressed an interest in and experience with issues-use. Yet, the topic of population stabilization produced an unusual pattern in their responses (Fig. 4, p. 101). This pattern cannot be explained on the basis of the data reported here, but suggests that some issues or topics may be more likely than others to stimulate anxiety for science teachers.

The teachers' insights gained from practical experience with issues-use were offered as advice, hypothetically, to a beginning teacher considering issues-based instruction in science class. Eight teachers responded to this hypothetical situation and their responses confirmed earlier positions about maintaining neutrality and the importance of being "objective." The teachers encouraged the new teacher to: know the community; understand the issue and have reliable information; demonstrate that the issue is relevant to students' lives; involve students actively; facilitate and participate
in learning; offer a forum for discussion that productively utilizes disagreement as a fundamental component of scientific inquiry; be sensitive to the fact that students may not have self-determination, and acknowledge that improved awareness of options can also be part of the lesson.

These teachers did not specifically refer to the utility of issues-based instruction for improving student communication skills or interpersonal skills. However, giving the students some experience with consideration of issues and modeling the processes of consensus building and conflict resolution were emphasized by the teachers as reasons why issues should be included in science classes.

"Critical thinking" was mentioned directly by only one of the teachers (2626). But this idea was included as an important aspect of issues-use through statements about “responsible decision-making” (0728) and “decisions that they will have to make” (5678) that were made by several of the teachers.

Similarly, use of the term "science literacy" was not offered in support of issues-use, but was apparent in the analysis of the teachers' statements, and was confirmed as an implicit factor in the teachers' thinking through the member checks process. Clearly, these teachers believed that they were contributing to their students' knowledge base and decision-making potential about topics that the teachers believe to be important to our collective future.

During the interviews, the teachers also revealed strategies that were used to accommodate their concerns. These strategies are summarized as follows:

-use of conflict resolution techniques,

-presentation of “both” sides, [or better yet, a variety of positions],
- assessment of the science concepts and the bases of arguments related to the issue,
- revisiting the issue throughout the year,
- making the lesson relevant to their students' lives (local issues), and
- attempts to remove teacher bias in the lesson.

It is recommended that conscious consideration be given to the role of the teacher in issues-use (Kelly, 1986), and that teachers consider whether or not it is possible or desirable for them to remove their biases during instruction. The impacts of strategies that address political position statements should be examined carefully.

The Model

The admittedly complex model of teacher thinking regarding instruction is based on the theoretical sensitivity developed through my experiences as a classroom teacher and as a facilitator for other teachers' experiences. Heuristics are evident in the development of both the study and the model. The graphic model on page 32 portrays the factors that are part of teachers' thinking as they consider topics for use in class. What is intended and cannot be displayed in the model is the analogy of teaching to the act of directing a "live" play. Notice that the teacher is not visible in the model. Instead the model shows the interacting factors that influence a teacher's choices. Attention to these factors provides the background for the "scene" that is viewed by the audience. The result, in terms of the broader interpretation and representation of the action, can be as recognizable as the director's influence on a major theatrical event.

Unlike the director's role in a Broadway play, in this analogy the director not only designs and constructs the set, but also chooses and orients the lighting, examines and considers the effects of the various filters and lenses, selects the acting players from
the available cast, and has outlined a script. The script can only be an outline because the players are improvisational and temporary. The director/designer maintains control of the soundboard, and in doing so, allows one voice or group of voices to be heard over others. In directing the "scene," the dialogue is either allowed to proceed or the action is stopped and given more direction. So, in this analogy, the director is also the author, in charge of set design and construction, and monitors the soundboard, as well.

Obviously, the director/designer makes professional judgments throughout each performance; no two of which are alike, and each of which are received differently by the audiences who favor one or another of the players. The reviews vary, and the director/designer considers them in her or his assessment of how to direct the next act. Just as one can recognize the "trademark" qualities of favorite screenplay directors, so too the "signatures" of teachers' collective choices for their instruction become clearly recognizable over time, as their roles are enacted.

As was mentioned in Chapter 4, the analysis of the data from this study supports the elements of the model, and each of the headings shown in the graphic could have been given more detailed attention and inspection. In the revision of the model (see Fig. 5, p. 125) the lighting has been displayed as a linked pair of lights, illustrating that the contributions of the teachers' personal and professional backgrounds to their teaching are closely related and almost indistinguishable in effect. The original graphic model differentiated between the personal and professional background of a teacher. This distinction was difficult to identify when analyzing the teachers' statements. The survey-like nature of this investigation does not enable intricate development of the interrelationships between the personal and professional contributions to teacher thinking, and does not allow clear distinctions to be made between them.
In the revised model, the students are placed at the focal point of instruction, as opposed to acting as an additional lens that filters the teacher's background in response to the institutional considerations. The teachers' expressed concerns for the students' readiness to consider issues, and the utility of issues-based instruction in helping these students to attain critical thinking skills and scientific knowledge, are better illustrated by placing the students at "center stage."
Fig. 5
Revised Model of Teacher Thinking Related to Issues-Based Instruction
So, how does this model relate to this study? The investigation of teachers' thinking in the use of issues offers an opportunity to describe teacher preferences and reasoning that support their design of the instructional setting. This is the interface between the teacher's Preconceptions and Implicit Theories and their Planning and Reflection mentioned in Chapter 2 as a focus of this study.

As a result of planning, and during the implementation of the lesson, the teacher directs the integral components of each activity. The teacher controls to a considerable extent who speaks, which behaviors and input are permitted and which are denied, and the time that is granted to develop a theme or concept. Furthermore, the teacher essentially controls the resources that are available to the students, as well as the physical and personal space in which the interactions can occur. While those effects are interactive during implementation, they are subject to the planning and implicit theories of the teacher.

Both planning and implicit theories govern the activities that occur in science classrooms. Drawing on the analogy of the stage, the angle, source and intensity of the lighting determine what is visible on stage. Likewise, what is allowed to be seen in the classroom is a function of the personal and professional background of the teacher. The choices that are made by that teacher are manifestations of their values and attitudes, their philosophy of what it means to be an educator, and more specifically, what being a science teacher means to them.

Similarly, the filters on stage lights control the placement and amount of light on the stage. The filter in the revised graphic on page 125 represents the influences of the community that act to focus the teacher's efforts on this group of students. Community and Institutional Considerations act as a lens or filter which controls to varying degrees the extent to which the personal and professional background of the teacher is expressed.
For example, the teacher’s assessment of student characteristics shapes the lesson by requiring an adequate grounding in basic information and skill development and variation in the modes and pace of instruction. Yet the process through which that occurs is shaped by the teacher’s perceptions of her or his role within the community and her or his own personal and professional background. Drawing once more on the analogy of the stage, in theatre, it is the director’s who notices when an area of the stage is not sufficiently lit, or receives too much attention, all the while maintaining awareness of and direction for the other ongoing activities. Likewise, the teacher examines the institutional and community filter and adjusts the activities accordingly, in keeping with her or his perception of how to best present an important topic to this group of students.

The revolving stage of interaction between the topic or issue and the pedagogical decisions that a teacher makes is difficult to represent in a graphic. These two concepts seem to balance each other, are necessary parts of the instructional moment, and are drawn here in the form of the yin and yang to represent their complementarity. The activities that transpire on stage, or in the classroom, are governed by the director’s approval, and are set up according to her or his best presentation, as judged from past experiences and professional training. So, too, the classroom teacher judges the best presentation for these students while planning activities.

Concerns for the students are supported by the interactions of the pedagogical decisions and the topic and issue. It is understandable that the student is at the center of the graphic model. Consideration of the students, their cognitive and social development, and their interest and understanding of the concepts, was shown to be the primary focus of attention as these teachers plan their instruction.
The graphic model is neither intended to imply that some of the factors are more important than others, nor that the considerations are sequential in any way. It is only my representation of the interacting factors within teacher thinking about the use of issues-based instruction.

Summary

This study relates well to other research and reports of secondary teachers’ use of issues-based instruction. For example, Kelly (1986) synthesized research from several fields to present and critique four perspectives on the teacher’s role in discussing controversial issues. They were characterized as: exclusive neutrality, exclusive partiality, neutral impartiality, and committed impartiality. He proposed the latter as the most defensible teacher role, and explained the somewhat paradoxical term.

Committed impartiality entails two beliefs. First, teachers should state rather than conceal their own views on controversial issues. Second, they should foster the pursuit of truth by insuring that competing perspectives receive a fair hearing through critical discourse (1986, 130).

The teachers in this study repeatedly emphasized “neutral impartiality” or the ideal of removing the authority position of their own opinions. Several stated the belief that the teacher’s opinions should not be offered to the class. Others stated that doing so would be acceptable, but only at the end of the unit. Perhaps preservice and inservice teachers should be encouraged to consider and define their considered roles in issues-based instruction within the scope of teacher education programs.
Rossi (1993) wrote about in-depth study in secondary social studies classrooms, which is analogous to issues-based instruction in a science class that includes student investigations. Both strategies benefit from student involvement, are more open-ended than traditional instruction, and are less defined or constrained by the narrow scope of some objectives in the curriculum. He wrote:

The role of disseminator of knowledge is one clearly defined in the minds of most teachers. . . . The role of teacher as guide or director is less defined. It requires greater teacher spontaneity and flexibility in a complex environment. It raises the challenge of how and when to use the teacher's subject matter background. It challenges teachers to re-examine their beliefs about what knowledge is of most worth. It challenges them to re-examine their knowledge about the abilities and priorities of learners (1993, 266).

Science teachers who consider issues-based instruction must respond to those challenges, possibly departing from their own experiences and preferences as learners. Remember that this re-examination of knowledge and beliefs is subject to the expectations of others outside the classroom door. The contextual factors within the school and community that influence and focus teacher attention on the implementation of their instruction have been identified as being significant (Ladwig & King, 1991; Onosko, 1991). The participants in this study also reported community concerns and suggested strategies that they have found to be successful in addressing those concerns.

Nelson (in Crow, 1989) refers to an "illusion of tragic trade-off between content and critical thinking in the teaching of science" which was also expressed by the teachers in this study. The amount of time they allotted to issues-use was often stated along with an acknowledgment of their accountability regarding content knowledge and skill development. These teachers believe that consideration of issues is
an important component of science instruction, yet the majority reported a “trade-off” view of issues-based instruction.

Several assumptions that are foundational in the writing on teacher thinking and teacher beliefs were cited by Vey (1992) and are reaffirmed by this study:

The teacher is semi-autonomous; the teacher’s actions reflect that teacher’s thinking which is based upon and expressed through the personal knowledge of the teacher; the teacher’s thinking is influenced by knowledge which is idiosyncratic, effected by the experiential base of the teacher, and the context of the school, and which affects the teacher’s perception of and response to classroom events (p. 28).

Acknowledging the effects of these influences, recommendations for a school policy regarding the use of controversial issues are also part of the literature. As early as 1975, Uphoff and Helms suggested that community members and personnel within the schools should be involved in the development of such a policy. Guyton and Hoffman (1983) have also argued that “the individual school should adopt a policy outlining the teaching of controversial issues.” It should be noted, however, that policies can also be restrictive, and that their formulation requires active involvement of the teaching staff, rather than simple representation.

This study outlines some practical considerations regarding issues-use as reported by this group of secondary science teachers (see pages 120-122). It also links their thinking to common contract language that reflects some of their concerns and that can support the “proper introduction and conduct” of issues-based instruction.
Implications

The importance of science literacy as a primary goal in science education is foundational to the use of issues-based instruction at the secondary level. In order to feel confident in the constructive use of issues as the basis for instruction, teachers must understand what science literacy is, value its primacy in the current science education reform efforts and in their own teaching, and experience success in the strategies and methods of issues-use. They may also need to examine their roles as science teachers and reconcile their experiences and preferences as learners and as teachers with the goals and objectives of initiatives being instituted within their districts and states. Furthermore, they may require professional support through collegial interactions, contract language, and professional associations to improve the effectiveness of their teaching toward the goal of science literacy.

As has been shown in the model, the interacting elements in teacher thinking encompass teachers' personal and professional backgrounds, community and institutional considerations, student concerns, pedagogical concerns, and the nature of the topic or issue to be examined. Teachers exercise professional judgment as they make implementation decisions regarding issues-based instruction.

Professional judgments made by science educators may also be sources of anxiety and may present an academic freedom question that was addressed by Moshman (1994). While the construct of "academic freedom" is more frequently associated with higher education, Moshman offered two reasons to support academic freedom at "all educational levels." He argues that restriction of student access to books and ideas violates their First Amendment rights, and he maintains that "Students learn and develop best in
environments in which they have free access to multiple sources of information and are
encouraged to form, express, and discuss their own ideas." He maintains that academic
freedom for teachers is "valuable not only because it tends to protect students' First
Amendment rights, but also because it promotes quality education" (1994, 33-34).

Both academic freedom and professional judgment are at the heart of a teacher's
decision to use issues-based instruction, and all three are defined within the teacher's
preconceptions and implicit theories about: students and learning, their role as a
teacher, and the subject matter that they teach.

The teachers in this study described their concerns and reported potential
sources and their own levels of anxiety related to their decision to use issues-based
instruction in secondary science classrooms. Their responses answered the research
questions posed here. But other questions about issues-use and science literacy were
raised as well. Research is a generative activity. It often raises more questions than are
resolved, and offers opportunities for reanalysis of the original context, questions, and
process.

The implications of this study can be addressed to at least three categories of
educators: classroom teachers at all levels, teacher educators, and researchers in
education. As was mentioned above, classroom teachers might consider their rationales
for and levels of use of issues in their instruction. They could investigate strategies and
materials that have been developed to foster critical thinking and to improve students'
decision-making skills. They might also reflect upon their perceived roles as educators
and the priority they currently give to science literacy in their teaching. Classroom
teachers are also encouraged to conduct action research to analyze their teaching. They
should be encouraged to compare the intended, implemented, attained, and null curricula
that are operational in their classrooms (Eisner, 1979) with the recommendations made in the *Benchmarks for Science Literacy* and *The National Standards for Science Education*. They could become more proactive in the resolution of the disparity between assessment and goals in science education. They should be knowledgeable about their district's definitions and treatment of academic freedom and professional judgment as they develop and implement their science curricula and adapt their instruction within their local settings.

The teachers in this study reported little formal training in issues-use. Teacher educators could help to prepare preservice and inservice teachers by providing guided practice and exploration of issues-based instruction in the relatively low-stakes environments of university classrooms. They could also provide successful models for integration of the disciplines for those teachers who have earned certification in a single area of science or who have never experienced "integrated science" as learners. Likewise, they could provide more strategic support for districts who struggle to restructure or revise their science curricula according to current recommendations for reform.

Science education researchers investigating issues-based instruction might consider some of the pedagogical aspects of issues-use. To what extent do the myths of "objectivity" and "neutral" presentation govern the use of issues in science instruction? What impact do these presentation styles have on students' thinking? How much authority is given to a "factual" presentation about an issue, and how are those facts selected? Whose facts are they? How much interaction between content knowledge and teaching style exists in the selection and presentation of issues as topics for issues-
based instruction in science class? Are students more actively engaged in learning during issues-based instruction?

Other questions are related to accountability in science instruction. Do teachers really believe that they risk imposing their values on their students, and is that an expression of a community concern? How can the measures of accountability be adjusted to support instruction that fosters critical thinking skills and social responsibility? How are efforts toward science literacy rewarded in public education? How accurate are science teachers' perceptions of their students' interests and needs, and their community's orientation toward, and their district's support for, issues-use?

Still other questions are related to teacher education. How might conflict resolution and classroom management training improve the likelihood of issues-use in secondary science classes? What can teacher education programs do to foster the acceptance of science literacy as a practical and meaningful goal for secondary science instruction? How are prospective teachers encouraged to define and compare their perceived roles as educators and as science educators with the roles defined by the legislative and governing bodies for their district? To what extent do science educators advocate science literacy? How can teacher education programs help science teachers appropriately and thoughtfully address differences in belief systems? These and other questions related to issues-based instruction in secondary science classrooms warrant continued investigation.

The rights of academic freedom and the professional judgment of public school teachers in reference to issues-use may be governed by local policies that are upheld through administrative decisions. The extent to which teachers are aware of policies related to the use of controversial issues varies (Engel, 1993). Because many
implementation decisions made by secondary science teachers are at least partially based upon preconceptions and implicit theories about their roles as teachers, including their personal assessments of the degree of academic freedom and professional judgment afforded to them, the ideas noted above may warrant further consideration in science education research and in teacher education programs.

The fact that these "issues-minded" teachers have not focused their teaching on science literacy as a goal also points to a notion of accountability. These teachers were motivated by their own senses of purpose and accountability. They acknowledged the importance of critical thinking and responsible decision-making and yet most have not been motivated or empowered to refocus their instructional priorities away from more traditional content themes. It seems that providing a local forum for interactive discussion about the implementation of state and national standards and goals, along with related assessment concerns, is a logical next step in effecting change.

Elements involved in teacher thinking have been identified and described in this investigation that can and should be considered formally in the experiences and training of preservice and inservice teachers. Support of issues-based instruction as a means of achieving the goals of Project 2061, as stated in the *Benchmarks for Science Literacy*, (AAAS, 1993) might be provided through experiential training in issues-use within teacher education programs at the university level. An open forum for the exploration of issues-based instruction and lively discussion about the expressed goal of science literacy and how it can be achieved can provide prospective and practicing teachers with opportunities to examine and frame their philosophies of teaching and their roles as formal educators.
APPENDIX A

PROTOCOL TO OBTAIN CONSENT AND CONSENT FORM
Introductory Script:

You are being asked to participate in a research study about the use of global environmental issues as the basis of lessons in science class. Your participation will include responses to questionnaires and interviews that are related to your personal, professional, and intellectual development; your history of issues use in the classroom, and your ideas about specific topics that are covered in this class. You may also elect to be the subject of a classroom observation as you teach using an issues-based lesson, if you wish. A standardized instrument will be administered periodically throughout the study to further document your feelings about issues use. The questionnaires will require written responses, and I would like to audio-tape these class sessions, as well as any classroom observations and/ or interviews that are conducted.

No personal risk or discomfort is expected as a result of participation in this research. On the other hand, your participation will serve to inform the science education community about secondary science teachers' ideas about the use of issues, and may contribute to improved teacher education programs in the future.

To protect your identity, you will be asked to generate a four-digit code that will be used to identify your responses. Envelopes with only your name on them will be used to distribute and collect written materials. Reporting of data will also involve occasional reversal of gender pronouns to further assure confidentiality. Any audio-tapes and original data sources that are produced will be maintained in my sole possession, and will be transcribed by me. I will personally destroy those audio-tapes and data sources upon completion of the study.

You are free to withdraw your consent to participate in this research at any time without consequence by notifying either Dr. McKenzie, Dr. Haury, or myself with a dated written statement to that effect. Please feel free to ask me questions about the research, either in person, by telephone or by using my e-mail address (clandis@magnus) all of which are listed on the board. You may also contact Dr. David Haury, who serves as the principal investigator for this study and whose telephone number is listed on the board, or the Human Subjects Review Board representative, whose telephone number is listed there as well, if you have any other questions about this research and/or your rights as a voluntary participant.

At this time if you choose to participate would you please read and sign the form that is headed, "Consent for Participation in Social and Behavioral Research" that has been distributed to the group. Please generate a four-digit code to identify your responses throughout the study period, and write it in the spaces marked on the upper right corner of the consent form. Then, write your name in the space provided on the envelope. Please insert the consent form in the envelope and pass the envelopes toward the front of the room at this time.
CONSENT FOR PARTICIPATION IN
SOCIAL AND BEHAVIORAL RESEARCH

I consent to participating in (or my child’s participation in) research entitled:

"Teachers' Thinking in the Use of Global Environmental Issues in Secondary Science Classes"

David Haury / Carol Landis (Principal Investigator) or his/her authorized representative has explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child’s) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child).

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date: January 4, 1995
Signed: (Participant)

Signed: (Principal Investigator or his/her Authorized Representative)
Signed: (Person Authorized to Consent for Participant - If required)

Witness:

HS-027 (Rev. 3/87) -- To be used only in connection with social and behavioral research.)
APPENDIX B

CHARACTERIZATIONS OF THE PANEL OF EXPERTS

AND PEER-REVIEWERS
Characterization of the Panel of Experts

(Data Source Document Review)

The panel used to determine the appropriateness of questions/prompts on the data source documents consisted of four educators/researchers as listed below:

Female educator/researcher who conducts global change research, teaches at the university level, and guides the development of autotutorial modules for pre-college science instruction.

Male environmental educator/researcher with ten years of experience in science education and educational research, including locus of control research.

Male science educator/researcher with precollege teaching experience and qualitative research experience at the university level, with major cognates of disciplinary knowledge and science literacy.

Male science educator/researcher with precollege teaching experience and qualitative research experience at the university level, whose research focus is conceptual change.

* * * * *

Characterization of the Peer-Reviewers

Female environmental educator/researcher with earned doctorate in science education and experience with qualitative research methods and teacher education.

Female graduate student/researcher with intensive exposure to qualitative research methodology and more than ten years of laboratory research experience in the biological sciences.
APPENDIX C

FORMS USED TO GATHER INFORMATION ABOUT THE TEACHERS
4-digit code: __ __ __

PLEASE CHECK OR COMPLETE THE FOLLOWING BLANKS (AS APPROPRIATE):

1. Female_______ Male_______

2. Age: 20-29____ 30-39____ 40-49____ 50-59____ 60+______

3. Degrees/years earned: Please indicate field(s).
   B.A._____________ (19___)
   B.S._____________ (19___)
   M.A._____________ (19___)
   M.S._____________ (19___)
   Ph.D._____________ (19___)

4. Certification(s) held:
   K-8 _____ 7-12 _____ K-12 _____ Other ______
   Science field(s): ______________________________
   ______________________________
   ______________________________
   Comprehensive ______________________________

5. Grade level (present teaching assignment): Circle all that apply.
   7  8  9  10  11  12  13  14  15  16  17

6. Years of teaching experience:
   0.5-3 ____ 4-6 ____ 7-9 ____ 10-12 ____ 13-15 ____ 16-18 ____
   19-21 ____ 22-24 ____ 25-27 ____ 28-30 ____ 31+ ____

7. Name of school district: _______________________________________
   Type of school: Public________ Private_______ Parochial ________

8. Ethnic Background:
   _________ White, non-Hispanic
   _________ Black, non-Hispanic
   _________ Hispanic
   _________ Asian or Pacific Islander
   _________ American Indian or Alaskan native
   _________ Multiracial
Please respond to questions 9-11 in the table below:

9. Please list the course(s) that you teach this year.

10. Please indicate the grade level(s) of students enrolled in each course.

11. Using the following codes, please indicate how much you contribute to decisions about the content of each course you teach.

   3 = considerable  2 = some  1 = very little  0 = none

<table>
<thead>
<tr>
<th>Courses assigned this year:</th>
<th>Student Grade level(s):</th>
<th>Your input:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. Please describe the process by which you normally provide input to decision-making about course content. If necessary, please describe how this process varies for any of the courses that you are assigned to teach this year.

-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------------------------
Autobiographical Sketch

Please respond to the items listed below on your own paper. Please identify the item to which you are responding as you proceed. In all cases, feel free to give examples where appropriate, and feel free to use as many pages as you require.

*Remember to identify your paper with your four-digit code.

Part I:

A) Please describe your personal background. If you wish, please include such information as: state in which you grew up; number of family members, including brothers and sisters; occupation(s) of parents; your hobbies and interests, then and now; your high school science experience, and any travel and/or intercultural experiences.

B) Please answer the following questions related to your intellectual development.

1) How do you perceive yourself politically? (i.e. Democrat, Republican, Independent, apolitical)
2) How would you describe your parents’ political stance(s) when you were growing up? (same categories as those listed in #1 above)
3) Did you and your family discuss politics, religion, and other issues while you were at home? How frequently and to what length(s) were such issues discussed? Were some topics discussed more frequently or in depth than other topics? If so, please describe the differences in the nature of these discussions.
4) If discussions about issues were not part of your upbringing, when did you begin to discuss them, and what influenced you to do so?

Part II:

Please describe your professional background. If you wish, please include such information as: college major(s) and minor(s); a general history of your teaching assignments; a general description of your teaching experience regarding the relative socio-economic status, ethnicity, and size of the district(s) in which you’ve worked; and your professional development. (You may attach a vita if you wish, but please remove your personal identification and replace it with your four-digit code.)

Part III:

Please describe your nonformal environmental education experiences. These would include experiences such as: Audubon camp or organized bird watching opportunities; tours (conducted by naturalists) of state parks/forests/natural areas; zoo and museum visits; television programming; “nature show” videos; presentations by invited speakers; demonstrations by animal rehabilitation staff; Scouting and Y-related youth programs etc.
Experience with Global Environmental Issues in the Classroom

"Global Environmental Issues" are defined to mean those topics over which disagreement exists between and among scientists and policy makers about the condition, maintenance, and/or use of the physical and biological components of the Earth's systems on a global scale, such as air, water, land, space, organisms/ecosystems.

Examples from Agenda 21 (the "Rio Summit"—UNCED) include:

- Consumption patterns
- Sustainable development
- Deforestation
- Human health
- Desertification/Drought
- Sustainable agriculture
- Biotechnology (use of)
- Biodiversity
- Sustainable mountain development
- Land-use planning/management
- Global climate change
- Freshwater resources
- Toxic and hazardous materials
- Solid waste management
- Sewage-related issues
- Radioactive waste management
- Indigenous people
- Small islands
- Coastal areas
- Oceans
- Demographic dynamics/stability
- Sustainable human settlement development

Please respond to the items listed below on your own paper. Please identify the item to which you are responding as you proceed. In all cases, feel free to give examples where appropriate, and feel free to use as many pages as you require.

*Remember to identify your paper with your four-digit code.

1. If you have used any of the global environmental issues listed above in your classroom, please describe your experience(s). Please include information such as:
   a) the course(s) where you have used them,
   b) the frequency of use in each course,
   c) the type(s) of issues used
   d) the classroom method(s) that you have used in conjunction with these issues, and
   e) the amount of time (in class periods/minutes) spent on each issue.

2. When you used the global environmental issues described above, how did they correspond to (or vary from) your district's existing curriculum for your course?
3. Please explain your rationale for using the global environmental issues at those times and in those ways.

4. How much class time did you allow for the lessons/activities about global environmental issues? Please describe this amount of time by relating the number of class periods (including fractions) that were used for each issue that was addressed.

5. What are your perceptions of the level of students' active involvement and interest in the examination of global environmental issues in science class? Please feel free to describe memorable student responses, if you wish.

6. Please complete the following statement, offering reasons why you think this way. (If you teach more than one subject, please answer this question separately for each subject area.)

I believe that global environmental issues should occupy about ______% of the instructional time in (subject area that I teach) ________________________________ because...

7. If you have been a learner in a college-level course(s) that included global environmental issues as a part of instruction, please describe your experience(s). Please be as explicit as possible, including information such as:
   a) the course(s) where they were used,
   b) the frequency of use in each course,
   c) the type(s) of issues used, and
   d) the classroom method(s) that were employed.
APPENDIX D

INTERVIEW SCHEDULES
Individual Interview Schedule

(The key words written in italics will be replaced with timely and pertinent key words as this interview schedule is used repeatedly throughout the quarter.)

Initial Question:

“What aspects of today’s topic/lesson about demographic issues might make you anxious about teaching it at your level?”

Probe(s):

1) “Given those concerns, would you plan to teach demographic issues to your students?”

2) “What methods might you use to reduce anxiety about teaching demographic issues?”

(If no anxiety is mentioned)...

1) “What are some concerns that you think might make other teachers anxious about teaching demographic issues at your level?”

2) “How can those concerns be addressed to reduce teacher anxiety?”
Focus Group Questions

As parents (or future parents) and citizens, we all have a vested interest in formal education. The presentations and readings made available to you through this class about population and resource issues may have contributed to your position(s) on some of these issues.

1) Do you think that issues-based lessons give students a better understanding of the issues, as opposed to an introduction, a ‘hook’ or interest-motivator, which is then discarded to pursue the science which is the basis of the lesson? Why or why not?

2) Do you think people make different decisions on the basis of these understandings?

3) If understanding and/or knowledge are not enough, then what things can be done in the classroom to promote "responsible environmental" decision-making?

4) Decisionmaking basically means taking a stance, and implies that action may result. (Consider the Senate vote that has been delayed.) Advocacy for one decision or the other is clearly at work and is valued in our democratic form of government. "Advocacy education" in relation to the environment has been defined as: "teaching for the promotion of utilitarian natural-resource and environmental management" (Disinger, 1993, 27)

What role, if any, do you think advocacy should play when issues-based lessons are being used in the classroom?

5) Some of you have mentioned the possibility of a “parent call.” What does that really mean? Who would they call? What process is expected to begin when that happens?
APPENDIX E

CODE NOTES AND CODE BOOK USED WITH DELPHI
<table>
<thead>
<tr>
<th>Code Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appropriateness</strong></td>
</tr>
</tbody>
</table>
| maturity/level  
maturity/level  
to existing curriculum  
improve science/thinking skills  
science ed reform efforts  
student interest/background  |
| **Implications to**  |
| student future  
student's/teacher's present life  
Earth's future  
system (local-->global)  |
| **Community**  |
| parents  
political/religious nature  
administrative  |
| **Nature of issues**  |
| both/all sides/overlapping issues  
PC/remove bias  
multicultural considerations  
current issue?  
issue of substance/prevalence  
historic/future of implications  
interdisciplinary  
how emotional/controversial  |
| **Teacher**  |
| knowledge/methods  
background/past experience  
evaluation of project  
interest/purpose/feelings  |
| **Educational Materials/Info**  |
| avail to student/tchr  
teacher materials/how to present  
nature: hands-on(h)/fun(f)  
difficulty  
reliability  
learning styles  |
| **Classroom considerations**  |
| Management/behavior/discussion  
$  
Safety  
Fragile/vandalism  
Student interpretations  |
| **Time**  |
| teacher prep  
use of class  
adequately approach/present  |
Code Book

The questions below each category name help to define the category. They are “properties” of the category and each property can be answered along a continuum. Any of the questions might be dimensionalized from “Not at all” to “Very much so.”

Appropriateness: (to science/science class)
Does this support skill development that is important to studying science?
Does this fit with my curriculum (course of study)?
Is this related to this science subject area? (i.e. biology)

Student Concerns: (concerns for students)
Are they mature enough to handle this topic?
Do they have the skills?
Is this something that my students are interested in learning?

Implications: (of the topic to the future)
How important is this to my students’ or society’s future?
Is this topic meaningful in my life or my students’ lives? (Is it relevant today?)
Is this topic important to Earth’s future?
Is this a topic that has local, regional, and global significance?

Community: (Stakeholders)
Will my students’ parents support the use of this topic?
Is this topic/lesson compatible with the religious or political tendencies of this district?
Does my principal or school board support this approach to learning science?
Will my students interpret my presentation of this topic as I intend?

Nature of the Issue:
Is this a current issue, that has enough of a history, to be worth examining?
Is it possible to present balanced positions on this topic?
How emotional or sensational is this topic?
Does it provide multicultural and/or interdisciplinary opportunities in my classroom?

Teacher Background:
Do I know very much about this topic?
Am I interested in this?
Can I remove my own bias?
Have I had a negative experience with something like this before?
Is evaluation of this topic/lesson a potential problem?

Teacher Philosophy:
Is this in line with my basic beliefs about teaching science?
Am I fulfilling my role as a science teacher?
Is my decision to implement this lesson based on important aspects of learning?
Can I uphold my standards for teaching and learning with this lesson?
Teacher Risk-Assessment:
    Am I willing to push for this?
    Have I considered the obstacles to presenting this lesson?
    Will this affect my job?
    Is there any risk to myself in doing this?

Educational Materials or Information:
    Are materials available to me or to my students on this topic?
    Can I obtain the materials that can help me to present this topic?
    Are the materials hands-on or fun to do?
    Are materials written at the right level of difficulty?
    How reliable are the facts presented in these materials?
    Do the materials address all learning styles?

Classroom:
    Are classroom management problems a concern?
    Are there safety or vandalism concerns in implementation?

Time:
    Will this topic require a great deal of preparation?
    Is coverage of this issue a good use of class time?
    Can I adequately present or approach this topic in the time that I have?

Advocacy:
    Should I use advocacy in the classroom on this topic?
    Is advocacy appropriate if it is structured into balanced presentations?
    Is student-generated advocacy useful?

Strategies:
    Could I structure the lesson to accomplish my objectives more fully?
    Can I avoid offending the sensibilities of others?
    Can I maximize student gain on this topic?
APPENDIX F

SCRIPTS USED TO INTRODUCE ST STPI ADMINISTRATIONS
Scripts Used to Introduce STPI measures

General Issues-Use  (G1 and G2)

Heading on (STPI Form X-1) (S-Anxiety measure):  
"How Do You Feel About Using Issues in Science Class?"

"Suppose that you are committed to promoting student understanding of, and action in regard to, controversial issues such as global environmental issues. You have elected to use these issues as the basis of at least one lesson or unit within each topic of your district's curriculum for the course(s) you teach."

"Now please read the directions to yourself for the questionnaire entitled, How Do You Feel About Using Issues in Science Class?, while I read the directions to you." (I read the directions on the Test Form.)

"In responding to each of the questions, consider the academic climate in your district. Consider your teaching situation within your department in your building. Are there any questions?" (In response to questions, I repeated the instructions and encouraged the participants to consider the teaching environment within their current assignment. Preservice teachers were asked to reflect upon their most recent high school experience, and to answer in response to that academic climate.)

*Heading on (STPI Form X-2): (T-Anxiety measure)
"How Do You Feel About Life in General?"

Population Stabilization  (P1 and P2)

Heading on (STPI Form X-1):  (S-Anxiety measure)
"How Do You Feel About Using Population Stabilization as an Issue in Science Class?"

"Suppose that you have chosen to implement a lesson or unit on population stabilization in your science class. The general issue of national population policies has been raised by your students. They would like to organize a forum and invite representatives from Planned Parenthood and local ethnic communities to participate."

"Now please read the directions to yourself for the questionnaire entitled, How Do You Feel About Using Population Stabilization as an Issue in Science Class?, while I read the directions to you." (I read the directions on the Test Form.)

"In responding to each of the questions, consider the academic climate in your district. Consider your teaching situation within your department in your building. Are there any questions?" (In response to questions, I repeated the instructions and encouraged the participants to consider the teaching environment within their current assignment. Preservice teachers were asked to reflect upon their most recent high school experience, and to answer in response to that academic climate.)

*Heading on (STPI Form X-2): (T-Anxiety measure)
"How Do You Feel About Life in General?"
Resources Use

Heading on (STPI Form X-1): (S-Anxiety measure)

“How Do You Feel About Resource Use as an Issue in Science Class?”

“Suppose that you have chosen to implement a lesson or unit on use of resources in your science class. The general issue of farmland reduction/urban sprawl has been raised by your students. They would like to interview local residents about a local zoning concern (a proposal extending an area for ‘light industry’) that has been under debate and reported in the local newspaper.”

“Now please read the directions to yourself for the questionnaire entitled, How Do You Feel About Resources Use as an Issue in Science Class?, while I read the directions to you.” (I read the directions on the Test Form.)

In responding to each of the questions, consider the academic climate in your district. Consider your teaching situation within your department in your building. Are there any questions?” (In response to questions, I repeated the instructions and encouraged the participants to consider the teaching environment within their current assignment. Preservice teachers were asked to reflect upon their most recent high school experience, and to answer in response to that academic climate.)

*Heading on the Trait STPI form (STPI Form X-2): “How Do You Feel About Life in General?”
APPENDIX G

OPEN-ENDED SURVEY USED WITH THE DELPHI TECHNIQUE
Please complete the following. Feel free to use the back of this page if you need more space and/or wish to include more items.

When I am deciding whether or not to use a particular issue in class, I think about:

1) 

2) 

3) 

4) 

5) 

6) 

7) 

8) 

9) 

10) 

(Please continue on the back, if you wish.)
APPENDIX H

DELPHI-ROUND 4
1) Suppose that your principal has asked you to make a presentation about your unit on the linkages between population and resource use to the school board, as a result of some communications s/he's received from a few of your students' parents. Please outline the basis of your presentation by writing your main points in the space below.

2) Who would be most supportive of your use of a global environmental issue as the basis of a science unit? What makes you think that?

3) Conversely, who would be most critical of your use of a global environmental issue as the basis of a science unit? What makes you think that?

4) Please describe a situation where you were asked (or felt compelled) to defend your use of a global environmental issue as the basis of a lesson in your classroom.
APPENDIX I

GROUP DATA FOR ST STPI
<table>
<thead>
<tr>
<th>Teacher</th>
<th>G-1</th>
<th>G-2</th>
<th>P-1</th>
<th>P-2</th>
<th>RU-1</th>
<th>RU-2</th>
<th>Individual Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0104</td>
<td>12.00</td>
<td>12.00</td>
<td>14.00</td>
<td>22.00</td>
<td>12.00</td>
<td>13.00</td>
<td>14.17</td>
</tr>
<tr>
<td>0728</td>
<td>13.00</td>
<td>12.00</td>
<td>11.00</td>
<td>16.00</td>
<td>13.00</td>
<td>10.00</td>
<td>12.50</td>
</tr>
<tr>
<td>0928</td>
<td>18.00</td>
<td>10.00</td>
<td>10.00</td>
<td>13.00</td>
<td>11.00</td>
<td>11.00</td>
<td>12.17</td>
</tr>
<tr>
<td>1234</td>
<td>24.00</td>
<td>10.00</td>
<td>20.00</td>
<td>25.00</td>
<td>19.00</td>
<td>19.60</td>
<td>19.60</td>
</tr>
<tr>
<td>2491</td>
<td>11.00</td>
<td>17.00</td>
<td>24.00</td>
<td>13.00</td>
<td>12.00</td>
<td>19.00</td>
<td>16.00</td>
</tr>
<tr>
<td>2626</td>
<td>18.00</td>
<td>10.00</td>
<td>16.00</td>
<td>17.00</td>
<td>14.00</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>2726</td>
<td>11.00</td>
<td>12.00</td>
<td>14.00</td>
<td>17.00</td>
<td>13.00</td>
<td>14.00</td>
<td>13.50</td>
</tr>
<tr>
<td>3456</td>
<td>12.00</td>
<td>18.00</td>
<td>13.00</td>
<td>19.00</td>
<td>15.00</td>
<td>21.00</td>
<td>16.33</td>
</tr>
<tr>
<td>3535</td>
<td>17.00</td>
<td>20.00</td>
<td>18.00</td>
<td>22.00</td>
<td>15.00</td>
<td>21.00</td>
<td>18.83</td>
</tr>
<tr>
<td>4665</td>
<td>22.00</td>
<td>18.00</td>
<td>30.00</td>
<td>31.00</td>
<td>24.00</td>
<td>19.00</td>
<td>24.00</td>
</tr>
<tr>
<td>5678</td>
<td>15.00</td>
<td>10.00</td>
<td>13.00</td>
<td>11.00</td>
<td>10.00</td>
<td>10.00</td>
<td>11.50</td>
</tr>
<tr>
<td>6534</td>
<td>19.00</td>
<td>17.00</td>
<td>27.00</td>
<td>23.00</td>
<td>15.00</td>
<td>14.00</td>
<td>19.17</td>
</tr>
<tr>
<td>8371</td>
<td>14.00</td>
<td>16.00</td>
<td>15.00</td>
<td>19.00</td>
<td>17.00</td>
<td>17.00</td>
<td>16.33</td>
</tr>
<tr>
<td>8479</td>
<td>14.00</td>
<td>22.00</td>
<td>28.00</td>
<td>20.00</td>
<td>29.00</td>
<td>20.00</td>
<td>22.17</td>
</tr>
<tr>
<td>9221</td>
<td>21.00</td>
<td>23.00</td>
<td>25.00</td>
<td>14.00</td>
<td>31.00</td>
<td>24.00</td>
<td>23.00</td>
</tr>
<tr>
<td>9613</td>
<td>25.00</td>
<td>20.00</td>
<td>16.00</td>
<td>21.00</td>
<td>14.00</td>
<td>17.00</td>
<td>18.83</td>
</tr>
</tbody>
</table>

**Group Mean** | 16.63 | 15.44 | 18.38 | 18.94 | 16.50 | 16.54 | **17.07**

**Standard Deviation** | 4.60 | 4.57 | 6.45 | 5.14 | 6.25 | 4.27 | **17.07**

*Individual mean of 5 scores (did not take RU-2)*
<table>
<thead>
<tr>
<th>Teacher</th>
<th>G-1</th>
<th>G-2</th>
<th>P-1</th>
<th>P-2</th>
<th>RU-1</th>
<th>RU-2</th>
<th>Individual Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0104</td>
<td>25.00</td>
<td>18.00</td>
<td>22.00</td>
<td>18.00</td>
<td>22.00</td>
<td>24.00</td>
<td>21.50</td>
</tr>
<tr>
<td>0728</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
<td>10.00</td>
</tr>
<tr>
<td>0928</td>
<td>27.00</td>
<td>27.00</td>
<td>27.00</td>
<td>23.00</td>
<td>24.00</td>
<td>19.00</td>
<td>24.50</td>
</tr>
<tr>
<td>1234</td>
<td>13.00</td>
<td>13.00</td>
<td>16.00</td>
<td>14.00</td>
<td>12.00</td>
<td>13.60</td>
<td>13.60</td>
</tr>
<tr>
<td>2491</td>
<td>20.00</td>
<td>21.00</td>
<td>19.00</td>
<td>20.00</td>
<td>21.00</td>
<td>22.00</td>
<td>20.50</td>
</tr>
<tr>
<td>2626</td>
<td>14.00</td>
<td>14.00</td>
<td>11.00</td>
<td>13.00</td>
<td>14.00</td>
<td>15.00</td>
<td>13.50</td>
</tr>
<tr>
<td>2726</td>
<td>19.00</td>
<td>16.00</td>
<td>21.00</td>
<td>14.00</td>
<td>18.00</td>
<td>19.00</td>
<td>17.83</td>
</tr>
<tr>
<td>3456</td>
<td>17.00</td>
<td>15.00</td>
<td>17.00</td>
<td>17.00</td>
<td>15.00</td>
<td>18.00</td>
<td>16.50</td>
</tr>
<tr>
<td>3535</td>
<td>12.00</td>
<td>14.00</td>
<td>11.00</td>
<td>16.00</td>
<td>15.00</td>
<td>13.00</td>
<td>13.50</td>
</tr>
<tr>
<td>4665</td>
<td>17.00</td>
<td>23.00</td>
<td>19.00</td>
<td>18.00</td>
<td>21.00</td>
<td>19.00</td>
<td>19.50</td>
</tr>
<tr>
<td>5678</td>
<td>16.00</td>
<td>10.00</td>
<td>13.00</td>
<td>11.00</td>
<td>13.00</td>
<td>12.00</td>
<td>12.50</td>
</tr>
<tr>
<td>6534</td>
<td>15.00</td>
<td>17.00</td>
<td>27.00</td>
<td>18.00</td>
<td>20.00</td>
<td>20.00</td>
<td>19.50</td>
</tr>
<tr>
<td>8371</td>
<td>19.00</td>
<td>17.00</td>
<td>16.00</td>
<td>18.00</td>
<td>20.00</td>
<td>20.00</td>
<td>18.33</td>
</tr>
<tr>
<td>8479</td>
<td>13.00</td>
<td>13.00</td>
<td>18.00</td>
<td>16.00</td>
<td>12.00</td>
<td>14.00</td>
<td>14.33</td>
</tr>
<tr>
<td>9221</td>
<td>23.00</td>
<td>26.00</td>
<td>33.00</td>
<td>24.00</td>
<td>30.00</td>
<td>25.00</td>
<td>26.83</td>
</tr>
<tr>
<td>9613</td>
<td>12.00</td>
<td>13.00</td>
<td>11.00</td>
<td>13.00</td>
<td>11.00</td>
<td>11.00</td>
<td>11.83</td>
</tr>
</tbody>
</table>

Group Mean | 17.00 | 16.69 | 18.19 | 16.44 | 17.38 | 17.16 | 17.14 |
Standard Deviation | 4.91 | 5.17 | 6.63 | 3.92 | 5.54 | 4.61 | |

*Individual mean of 5 scores (did not take RU-2)
APPENDIX J

INDIVIDUAL ST STPI DATA WITH RANGES AND MEANS
<table>
<thead>
<tr>
<th>Tchr</th>
<th>List</th>
<th>Range</th>
<th>Mean</th>
<th>F/M</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>0104</td>
<td>S-Anxiety T-Anxiety</td>
<td>12, 12, 14, 22, 12, 13</td>
<td>12-22</td>
<td>14.2</td>
<td>F 23-32</td>
</tr>
<tr>
<td>0728</td>
<td>S</td>
<td>13, 12, 11, 16, 13, 10</td>
<td>10-16</td>
<td>12.5</td>
<td>M 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>10, 10, 10, 10, 10, 10</td>
<td></td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>0928</td>
<td>S</td>
<td>18, 10, 10, 13, 11, 11</td>
<td>10-18</td>
<td>12.2</td>
<td>F 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>27, 27, 27, 12, 20, 22</td>
<td>19-27</td>
<td>21.5</td>
<td></td>
</tr>
<tr>
<td>1234</td>
<td>S</td>
<td>24, 10, 20, 25, 19, *</td>
<td>10-25</td>
<td>19.6</td>
<td>M 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>13, 13, 16, 14, 12, *</td>
<td>12-16</td>
<td>13.6</td>
<td></td>
</tr>
<tr>
<td>2491</td>
<td>S</td>
<td>11, 17, 24, 13, 12, 19</td>
<td>11-24</td>
<td>16.0</td>
<td>F 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>20, 21, 19, 20, 21, 22</td>
<td>19-22</td>
<td>20.5</td>
<td></td>
</tr>
<tr>
<td>2626</td>
<td>S</td>
<td>18, 10, 16, 17, 14, 15</td>
<td>10-18</td>
<td>15.0</td>
<td>F 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>14, 14, 13, 13, 14, 15</td>
<td>11-15</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>2726</td>
<td>S</td>
<td>11, 12, 14, 17, 13, 14</td>
<td>11-17</td>
<td>13.5</td>
<td>F 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>19, 16, 21, 14, 18, 19</td>
<td>14-21</td>
<td>17.8</td>
<td></td>
</tr>
<tr>
<td>3456</td>
<td>S</td>
<td>12, 18, 13, 19, 15, 21</td>
<td>12-21</td>
<td>16.3</td>
<td>F 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>17, 15, 17, 17, 15, 18</td>
<td>15-18</td>
<td>17.0</td>
<td></td>
</tr>
<tr>
<td>3535</td>
<td>S</td>
<td>17, 20, 18, 22, 15, 21</td>
<td>15-21</td>
<td>18.8</td>
<td>M 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>12, 14, 11, 16, 15, 13</td>
<td>11-16</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>4665</td>
<td>S</td>
<td>22, 18, 30, 31, 24, 19</td>
<td>18-31</td>
<td>24.0</td>
<td>M 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>17, 23, 19, 18, 21, 19</td>
<td>17-21</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td>5678</td>
<td>S</td>
<td>15, 10, 13, 11, 10, 10</td>
<td>10-15</td>
<td>11.5</td>
<td>M 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>16, 10, 13, 11, 12, 12</td>
<td>10-16</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>6534</td>
<td>S</td>
<td>19, 17, 27, 23, 15, 14</td>
<td>14-27</td>
<td>19.2</td>
<td>F 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>15, 17, 27, 18, 20, 20</td>
<td>15-27</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td>8371</td>
<td>S</td>
<td>14, 16, 15, 19, 17, 17</td>
<td>14-19</td>
<td>16.3</td>
<td>F 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>19, 17, 16, 18, 16, 18</td>
<td>16-19</td>
<td>17.3</td>
<td></td>
</tr>
<tr>
<td>8479</td>
<td>S</td>
<td>14, 22, 28, 20, 29, 20</td>
<td>14-29</td>
<td>22.2</td>
<td>M 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>13, 13, 18, 16, 12, 14</td>
<td>12-18</td>
<td>15.7</td>
<td></td>
</tr>
<tr>
<td>9221</td>
<td>S</td>
<td>21, 23, 25, 14, 31, 24</td>
<td>14-31</td>
<td>23.0</td>
<td>F 23-32</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>23, 26, 33, 24, 30, 25</td>
<td>23-33</td>
<td>26.8</td>
<td></td>
</tr>
<tr>
<td>9613</td>
<td>S</td>
<td>25, 20, 16, 21, 14, 17</td>
<td>14-25</td>
<td>18.8</td>
<td>F 33+</td>
</tr>
<tr>
<td></td>
<td>T</td>
<td>12, 13, 11, 13, 11, 11</td>
<td>11-13</td>
<td>11.8</td>
<td></td>
</tr>
</tbody>
</table>
LIST OF REFERENCES


166


Jackson Local Schools Board of Education. (1988). Program Policy 2240. (Adopted by Jackson Local Schools, 7984 Fulton Dr. N.W., Massillon, OH 44646)


Spielberger, C. D., in collaboration with Jacobs, G., Crane, R., Russell, S., Westberry, L., Barker, L., Johnson, E., Knight, J., & Marks, E. (no date given). *Preliminary manual for the State-Trait Personality Inventory,(STPI): Test forms and psychometric data.*


