NASA Kennedy Space Center Educator Workshops: Exploring Their Impact on Teacher Attitudes and Concerns

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ABSTRACT

There is a persistent concern regarding science literacy in the United States and because of this, many government agencies have been directed to assist in and enhance education efforts through outreach activities. The National Aeronautics and Space Administration holds summer teacher workshops at field centers to provide materials and help motivate teachers to use space science in their lessons.

Evaluation of these workshops, particularly with respect to teacher characteristics is important to facilitate the development and enhancement of future workshops. Teacher characteristics of interest in this study were attitudes toward science and science teaching and concerns about educational change and innovation. The Concerns Based Adoption Model developed by Hall, George, & Rutherford (1974) emphasizes teacher concerns when introduced to an innovation, in this case being the use of space science in education.

This study demonstrated differences in teacher concerns and beliefs relative to workshop attendance, workshop length, time since workshop attendance and the grade level taught indicating a degree of efficacy of the workshops. The data also indicated areas in which the workshops could be improved.

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The National Aeronautics and Space Administration (NASA)

Teacher Workshops

Space Science

Concerns

Beliefs

Stage of Concern

Beliefs about Science and Science Education

Pedagogy

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LIST OF ABBREVIATIONS

Bre.SS&M: Brevard Summer Science and Mathematics Institute

NASA: The National Aeronautics and Space Administration

NEWEST: NASA's Educators Workshop for Elementary School Teachers

NEWMAST: NASA's Educators Workshop for Math and Science Teachers

PA-ESB: NASA Public Affairs, Education Services Branch

STEP: Summer Teacher Enhancement Program

USF: University of South Florida (teachers workshop)

NASA EDUCATOR WORKSHOPS: EXPLORING THEIR IMPACT ON TEACHER ATTITUDES AND CONCERNS

by

THOMAS W. DRESCHEL

CHAPTER 1

INTRODUCTION

Statement of the Problem

There is a persistent national concern over education in science and engineering relative to preparing and motivating young men and women for careers in these areas (American Association for the Advancement of Science [AAAS], 1990, 1993). In response to this concern, national science education standards (NRC, 1996) and mathematics teaching standards (NCTM, 1991) have been established. Consequently, a major directive of many government agencies is to assist and enhance education through educational outreach. One form of educational outreach consists of providing teachers with printed educational materials, hands-on activities and training. The goal of these agencies is to develop effective methods of providing scientific information to teachers for classroom use.

The National Aeronautics and Space Administration (NASA) has a directive, as part of its charter, to enhance education, to maintain a supply of highly trained personnel for the agency's mission but also to aid in achieving the National Education Goals (NRC, 1994). In the past, a large emphasis has been placed on the college level with scholarships, grants and co-op students, though NASA has also maintained a significant effort at the elementary and high school levels. More recently, emphasis has shifted to the elementary and high school levels.

Teacher workshops have been a part of the NASA education enhancement effort for over a decade and there is a need to evaluate their efficacy. To date, there has not been a significant effort to measure teacher concerns and beliefs that may have been affected by the workshops. The purpose of this study is obtain responses from workshop participants on two instruments in order to evaluate characteristics relative to their attitudes and usage of workshop materials. This should provide valuable input for the enhancement and design of future workshops.

Background and Rationale

Description of NASA Outreach Activities

The National Aeronautics and Space Administration (NASA) administers a number of educational programs encompassing all age groups from preschool through graduate school and post-doctoral research (NASA, 1993a). The National Research Council (NRC) Committee on NASA Education Program Outcomes (NEPO) reported that almost 300 of these programs are in existence (NRC, 1994). Included in this effort are teacher outreach programs and inservice training to help teachers enhance and update their curricula. It is important to determine efficient means for distributing these materials and training.

The NASA Public Affairs Office, Education Services Branch (PA-ESB), at Kennedy Space Center (KSC) has developed a number of teachers' guides in the area of space science and engineering for preschool (NASA, 1992) and elementary school (NASA, 1993b) students. The PA-ESB efforts rely on a number of methods for distributing information to teachers. Teacher packets are available at the Educators Resource Center at the KSC Visitors Information Center and may be obtained at no cost. Spacemobile is a mobile education laboratory that visits schools to allow students to participate in hands on activities. Teachers may request teaching materials to prepare students for the visit and to debrief them after the visit.

A major outreach effort is in the form of KSC engineers and scientists making visits to classrooms. There they make presentations and at the same time may provide the teacher with NASA teaching materials.

Inservice teacher workshops are held as part of Teacher Preparation and Enhancement Programs. Teachers are brought to KSC during the summer months for training in various aerospace related areas. Each summer, since 1984, teacher workshops have been hosted by PA-ESB. The workshops for high school math and science teachers are called NASA's Educators Workshop for Math and Science Teachers (NEWMAST); Those for elementary school teachers called NASA's Educators Workshop for Elementary School Teachers (NEWEST). One workshop involves teachers from grades kindergarten through 12th, from any discipline and is called the Summer Teacher Enhancement Program or STEP (Dreschel et al., 1995). In 1995, two additional workshops were hosted by NASA PA-ESB at KSC. These were the University of South Florida (USF) teachers workshops and the Brevard Summer Science and Mathematics Institute

(BSS&M) also referred to as the Concepts in Science and Math workshop. During these workshops, teachers are tasked to develop curricular materials appropriate to the grade level that they teach. As with other NASA programs, the effectiveness of educational programs is of concern due to the time and funds involved.

Teachers Workshop Characteristics

The National Research Council (NRC) Committee on NASA Education Program Outcomes (NEPO) was formed to evaluate the many and diverse NASA educational programs (NRC, 1994). The NEPO was tasked to assist NASA in defining goals for their education programs and recommend comprehensive data collection procedures and indicators that would show program efficacy. NEPO defined an indicator as "statistics or other information to be collected from NASA education programs to determine whether these programs are meeting their goals and objectives". This indicator system relates to program resources or "inputs", the nature of the program or "processes" and the desired accomplishments of the program referred to as "outcomes". The goals of the Teacher Enhancement and Preparation programs and indicators for each program characteristic are presented as Figure 1.

Figure 1.

The National Research Councils Committee on NASA Education Program Outcomes Indicator System for Teacher Programs

PRECOLLEGE PROGRAMS INDICATOR SYSTEM FOR TEACHER ENHANCEMENT AND PREPARATION PROGRAMS		
OVERALL GOALS		
• Using NASA-related topics, increase teachers' content and pedagogical knowledge in mathematics and science. • Using NASA-related topics, increase teachers' capability to design and implement more stimulating and engaging lessons and experiences for students. • Provide a "multiplier" effect—that is, extend the benefits of the program beyond participants to other teachers. • Increase student interest and achievement in mathematics and science.		
RECOMMENDED INDICATORS		
Input Indicators	Process Indicators	Outcome Indicators
• Teacher's Background • Teacher's School Environment and Student Population Served • Teacher Awareness of and Participation in Continuing Education Activities	• Process of Selection of Participants • Program Characteristics • Program Content and Instructional Approach	• Changes in Teacher Attitudes and Practice • Change in Teacher Science and Mathematics Knowledge • Multiplier Effect on Other Teachers • Change in Student Interest and Achievement in Mathematics and Science

From: National Research Council, 1994.

Outcome indicators listed by the NEPO are changes related to: 1) the teacher's scientific interest, attitudes and awareness; 2) their sense of self-efficacy and empowerment and their associated perception of constraints in the work environment and; 3) their pedagogical beliefs and practice (NRC, 1994).

The Concerns Based Adoption Model (CBAM) was developed by Hall, Wallace and Dossett (1973) to describe the effect of educational change and the use of innovations in teaching. They designed the Stages of Concern Questionnaire (SoCQ) for the purpose of gathering information on teacher attitudes toward change and innovation. The seven stages of concern are presented in Table 1. These stages of concern are listed with the NEPO goal or outcome indicators that they relate to in Table 2. Research indicates that behavior with respect to an innovation is influenced by the most intense concerns at that time. As the use of the innovation develops, the level of concern changes in a wave-like developmental pattern shown in Figure 2 (O'Brien, 1987), peaking at the level of concern that is exhibited most strongly. This can be used to predict use of the innovation based on the concerns reported on the SoCQ. Prior research indicates that this can be done with a better than 90% accuracy (Rutherford, 1977; Rutherford and George, 1978).

Table 1.

The Stages of Concern about Innovation (Definitions)

0) Awareness-Little concern about or involvement with the innovation is indicated.

1) Informational-A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.

2) Personal-Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implications of the program for self and colleagues may also be reflected.

3) Management-Attention is focused on the process and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.

4) Consequence-Attention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.

5) Collaboration-The focus is on coordination and cooperation with others regarding use of the innovation.

6) Refocusing-The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.

From Hall, George, and Rutherford, 1977.

Table 2.

The Stages of Concern (from Table 1) and The NASA Education Goals and Outcome Indicators (from Figure 1)

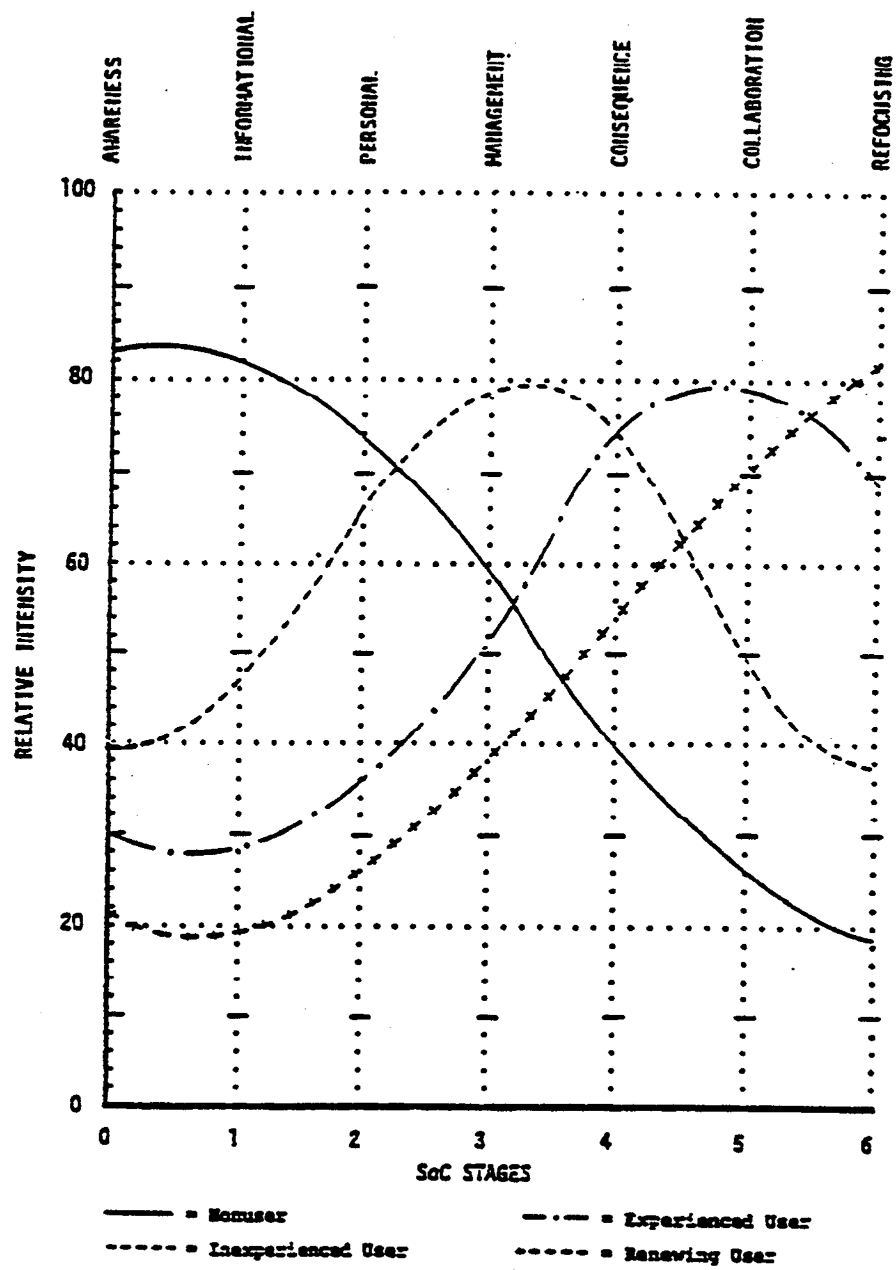
Stage of Concern	NEPO Indicators	NEPO Goals
0) Awareness	Teacher awareness and participation in continuing ed. activities.	Dissemination of information (NASA, 1992).
1) Informational	Change in teacher math and science knowledge.	Increased teacher content knowledge (math & science).
2) Personal	Changes in teacher attitudes and practice.	Increased teacher pedagogical knowledge in math and science.
3) Management	Changes in teacher attitudes and practice. (Lesson modification or enhancement)	Increased teacher capability to design/implement stimulating & engaging lessons/ experiences.
4) Consequence	Increasing student interest and achievement in math/science as perceived by the teacher.	Increased student interest and achievement in math/science.
5) Collaboration	"Multiplier" effect on other teachers.	Extend benefits to colleagues. of participants.
6) Refocusing	Changes in teacher attitude and practice (Lesson Plan redesign).	Increased teacher capability to design/implement more stimulating/ engaging lessons/ experiences.

Beliefs about science and science teaching are teacher input indicators and are listed as an outcome indicator (attitudes and practice, Figure 1).The measurement of changes in the beliefs about science and science education can also be an indication of the efficacy of the NASA teacher enhancement and preparation program. The Beliefs about Science and Science Education (BSSE) survey was developed to measure this (Good, 1971).

Because of NASA's concern about managing the myriad of educational programs, and due to budget and manpower constraints, it is important to evaluate the impact of the workshops for justification and enhancement (NRC, 1994). The present study is designed to determine if the workshops meet the stated goals by using the Concerns Based Adoption Model and to measure attitudes toward science and science teaching using the Beliefs about Science and Science Education survey. In addition, differences that may exist between teachers of different grade levels on these same characteristics will provide insight into how the input and process indicators effect the outcome indicator. This may indicate needed changes in teacher selection, program characteristics, content and instructional approach.

Figure 2.

Hypothesized Development of the Stages of Concern



From: O'Brien, 1987.

Significance of the Problem

A great deal of effort has been directed toward developing and implementing the NASA teacher workshops but very little has been done to evaluate the results. An important aspect of this evaluation is the determination of the utility of the workshop information and materials in curriculum enhancement. Teacher concerns over utilizing these products provide important feedback for the design and enhancement of future workshops.

Taking concerns and attitudes into account, there is a need for an in-depth assessment of a workshop series over a sufficiently long time span. In assessing the concerns and attitudes of former and current workshop participants, informed decisions for enhancement of the training can be made. This may include recommendations for emphasizing different workshop content, materials, and instructional approach depending upon grade level taught. This evaluation could result in greater utility of the subject material in curriculum development, provide evidence of workshop efficacy, and identify important teacher characteristics, specifically concerns and attitudes for the workshop implementers to key on. It fulfills one recommendation of the National Research Council's Committee on NASA Education Program Outcomes recommendation on data collection of: 1) Teacher's scientific interest, attitudes and awareness; 2) Teacher's sense of self-efficacy, empowerment and perception of constraints in the work environment and; 3) Teacher's classroom practice and pedagogical beliefs. Another aspect of this study is to provide evidence for the utility of the Concerns Based Adoption Model in this situation.

Research Questions

Two main research questions will be investigated in this study. These are:

1) Are there differences in the levels of concern for using Space Science in teaching and the beliefs about science and science education in teachers that have participated in the workshops, and do these differences vary with different workshop lengths and the passage of time since workshop participation?

2) Are measurable differences between the concerns and beliefs of teachers by grade level taught?

Current participants were surveyed at the beginning of a workshop and again at the end to obtain pre-test and post-test measures of concerns and beliefs for comparison by workshop length. This is a pre-experimental, causal-comparison design. Workshop participants and teachers that have visited the Kennedy Space Center (KSC) and received teacher packets only were post-tested for concerns and beliefs. Life sciences researchers at KSC were also tested for beliefs about to science and science education. This is a cross-sectional survey design and the individuals in the study were grouped by length of workshop (zero to four weeks), time since workshop (no workshop with 1995 pre-test, 1984-1989, 1990-1994, and 1995 post-test), and grade level taught (not teaching, prekindergarten through 6th grade, middle and high school, and college).

Definition of Important Terms

Beliefs about Science and Science Education (BSSE) survey- A survey instrument developed by Good (1971) containing thirty-five Likert scale questions.

BSS&M-Brevard Summer Science and Mathematics Institute, a NASA/Brevard County sponsored teacher workshop for middle and high school teachers, three weeks in length. Also known as the Concepts of Science and Math teachers workshop (Concepts).

Concern-operationally defined as a preoccupation with a particular issue or task as determined by the Stages of Concern Questionnaire (Hall, George, and Rutherford, 1977).

Concerns Based Adoption Model (CBAM)-A model developed by Hall, George, and Rutherford (1974) which emphasizes teacher concerns toward and facilitating educational innovation. Several instruments have been developed based on this model, including the Stages of Concern Questionnaire.

Innovation-An improved technique or idea defined operationally for the Stages of Concern Questionnaire (Hall, George, and Rutherford, 1977). In this case, the innovation is space science.

NASA-The National Aeronautics and Space Administration.

NEWEST-NASA's Educational Workshop for Elementary School Teachers, two weeks in length.

NEWMAST-NASA's Educational Workshop for Math And Science Teachers, two weeks in length.

Space Science-Materials presented in the NASA teachers workshops related to research in physics, chemistry, life science, astronomy, earth science, and engineering performed by NASA. It is the innovation in this application of the Concerns Based Adoption Model.

Stages of Concern Questionnaire (SoCQ)-A thirty-five item, Likert scale instrument to determine teacher stage of concern toward an educational innovation, developed by Hall, George, and Rutherford (1974).

STEP-Summer Teacher Enhancement Program, a NASA teachers workshop for prekindergarten through high school educators, four weeks in length.

USF-The University of South Florida summer teachers workshop, one-week in length.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Workshop Related Design and Materials

Examples of workshops and associated teachers guides exist both within and external to NASA. O'Brien (1992) presented guidelines for successful inservice science workshops for elementary school teachers, all of which have been used in NASA workshops at some level. He also made suggestions for encouraging participation, many of which have been utilized by NASA for recruiting.

Dyche (1980) recommended short intensive science courses or workshops for elementary school teachers and cites examples of teacher interest in increasing science teaching time, interest in attending further courses, interest in teaching science differently by utilizing more outdoor work and "hands-on" activities.

Other examples of workshops emphasizing hands-on activities are described by Walton (1987) pertaining to middle school chemistry, and Rice (1986) using soap bubbles for demonstrating math and science concepts. A special facility called the Exploratorium is a "library of experiments" for teachers and students, also emphasizing hands-on activities (Preuss et al., 1983).

Cooperative relationships have been formed (for teacher enhancement) with colleges and universities (Vaidya, 1992; Mattheis and Byrd, 1981; Little, 1983; Pottle, 1992; Pottle, 1993). Miller and colleagues (1992) describe a cooperative relationship between a medical school and public schools and Blueford and Gordon (1989) a relationship between public schools and the United States Geological Survey. NASA has also been actively involved with local elementary, middle and high schools and many KSC directorates have "adopted" a school.

Williams, Green and Williams (1989) host teacher workshops at the University of Wisconsin for science teachers which concerns using fast-growing Brassica plants to teach plant development, anatomy, reproduction and genetics. Williams and his colleagues (1993) have also developed ways of constructing inexpensive laboratory equipment and teaching aids from discarded containers such as two-liter soda bottles and one-gallon milk jugs as growth chambers for small plants and animals (Williams, Greenler, Greenler, Graham, Ingram, Kehle and Eagan 1993).

A manual which covers many more aspects of life science has been prepared by Granger (1989). His approach stresses the use of hands-on activities and teaching by exploration, concept introduction and concept application. NASA has also been involved in the development of relevant teachers guides pertaining to living in space (Andrews and Kirschenbaum, 1987), human physiological effects of spaceflight (Lujan and White, 1989), the potential for extraterrestrial life or exobiology (SETI Research Institute, 1993) and general biology related to space exploration (Lee, Jackman and Hilbert, 1969).

Studies of Workshop and Education Outreach Efficacy

A number of studies have been conducted to evaluate the efficacy of inservice training in the context of science education. Workshops have been conducted with varying degrees of success. Vandegrift and Crafton (1990) evaluated the effectiveness of two National Science Foundation (NSF) chemistry/physics workshops on a convenience sample of teachers and found an enhancement of teacher grasp of subject matter, laboratory background, computer use, attitude, self confidence and enthusiasm. The teachers also indicated that developing contacts with other teachers was an important aspect of workshop attendance.

Clermont, Krajcik and Borko (1993) obtained positive results during short-term, intensive inservice training with eight purposefully selected novice instructors who demonstrate chemistry principles. They found that participation in an Institute for Chemical Education Workshop lead to an increase in the breadth and depth of demonstrations performed relating to basic chemical concepts.

Glass (1981) observed positive results with another convenience sample of 25 high school teachers attending an energy workshop. She found that a significant increase in knowledge and change in attitude about science occurred which persisted for at least a year. Hadfield and Lillibridge (1993) found persistent effects on instruction by a workshop for two years following and listed the key elements in providing a valuable workshop experience. Scharmann and McLellan (1992) found that an intensive inservice workshop caused a significant shift in instructional goals.

Smith and Haley (1981), using a convenience sample of 127 teachers, reported favorable teacher responses as measured by a survey. Increases in student achievement on the Stanford Achievement Test by students of participants were obtained compared to comparable classes of students of non-participants. Important aspects of developing this training were collaborative planning with district personnel, teacher involvement at all stages, a convenient location of classes, and the relating of provided materials to classroom activities.

Hendren, Mertens and Nisbet (1973) evaluated a convenience sample of 39 teachers attending an NSF institute and found it to be effective in motivating teachers to increase their level of emphasis in 45 of the 55 topics covered in the workshop. Lawrenz (1987), in a physics inservice training workshop, found some improvement but that the teachers generally felt that the content of the workshop was too difficult. The greatest benefit derived by the teachers was from interaction and idea exchange with other teachers. Brazler (1993) obtained a positive response from teachers attending the "Frontiers in Science" workshop program.

The impact of session length has also been examined by Lawrenz (1984) using five session courses with 140 participants and fifteen session courses with 296 participants in energy education. She found the longer course to be slightly more effective but the difference may not justify the greater time involved.

Bowyer (1987) evaluated varying workshop organization and found a minimum of eight to sixteen hours were needed for the teachers to use the new teaching strategies. She also found "coaching" from an experienced practitioner as critical to staff development. On the other hand, Wade (1985) in a meta-analysis on 91 studies of inservice teacher education found no evidence that coaching enhanced the effectiveness of the training. She also found that training that includes both elementary and high school teachers was more effective. Other contributions to success were selective competition for participation, independent study, and audio and visual feedback.

Gardella (1976) found positive benefits from a resource guide used in combination with a training workshop relative to use of the guide without such training. In a follow-up study, Wilke (1980) compared a sixty hour training session with concurrent involvement in the development of an environmental resource manual compared to a two hour training session in the use of the manual and the use of the manual without training. He found that teachers in the first two groups had a higher frequency of resource use for instructional purposes and the first group had a higher frequency of resources identified for teaching specific environmental concepts.

Mayer and Fortner (1988) evaluated four modes of disseminating educational materials with various sample sizes and convenience samples and found that short, intensive, awareness workshops were the best. Longer, implementation workshops were less effective, followed by mail order and lastly, handing out the materials at a museum resulted in little utilization by the teachers. Some of these differences between workshop attendees were attributed to differences between the teachers who chose to participate in the workshops.

Gabel and Rubba (1979), on the other hand, concluded that persistent changes cannot be made through short-term programs and saw little differences due to the science curricula emphasized during their workshop although attitudes toward science were affected. This was observed from a sample of 36 elementary school teachers. Sheldon (1978) obtained similar results from a convenience sample of 100 teachers and administrators. She found that little implementation of programs was observed if there was a requirement for commitments of money, kits, or grade level articulation.

Sparks (1983) reviewed efforts to date in the area of staff development and concluded that success of inservice programs were improved if: Teachers were involved in decision making; the training sessions were held two or three weeks apart; presentation, demonstration, practice and feedback were included; interaction between teachers was encouraged between inservice sessions; rationales for the new methods and information were being introduced; detailed discussions, sharing of experiences, and encouragement were provided for; and sufficient time was set aside for practice.

Although there were instances of studies in which researchers concluded that little benefit resulted from workshops, generally studies indicated some benefit in improving the attitude and achievement of the attendees concerning the subject presented. Because most of the subjects of studies comparing methods of providing educational materials were volunteer or other convenience samples, the external validity of conclusions is questionable.

Teacher Beliefs about Science and Concerns about Change

There has been a movement during the past several decades to evaluate the efficacy of inservice training relative to changes in the affective domain of teachers in the context of science education. Teacher beliefs, attitudes and concerns have become of particular interest because of their impact on the classroom. Good (1971) developed the Beliefs about Science and Science Education (BSSE) questionnaire to measure attitudes toward science and science education. Lawrenz (1984) utilized the 35 question instrument in a study of energy education workshops. She identified three factors relative to this instrument: 1. specific science concepts; 2. structured science teaching; and 3. laboratory-oriented science. She used repeated measures MANOVA to evaluate the results from workshops of two different lengths which demonstrated a difference in belief about the structured science teaching depending on the length of the workshop. In another study, Lawrenz (1987) utilized the BSSE with another instrument to evaluate the effectiveness of inservice training in physical science for elementary school teachers. She administered the instruments to both participants and students of the participants. She observed positive changes in the laboratory-oriented science beliefs in the teachers but observed no differences in the students (alpha=0.01).

Jones and Levin (1994) examined attitudes of elementary school teachers toward science and science instruction and differences in attitude related to gender differences. Rampal (1992) examined teacher beliefs relative to the qualities of scientists and personal beliefs about medicine and astrology.

Fuller (1969) discussed the concept of teacher concerns related to motivation and experience. Three categories of concern were identified which related to where the concerns were directed: 1. self adequacy; 2. student behavior; and 3. student gain. A comparison was made between inexperienced and experienced teachers and very different sources of concern and satisfaction were observed. Hall, George, and Rutherford (1974) expanded on Fuller's concepts and proposed the Concerns-Based Adoption Model (CBAM) which was intended to provide a framework and diagnostic tools for the development and enhancement of inservice training. They developed the Stages of Concern Questionnaire (SoCQ) as a tool to evaluate teachers relative to their attitudes toward change. This model has been found to be valuable in curriculum and staff development activities (O'Brien, 1992).

Showers, Joyce, and Bennett (1987) performed a meta-analysis of over 200 research studies and found that teacher characteristics such as self-esteem, enthusiasm, and flexibility contribute significantly to teacher effectiveness. They also found that the design of staff development is critical to success and found that coaching contributes to whether a teacher will use new strategies or concepts in their teaching.

Lombard, Konicek and Schultz (1985) used the SoCQ with secondary science teachers participating in a workshop emphasizing the development of reasoning ability. They observed a shift during the workshop from concerns about awareness to concerns about collaboration.

O'Brien (1987), in a study of participants in NSF chemistry workshops, examined teacher characteristics, particularly concerns and attitudes, in assessing the value of the workshop materials. He presented an inservice program assessment model which utilizes the Concerns Based Adoption Model and emphasizes teacher characteristics as a determinator for workshop success. Concerns over the utilization of new ideas and material presented within the workshop and attitudes toward science and teaching science were found to be important measures for designing successful inservice training. In a study with teachers of various grade levels, he found that the workshop was successful in advancing the level of teachers concerns about chemical demonstrations as measured by the Stages of Concern Questionnaire. His conclusion was that for a focused, limited innovation, a target inservice program can effect significant teacher changes.

James and Hord (1988), in discussing the implementation of elementary science education programs, referred to the CBAM as yielding important insights into teacher behaviors. James and Francq (1988) examined innovation concepts relative to the Concerns Based Adoption Model (CBAM) in evaluating the value of a program called: Science: A Process Approach II and found the CBAM to be valuable in developing interventions to enhance the implementation of the program.

Bailey and Palsha (1992) used the Concerns Based Adoption Model and the Stages of Concern Questionnaire (SoCQ) to evaluate concerns over innovative training on early intervention. They found the model to be appropriate for their research and recommended a shorter version of the SoCQ. Kember and Mezger (1990) used the CBAM in evaluating a course team approach and Nielson and Turner (1987) used the CBAM to evaluate the acceptance of a new mathematics program and found it to be viable for directing change. Van den Berg (1993) described the use of the CBAM in several countries in Europe where it was found to be useful in cases where schools are dealing with change. The CBAM has also been applied in the area of the use of computers in teaching humanities. Willis (1992) found applications of the model in this area in the evaluation of teacher training.

The studies discussed above emphasize the importance of teacher behaviors when presented with educational innovation. Facilitating change in these behaviors is important in successful inservice training. This entails having an impact on preconceived beliefs and concerns pertaining to educational innovations.

CHAPTER 3

METHODS

Population and Sample Description

The target population was American teachers and the accessible population consisted of teachers involved in NASA teacher workshops at Kennedy Space Center (KSC), teachers that have visited the NASA Educators Resource Center at KSC and life sciences researchers at KSC. Teachers participated in summer 1995 NASA workshops of lengths varying from one to four weeks. The four samples from 1995 were: The Brevard Summer Science and Mathematics Institute (BSS&M), consisting of 17 Brevard County teachers with a length of three weeks; The NASA Educators Workshop for Elementary School Teachers (NEWEST) consisting of 16 elementary school teachers from across the U. S. (two weeks); The Summer Teacher Enhancement Program (STEP) with 25 kindergarten through high school teachers for four weeks; and The University of South Florida teachers workshop (USF) with 19 science and mathematics teachers for one week. The participants of each of these workshops were asked to fill out surveys at the start of the workshop and at the end, providing pre-test and post-test data from these groups.

Another group of participants that made up an accessible population were past participants from the various NASA workshops since 1984. The sample size for each workshop was dependent on accessibility of the teacher and willingness to participate. These teachers were initially contacted by a mailing of a letter and a survey. Those teachers showing an interest in further participation as well as those for whom the surveys were not returned due to change of address were mailed the second round of instruments.

The comparison group consisted of teachers that have visited the Space Center Educators Resource Center and picked up teacher packets but have not participated in a NASA workshop. Two hundred and fifty surveys were sent to teachers in this category. These teachers have received materials that are presented during NASA teacher workshops but have not participated in the workshops. The third group that was surveyed was the life science researchers under the Life Sciences Support Contract at KSC. These individuals were asked to fill out only the Beliefs about Science and Science Education survey to evaluate their attitudes relative to those of teachers.

Instruments

The letter and Contact Survey are included as Appendix A. The Contact Survey reported current addresses, phone numbers, teaching information and willingness to participate further in the study. A second letter (Appendix B) with a disclaimer was presented with the Beliefs and Concerns Survey Set.

In the Beliefs and Concerns Survey Set, one survey was attitude toward science instrument called the Beliefs about Science and Science Education (BSSE) instrument (Appendix C). This was developed by Good (1971) and structured by Lawrenz (1984) and it is a Likert-type instrument using a five point scale shown below:

-----1------------2--------3--------4----------5--------
strongly agree/agree/undecided/disagree/strongly disagree.

Lawrenz (1984) found the questions to fit into three factors: Laboratory Oriented Science (LOS); Specific Science Concepts (SSC); and Structured Science Teaching (SST). The Cronbach alphas measured for this instrument were: 0.63 for the complete instrument, 0.54 for the LOS; 0.55 for the SSC; and 0.70 for the SST.

Although these alpha coefficients are moderate at best, this instrument has been utilized in similar studies and specific questions on the BSSE address the goals of the NASA workshops and of this study. Of particular importance are the questions concerning elementary school science (question 1), the importance and relevance of science (questions 4, 6, and 15), logical thinking (questions 9, 12, and 13), teaching techniques (questions 7, 8, 17, 21, 27, 29, and 33), and teacher characteristics (question 35).

The Stages of Concern questionnaire or SoCQ (Hall et al., 1974) is a Likert-type instrument with 35 statements indicating the respondents feelings toward an educational innovation. The respondents indicate their agreement with each statement by designating their feelings according to the scale below:

1--------2--------3--------4---------5--------6-------7

Irrelevant/Not true/Somewhat true/Very true of me now.

Five randomly-distributed questions of the SoCQ pertain to each of the seven Stages of Concern (Table 1). The total of these five questions is a score used to evaluate teacher attitude toward using an educational innovation. In this case, the innovation is the use of space science in their classroom teaching.

Differences between the pretest and posttest from the 1995 workshops were used to identify changes that occurred during the workshop. Changes in the level of concern over using workshop materials indicate areas where program content and instructional approaches facilitate changes in teacher concerns in these categories. The scores for each stage were calculated and paired t-tests (SPSS, 1993) run to find significant differences between pre-workshop and post-workshop responses. The scores were also averaged for each workshop and Stages of Concern plots were generated for analysis according to the recommendations of Hall, George and Rutherford (1977).

The Stages of Concern questionnaire or SoCQ (Hall et al., 1974) was used to evaluate the teacher attitude toward incorporating space science in their lessons (Appendix D). O'Brien (1987) reported one week test-retest correlations from 0.65 to 0.86 with alpha coefficients (Fraenkel and Wallen, 1993) of 0.64 to 0.83. Other validity studies utilizing interview data and other measures by Hall, George and Rutherford (1979) were used to verify the construct validity of the SoCQ.

Procedures

The study entails an evaluation of the effectiveness of NASA workshops for teacher enhancement. Teachers attending the four 1995 NASA workshops were pre-test and post-tested using the surveys described. Names and addresses of former participants of the NEWMAST, NEWEST, and STEP workshops since 1984 were mailed an initial contact letter and later sent the SoC and BSSE questionnaires as the follow-up. Two-hundred and fifty teachers that visited the Educators Resource Center for teaching materials during the spring of 1995 were mailed the latter packet as well. Seventy-five life sciences research from KSC were also given the BSSE to fill out.

The current study evaluates the characteristics of participants relative to their concerns about using the material presented in the workshops (or received at the Educators Resource Center for the comparison group) based on the Concerns Based Adoption Model and their beliefs about science and science education. The pre-test and post-test from the 1995 workshops will be used to identify changes that occurred during the workshop.

An evaluation of differences between the past participants and the comparison group will help to determine the output indicators or concerns of teachers that the workshops fail to address and those for which concerns are lowered. This information will be of value in the planning and development of future workshops.

Changes in the beliefs about science and about teaching science will indicate areas where program content and instructional approaches have been appropriate and also areas where these characteristics have been ineffective. Differences between the current workshop participants (1995), past participants, teachers receiving materials but no training, and science researchers will provide insight on the pedagogical and science beliefs of these groups and any differences relative to workshop participation or research participation.

Data Collection and Analysis Techniques

The two survey sets included an initial contact survey (personal information) and a second set including the Beliefs about Science and Science Education (BSSE) questionnaire and the Stages of Concern questionnaire (SoCQ). These were administered to the 1995 participants at the start of the workshop and at the end. The past participants were mailed the initial contact survey. Attempts were made to contact non-respondents by a second mailing. The respondents were then mailed the second survey set as well as teachers selected for the comparison group. All the information gathered by these activities can be used in evaluating interest and attitudes on the part of the participants. Life Sciences researchers at KSC were given the BSSE to fill out at their convenience.

Scoring and interpretation of both the BSSE and SoCQ were done on an individual level or by group means. Scores in each of the categories defined for the BSSE by Lawrenz (1984) and for the SoCQ by Hall, George, and Rutherford (1977) provide evidence of changes in beliefs and levels of concerns associated with workshop participation. For the SoCQ, raw scores for individuals fall between 0 to 35 (five items per stage, rated 0 to 7). Changes in the total scores and the scores for each level of concern, pre- versus post-test (or differences between comparison groups) are an indication of how the workshop addressed the concerns and beliefs of the participants.

Profile of concerns plots were produced using percentile scores as in Figure 2. This provides a graphic picture of the concerns about the innovation which is related to teacher behavior with respect to the innovation. By comparing pre- and post-test profile plots, changes in levels of concern related to outcome indicators are using group means.

Hall, George and Rutherford (1977) have recommended guidelines for interpreting the SoCQ. These are: 1) Establish a Holistic Perspective; 2) Look at High and Low Stage Scores; 3) Look at Individual Item Responses and; 4) Look at the Total Score.

Repeated Measures Multivariate Analysis of Variance has been used by Lawrenz, 1984 in the evaluation of relationships among the beliefs and concerns measured and workshop characteristics in comparing two workshop lengths. She also used t-tests to measure effects of a workshop on teacher beliefs (Lawrenz, 1987).

The samples of the current study were pooled and the individuals grouped by number of weeks of workshop attendance, time since workshop, and grade level taught. The Stages of Concern scores within the current study were found to be normal and thus a paired t-test was used to test for changes during the workshop. One-Way Analysis of Variance was performed to identify significant differences between groups that were made up of current, past, or non-participant teachers.

Responses to the BSSE were evaluated on a sample by sample basis and ten of the questions were found to show some significant differences, but were not normal in distribution. These were questions 3, 7, 8, 13, 16, 27, 30, 33, 34, and 35. These were compared pre-post using the Wilcoxon matched pairs, signed ranks (SPSS, 1993). Kruskal-Wallis One-Way Analysis of Variance (SPSS, 1993) was performed to identify significant differences between groups pooled data sets, divided up by grade level taught, time since workshop, and weeks of the workshop.

CHAPTER 4

RESULTS

Responses to Distribution Methods

An important aspect of a survey study is the method of delivering the instrument sets with which the measurement is made. For this study, the instrument sets were distributed directly to the 1995 workshop participants and collected a day later, both for the pre-test and the post-test. The distribution to the other participants in the study was by a mailing for the past workshop participants and for the visitors to the Educators Resource Center (ERC). The life sciences researchers received the instrument via interoffice mail. The number of instruments administered and the response by the different groups is presented in Table 3. The number of instrument sets mailed to past participants was the number of current addresses available.

Instrument Scoring and Analysis

The scores for each Stage of Concern from the SoCQ were totalled to yield a level of concern for each individual for each Stage of Concern. Responses on the

Table 3.

Instrument Sets (BSSE+SoCO) Distributed and Received

Group	Number Sent	Number Received	Response
USF 1995 (pre+post)*	20	19	95%
NEWEST 1995 (pre+post)*	19	16	84%
Bre. SS&M 1995(pre+post)*	18	17	94%
STEP 1995(pre+post)*	27	25	93%
STEP 1994	37	11	30%
NEWMAST 1994	23	10	43%
NEWEST 1993	21	9	43%
NEWEST 1992	18	7	39%
NEWMAST 1991	19	7	37%
NEWEST 1990	20	7	35%
NEWMAST 1989	20	9	45%
NEWMAST 1988	15	4	27%
NEWEST 1988	11	5	45%
NEWMAST 1987	22	7	32%
NEWMAST 1986	18	5	28%
NEWMAST 1985	18	8	44%
NEWMAST 1984	12	2	17%
No Workshop (ERC)	250	16	6%
Science Researchers**	75	15	20%

*Numbers represent: [pre-test]+[post-test]=one instrument.

**Only the BSSE was distributed to this group.

Beliefs about Science and Science Education were averaged and twelve questions were identified which appeared to demonstrate operationally significant differences between groups. These were BSSE questions 3, 7, 8, 9, 13, 16, 21, 27, 30, 33, 34, and 35 (Appendix E). The individual values for the seven Stages of Concern (Appendices F and G) and the responses to the twelve BSSE questions were analyzed to answer the research questions. The 1995 workshops, providing both pre-test and post-test responses were analyzed separately as a causal comparison evaluation and then combined with the responses of the past workshop participants for the subsequent analyses. Because of the sample size and that a small to medium effect is expected, an alpha of 0.05 was chosen for statistical significance.

For the full data set (pre-1995+1995), responses to the two instruments were grouped in three ways for analysis. The study participants were grouped by the highest grade level taught by the participant, by the number of weeks duration that the workshop they attended was held, and by the time elapsed since the workshop was attended.

The coding for Weeks (the length of the workshop in weeks) is: 0=No workshop attended (teachers); 1=One week; 2=Two Weeks; 3=Three Weeks; 4=Four Weeks; and 99=Life sciences researchers. The coding for Time Since Workshop (the period of time since participation in the workshop) is: 0=1995 workshop participants (post-test); 1=1990-1994 workshop participants; 2=1984-1989 workshop participants; 9=No workshop, visitors to KSC receiving teacher kits and the pretest from the 1995 workshop participants; and 99=Life sciences researchers. The coding for Grade Code (the highest grade level taught) is: 0=Don't teach; 1=Prekindergarten through 6th grade; 2=6th Grade through High School; and 3=College.

Results of the 1995 Summer Workshops

The Stages of Concern Questionnaire Results

The Stages of Concern mean values for each of the 1995 workshops, pre- and post-, were converted to percentile values relative to a reference population as recommended by Hall, George and Rutherford (1977) prior to the creation of the profiles presented in Appendix F and Figures 3,4,5, and 6. These profiles are generally characteristic of non-users, with relatively high stages 0, 1, 2 and 3 (Hall, George and Rutherford, 1977). However, they graphically demonstrate changes in concerns as did the t-test. Particularly, data from the STEP

Figure 3.

The Levels of Concern: University of South Florida 1995

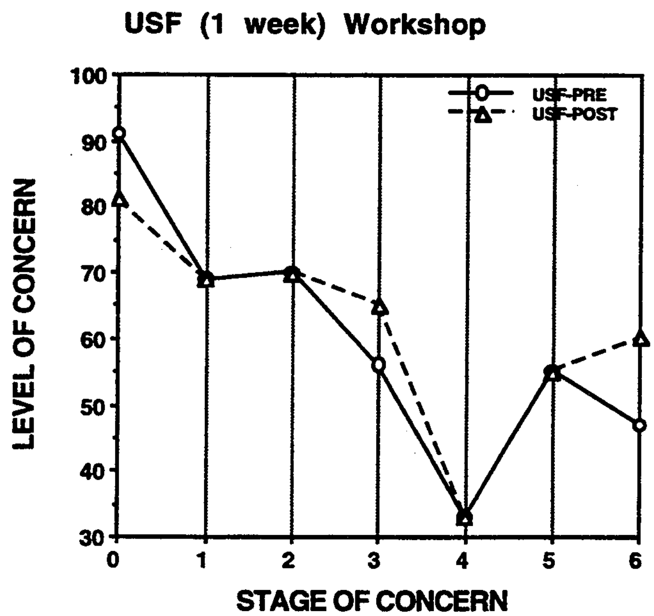


Figure 4.

Levels of Concern: NEWEST 1995

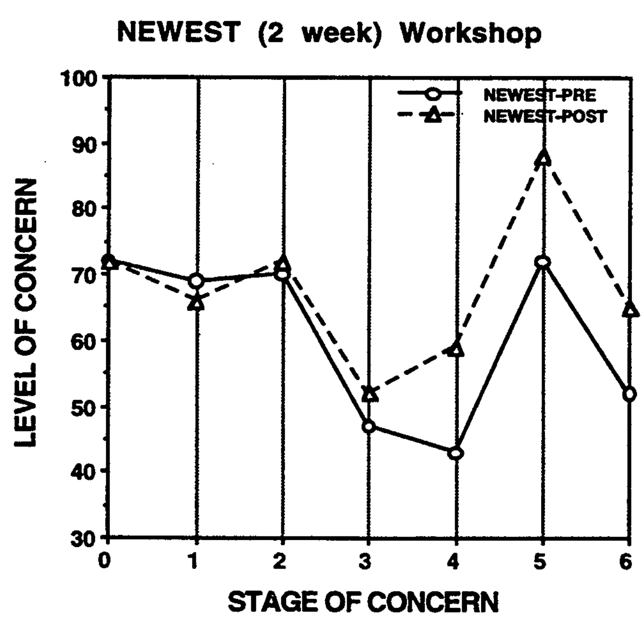


Figure 5.

Levels of Concern: Brevard Summer Science and Math 1995

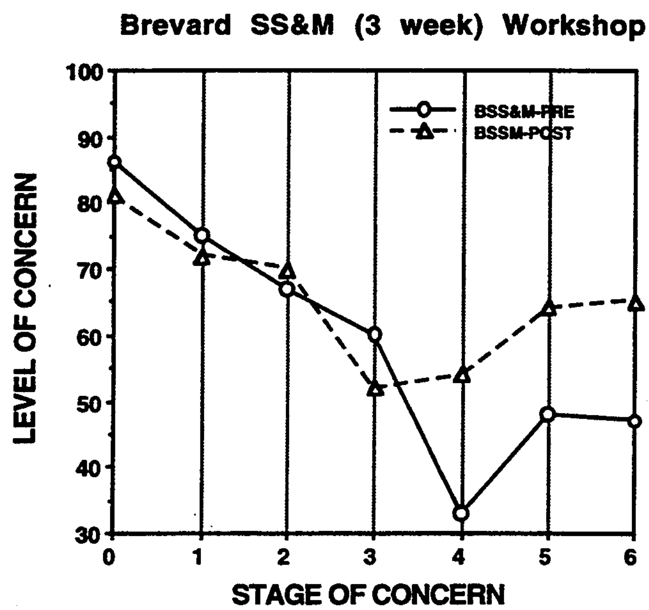
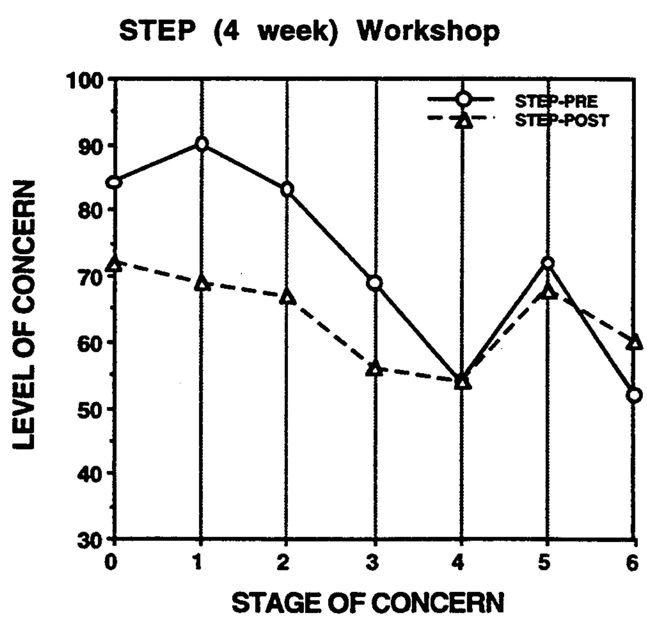


Figure 6.

Levels of Concern: STEP 1995



workshop showed a marked change in Stages 0, 1, and 2, indicating significantly reduced concerns toward awareness, understanding, and personal confidence toward using space science in their classrooms (Dreschel, Hodges, Dutczak and Fronk, 1996).

Inferential statistics were performed on the raw scores taken from the Stages of Concern Questionnaire, totaled for each Stage of Concern. A Kolmogorov-Smirnov (Lilliefors) test (SPSS, 1993) for normal distribution was performed on the total sample for each Stage of Concern and indicated a normal sample distribution for each Stage. Because of the pre-post sampling for the 1995 workshops, paired t-tests (SPSS, 1993) were performed to test for significance. An alpha level of 0.05 was chosen as a small to moderate effect was expected. The results of paired t-tests (Appendix H) for each Stage of Concern by workshop are presented in Table 4.

Significant changes were indicated for Stage 0 (awareness) from the one week (USF) and the four-week (STEP) workshops. Changes for Stage 1 (informational) and Stage 2 (personal) were indicated for the Step workshop. There were no significant changes in management concerns (Stage 3) observed. The three-week workshop (SS&M) yielded a change indicated for Stage 4 (consequence) concerns and the two-week, elementary school (NEWEST) workshop, a change in Stage 5 (collaboration) concerns. The one-week (USF) workshop participants also showed a change in concerns pertaining to refocusing (Stage 6).

When the data were pooled and the group viewed as a whole, changes in responses relative to Stage 0, Stage 4, Stage 5, and Stage 6 were observed. Stage 0 and Stage 1 relate to awareness and understanding of the materials from the workshop (printed and presented materials on space science).

Table 4. Two-Tailed t-values for the Stages of Concern

Workshop	Stage 0 Awareness	Stage 1 Information	Stage 2 Personal	Stage 3 Management	Stage 4 Consequence	Stage 5 Collaborate	Stage 6 Refocusing
USF	-2.42*	0.55	0.60	1.11	0.80	0.59	2.30*
NEWEST	-0.17	-0.62	0.39	0.34	1.85	3.07*	1.35
SS&M	-0.58	-0.39	0.71	-0.87	2.89*	2.05	1.84
STEP	-2.16*	-3.49*	-2.73*	-2.01	0.78	0.60	0.81
Total (pooled)	-2.75*	-1.77	-0.84	-0.98	2.67*	2.76*	2.74*

*Indicates significance at $\alpha = 0.05$.

Beliefs about Science and Science Education Results

A Kolmogorov-Smirnov (Lilliefors) (SPSS, 1993) for normal distribution was performed on the responses to the Beliefs about Science and Science Education instrument and found not have a normal distribution. The Wilcoxon Matched Pairs, Signed Ranks test (Appendix I) was performed on the responses to the Beliefs about Science and Science Education instrument (BSSE). A significant difference in response pre- vs. post-workshop was observed for four BSSE statements, one for each of the four 1995 workshops. These were statements 13, 30, 33, and 35.

BSSE Question #13: Science at the elementary school level should help children to develop logical thinking abilities and need not be concerned with any specific scientific subject matter.

For the Step 1995 workshop

Mean Rank	Cases
6.95	11 - Ranks (post-test less than pre-test)
7.25	2 + Ranks (pre-test less than post-test)
	12 ties
	25 Total

Z=-2.1665 2-Tailed P=0.0303

Nearly half of the participants in the Step workshop changed their response following the workshop. The pre-test mean for this statement was 2.60 and the post-test mean was 2.08, indicating that logical thinking skills have become more important over the course of this workshop.

<u>BSSE Question #30: An important function of science teachers is providing students with the right answers to their questions.</u>

<u>For the USF 1995 workshop</u>

Mean Rank	Cases
6.00	11 - Ranks (post-test less than pre-test)
12.00	1 + Ranks (pre-test less than post-test)
	7 ties
	19 Total
Z=-2.1181	2-Tailed P=0.0342

More than half of the participants in the USF workshop changed their response following the workshop. The pre-test mean for this statement was 2.89 and the post-test mean was 2.42, indicating that the role of the teacher as a provider of correct answers has become more important to these teachers over the course of this workshop.

<u>BSSE Question #33: The technique of assigned readings in the science text, is a means of providing a good understanding of basic science principles.</u>

<u>For the Brevard SS&M 1995 workshop</u>

Mean Rank	Cases
2.50	1 - Ranks (post-test less than pre-test)
4.79	7 + Ranks (pre-test less than post-test)
	9 ties
	17 Total
Z=-2.1704	2-Tailed P=0.0300

Nearly half of the participants in the Brevard SS&M workshop changed their response following the workshop. The pre-test mean for this statement was 2.65 and the post-test mean was 3.23, indicating a change from agreement with this statement to disagreement following the workshop. Assigned readings have become less important to these teachers in science teaching over the course of this workshop.

BSSE Question #35: A teacher need not have a strong background in science to be effective in teaching science.

For the Newest 1995 workshop

Mean Rank	Cases
4.57	7 - Ranks (post-test less than pre-test)
4.00	1 + Ranks (pre-test less than post-test)
	8 ties
	16 Total
Z=-1.9604	2-Tailed P=0.0499

Nearly half of the participants in the Newest workshop changed their response following the workshop. The pre-test mean for this statement was 2.38 and the post-test mean was 1.81, indicating a stronger agreement with this statement following the workshop. A strong science background has become less important to these teachers for teaching science over the course of this workshop. Since this workshop is made up primarily of preschool and elementary school teachers, more confidence is indicated for these teachers to teach science to their classes.

Results from All Sample Groups

The Stages of Concern Questionnaire Results

A Kolmogorov-Smirnov (Lilliefors) test (SPSS, 1993) for normal distribution was performed on the sum of responses for each Stage of Concern by these categories and indicated a normal sample distribution for each Stage.

The Stages of Concern mean values for each of categories were converted to percentile values and used to create the profiles presented in Appendix G and Figures 7, 8, and 9. These profiles are characteristic of non-users, with relatively high stages 0, 1, and 2.

Four Stages of Concern demonstrated significant differences in responses using One-way Analysis of Variance (Appendix J). These were stages 0, 2, 4, and 5. Significant results from responses to the Stages of Concern Questionnaire are discussed on an individual basis in this section.

Figure 7.

The Levels of Concern by Workshop Duration (Weeks)

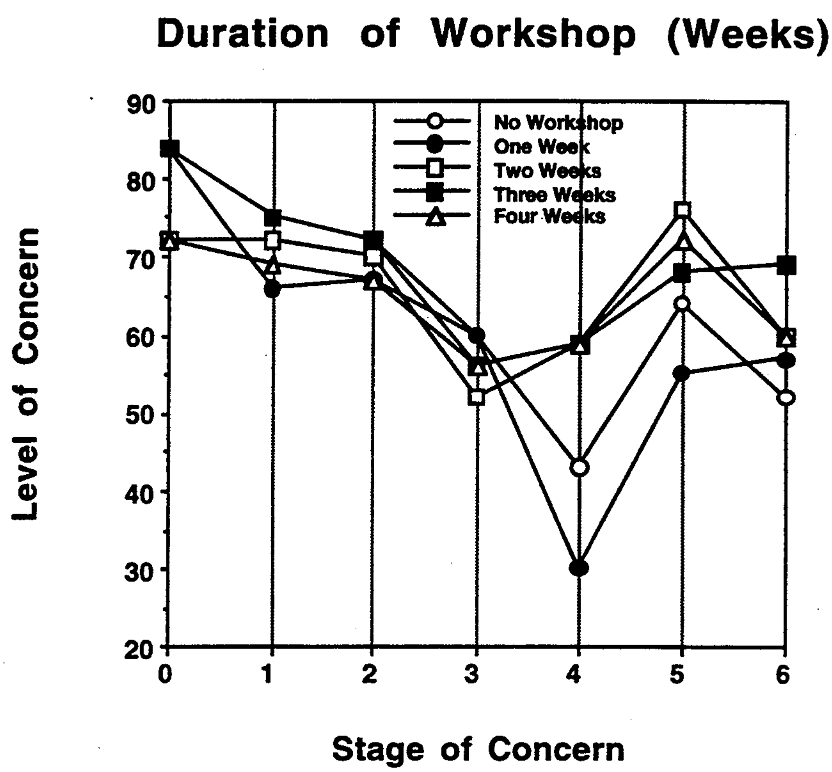


Figure 8.

The Levels of Concern by Time Since Workshop

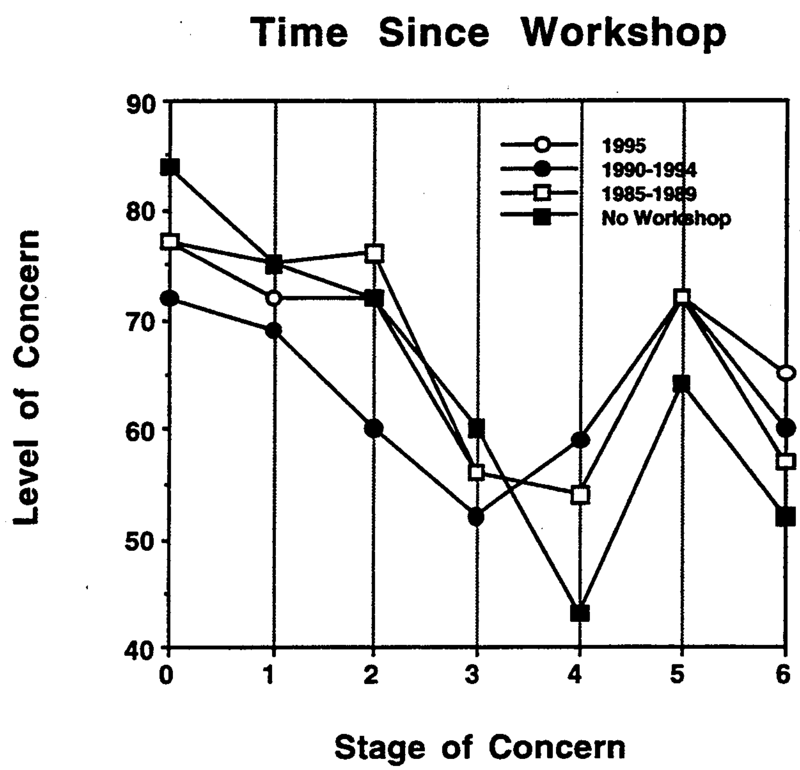
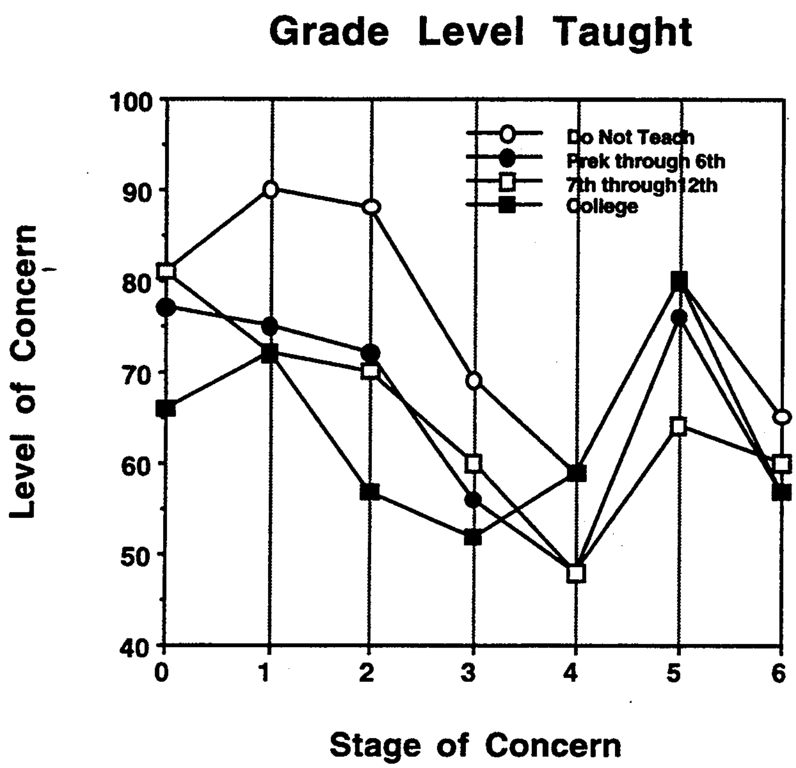


Figure 9.

The Levels of Concern by Grade Level Taught



Stage of Concern 0: Awareness (general familiarity with the subject).

Variable STAGE0 By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	479.9976	119.9994	3.9295	0.0041
Within Groups	254	7756.674	30.5381		
Total	258	8236.672			

By number of weeks of workshop, differences were observed at a p=0.0018. Those that hadn't had a workshop had a mean of 10.96, the one-week mean was 10.74, the two-week mean was 8.48, the three-week mean was 10.53, the four-week mean was 7.53. The largest difference in attitude was between those that had no workshop and the four-week workshop attendee groups.

The success of the workshops in meeting the awareness concerns is indicated as well as a dependence on the length of the workshop.

Variable STAGE0 By Variable TIME SINCE WORKSHOP

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	361.8910	120.630	3.9062	0.0094
Within Groups	255	7874.781	30.8815		
Total	258	8236.672			

By time since workshop, differences were observed at a p=0.0094. Those that hadn't had a workshop had a mean of 10.96, the 1995 mean was 9.26, the 1990-1994 mean was 7.76, the 1985-1989 mean was 8.98. The largest difference was between those that had no workshop and the 1990-1994 attendees.

The greater concerns for those that hadn't had a workshop indicates that the workshops were successful in satisfying teachers concerns over awareness of space science more than just the materials themselves.

Variable STAGE0 By Variable GRADE CODE

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	260.2845	86.7615	2.7737	0.0420
Within Groups	255	7976.387	31.2800		
Total	258	8236.672			

By grade level, differences were observed at a p=0.0041. Those not teaching had a mean of 10.4, the prekindergarten through 6th grade teachers' mean was 8.94, the middle and high school teachers had a mean of 10.23, and a mean of 6.53 was observed for college teachers. The largest differences were between the non-teachers and the college instructors.

The lower concerns for the college instructors may indicate a prior awareness and understanding of space science.

Stage of Concern 2: Personal (how they will be able to implement the innovation).

Variable STAGE2 By Variable TIME SINCE WORKSHOP

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	687.8339	229.2780	2.9191	0.0347
Within Groups	255	20028.57	78.5434		
Total	258	20716.40			

By time since workshop, differences were observed at a p<0.0001. Those that hadn't had a workshop had a mean of 20.31, the 1995 mean was 19.53, the 1990-1994 mean was 16.14, the 1985-1989 mean was 20.73. The largest difference was between the 1990-1994 and the 1985-1989 attendee groups.

High personal concerns were characteristic of those teachers that hadn't had a workshop and those who had the workshop over five years ago. The personal concerns generally were high.

Stage of Concern 4: Consequence (the effect on the students).

Variable STAGE4 By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	668.2593	167.065	3.4663	0.0089
Within Groups	254	12242.16	48.1975		
Total	258	12910.42			

By number of weeks of workshop, differences were observed at a p=0.0018. Those that hadn't had a workshop had a mean of 23.11, the one-week mean was 20.42, the two-week mean was 25.56, the three-week mean was 26.00, the four-week mean was 25.5. The largest difference in attitude was between the one-week and the three-week workshop attendee groups.

The consequence concerns were generally high but lowest in the one-week participants. This may be due in part to the fact that the teachers in this group had high concerns in the area of awareness, thus did not consider the use of space science in their teaching as feasible at that time. The three-week participants exhibited the highest concerns over consequence which may indicate that they were considering using space science in their teaching but were concerned over the student reaction.

Stage of Concern 5: Collaboration (working with other teachers to implement the innovation).

Variable STAGE5 By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	787.664	196.916	3.192	0.0140
Within Groups	254	15670.81	61.6961		
Total	258	16458.47			

By number of weeks of workshop, differences were observed at a p=0.0018. Those that hadn't had a workshop had a mean of 23.69, the one-week mean was 21.63, the two-week mean was 27.04, the three-week mean was 25.29, and the four-week mean was 25. The largest difference in attitude was between the one-week and the two-week workshop attendee groups.

Again, the concern level for collaboration was high. This indicates a need for more teacher-to-teacher interactions, both at school and during in-service activities.

<u>Variable STAGE5 By Variable GRADE CODE</u>

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	707.518	235.839	3.8181	0.0106
Within Groups	255	15750.95	61.768		
Total	258	16458.47			

By grade level, differences were observed at a p<0.0001. Those not teaching had a mean of 28, the prekindergarten through 6th grade teachers' mean was 26.77, the middle and high school teachers had a mean of 23.70, and college teachers' mean was 27.82. The largest differences were between the middle and high school teachers and those not teaching.

Those not teaching had very high collaboration concerns, possibly because of their role in school administration. The middle and high school teachers probably already collaborate to a degree as a matter of course, so had the lowest concerns over collaboration.

Beliefs about Science and Science Education Results

A Kolmogorov-Smirnov (Lilliefors) test (SPSS, 1993) for normal distribution was performed on the responses to the Beliefs about Science and Science Education instrument and found not have a normal distribution. Ten Beliefs about science and Science Education statements were found to show significant differences in responses from the various sample groups using the Kruskal-Wallis 1-way Analysis of Variance (Appendix K). These were 3,7,8,13,16,27,30,33,34, and 35. Significant results from responses to the Beliefs about Science and Science Education (BSSE) instrument are discussed on an individual basis in this section.

BSSE Question #3: Science is something you do and a textbook offers little help in providing an activity science program.

BSSE #3 by WEEKS

Mean Rank	Cases		
134.17	93	WEEKS =	0
173.76	19	WEEKS =	1
137.06	96	WEEKS =	2
148.09	17	WEEKS =	3
112.04	36	WEEKS =	4
182.57	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
12.7868	5	0.0255	13.9208	5	0.0161

By number of weeks of workshop, differences were observed at a p=0.016. Those that hadn't had a workshop had a mean of 2.89, the one-week mean was 3.53, the two week mean was 2.94, the three week mean was 3.12, the four-week mean was 2.58, and there was a mean of 3.67 for the science researchers.

This indicates that the longer workshops may have a negative effect on an educators attitude toward textbooks. Another explanation is that this may have been closely tied to grade level taught as the one-, three-, and four-week workshops were only the 1995 workshops and the "no workshop" group was made up of pre-tested 1995 teachers, visitors to the Educators Resource Center. The two-week workshop group was made up of teachers from the past through the 1995 post-tested teachers. The largest difference was between the four-week workshop attendees and the science researchers. The four-week workshops were the STEP teachers, with a high percentage of elementary school teachers, indicating that the grade level again related to attitude toward textbooks.

BSSE #3 by GRADE CODE

Mean Rank	Cases		
188.38	20	GRADE_CO =	0
110.79	95	GRADE_CO =	1
150.99	144	GRADE_CO =	2
128.82	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
23.0321	3	0.0000	5.0747	3	0.0000

By grade level, differences were observed at a $p<0.0001$. Those not teaching had a mean of 3.75, the prekindergarten through 6th grade teachers' mean was 2.54, the middle and high school teachers had a mean of 3.16, and college teachers' mean was 2.82. This is probably due to the amount of science content taught in the different grade levels and the reading level of the students. Elementary school classes probably depend on science texts to a lesser degree as do college instructors. Those not teaching, mainly the science researchers indicated a belief in the positive value of textbooks in learning science. The largest difference was between those not teaching (including the science researchers) and the prekindergarten through 6th grade teachers.

The not-teaching group indicated disagreement with the statement which means that they feel that textbooks play a role in a science activity program. The high school teachers indicated the same feelings, although not as strongly. The elementary and college teachers were in agreement with the statement indicating less dependence on textbooks in their pedagogical approaches. For the elementary school teachers, this may also be linked to student reading levels, whereas for the college instructors, greater dependence on lectures and lecture notes for science learning may be indicated.

BSSE Question #7: Allowing Students to do what they want when working with science equipment could result in many discipline problems.

BSSE #7 by GRADE CODE

Mean Rank	Cases		
143.40	20	GRADE_CO =	0
144.44	95	GRADE_CO =	1
128.56	144	GRADE_CO =	2
183.76	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
8.3042	3	0.0401	9.0168	3	0.0291

By grade level, differences were observed at a $p<0.029$. Those not teaching exhibited a mean of 2.85, the prekindergarten through 6th grade teachers' mean was 2.87, the middle and high school teachers had a mean of 2.63, and the college teachers responses yielded 3.41 as a mean. The largest difference was between middle and high school teachers versus college-level teachers.

College instructors should have less of a concern about discipline and may place more emphasis on problem-solving activities whereas in middle and high school classes, as well as in elementary school classes, there is greater concern over discipline. The response of the not-teaching group indicate a perception of the need for discipline greatly outweighing the need for problem solving activities.

BSSE Question #8: Written tests are necessary in science in order to find out if students have learned the concepts and principles studied in class.

BSSE #8 by WEEKS

Mean Rank	Cases		
135.95	93	WEEKS =	0
119.89	19	WEEKS =	1
142.71	96	WEEKS =	2
138.03	17	WEEKS =	3
171.07	36	WEEKS =	4
73.27	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
17.4082	5	0.0038	19.7934	5	0.0014

By number of weeks of workshop, differences were observed at a p=0.0014. Those that hadn't had a workshop had a mean of 2.97, the one-week mean was 2.73, the two-week mean was 3.07, the three-week mean was 3.0, the four-week mean was 3.47, and there was a mean of 2.07 for the science researchers. The largest difference was between the science researchers and the four-week (Step)workshop attendees.

This indicates that the longer workshops may have an effect on an educators' attitude toward written tests. As with textbooks, the researchers believe that written tests are important in evaluating science learning. The Step workshop participants were, in large part, elementary school teachers and thus have a lower dependence on written tests.

BSSE #8 by TIME SINCE WORKSHOP

Mean Rank	Cases		
146.97	77	TIME_SIN =	0
160.98	51	TIME_SIN =	1
123.91	40	TIME_SIN =	2
135.95	93	TIME_SIN =	9
73.27	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
16.3632	4	0.0026	18.6052	4	0.0009

By time since workshop, differences were observed at a p=0.0009. Those that hadn't had a workshop had a mean of 2.96, the 1995 mean was 3.13, the 1990-1994 mean was 3.33, the 1985-1989 mean was 2.8, and there was a mean of 2.07 for the science researchers. The largest difference was between the 1990-1994 attendees group and the science researchers.

There is general agreement on the use of tests except by the 1990-1994 and 1995 attendees who generally do not believe written tests are necessary to determine if learning has occurred.

BSSE #8 by GRADE CODE

Mean Rank	Cases		
82.80	20	GRADE_CO =	0
167.39	95	GRADE_CO =	1
126.76	144	GRADE_CO =	2
142.06	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
25.3351	3	0.0000	28.8064	3	0.0000

By grade level, differences were observed at a $p<0.0001$. Those not teaching had a mean of 2.2, the prekindergarten through 6th grade teachers' mean was 3.42, the middle and high school teachers had a mean of 2.84, and college teachers' mean was 3.06. The largest differences were between those not teaching (including the science researchers) and the prekindergarten through 6th grade teachers.

This is probably due to the dependence on written tests in the different grade levels and also the reading level of the students. Elementary school teachers probably depend on science tests to a lesser degree compared to middle and high school teachers. This again relates to the attitude toward textbooks, readings in the texts, and the reading abilities of students in relation to their ability to learn science concepts.

BSSE Question #13: Science at the elementary school level should help children to develop logical thinking abilities and need not be concerned with any specific scientific subject matter.

BSSE #13 by WEEKS

Mean Rank	Cases	
133.61	93	WEEKS = 0
107.66	19	WEEKS = 1
150.37	94	WEEKS = 2
104.68	17	WEEKS = 3
157.43	36	WEEKS = 4
108.13	15	WEEKS = 99

	274	Total

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
12.6540	5	0.0268	14.8564	5	0.0110

By number of weeks of workshop, differences were observed at a p=0.0110. Those that hadn't had a workshop had a mean of 3.20, the one-week mean was 2.84, the two-week mean was 3.43, the three-week mean was 2.71, the four-week mean was 3.53, and there was a mean of 2.8 for the science researchers. The greatest difference was between the three-week and the four-week workshop attendees.

The groups with no-, two-, and four-week workshops indicated a belief in a greater emphasis on specific subject matter whereas the one- and three-week as well as the science researchers emphasis was on logical thinking. Here again, this may well be linked to grade level as the one- and three-week workshops were only the 1995 workshops, the four-week workshops were the Step workshops (1994 and 1995) and the "no workshop" group was made up of pre-tested 1995 teachers and visitors to the Educators Resource Center. The researchers believe that problem solving skills are important in elementary science learning as do the one-week and three week workshops, made up primarily of high school and college instructors. The two-week workshop groups were made up of teachers from the past through the 1995 post-tested teachers and included a mixture of teachers from all grade levels, and the four-week workshops were the two Step workshops.

BSSE #13 by GRADE CODE

Mean Rank	Cases		
108.35	20	GRADE_CO =	0
151.23	95	GRADE_CO =	1
129.73	142	GRADE_CO =	2
160.00	17	GRADE_CO =	3

	274	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
8.2933	3	0.0403	9.7367	3	0.0209

By grade level, differences were observed at a p=0.0209. Those not teaching had a mean of 2.8, the prekindergarten through 6th grade teachers' mean was 3.43, the middle and high school teachers had a mean of 3.14, and a mean of 3.59 was observed for the college instructors. The largest difference was between those not teaching (including the science researchers) and the college instructors.

Those not teaching, mainly the science researchers indicated a belief in emphasizing problem solving in science whereas the teachers may have a requirement for content, even at the elementary school level. High school and college teachers may believe that a level of preparation in content areas may be needed at the lower grade levels as a prerequisite to their courses.

BSSE Question #16: It is okay for children to play around with science materials for awhile but eventually the teacher must direct their attention to the really important concepts.

BSSE #16 by WEEKS

Mean Rank	Cases	
144.41	93	WEEKS = 0
134.00	19	WEEKS = 1
135.02	94	WEEKS = 2
180.35	17	WEEKS = 3
113.50	36	WEEKS = 4
123.67	15	WEEKS = 99

	274	Total

Chi-Sq	D.F.	Significance	Corrected for ties Chi-Sq	D.F.	Significance
9.5672	5	0.0885	11.3181	5	0.0454

By number of weeks of workshop, differences were observed at a p=0.0454. Those that hadn't had a workshop had a mean of 2.64, the one-week mean was 2.52, the two-week mean was 2.53, the three-week mean was 3.11, the four-week mean was 2.27, and there was a mean of 2.33 for the science researchers. The greatest difference was between the three-week and the four-week workshop attendees.

Again, interpretation of responses is difficult. The question is whether the teacher responded to the first part of the question or the second part. Generally, those in all workshop-length categories agreed with this statement.

<u>BSSE #16 by GRADE CODE</u>

Mean Rank	Cases		
125.72	20	GRADE_CO =	0
120.95	95	GRADE_CO =	1
147.16	142	GRADE_CO =	2
163.18	17	GRADE_CO =	3

	274	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
8.4814	3	0.0370	10.0337	3	0.0183

By grade level, differences were observed at a p=0.0183. Those not teaching had a mean of 2.35, the prekindergarten through 6th grade teachers' mean was 2.35, the middle and high school teachers had a mean of 2.69, and a mean of 2.53 was observed for the college instructors. The largest difference was between those not teaching (including the science researchers) and the middle and high school teachers.

It is assumed that the emphasis was placed on the second part of this question, in which the teacher must play a strong roll in science teaching. This then indicates that most of the teachers and researchers involved in the study, feel that the teachers has an important role in giving direction to students. When placed in these categories, all the teachers agreed with this statement.

BSSE Question #27: Asking questions for which there are specific answers and then providing immediate positive feedback is important to good science teaching and helps to eliminate uncertainty among students.

BSSE #27 by WEEKS

Mean Rank	Cases		
124.06	93	WEEKS =	0
102.53	19	WEEKS =	1
160.34	95	WEEKS =	2
116.44	17	WEEKS =	3
150.54	36	WEEKS =	4
122.23	15	WEEKS =	99

	275	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
16.8656	5	0.0048	19.8450	5	0.0013

By number of weeks of workshop, differences were observed at a p=0.0013. Those that hadn't had a workshop had a mean of 2.39, the one-week mean was 2.11, the two-week mean was 2.88, the three-week mean was 2.24, the four-week mean was 2.72, and there was a mean of 2.27 for the science researchers. The largest difference in attitude was between the one-week and the two-week workshop attendees although all groups agree with the statement.

All groups were in agreement with this statement indicating a positive attitude toward science pedagogy which includes asking questions with answers and providing immediate feedback.

BSSE #27 by TIME SINCE WORKSHOP

Mean Rank	Cases	
130.30	76	TIME_SIN = 0
176.59	51	TIME_SIN = 1
141.75	40	TIME_SIN = 2
124.06	93	TIME_SIN = 9
122.23	15	TIME_SIN = 99

	275	Total

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
16.2546	4	0.0027	19.1260	4	0.0007

By time since workshop, differences were observed at a p=0.0007. Those that hadn't had a workshop had a mean of 2.40, the 1995 mean was 2.45, the 1990-1994 mean was 3.12, the 1985-1989 mean was 2.63, and there was a mean of 2.27 for the science researchers. The largest difference was between the 1990-1994 attendees group and the science researchers.

Science researchers indicated agreement with this statement as did most of the teacher groups. The group of workshop attendees from 1990-1994 tended to disagree with this approach which may indicate a difference in pedagogical emphasis within the workshops during that period.

<u>BSSE Question #30: An important function of science teachers is providing students with the right answers to their questions.</u>

<u>BSSE #30 by WEEKS</u>

Mean Rank	Cases		
130.04	93	WEEKS =	0
94.32	19	WEEKS =	1
156.43	96	WEEKS =	2
144.88	17	WEEKS =	3
149.18	36	WEEKS =	4
99.30	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
16.0841	5	0.0066	17.5362	5	0.0036

By number of weeks of workshop, differences were observed at a p=0.0036. Those that hadn't had a workshop had a mean of 2.97, the one-week mean was 2.42, the two-week mean was 3.33, the three-week mean was 3.18, the four-week mean was 3.25, and there was a mean of 2.53 for the science researchers. The largest difference in attitude was between the one-week and the two-week workshop attendees.

There appears to be a relationship between amount of workshop attendance and attitudes toward teachers as providers of information. Those that hadn't had the workshop including the pretest teachers, the science researchers and the no-workshop group agree with this attitude as did the one-week group. The other attendee groups, the two-, three-, and four-week groups disagree.

<u>BSSE #30 by TIME SINCE WORKSHOP</u>

Mean Rank	Cases		
133.55	77	TIME_SIN =	0
160.44	51	TIME_SIN =	1
154.43	40	TIME_SIN =	2
130.04	93	TIME_SIN =	9
99.30	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
10.4051	4	0.0341	11.3446	4	0.0230

By time since workshop, differences were observed at a p=0.0230. Those that hadn't had a workshop had a mean of 2.97, the 1995 mean was 3.0, the 1990-1994 mean was 3.41, the 1985-1989 mean was 3.3, and there was a mean of 2.53 for the science researchers. The largest difference was between the 1990-1994 attendees group and the science researchers.

From this data, there is an indication that the workshops have an effect on attitude in this area. Following the workshop, providing right answers to students becomes a lower priority in science teaching. The no-workshop teachers and the science researchers on the other hand, agreed that this is an important role for teachers.

BSSE #30 by GRADE CODE

Mean Rank	Cases		
101.35	20	GRADE_CO =	0
158.37	95	GRADE_CO =	1
126.00	144	GRADE_CO =	2
177.03	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
17.7097	3	0.0005	19.3086	3	0.0002

By grade level, differences were observed at a p=0.0002. Those not teaching had a mean of 2.55, the prekindergarten through 6th grade teachers' mean was 3.36, the middle and high school teachers had a mean of 2.91, and college teachers' mean was 3.65. The largest differences were between those not teaching (including the science researchers) and the college instructors.

Middle and high school teachers indicated that they perceive themselves as the providers of information and the science researchers agreed. Elementary school and college teachers both disagreed with this statement, due to differences in pedagogy. This is likely linked to an emphasis on logical thinking and problem solving versus content. Greater emphasis in middle and high school is placed on teaching content, in preparing students for specific college courses.

<u>BSSE Question #33: The technique of assigned readings in the science text, is a means of providing a good understanding of basic science principles.</u>

BSSE #33 by WEEKS

Mean Rank	Cases		
130.92	93	WEEKS =	0
98.74	19	WEEKS =	1
146.85	96	WEEKS =	2
157.68	17	WEEKS =	3
166.43	36	WEEKS =	4
93.67	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
16.7263	5	0.0050	18.7076	5	0.0022

By number of weeks of workshop, differences were observed at a p=0.0022. Those that hadn't had a workshop had a mean of 2.83, the one-week mean was 2.42, the two-week mean was 3.06, the three-week mean was 3.23, the four-week mean was 3.31, and there was a mean of 2.33 for the science researchers. The largest difference in attitude was between the science researchers and the four-week workshop attendees.

Again as in question #3, this indicates that the longer workshops may have a negative effect on an educators attitude toward textbooks.

BSSE #33 by TIME SINCE WORKSHOP

Mean Rank	Cases		
144.73	77	TIME_SIN =	0
162.73	51	TIME_SIN =	1
130.06	40	TIME_SIN =	2
130.92	93	TIME_SIN =	9
93.67	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
11.1849	4	0.0246	12.5098	4	0.0139

By time since workshop, differences were observed at a p=0.0139. Those that hadn't had a workshop had a mean of 2.84, the 1995 mean was 3.04, the 1990-1994 mean was 3.27, the 1985-1989 mean was 2.8, and there was a mean of 2.33 for the science researchers. The largest difference was between the 1990-1994 attendees group and the science researchers.

This indicates that the effect of the workshop on the teachers' attitudes toward textbooks may be change over time. Researchers again indicated a positive attitude toward teaching from textbooks.

BSSE #33 by GRADE CODE

Mean Rank	Cases		
91.03	20	GRADE_CO =	0
166.89	95	GRADE_CO =	1
124.41	144	GRADE_CO =	2
155.03	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
24.3143	3	0.0000	27.1945	3	0.0000

By grade level, differences were observed at a $p<0.0001$. Those not teaching had a mean of 2.3, the prekindergarten through 6th grade teachers' mean was 3.33, the middle and high school teachers had a mean of 2.76, and college teachers' mean was 3.11. The largest differences were between those not teaching (including the science researchers) and the prekindergarten through 6th grade teachers.

This is the companion question to question #3. The not-teaching group indicated agreement with the statement which means that they feel that textbooks play a role in science teaching. The high school teachers indicated the same feelings, although not as strongly. The elementary and college teachers indicate less dependence on textbooks in their pedagogical approaches. For the elementary school teachers, this may also be linked to student reading levels, whereas for the college instructors, emphasis on lectures and lecture notes for science learning may be indicated.

<u>BSSE Question #34. A student with a low reading level will have difficulties learning science concepts and skills of problem solving.</u>

<u>BSSE #34 by WEEKS</u>

Mean Rank	Cases		
135.84	93	WEEKS =	0
102.74	19	WEEKS =	1
158.57	96	WEEKS =	2
102.21	17	WEEKS =	3
151.42	36	WEEKS =	4
81.97	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
21.9715	5	0.0005	25.7434	5	0.0001

By number of weeks of workshop, differences were observed at a p=0.0001. Those that hadn't had a workshop had a mean of 3.70, the one-week mean was 3.26, the two-week mean was 4.02, the three-week mean was 3.23, the four-week mean was 3.83, and there was a mean of 2.87 for the science researchers. The largest difference in attitude was between the science researchers and the two-week workshop attendees.

This also indicates the difference in opinion over reading between science researchers and teachers.

<u>BSSE #34 by TIME SINCE</u>

Mean Rank	Cases		
133.38	77	TIME_SIN =	0
155.56	51	TIME_SIN =	1
153.99	40	TIME_SIN =	2
135.84	93	TIME_SIN =	9
81.97	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
11.7800	4	0.0191	13.8024	4	0.0080

By time since workshop, differences were observed at a p=0.0080. Those that hadn't had a workshop had a mean of 3.70, the 1995 mean was 3.65, the 1990-1994 mean was 3.94, the 1985-1989 mean was 3.98, and there was a mean of 2.87 for the science researchers. The largest difference was between the 1985-1989 attendees group and the science researchers.

Again, the teachers were of a very different attitude than the science researchers.

BSSE #34 by GRADE CODE

Mean Rank	Cases		
78.03	20	GRADE_CO =	0
159.22	95	GRADE_CO =	1
130.08	144	GRADE_CO =	2
165.21	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
21.3855	3	0.0001	25.0568	3	0.0000

By grade level, differences were observed at a $p<0.0001$. Those not teaching had a mean of 2.85, the prekindergarten through 6th grade teachers' mean was 3.99, the middle and high school teachers had a mean of 3.63, and college teachers' mean was 4.06. The largest differences were between those not teaching (including the science researchers) and the college instructors.

The teachers all disagreed with this statement, from all grade levels. The response from the science researchers again emphasize their belief that reading is a very important part of learning science.

BSSE Question #35: A teacher need not have a strong background in science to be effective in teaching science.

BSSE #35 by WEEKS

Mean Rank	Cases		
134.76	93	WEEKS =	0
129.95	19	WEEKS =	1
148.06	96	WEEKS =	2
174.59	17	WEEKS =	3
96.97	36	WEEKS =	4
170.10	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
17.3693	5	0.0039	19.1222	5	0.0018

By number of weeks of workshop, differences were observed at a p=0.0018. Those that hadn't had a workshop had a mean of 2.61, the one-week mean was 2.53, the two-week mean was 2.90, the three-week mean was 3.29, the four-week mean was 2.06, and there was a mean of 3.2 for the science researchers. The largest difference in attitude was between the three-week and the four-week workshop attendee groups.

The three week participants and the science researchers indicated beliefs in the need for a strong science background for teaching science. The former were teachers with the Brevard Summer Science and Math Institute made up of primarily of high school teachers. The four-week workshops were the STEP which had a large representation by elementary school teachers.

BSSE #35 by TIME SINCE

Mean Rank	Cases		
116.68	77	TIME_SIN =	0
127.92	51	TIME_SIN =	1
190.84	40	TIME_SIN =	2
134.76	93	TIME_SIN =	9
170.10	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
26.4054	4	0.0000	29.0703	4	0.0000

By time since workshop, differences were observed at a p<0.0001. Those that hadn't had a workshop had a mean of 2.61, the 1995 mean was 2.38, the 1990-1994 mean was 2.55, the 1985-1989 mean was 3.58, and there was a mean of 3.2 for the science researchers. The largest difference was between the 1995 and the 1985-1989 attendee groups.

The science researchers and the 1985-1989 attendees disagree with the statement indicating a belief that a strong background in science is important in science teaching. The no-workshop, 1995, and 1990-1994 workshop teachers feel that a strong background in science is not critical to teaching science.

BSSE #35 by GRADE CODE

Mean Rank	Cases		
167.93	20	GRADE_CO =	0
104.06	95	GRADE_CO =	1
152.28	144	GRADE_CO =	2
179.65	17	GRADE_CO =	3

	276	Total	

			Corrected for ties		
Chi-Sq	D.F.	Significance	Chi-Sq	D.F.	Significance
29.2150	3	0.0000	32.1634	3	0.0000

By grade level, differences were observed at a $p<0.0001$. Those not teaching had a mean of 3.15, the prekindergarten through 6th grade teachers' mean was 2.2, the middle and high school teachers had a mean of 2.90, and college teachers' mean was 3.35. The largest differences were between the college instructors and the prekindergarten through 6th grade teachers.

College teachers and those not teaching (including the science researchers) believe that a strong science background is necessary for teaching science, prekindergarten through high school teachers disagree. This is probably related to the science backgrounds of the respondents.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

Summary

This study evaluated the impact of NASA teacher workshops on teachers concerns over using space science and examined changes in attitude toward science and science education. In this study, responses from teachers by the length of the workshop, the grade level taught and the time since the workshop was attended were compared. A pretest/posttest pre-experimental design was used for four 1995 workshops of lengths of one to four weeks (1995 attendees). Surveys were also sent to past participants (pre-1995 attendees) of the NASA workshops and to teachers that had received related materials but not attended a workshop (visitors). A high response was obtained from 1995 attendees, a moderate response from pre-1995 attendees, and a poor response from the visitors group. Significant differences, pre- versus post- from the 1995 group were particularly evident in the four-week workshop participants. Differences in response by length of workshop, grade level taught, and time since workshop were also observed in the pooled data.

Teacher Response Frequency

Perhaps the most significant result in this study as to reflecting the attitudes of the teacher groups was the number or frequency of completed and returned instruments. Because of the direct administration to and subsequent in-class submission by the 1995 workshop participants, the frequency of completed and returned instruments was very high, on the order of 90%. The past participants responses to a mailing were also quite high, considering the fact that no other significant contact had been made since participation and up to 11 years had passed since participation. This frequency was somewhat variable but generally was about 30%-40%. This indicates a maintained high interest in space-related topics and is indicative of the positive experience the workshop provided. The third set of teachers consisted of 250 teachers who had stopped in the Educators Resource Center and received the materials that the workshops are based on. These teachers were mailed the instrument and the response was very low, less than 10%. This is consistent with the findings of Mayer and Fortner (1988) when comparing four modes of disseminating educational materials. They concluded that distributing free material without formal training in their use "appears to be a waste of time and money".

Research Questions

Differences by Length of Workshop and Time Since Workshop

The first research question investigated in this study was: Is there a difference in the level of concern for using Space Science in teaching and the beliefs about science and science education in teachers that have participated in the workshops and does this difference vary depending on the length of the workshop and the time that has passed since workshop attendance?

There are differences in the levels of concern for using Space Science in teaching and in the beliefs about science and science education in teachers that have participated in the workshops. These differences vary depending on the length of the workshop and the time that has passed since workshop attendance. Evidence for differences comes from the 1995 workshops (pre-test versus post-test) and in comparing participant teachers with non-participant teachers from all the sampled groups in concerns and attitudes. The responses from the 1995 workshops indicate that there was an effect of the length of the workshop on the understanding of and confidence in using the workshop materials. This is supported in a study of teacher enhancement programs by Gabel and Rubba

(1979), who found no lasting changes evident from short-term programs. Bower (1987) concluded that 8 to 16 hours was the minimum amount of time that should be spent for staff development workshops to be of value. Gardella (1975) found that a resource workshop was effective and Wilke (1980) in a similar study found that a 60-hour resource training session was significantly more effective that a 2-hour training course. Another study by Lawrenz (1984) demonstrated differences in attitudes toward structured science teaching related to the length of the workshop. Mayer and Fortner (1988), on the other hand, found a short, intensive awareness workshop to be more effective than longer, implementation workshops.

Samples were pooled and participation in the workshops was examined. The participant's level of concern decreased relative to awareness of the material and increased relative to the consequences of utilizing the workshop materials, forming collaborative relationships relative to the materials, and modifying (refocusing) their curricula relative to the workshop materials. This shift from concerns over awareness and understanding to concerns about collaboration from workshops has also been observed by Lombard, Konicek and Schultz (1985). O'Brien (1987) observed a similar shift in concerns during a chemistry demonstrations workshop that he studied. The results indicate that the workshop participants are learning the material and feel more comfortable with their knowledge following the workshop and have begun to consider how to utilize the information in their classrooms and also transfer the information to and develop the information with other teachers.

In the area of beliefs, changes in attitude were observed for the Step 1995 workshop as a positive attitude toward the development of logical thinking. For the USF 1995 it was a positive change in attitude toward the role of teachers in providing right answers to questions. O'Brien (1987) found a similar response in increased confidence for using more "hands-on" science. Hendren, Mertens, and Nesbit (1973) found an increased motivation and shift in pedagogy from their workshop as did Clermont, Krajic, and Borko (1993). Dyche (1980) also observed a change in teaching approach from the five- to eight-week minicourses that were studied.

A reversal of attitude was seen in the Brevard SS&M 1995 workshop in the area of assigned readings. The use of assigned readings became much less important to these teachers in their science teaching. The attitude change observed during these workshops relative to assigned readings and effective science teaching indicates that the workshop was successful in making the teacher more comfortable with the in-class coverage and in their knowledge of the material, regardless of their science education background. The facilitators demonstrated and presented space science in a way that was transferable, understandable, and pertinent to their classroom situation. Lombard (1982) in contrast found little change in attitudes toward using textbooks resulting from workshop participation.

Finally, for the Newest 1995 workshop participants, the attitude that effective science teaching was not dependent on a strong science background was significantly stronger following the workshop. Scharmann and McLellan (1992) similarly found shifts in instructional goals corresponding to attendance of a short an intensive inservice workshop which are consistent to the findings of the current study. Vandegrift and Crafton (1989) also found an increased feeling of adequacy in teaching science following workshop participation as did O'Brien (1987), Dyche (1980), and Good (1971).

The comparison between participant teachers and non-participant teachers both for concerns and beliefs indicate that workshops had an effect in these areas. The non-participant teachers had the greatest concerns of any of the teacher groups (relative to time since workshop) in Stage 0 (awareness), and the second highest concerns in Stage 2 (personal), just slightly less than those that had the workshop five or more years ago. This indicates that the visitors group either did not look at or consider utilizing the materials they received in their class curricula. This is consistent with the findings of Mayer and Fortner (1988) in which hand-outs yielded little or no usage. Participants all had high concerns over collaboration which indicates that there is hesitation over working with others using the workshop materials. The latter also indicates a difference in personal concerns relative to the time since the workshop for the participants. As for the length of the workshops, those that had not participated in a workshop again had the highest concerns over Stage 0 (awareness) and those attending the longest (4-week) workshops had the lowest. For Stage 4 (consequence), the shortest (1-week) workshop participants had the lowest concern and the three-week had the highest. Hall, George, and Rutherford (1977) suggest different ways of interpreting the high and low stages and because of the short exposure to the material by the 1-week participants, the lowest concern may be associated with the fact that the teacher would not be seriously considering adopting the workshop material in teaching (non-user) whereas the 3-week participants have enough exposure to consider using the materials but have a high-degree of concern for consequences. For Stage 5 (collaboration), the two-week workshops yielded the highest concerns, although all of the teachers showed relatively high concerns for this stage. Scharmann and McLellan (1992) observed a shift from high concern stages 0 through 2 to high concern stages 4 through 6. O'Brien (1987) also observed a lowering of the 0 through 2 stages of concern with an evolution toward higher 4 through 6 stages of concern resulting from workshop participation.

The workshops served to provide another avenue for the teachers to deliver science to the student other than through the textbook and written tests. This being in demonstrations to and feedback from students, with teachers as facilitators of discussions and problem-solving.

From the Beliefs about Science and Science Education, the length of the workshop coincided with an increasing disagreement toward the use of textbooks, the use of written tests, and the perception of science teachers as providers of correct answers. This indicates that there was an attitude shift in how science teaching is performed and toward the role of the teacher. A more positive attitude toward "hands-on" science and the role of the teacher as "facilitator" appear to be a result of the NASA workshops.

Differences by Grade Level Taught

The second research question investigated in this study was: Are measurable differences between the concerns and beliefs of teachers teaching at different grade levels? There are measurable differences between the concerns and beliefs of teachers teaching at different grade levels.

Evidence for differences in response to the workshops by the grade level taught was found both in the levels of concern and in the differences in the beliefs between elementary school teachers, middle and high school teachers and college teachers. The comparison between the grade level groups of teachers and non-teachers both for concerns and beliefs indicate differences in these areas due to grade level taught. Shapely and Luttrell (1992) also found significant changes in the beliefs and attitudes of elementary school teachers toward science during an intensive workshop. For Stage of Concern 0 (awareness), a large difference in concern between the non-teachers and high school teachers and the college teachers was observed. For Stage 5 (collaboration), the largest difference in concern was between the non-teachers and the middle and high school teachers. The non-teachers had a much higher concern, possibly due to having a role in school administration.

The grade level differences in beliefs were more striking. Elementary school and college teachers indicated a much lower emphasis on the use of textbooks, assigned readings, and written tests, whereas the non-teachers (including researchers) and the middle and high school teachers indicated the opposite. The same difference in attitude was observed relative to the perception that an important function of science teachers is to provide students with correct answers to their questions. Elementary school teachers' attitudes and concerns about teaching science are closely aligned to the mode of teaching to students with a limited reading capability. The elementary school teachers and college instructors are less dependent on textbooks than high school teachers. The non-teachers indicate that they believe in an emphasis on logical thinking and that reading is important in learning science. The teachers feel that the emphasis must be on specific scientific subjects and that good reading skills are not as important in learning science concepts and problem solving. O'Brien (1987) found for a focused, limited innovation (chemistry demonstrations), advancement of the stage of concern and a change in attitude toward science and teaching science was facilitated by inservice training.

In summary, differences were observed in the levels of concern and the beliefs about science and science education by workshop attendance, by workshop length, and by the time since workshop attendance. Differences were also seen between the different grade levels taught which point to differences in pedagogical approaches at different grade levels.

Conclusions from the Study

1. Workshops length should be no shorter than four weeks. This is based on the 1995 data in which most significant changes were observed during the four-week workshop.

2. "Refresher" workshops be offered to teachers that have not participated in a workshop for the last five years. Participant teacher responses indicated that concerns over the materials increased when more than five years had passed since workshop attendance.

3. Workshops should target the teachers that teach in a particular grade level, (prekindergarten through 6th, middle and high school, or college). The results of this study indicate that teachers of different grade levels, particularly when grouped as in this study, have different concerns toward utilizing the workshop materials and different beliefs about science teaching.

4. Time during the workshops should be set aside for the teachers to interact and develop space science related curricula and lesson plans in a collaborative manner. The responses to the Stages of Concern Questionnaire indicate that higher concerns over collaboration are present in all groups surveyed.

Suggestions for Further Research

1. There is a need to develop and validate a clear and directly pertinent "beliefs and attitudes" instrument for the NASA teachers workshops because of lack of clarity and marginal application of some of the items on the BSSE.

2. Develop and validate a directly pertinent "concerns" instrument based on the Stages of Concern Questionnaire in order to clarify the instructions and avoid confusion as to what the "innovation" referred to in the items means to the workshop attendee.

3. Implement a pre-post evaluation of each NASA teacher workshop utilizing these instruments. The results of the 1995 allows better interpretation of the responses on an individual respondent basis.

4. Implement follow-up evaluations of material usage and student acceptance. Although the SoCQ gives some indication of material usage and anticipated student acceptance by the participant, direct measures should be made which will not only add another dimension to the workshop evaluations but serve to verify the SoCQ.

LIMITATIONS

The interpretation of the results of this study are limited due to a number of factors:

1. The study was pre-experimental in design. The causal-comparative design has two main inherent weaknesses which are the lack of randomization and the inability to manipulate the independent variable. This limits the ecological validity (application to other teacher populations).

2. The teachers participating in these workshops have already shown a high level of involvement in their work by their desire to spend vacation time in training (subject characteristics threat). The conclusions from this study must be limited to teachers with this characteristic.

3. Although the pooled data were normally distributed for each of the Stages of Concern and the material covered was similar, the workshops were administered by different persons (implementer threat). This fact may limit the degree to which comparisons are made between the different workshops.

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APPENDIX A

INITIAL WORKSHOP PARTICIPANTS CONTACT LETTER AND SURVEY

January 25, 1995

Dear NASA Kennedy Space Center Workshops Participant:

The Education Services Division of NASA at the John F. Kennedy Space Center has been holding teacher enhancement workshops since 1984 and hopes to continue this effort indefinitely. We are writing to former workshop participants for two specific purposes: to maintain the ability to locate participants and keep our files current; and we are planning, in the near future, to make follow-up contacts for your assistance in assessing these programs as part of a study. The enclosed survey is designed to provide us with information for our data-base and to provide some preliminary evaluation information to help with future workshops. Your responses will be used in planning for revisions to this workshop effort in future years. Your identity will be kept confidential and we will provide you with the results of the study.

We would greatly appreciate it if you will complete the enclosed survey, fold and staple it with our address on the outside and place it in the mail by February 20th. We realize that your schedule is a busy one and that your time is valuable, but we are sure that you would want to improve the quality of teacher training as much as we do.

We thank you in advance for your cooperation. Please feel free to call if you have any questions.

Sincerely,

Dr. Steve Dutczak, Director
Public Affairs, Education Services Division
NASA
Mail Code: PA-ESB
J. F. Kennedy Space Center, FL 32899
(407) 867-4444

NASA-KSC WORKSHOP PARTICIPANT SURVEY

1) NAME:____

2) SCHOOL:____

3) ADDRESS:____

____

4) TELEPHONE:________________ 5) FAX:__________________

6) EMAIL:____

7) EDUCATION LEVEL (DEGREE OR EQUIVALENT):
O H.S. DIPLOMA O BS/BA O MS/MA O PHD/EDD O OTHER DEGREE

8) NUMBER OF YEARS TEACHING:
O 0-5 O 5-10 O 10-20 O 20-30 O 30 +

9) GRADE LEVEL(S) TAUGHT:
PRE K 1 2 3 4 5 6 7 8 9 10 11 12 College N/A

10) SUBJECT(S) TAUGHT:________________________________

WOULD YOU BE WILLING TO ASSIST IN OUR EVALUATION FURTHER:

11) BY CONFIDENTIAL QUESTIONNAIRE?: O YES O NO
12) BY CONFIDENTIAL TELEPHONE INTERVIEW?: O YES O NO
13) BY CONFIDENTIAL PERSONAL INTERVIEW?: O YES O NO

RATE THE MATERIALS OR WORKSHOP ACCORDING TO THE FOLLOWING CRITERIA:

14) SUBJECT UTILITY FOR TEACHING: 1 2 3 4 5
(POOR EXCELLENT)

15) LENGTH OF WORKSHOP OR AMOUNT OF MATERIALS: 1 2 3 4 5
(TOO LITTLE TOO MUCH)

16) HAVE YOU UTILIZED INFORMATION OR MATERIALS FROM THE WORKSHOP IN YOUR TEACHING? O YES O NO

17) IF SO, ARE YOU STILL UTILIZING THE INFORMATION OR MATERIALS? O YES O NO O N/A

18) ARE YOU WILLING TO PROVIDE THESE EXAMPLES FROM YOUR CURRICULA? O YES O NO O N/A

THANK YOU FOR YOUR PARTICIPATION

APPENDIX B

LETTER AND WAIVER FOR SURVEY DATA USE

Dear Educator:

We are requesting your participation in a study to evaluate the impact of NASA teacher workshops and curriculum materials on teacher attitudes, beliefs and enhancement. The results of this study will aid in developing and enhancing future NASA Teachers Workshops. Your participation will be kept strictly confidential.

The data collected in this study will be used in a Ph.D. dissertation and the intent is that it be published in appropriate educational journals. We are asking that you sign this waver to allow us to utilize this data with the understanding that your name or any other identifier not be made public. We intend to provide the results of this study to you following the compilation, analysis and reporting. Thank you for your participation in what should prove to be an important effort in the evaluation and enhancement of NASA Teachers Workshops.

Sincerely,

Thomas W. Dreschel
Science Education Coordinator
Mail Code: DYN-1
Kennedy Space Center, FL 32899

I understand the purpose of this study and grant permission to utilize my responses to the surveys in this NASA Teacher Workshop Evaluation Study.

Signed____

Please enter also, the last six digits of your Social Security Number

______ ______ ______ ______ ______ ______

APPENDIX C

BELIEFS ABOUT SCIENCE AND SCIENCE EDUCATION INSTRUMENT
(BSSE)

BELIEFS ABOUT SCIENCE AND SCIENCE EDUCATION

Directions: This instrument is designed to assess your beliefs about consideration to each statement and respond by circling the letter which corresponds to the degree of your science and science education. Please give serious agreement with the statement. Your responses can range from (A) Strongly Agree (B) Agree (C) Undecided (D) Disagree to (E) Strongly Disagree.

Please enter the last six digits of your Social Security Number: __ __ __ __ __ __

---

1. It is important to prepare children in elementary school for the kinds of science concepts they will be expected to know in junior high and senior high school.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

2. Although practice may not make perfect, it is important to see that students practice certain scientific skills.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

3. Science is something you do and a textbook offers little help in providing an activity science program.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

4. There are no specific science concepts and principles that must be taught in elementary school.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

5. When children do work with science equipment appropriate for their grade level, they usually need some guidance in determining what should be done with the equipment.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

6. Relative to reading, social studies, and arithmetic, science is of little practical importance in a student's life.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

7. Allowing students to do what they want when working with science equipment could result in many discipline problems.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

8. Written tests are necessary in science in order to find out if students have learned the concepts and principles studied in class.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

9. Students should be taught to behave like scientists if they are to learn science.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

10. If some students do not learn science concepts and principles in regular classroom sessions, the teacher should provide alternate methods for better understanding.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

11. It is important for the teacher to ask students to keep records of science experiments.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

12. The purpose of the experiment in elementary or secondary school science is to verify earlier scientific experiments.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

13. Science at the elementary school level should help children to develop logical thinking abilities and need not be concerned with any specific scientific subject matter.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

14. Science cannot be taught with any effectiveness unless concrete materials are available for each student to use.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

15. If textbooks are the main ingredient in science lessons, science is not fun, interesting, or relevant to the students.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

16. It is okay for children to play around with science materials for a while but eventually the teacher must direct their attention to the really important concepts.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

17. Teachers who use demonstration and discussion in addition to laboratories in science probably help students to learn science concepts more effectively than teachers who use only a laboratory approach.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

18. There are certain facts and concepts in science that should be learned by children while they are in elementary school.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

19. The technique of summarizing (through group discussion) what students have experienced during science activities has little value in helping them to understand science and may even have detrimental effects.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

20. In order to gain an understanding of what science is all about, it is critical that students have equipment to work with during science lessons.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

21. The science teacher should not suggest to a student that he has given a wrong answer as a result of working with equipment during a science "experiment".

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

22. If a student decides they do not want to do anything with science equipment available to them, they should have the option of doing nothing.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

23. Students should be allowed to freely experiment with scientific equipment for a certain period of time, but eventually the teacher needs to direct their thoughts and actions toward more substantial learning situations.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

24. Positive reinforcement directed toward those students who are doing valuable things with their science equipment should be used by the teacher in order to indirectly influence other children toward these goals.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

25. "Brighter" students who seem to understand what is going on should not be used in helping the science teacher work with "slower" students because the "slower" student may learn that only certain people know or can find answers in science.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

26. There is a basic structure of science that should be studied by all persons interested in science.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

27. Asking questions for which there are specific answers and then providing immediate positive feedback is important to good science teaching and helps to eliminate uncertainty among students.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

28. During laboratory activities the student to student verbal exchange offers greater possibility for the student to grasp the viewpoint of another and hence to come to a more solidly based understanding of science than the teacher to student verbal exchange.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

29. Science teachers should take time to explain science concepts and principles which the pupils have difficulty in understanding.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

30. An important function of science teachers is providing students with right answers to their questions.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

31. A key to good science teaching is finding appropriate questions to guide students into further observations and discoveries without telling them what they are to see and find.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

32. It is important to see that students practice scientific skills.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

33. The technique of assigned readings, in the science text, is a means of providing a good understanding of basic science principles.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

34. A student with a low reading level will have difficulties learning science concepts and the skills of problem solving.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

35. A teacher need not have a strong background in science to be effective in teaching elementary school science.

A=Strongly Agree B=Agree C=Undecided D=Disagree E=Strongly Disagree

APPENDIX D

STAGES OF CONCERN QUESTIONNAIRE
(SoCQ)

LETTER OF PERMISSION TO USE THE SoCQ

Concerns Questionnaire

Name
(optional)____

In order to identify these data, please give us the last six digits of your Social Security Number:

____ ____ ____ ____ ____ ____

The purpose of this questionnaire is to determine what people who are using or thinking about using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years experience in using them. Therefore, a good part of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale.

For example:

This statement is very true of me at this time.	0 1 2 3 4 5 6 (7)
This statement is somewhat true of me now.	0 1 2 3 4 (5 6) 7
This statement is not at all true of me at this time.	0 (1 2) 3 4 5 6 7
This statement seems irrelevant to me.	(0) 1 2 3 4 5 6 7

Please respond to the items in terms of your present concerns, or how you feel about your involvement or potential involvement with using Space Science in your lessons. We do not hold to any one definition of this innovation, so please think of it in terms of your own perception of what it involves. Since this questionnaire is used for a variety of innovations, the name "using Space Science in your lessons" never appears. However, phrases such as "the innovation", "this approach", and "the new system" all refer to using Space Science in your lessons. Remember to respond to each item in terms of your present concerns about your involvement or potential involvement with using Space Science in your lessons.

Thank you for taking time to time to complete this task.

0	1	2	3	4	5	6	7
Irrelevant	Not true of me now			Somewhat true of me now			Very true of me now

1. I am concerned about student's attitudes toward this innovation. 0 1 2 3 4 5 6 7

2. I now know of some other approaches that might work better. 0 1 2 3 4 5 6 7

3. I don't even know what the innovation is. 0 1 2 3 4 5 6 7

4. I am concerned about not having enough time to organize myself each day. 0 1 2 3 4 5 6 7

5. I would like to help other faculty in their use of the innovation. 0 1 2 3 4 5 6 7

6. I have a very limited knowledge about the innovation. 0 1 2 3 4 5 6 7

7. I would like to know the effect of reorganization on my professional status. 0 1 2 3 4 5 6 7

8. I am concerned about conflict between my interests and my responsibilities. 0 1 2 3 4 5 6 7

9. I am concerned about revising my use of the innovation. 0 1 2 3 4 5 6 7

10. I would like to develop working relationships with both our faculty and outside faculty using this innovation. 0 1 2 3 4 5 6 7

11. I am concerned about how the innovation affects students. 0 1 2 3 4 5 6 7

12. I am not concerned about this innovation. 0 1 2 3 4 5 6 7

13. I would like to know who will make the decisions in the new system. 0 1 2 3 4 5 6 7

14. I would like to discuss the possibility of using this innovation. 0 1 2 3 4 5 6 7

15. I would like to know what resources are available if we decide to adopt this innovation. 0 1 2 3 4 5 6 7

16. I am concerned about my inability to manage all the innovation requires. 0 1 2 3 4 5 6 7

17. I would like to know how my teaching or administration is is supposed to change. 0 1 2 3 4 5 6 7

18. I would like to familiarize other departments of persons with the progress of this new approach. 0 1 2 3 4 5 6 7

0	1	2	3	4	5	6	7
Irrelevant	Not true of me now			Somewhat true of me now			Very true of me now

19. I am concerned about evaluating my impact on students. 0 1 2 3 4 5 6 7

20. I would like to revise the innovation's instructional approach 0 1 2 3 4 5 6 7

21. I am completely occupied with other things. 0 1 2 3 4 5 6 7

22. I would like to modify our use of the innovation based on the experiences of our students. 0 1 2 3 4 5 6 7

23. Although I don't know about this innovation, I am concerned about things in the area. 0 1 2 3 4 5 6 7

24. I would like to excite my students about their part in this approach. 0 1 2 3 4 5 6 7

25. I am concerned about time spent working with nonacademic problems related to this innovation. 0 1 2 3 4 5 6 7

26. I would like to know what the use of the innovation will require in the immediate future. 0 1 2 3 4 5 6 7

27. I would like to coordinate my effort with others to maximize the innovation's effects. 0 1 2 3 4 5 6 7

28. I would like to have more information on time and energy commitments required by this innovation. 0 1 2 3 4 5 6 7

29. I would like to know what other faculty are doing in this area. 0 1 2 3 4 5 6 7

30. At this time, I am not interested in learning about this innovation. 0 1 2 3 4 5 6 7

31. I would like to determine how to supplement, enhance or replace the innovation. 0 1 2 3 4 5 6 7

32. I would like to use student feedback to change the program. 0 1 2 3 4 5 6 7

33. I would like to know how my role changes when I am using the innovation. 0 1 2 3 4 5 6 7

34. Coordination of tasks and people is taking too much of my time. 0 1 2 3 4 5 6 7

35. I would like to know how this innovation is better than what we have now. 0 1 2 3 4 5 6 7

The Research and Development Center for Teacher Education
University of Texas Austin 78712

Dear Colleague:

Thank you for your interest in the Stages of Concern theory and the questionnaire we have developed to measure user and nonuser concerns about an innovation. We hope that Stages of Concern will assist you in your work.

Enclosed is a copy of the Manual for Assessing Stages of Concern Using the Stages of Concern Questionnaire. We hope that this manual will provide you with the information that you need.

In this manual we have attempted to provide information about the development and use of the SoC Questionnaire. This includes detailed scoring procedures and an extended presentation of interpretation of the data. Since the manual has just been developed, we cannot guarantee that the answers to all of your questions have been included. We very much wish to maintain contact with you. We hope to be of assistance to the users of this measure and manual. We have already encountered several instances in which attempts have been made to use the Stages of Concern Questionnaire in ways other than it was developed to be used. We strongly recommend that the questionnaire be used only as it was designed and intended to be used. This includes using the items in their present form and using the scoring procedure outlined in the manual. Attempts to develop unique scoring and interpretation procedures are discouraged. Validity and reliability can in no way be assumed if changes are made. Specific guidelines and cautions are included in the manual. We strongly believe that these qualifications should be closely attended to.

If you have questions, please feel free to let us know. Also, we are very much interested in learning about your own applications of the measure and the findings from your studies.

Sincerely yours,

Gene E. Hall, Project Director
Procedures for Adopting Educational Innovations/CBAM Project

Archie A. George
Project Associate

William L. Rutherford
Project Associate

APPENDIX E

Individual Study Participant Data for the Select BSSE statements and the Stages of Concern

wkyr	id	grd	b3	b7	b8	b9	b13	b16	b21	b27	b30	b33	b34	b35	0st	1st	2st	3st	4st	5st	6st
USF95	157299	2	4	2	4	2	2	2	1	1	1	1	4	4	6	18	9	7	18	31	11
USF95	292492	2	3	2	2	2	2	2	4	2	4	2	2	3	17	22	28	21	25	19	22
USF95	309797	0	4	2	2	2	2	2	2	2	4	2	3	2	14	23	27	19	27	31	22
USF95	344848	2	2	2	2	3	2	3	2	2	3	2	4	4	23	35	28	13	15	23	20
USF95	367053	2	5	1	4	2	4	5	4	4	2	2	2	2	20	26	33	27	25	20	26
USF95	462476	2	4	2	2	2	4	4	3	2	2	2	2	4	2	22	13	25	29	29	21
USF95	483568	2	3	3	4	4	2	3	2	2	2	2	4	2	9	18	24	24	28	26	24
USF95	488372	2	4	2	1	3	3	2	4	1	1	4	1	3	16	15	14	18	16	15	14
USF95	561359	2	2	3	2	2	2	2	2	2	2	2	4	4	21	21	24	23	20	21	21
USF95	565555	2	4	2	4	4	4	4	2	2	2	3	4	2	12	19	19	11	23	33	29
USF95	569492	2	4	3	2	2	4	3	3	2	2	2	3	3	0	0	0	0	0	0	0
USF95	604485	2	4	4	4	3	3	2	2	2	1	3	4	2	6	0	0	1	4	0	5
USF95	608028	2	3	2	2	4	2	2	2	2	3	2	2	2	7	11	15	11	17	15	11
USF95	688532	2	4	4	3	4	3	2	3	2	3	4	4	3	7	17	6	12	17	25	19
USF95	741640	2	2	2	4	2	1	2	2	3	3	2	4	1	7	10	17	23	23	25	24
USF95	781042	2	4	4	2	4	4	2	2	4	2	4	4	3	7	21	23	12	27	23	19
USF95	881990	2	3	4	2	2	3	2	2	2	4	3	4	2	8	25	27	18	23	31	22
USF95	893970	1	3	1	2	3	2	2	4	1	1	2	3	1	6	22	20	22	25	24	6
USF95	939133	2	5	3	4	2	5	2	3	2	4	2	4	1	16	24	19	26	26	20	27
NEE95	326331	1	1	2	4	2	1	2	4	3	5	5	5	1	0	2	15	6	35	35	22
NEE95	350300	1	1	4	2	4	2	2	3	2	3	2	4	2	12	26	31	22	32	30	30
NEE95	384793	1	3	3	2	2	4	4			4	3	4	2	17	22	25	21	26	26	25
NEE95	389599	1	2	2	4	2	4	2	4	3	3	3	4	2	17	27	24	26	27	28	26
NEE95	420485	1	5	2	2	1	4	4	4	3	4	2	4	2	13	13	9	23	21	19	5
NEE95	423645	1	4	3	2	1	4	2	1	1	1	2	5	1	5	29	31	16	30	32	12
NEE95	427514	1	4	3	4	4	4	4	2	2	4	2	3	2	7	29	31	18	28	35	21
NEE95	456938	1	2	3	4	4	4	1	1	4	5	5	4	5	8	24	29	12	35	35	28
NEE95	508689	1	4	4	2	2	4	2	2	4	3	4	5	1	3	4	3	7	27	26	13
NEE95	524520	1	4	4	2	4	4	1	2	2	4	4	5	1	7	18	15	5	20	33	26
NEE95	526198	2	4	4	5	4	2	2	4	5	1	2	5	2	2	23	35	3	19	35	18
NEE95	527290	1	2	4	4	2	2	2	2	4	4	2	5	2	6	2	1	10	22	24	19
NEE95	559975	1	2	2	4	4	4	2	3	2	4	4	3	2	4	29	30	13	22	35	24
NEE95	702458	1	4	2	5	2	5	2	4	4	1	4	5	2	14	13	5	19	13	30	10
NEE95	869088	1	1	5	5	5	5	4	2	4	4	4	4	1	5	21	21	5	28	35	23
NEE95	965422	1	4	4	4	4	4	2	1	4	4	4	5	1	4	8	11	12	30	24	13
BSS95	303077	2	4	2	2	4	4	2	3	2	2	2	2	5	9	19	19	10	25	14	21
BSS95	422426	2	2	4	4	1	4	2	4	4	4	5	2	4	3	28	29	19	31	29	26
BSS95	425964	2	3	4	4	3	2	4	3	3	4	4	3	2	18	20	21	19	21	19	20
BSS95	465561	2	4	1	4	4	3	4	2	1	4	2	4	2	9	8	9	5	11	16	7
BSS95	484678	2	1	3	2	3	2	1	2	2	2	2	2	2	33	35	35	35	35	35	35
BSS95	503114	0	4	1	1	2	1	2	3	2	2	2	2	4	9	27	29	15	31	28	16
BSS95	541407	2	3	4	4	3	4	3	2	2	3	4	4	2	2	20	14	2	12	32	21
BSS95	546284	2	4	1	2	2	2	3	2	2	2	2	2	4	14	21	26	17	25	23	22
BSS95	548625	2	4	4	4	2	4	3	1	2	5	4	4	5	1	10	0	4	32	30	18
BSS95	600698	2	5	2	3	2	1	2	2	3	2	2	4	3	11	27	26	23	29	28	28
BSS95	667744	2	2	4	4	4	2	3	3	2	3	5	4	4	6	16	20	13	27	26	21
BSS95	694931	1	1	3	2	2	1	4	3	2	4	3	2	5	7	11	14	8	21	25	15
BSS95	707999	2	3	4	5	2	1	4	2	1	4	4	4	2	15	20	17	15	20	15	22
BSS95	744655	3	4	4	4	2	4	4	2	3	4	4	5	4	5	14	13	19	20	30	14
BSS95	823083	2	3	1	2	2	3	4	4	2	3	4	3	4	10	22	25	24	25	24	22

wkyr	id	grd	b3	b7	b8	b9	b13	b16	b21	b27	b30	b33	b34	b35	0st	1st	2st	3st	4st	5st	6st
BSS95	862234	2	4	2	2	2	4	4	4	2	2	2	4	2	16	29	22	21	34	30	30
BSS95	894115	2	2	4	2	2	4	4	2	3	4	4	4	2	11	25	28	10	32	26	20
STE95	0.0265	2	2	2	4	2	2	2	2	2	4	2	2	3	12	12	11	8	18	15	16
STE95	0.0779	1	2	4	4	2	4	4	2	2	3	3	4	2	9	21	25	21	24	14	17
STE95	237816	2	3	3	3	3	4	2	2	2	2	3	3	2	9	15	18	18	22	20	19
STE95	245482	2	5	4	4	5	4	4	4	2	2	1	5	1	6	24	34	29	34	35	20
STE95	256482	2	2	3	3	3	3	2	3	3	3	3	3	4	0	13	13	10	26	35	23
STE95	274285	1	1	2	4	1	3	1	1	3	2	2	4	2	10	34	27	13	12	8	1
STE95	336370	1	2	3	4	3	2	2	3	2	4	5	4	1	5	21	17	11	26	31	15
STE95	341221	2	3	2	4	4	4	2	2	4	5	5	4	3	10	11	13	15	35	23	24
STE95	403651	1	3	4	2	2	4	4	2	4	4	3	5	2	9	26	31	25	33	35	32
STE95	440568	1	4	4	4	2	4	1	4	3	4	3	5	1	1	23	18	6	16	28	22
STE95	461658	1	2	2	2	2	4	2	1	2	2	4	2	2	10	19	17	10	26	23	20
STE95	483268	2	2	3	2	2	2	2	2	2	2	4	5	3	16	27	30	28	28	30	27
STE95	489511	1	4	4	3	2	4	2	3	2	3	3	4	2	8	24	23	26	27	25	20
STE95	514340	1	3	3	4	2	3	2	3	2	2	4	4	2	14	34	26	20	34	34	25
STE95	521513	2	2	4	2	2	2	2	2	2	2	2	2	4	8	21	18	17	31	35	24
STE95	562303	1	4	1	5	2	4	2	1	1	5	4	5	1	17	14	17	21	23	34	15
STE95	612371	2	2	1	3	1	4	2	1	2	1	4	3	1	5	20	16	10	32	33	30
STE95	666084	1	1	5	4	2	4	2	2	2	4	4	1	1	5	24	23	13	21	35	19
STE95	686531	1	4	3	4	2	4	2	1	4	4	4	4	2	6	26	27	11	34	25	26
STE95	722123	1	1	1	4	1	4	1	1	3	2	2	4	2	18	21	15	21	29	25	21
STE95	728648	1	2	2	4	2	2	2	2	2	2	4	4	2	7	22	27	17	26	30	21
STE95	787964	1	1	2	4	2	4	2	2	3	3	4	4	2	2	20	19	8	27	32	16
STE95	894115	2	3	4	2	2	2	3	2	2	5	3	4	2	15	23	25	20	35	25	17
STE95	899218	2	3	2	2	3	4	1	4	2	2	3	4	2	4	11	5	17	12	17	18
STE95	901096	1	2	3	2	2	4	1	3	3	5	2	5	1	0	7	0	1	32	34	24
NEM84	349712	2	2	2	4	3	2	1	4	4	4	4	4	4	7	22	16	15	31	33	28
NEM84	445832	2	4	2	2	1	2	1	2	1	2	4	4	2	19	8	7	6	7	0	0
NEM85	344973	2	4	2	2				4	2	2	2	4	4	4	15	12	11	16	24	11
NEM85	462098	2	4	4	2	3	2	3	1	2	4	4	4	4	6	13	13	8	20	20	12
NEM85	863023	3	3	1	3	4	3	3	3	2	4	3	2	5	5	11	3	12	33	35	14
NEM85	789420	2	4	2	2	2	2	2	2	2	2	2	4	4	17	33	33	29	35	34	32
NEM85	922289	3	3	3	3	3	4	2	2	4	2	3	4	4	10	32	34	20	35	35	14
NEM85	960069	2	2	2	2	3	3	2	3	2	3	2	4	2	8	25	29	12	23	31	16
NEM85	584711	2	3	4	2	2	4	4	2	4	5	3	4	5	7	6	13	15	28	27	26
NEM85	302807	3	2	3	2	3	4	1	1	1	5	1	4	4	0	19	20	0	21	22	17
NEM86	583759	2	4	3	2	3	5	2	4	2	2	3	4	4	2	23	24	10	31	29	15
NEM86	881526	2	4	1	2	1	4	2	3	2	4	2	4	4	9	25	28	17	33	35	20
NEM86	364836	2	4	2	3	4	2	3	2	2	4	3	4	2	11	18	17	23	13	17	5
NEM86	807060	2	4	4	2	4	3	3	2	2	3	2	3	4	14	14	14	8	12	14	12
NEM86	105551	2	2	1	1	2	2	4	2	2	2	4	4	4	11	29	30	22	33	35	20
NEM87	845509	3	3	4	2	2	3	2	1	4	4	2	5	4	7	13	6	12	27	28	18
NEM87	345712	2	4	4	2	1	4	4	2	4	4	2	5	5	4	26	21	16	23	31	18
NEM87	509688	2	2	3	2	2	4	2	4	2	2	3	2	4	4	25	25	13	15	30	20
NEM87	544106	2	1	3	5	2	4	1	4	5	4	5	5	5	0	10	8	11	30	15	27
NEM87	448935	3	4	4	2	2	4	4	5	1	2	2	4	2	11	17	15	14	18	15	11
NEM87	809121	2	4	4	4	3	4	2	4	2	4	2	5	5	3	24	28	29	29	27	23
NEM87	860702	2	4	2	3	4	4	2	2	3	2	3	4	4	16	18	18	8	24	21	21
NEE88	625475	1	4	2	4	2	4	2	4	2	4	2	4	3	13	8	8	10	19	35	6
NEE88	428966	1	2	2	4	3	3	3	4	3	3	2	4	1	16	29	33	26	31	34	27

wksyr	id	grd	b3	b7	b8	b9	b13	b16	b21	b27	b30	b33	b34	b35	0st	1st	2st	3st	4st	5st	6st
NEE88	282163	3	1	4	5	2	4	3	4	4	5	4	4	2	7	14	8	0	25	35	8
NEE88	569577	1	2	2	2	1	4	2	1	2	4	4	5	2	17	23	20	12	23	20	14
NEE88	426675	2	2	2	4	3	3	2	3	4	3	4	4	2	4	17	20	9	23	28	23
NEM88	505110	2	4	2	2	2	4	2	2	3	4	3	4	2	3	26	18	19	26	26	19
NEM88	863819	2	4	2	2	3	1	5	5	4	2	3	5	5	5	29	35	11	29	35	26
NEM88	665692	2	1	4	4	4	2	4	2	4	4	2	4	4	9	29	31	27	24	21	27
NEM88	505228	3	3	3	2	2	4	2	3	3	3	3	3	4	9	30	33	16	28	35	21
NEM89	887549	2	4	2	4	4	4	4	2	4	4	2	5	2	10	15	20	15	16	19	11
NEM89	805445	2	3	1	3	2	5	5	5	2	1	2	3	5	23	28	32	31	30	32	26
NEM89	783039	2	4	2	4	4	4	4	4	2	4	2	2	4	14	35	23	9	25	24	16
NEM89	989384	2	4	3	3	3	4	3	3	2	3	2	4	4	12	27	35	16	31	10	17
NEM89	562333	2	2	4	4	4	5	4	2	1	4	4	5	2	9	21	20	18	28	26	19
NEM89	304310	2	4	2	2	4	1	2	4	2	2	2	4	5	5	13	5	3	21	18	19
NEM89	982604	2	1	1	3	3	3	2	4	2	4	4	4	4	22	26	31	28	26	31	26
NEM89	968684	2	4	3	2	4	2	2	2	3	4	3	4	5	3	19	28	10	29	35	26
NEM89	840117	0	3	4	4	4	4	3	2	3	4	4	4	2	3	21	15	9	17	19	15
NEE90	940322	1	1	4	5	2	5	2	3	3	5	5	5	2	3	10	0	2	15	35	22
NEE90	622822	2	2	4	3	1	3	2	2	4	3	4	2	2	1	1	0	2	30	28	10
NEE90	841856	3	1	4	4	4	2	2	2	2	2	4	4	2	6	23	18	22	31	32	30
NEE90	609818	1	2	2	3	2	4	3	2	4	3	3	4	4	7	19	14	8	22	25	9
NEE90	480821	2	3	3	2	3	4	2	4	2	3	2	4	4	22	9	4	8	17	5	3
NEE90	460344	2	2	4	4	3	4	2	2	3	3	4	4	2	3	17	18	22	27	16	17
NEE90	232826	1	2	4	5	3	2	2	2	5	4	4	5	2	12	19	11	17	19	17	23
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NEM91	783230	2	4	2	1	4	4	4	4	4	2	4	2	4	10	24	25	5	27	29	22
NEE92	211424	1	1	2	4	1	4	2	2	4	4	5	4	4	10	22	16	11	20	23	20
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NEE92	136846	1	2	5	5	3	4	2	1	4	5	3	5	1	4	28	25	11	33	32	26
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NEE92	368308	1	4	4	4	4	4	3	2	2	2	4	5	1	13	32	35	21	34	34	11
NEE92	424679	1	2	4	4	2	2	2	3	2	4	3	4	4	1	12	10	5	19	35	16
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NEE93	366391	1	2	4	3	5	2	2	2	3	3	4	4	2	12	9	10	14	21	25	8
NEE93	380458	1	1	1	4	1	5	1	2	4	5	5	5	4	8	28	15	17	22	30	16
NEE93	100000	3	1	4	4	4	4	3	4	4	4	3	4	4	0	20	10	6	25	19	5
NEE93	585563	1	2	2	4	1	2	2	2	4	4	2	4	2	9	23	13	13	21	35	22
NEE93	501702	1	3	2	2	2	4	2	2	2	4	4	4	1	14	27	27	28	35	35	27
NEE93	423867	1	4	4	3	2	4	3	1	3	3	4	4	2	4	2	8	14	34	34	20
NEE93	926798	1	4	2	3	4	4	2	4	1	4	2	3	2	11	29	28	31	34	35	34
NEE93	144250	2	2	2	2	2	4	4	2	2	5	2	5	2	6	24	28	19	33	29	27
NEM94	366251	2	4	4	2	2	4	2	4	4	4	2	3	2	13	25	9	17	26	26	27
NEM94	861295	3	2	2	4	2	3	4	1	4	5	3	5	4	9	31	32	21	28	35	23
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NEM94	423578	2	3	3	2	1	3	3	4	3	3	2	4	5	7	29	13	14	31	32	32
NEM94	502198	2	4	2	2	4	4	2	4	2	2	2	4	4	10	19	24	22	24	32	27

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NEM94	427329	2	2	2	4	2	2	2	2	2	5	4	4	2	7	25	28	21	30	31	28
NEM94	305403	2	5	5	5	5	4	4	2	5	4	4	4	2	8	5	20	16	33	13	20
NEM94	584299	2	4	2	2	4	3	3	4	2	2	2	3	2	10	30	25	18	28	27	20
NEM94	612371	2	2	1	3	2	4	4	4	2	2	2	3	2	4	15	5	16	33	33	21
NEM94	363697	2	5	1	2	4	4	2	2	2	2	2	4	2	7	24	28	15	32	26	29
STE94	63063	3	2	1	4	2	4	4	1	5	4	4	5	2	6	18	7	8	32	26	30
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STE94	520193	2	4	4	5	5	4	2	2	3	5	3	5	3	15	13	10	14	10	10	11
STE94	868450	1	2	2	4	4	4	2	2	3	4	4	1	1	8	23	24	22	25	26	18
STE94	660605	1	4	2	4	4	4	4	2	4	5	3	5	4	7	21	13	10	24	25	11
STE94	569995	1	5	2	4	3	5	1	4	5	4	4	2	2	1	23	0	8	31	33	25
STE94	86337	2	3	3	4	3	5	2	4	3	4	2	5	2	7	6	16	23	32	28	30
STE94	828054	2	1	1	4	2	4	2	4	2	2	4	4	1	3	16	14	25	30	29	9
STE94	119135	3	2	4	2	2	4	4	2	2	2	2	4	2	3	23	13	13	19	24	11
Nowks	686627	3	4	4	3	4	4	3	3	2	4	3	5	3	9	8	0	11	16	28	11
NoWks	69549	2	4	3	4	4	4	3	2	2	3	2	4	2	6	11	16	16	20	11	17
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NoWks	420150	1	2	4	3	4	2	2	2	3	2	3	4	4	14	25	25	16	30	32	12
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NoWks	787004	1	2	4	3	4	4	3	4	3	3	4	4	4	11	24	25	25	26	27	21
NoWks	729599	2	1	1	4	4	2	2	1	2	3	4	4	3	1	9	18	5	16	23	11
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NoWks	900986	2	3	1	2	2	4	3	3	2	3	3	4	4							
NoWks	469316	2	5	4	3	2	5	3	2	3	3	2	4	3							
LSSC	582752	0	3	3	2	3	3	2	1	3	3	2	4	1							
LSSC	708837	0	4	4	2	1	2	2	2	3	4	2	2	2							
LSSC	115044	0	4	4	4	5	2	2	4	3	2	3	1	3							
LSSC	648812	0	5	3	1	3	4	2	3	3	3	4	3	4							
LSSC	852437	0	4	3	2	4	2	3	4	2	3	2	3	3							
LSSC	300000	0	3	2	2	2	1	3	1	1	3	1	1	5							
LSSC	134515	0	4	4	4	3	4	2	2	2	2	3	5	1							
LSSC	705203	0	3	4	2	3	4	4	4	1	3	4	5	4							
LSSC	591096	0	3	3	2	3	3	3	3	3	3	3	3	3							
LSSC	442992	0	2	5	1	2	4	2	3	2	2	2	2	3							
LSSC	487642	0	3	2	2	3	1	3	3	2	3	2	3	2							
LSSC	400000	0	4	2	2	2	4	2	4	2	2	2	2	5							
LSSC	500000	0	5	3	2	4	2	2	2	3	2	2	2	3							
LSSC	600000	0	4	1	1	3	2	1	4	2	1	1	4	5							
LSSC	255390	0	4	3	2	4	4	2	4	2	2	2	3	4							
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wkshyr	id	grd	b3	b7	b8	b9	b13	b16	b21	b27	b30	b33	b34	b35	0st	1st	2st	3st	4st	5st	6st
USF95	367053	2	4	2	2	2	2	4	4	4	2	2	4	2	14	20	20	14	16	16	14
USF95	462476	2	4	2	2	2	3	4	4	2	3	2	2	4	13	13	12	24	13	19	15
USF95	483568	2	4	1	2	3	3	3	2	2	2	2	4	3	15	20	26	26	27	25	22
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USF95	561359	2	1	4	2	3	2	4	2	2	3	2	4	4	22	24	25	24	24	26	20
USF95	565555	2	3	3	2	4	4	4	2	2	4	2	4	1	11	27	19	14	18	32	28
USF95	569492	2	3	3	2	4	3	3	2	2	2	2	3	2	19	33	32	13	29	28	32
USF95	604485	2	4	3	2	2	2	2	2	2	2	4	5	3	16	15	12	5	11	8	7
USF95	608028	2	2	2	3	2	4	2	1	2	4	2	4	3	14	17	16	19	25	24	14
USF95	688532	2	4	3	2	4	3	2	3	2	4	2	4	3	8	14	9	7	21	27	13
USF95	741640	2	2	3	4	3	2	2	2	2	3	2	4	2	15	25	26	19	24	21	14
USF95	781042	2	4	4	2	4	4	2	2	4	2	4	4	3	7	21	23	12	27	23	19
USF95	881990	2	3	3	3	2	2	2	2	4	5	3	4	3	13	22	18	11	24	29	18
USF95	893970	1	3	2	2	3	2	2	2	2	2	2	4	2	12	24	23	20	22	13	10
USF95	939133	2	4	4	4	4	4	2	2	2	4	2	4	1	13	25	22	24	25	25	19
NEE95	326331	1	1	3	5	1	1	2	3	4	4	5	5	1	0	7	11	4	33	33	17
NEE95	350300	1	1	4	2	4	3	2	2	2	3	3	4	2	7	29	29	23	25	23	20
NEE95	384793	1	3	2	3	3	4	3	4	2	4	4	4	3	5	20	22	13	22	28	17
NEE95	389599	1	4	2	4	4	4	2	4	3	3	4	4	3	10	23	22	15	30	26	19
NEE95	420485	1	4	2	2	3	4	2	4	2	3	2	4	3	20	1	13	12	4	1	0
NEE95	423645	1	4	2	4	3	4	3	3	1	2	4	4	2	8	27	25	13	19	27	6
NEE95	427514	1	1	3	4	4	4	3	3	2	4	3	4	2	6	22	22	12	19	25	17
NEE95	456938	1	2	2	4	4	4	1	1	5	4	4	4	5	6	20	22	19	35	35	33
NEE95	508689	1	4	4	2	2	4	4	2	4	2	4	4	2	11	22	12	13	25	21	17
NEE95	524520	1	5	4	2	4	2	2	2	1	2	2	4	1	4	11	8	3	26	34	29
NEE95	526198	2	2	4	5	2	4	2	2	2	2	2	5	1	0	24	21	3	22	35	23
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NEE95	559975	1	2	2	5	5	2	1	3	2	4	4	2	2	7	26	27	16	26	34	21
NEE95	702458	1	2	3	3	3	4	4	2	4	3	3	3	2	10	24	18	23	16	20	17
NEE95	869088	1	1	2	2	3	1	4	4	4	4	5	5	5	11	21	16	9	20	24	12
NEE95	965422	1	2	2	2	5	3	2	1	4	4	4	5	2	12	24	28	22	22	21	18
BSS95	303077	2	4	2	2	4	4	4	2	2	2	2	2	2	8	22	17	9	19	26	16
BSS95	422426	2	2	2	5	3	4	2	4	5	4	4	2	4	2	21	18	11	33	31	25
BSS95	425964	2	4	3	3	2	2	3	2	2	4	2	3	3	14	14	11	16	14	11	17
BSS95	465561	2	3	1	4	3	3	4	2	2	3	2	4	2	11	7	0	3	4	0	0
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BSS95	548625	2	4	4	2	2	2	2	2	1	2	2	4	4	3	14	8	6	30	21	26
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BSS95	744655	3	5	5	4	5	2	4	3	4	4	4	4	4	8	26	29	33	31	25	24
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BSS95	862234	2	4	1	2	2	4	2	4	2	2	2	4	2	12	20	24	22	24	20	21
BSS95	894115	2	2	2	2	3	4	4	2	4	4	3	4	3	13	29	17	14	27	27	12
STE95	0.0265	2	2	4	4	3	4	2	2	2	2	2	2	2	16	23	23	24	26	25	23
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STE95	274285	1	1	2	4	2	4	1	2	2	2	3	2	2	16	31	35	24	32	32	31
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STE95	341221	2	3	3	4	5	3	2	2	4	4	3	5	3	14	26	28	18	31	24	15
STE95	403651	1	2	4	3	2	4	4	2	3	4	3	5	1	16	27	28	24	34	33	17
STE95	440568	1	4	4	4	1	4	3	2	3	4	4	4	2	16	24	33	17	13	17	13
STE95	461658	1	2	3	2	3	4	2	3	2	2	2	4	2	12	22	19	13	24	24	16
STE95	483268	2	1	1	2	4	2	3	4	3	3	3	4	4	15	22	25	24	25	28	27
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STE95	514340	1	4	3	4	2	3	2	2	1	2	4	4	2	14	35	35	14	14	20	0
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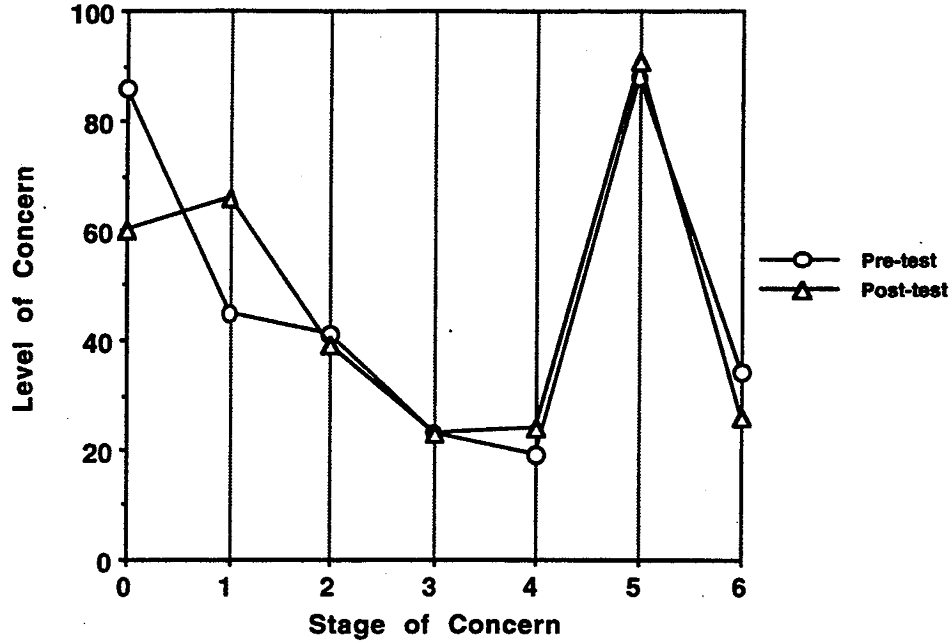
STE95	562303	1	2	1	4	1	4	2	1	1	5	4	5	1	5	31	33	12	25	33	11
STE95	612371	2	4	2	3	3	4	4	1	2	2	3	2	2	4	26	26	20	32	29	22
STE95	666084	1	1	4	4	2	4	2	2	2	3	4	2	2	5	34	22	17	25	30	8
STE95	686531	1	3	4	4	4	3	2	1	2	3	4	4	2	6	25	14	19	31	24	19
STE95	722123	1	1	2	4	2	4	2	2	4	4	4	4	4	15	35	35	15	35	35	35
STE95	728648	1	2	2	3	3	2	4	2	1	2	3	4	2	22	22	23	24	20	23	14
STE95	787964	1	2	2	3	2	3	1	3	2	2	3	4	2	9	22	28	15	33	34	25
STE95	894115	2	2	4	2	2	4	4	2	4	4	3	4	2	13	26	25	21	30	24	21
STE95	899218	2	2	2	2	3	4	2	3	2	2	2	3	2	12	22	9	15	15	17	0
STE95	901096	1	1	2	4		3	1	2	2	3	1	5	1	2	19	9	11	2	16	7

APPENDIX F

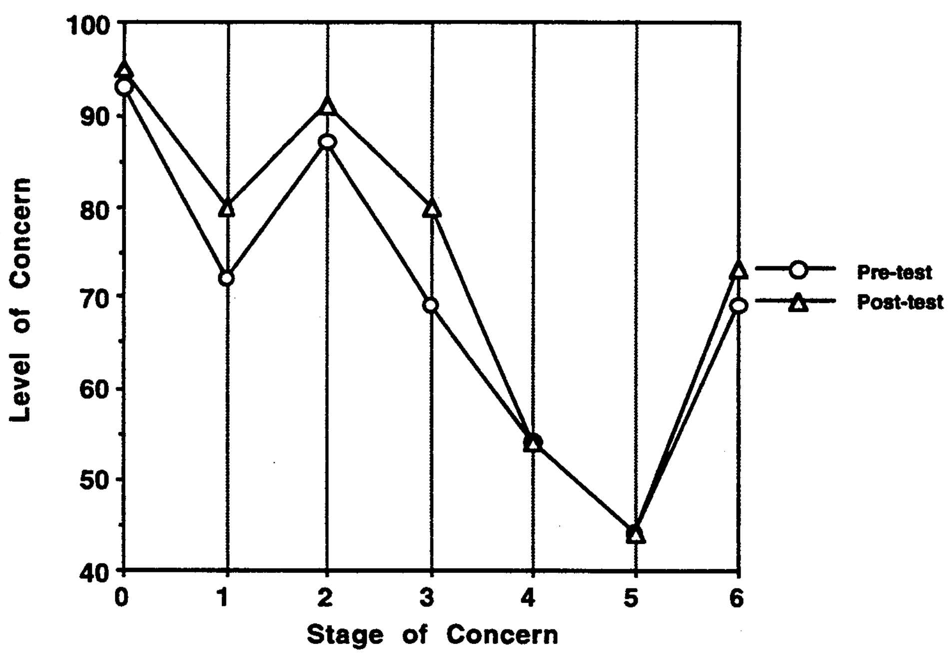
GRAPHS OF THE LEVELS OF CONCERN FOR THE 1995 WORKSHOP PARTICIPANTS SHOWING PRE-TEST AND POST-TEST SCORES

UNIVERSITY OF SOUTH FLORIDA TEACHERS WORKSHOP (USF)
NASA EDUCATORS WORKSHOP FOR ELEM. SCHOOL TEACHERS (NEWEST)
BREVARD SUMMER SCIENCE AND MATH INSTITUTE (SS&M)
SUMMER TEACHER ENHANCEMENT PROGRAM (STEP)

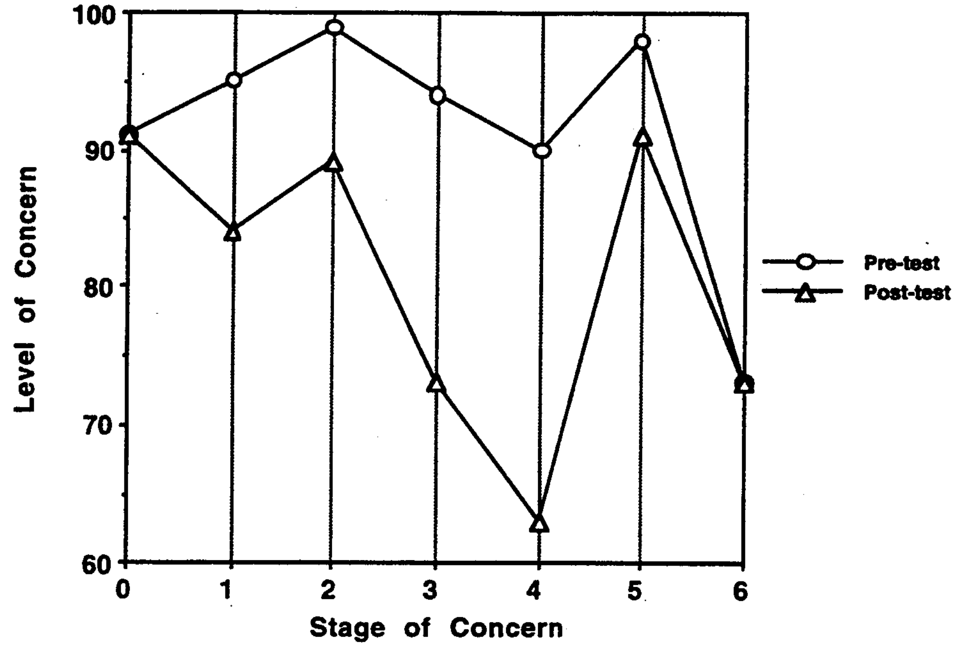
USF Teacher 157299



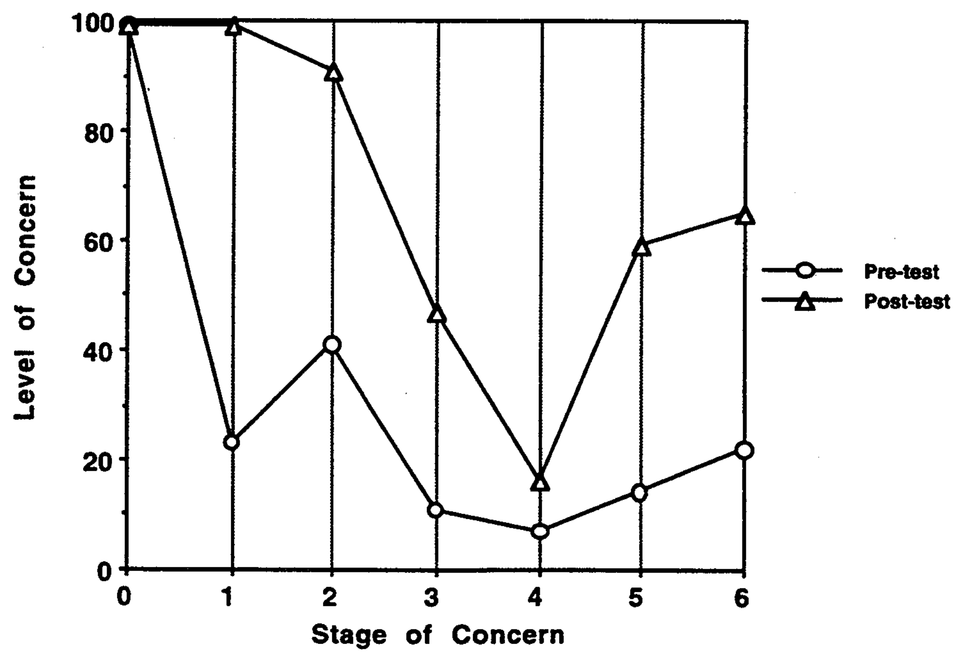
USF Teacher 292492

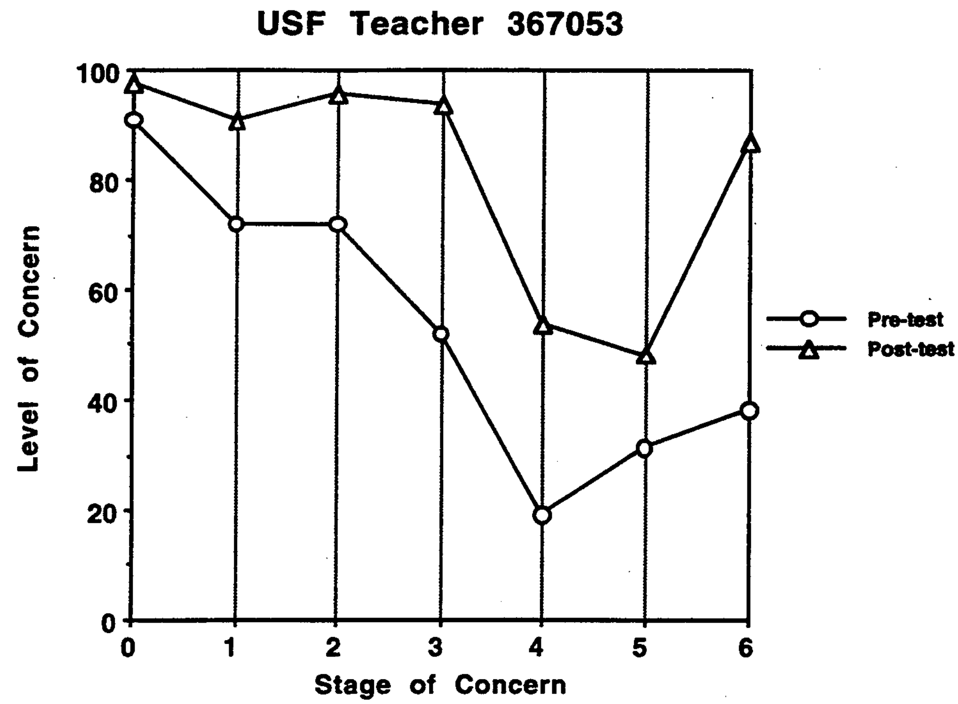


USF Teacher 309797



USF Teacher 344848




USF Teacher 367053
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Level of Concern
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1
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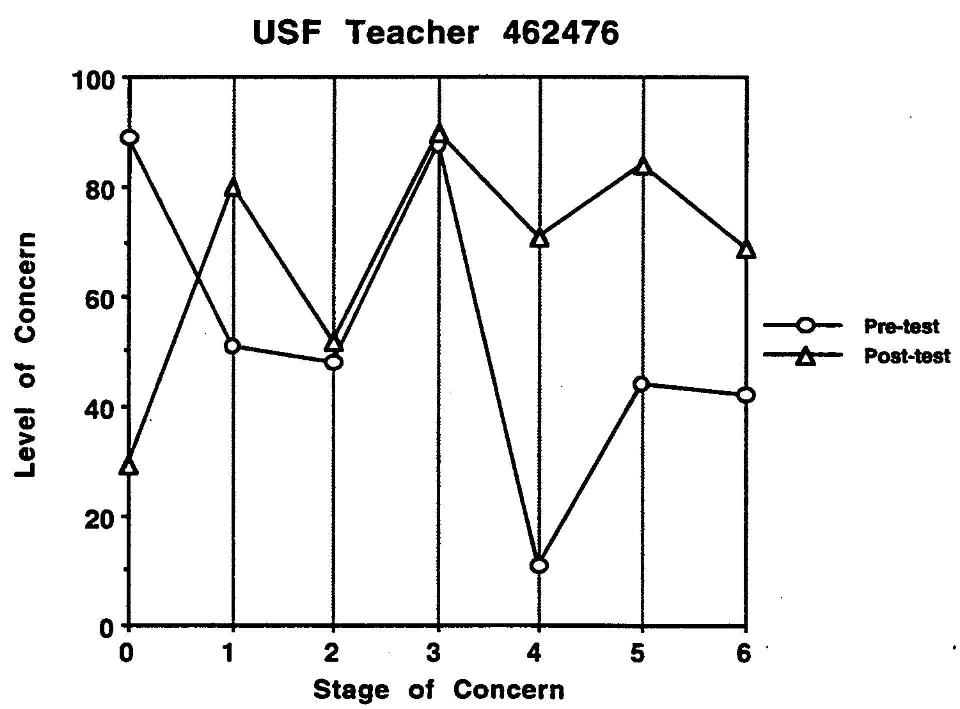
Stage of Concern
Pre-test
Post-test


USF Teacher 462476
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Level of Concern
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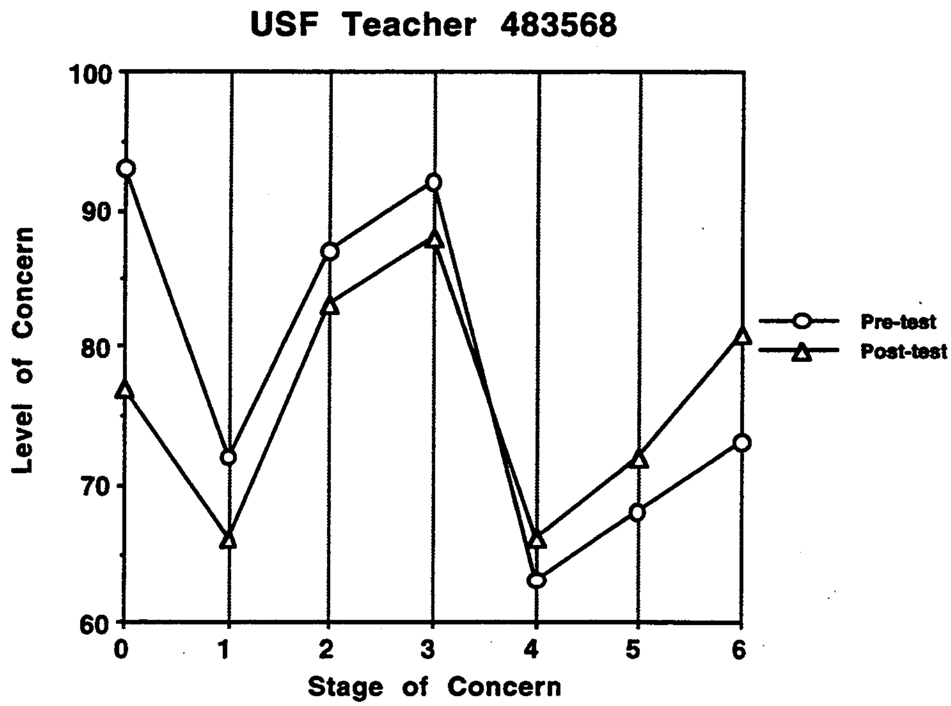
Stage of Concern
Pre-test
Post-test



USF Teacher 483568
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Level of Concern
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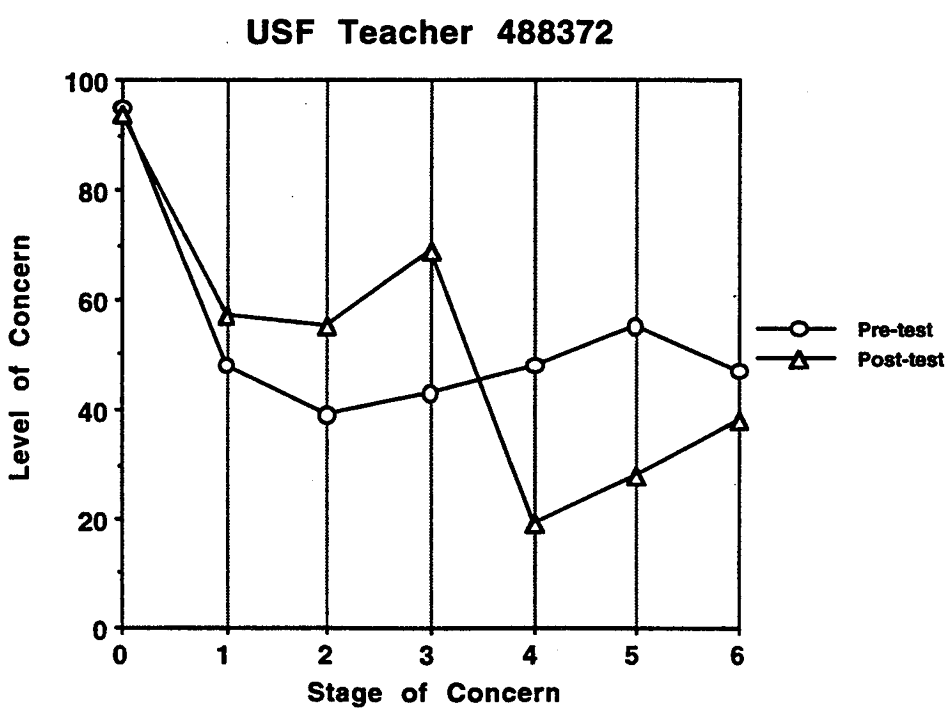
Stage of Concern
Pre-test
Post-test



USF Teacher 488372
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Level of Concern
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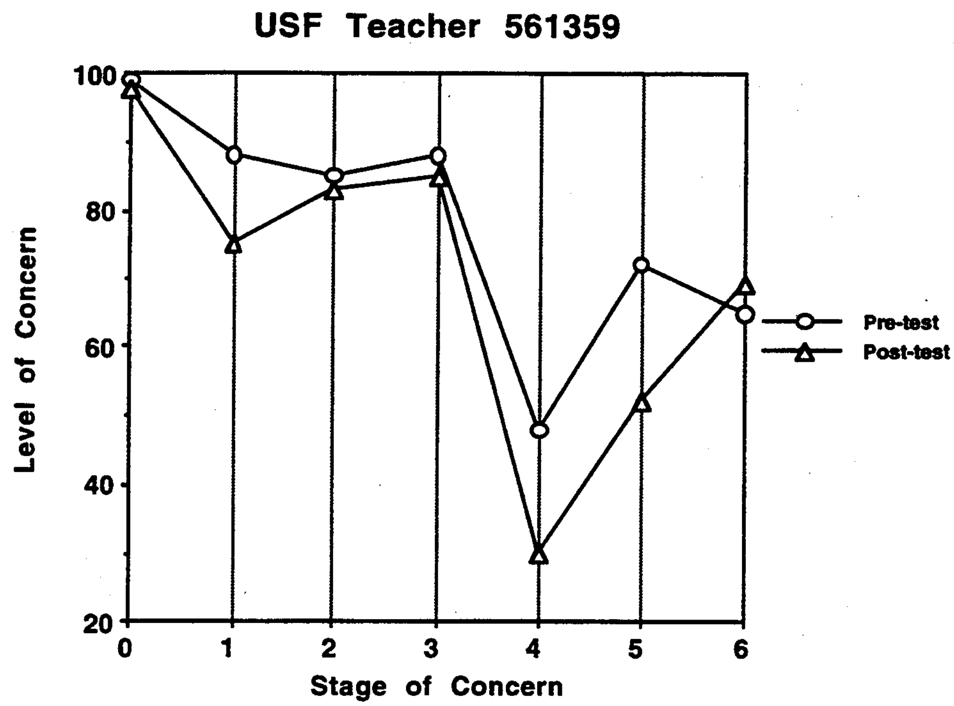
Stage of Concern
Pre-test
Post-test



USF Teacher 561359
Level of Concern
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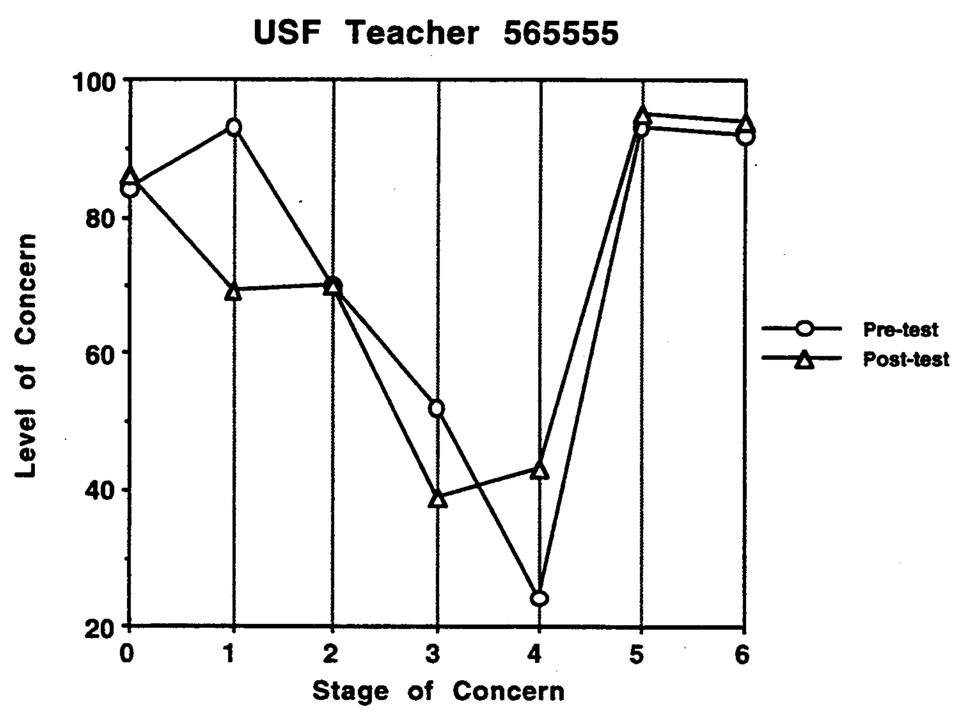
Stage of Concern
Pre-test
Post-test



USF Teacher 565555
Level of Concern
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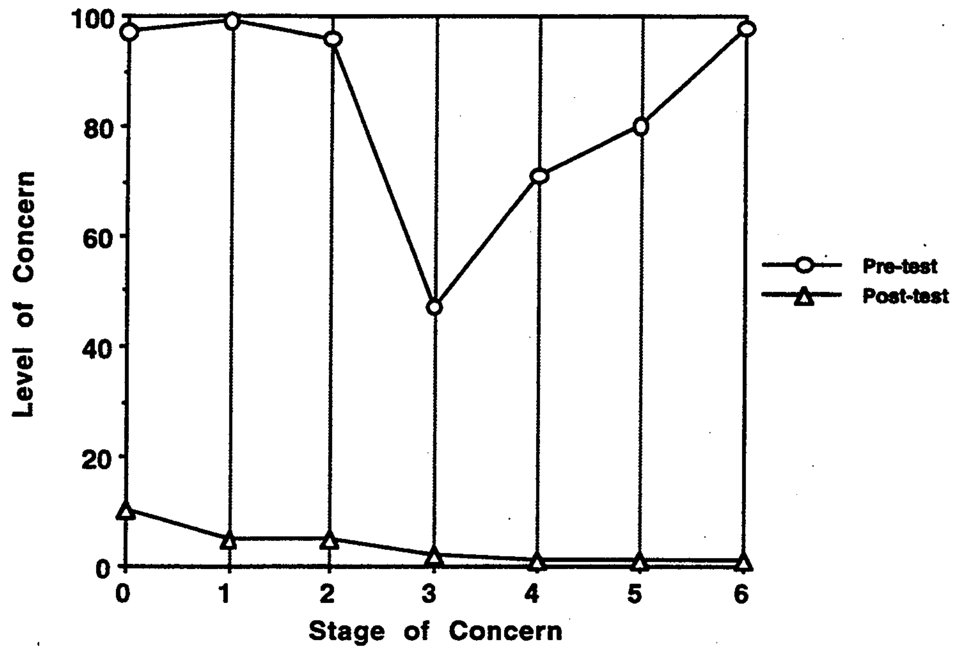
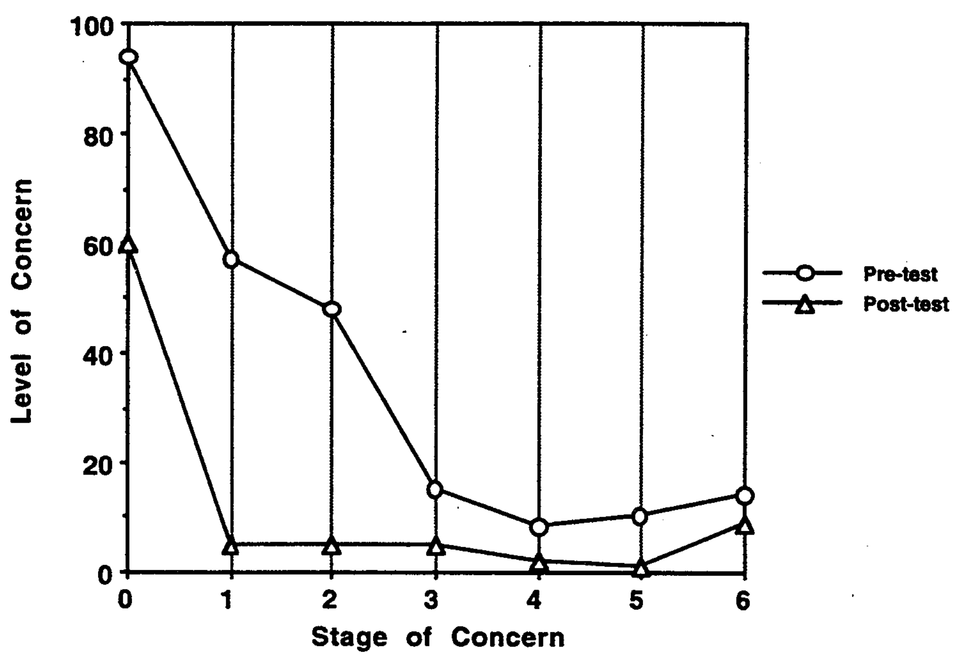
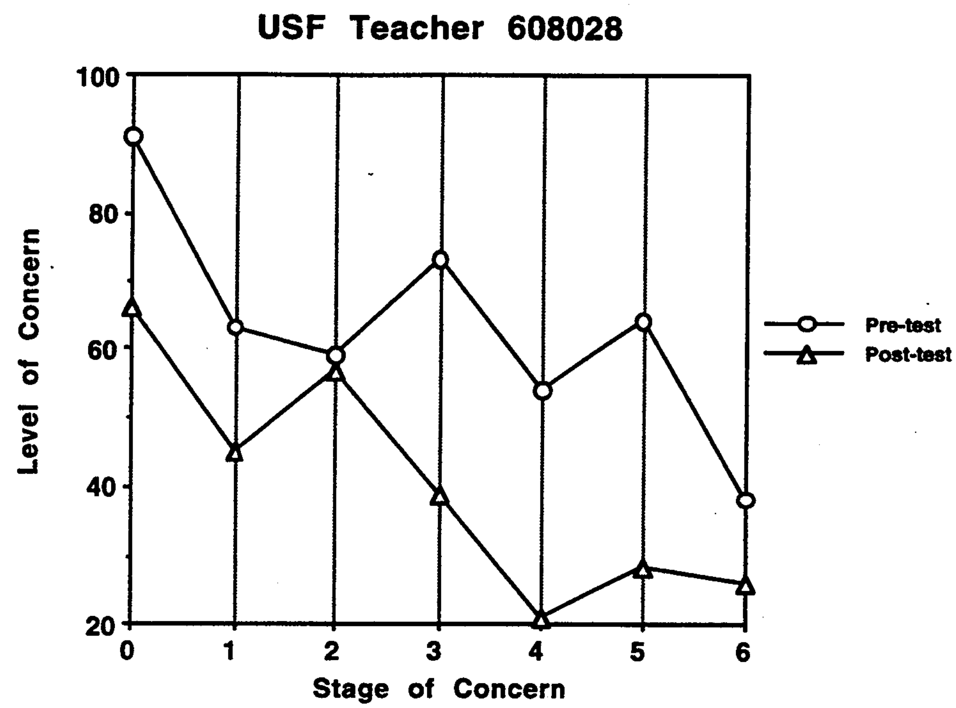
Stage of Concern
Pre-test
Post-test

USF Teacher 569492



USF Teacher 604485




USF Teacher 608028
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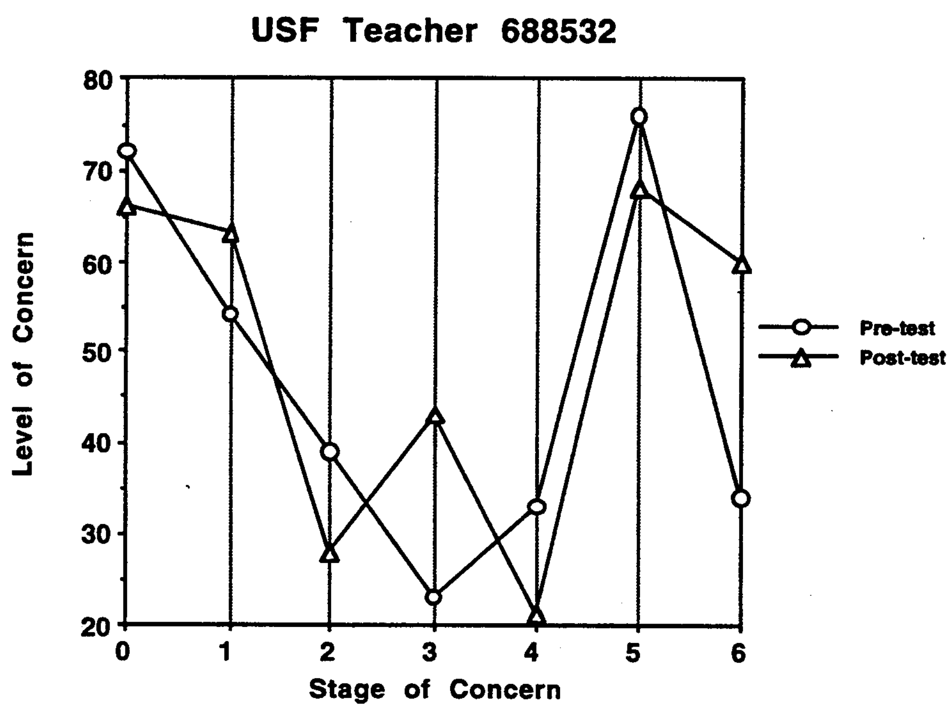
Stage of Concern
Pre-test
Post-test


USF Teacher 688532
Level of Concern
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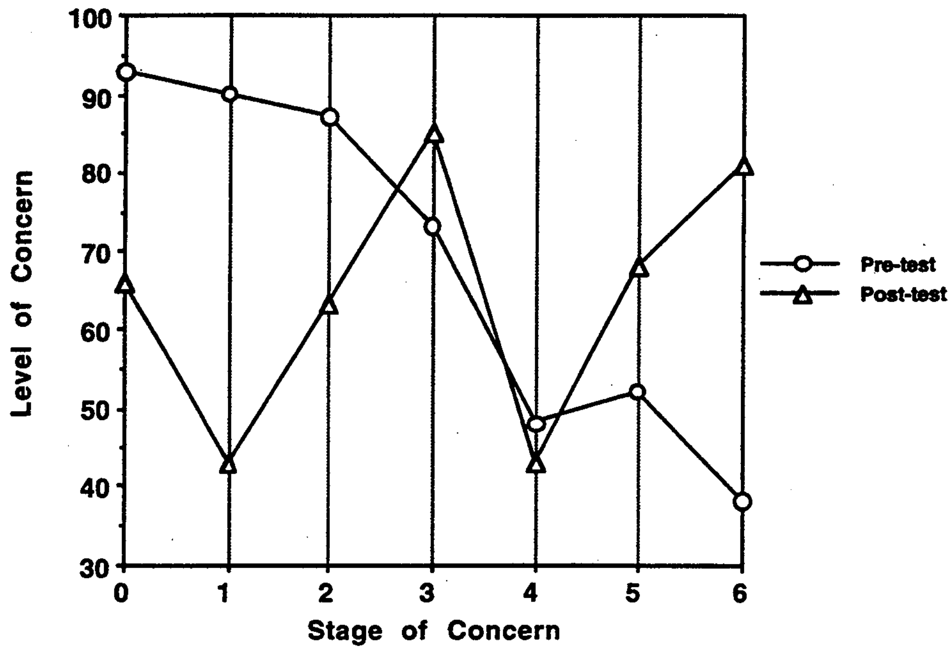
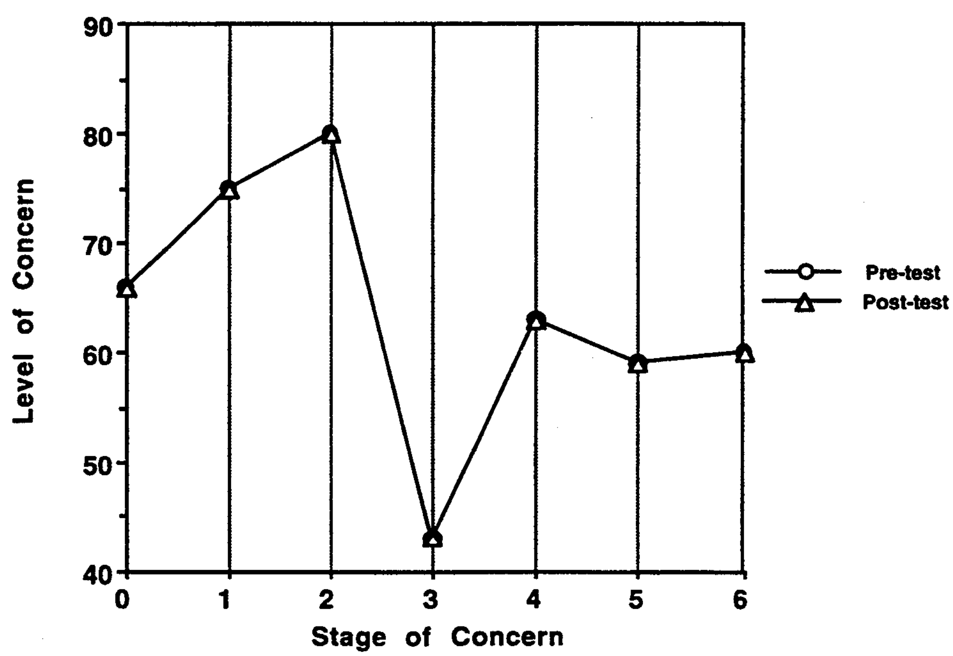
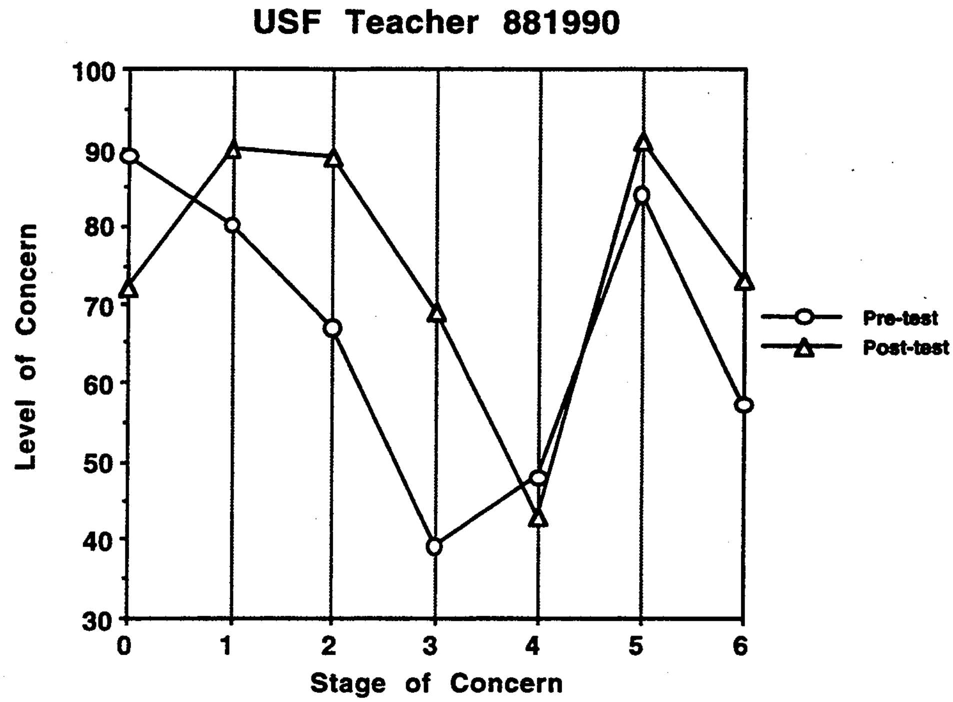
Stage of Concern
Pre-test
Post-test

USF Teacher 741640



USF Teacher 781042




USF Teacher 881990
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Level of Concern
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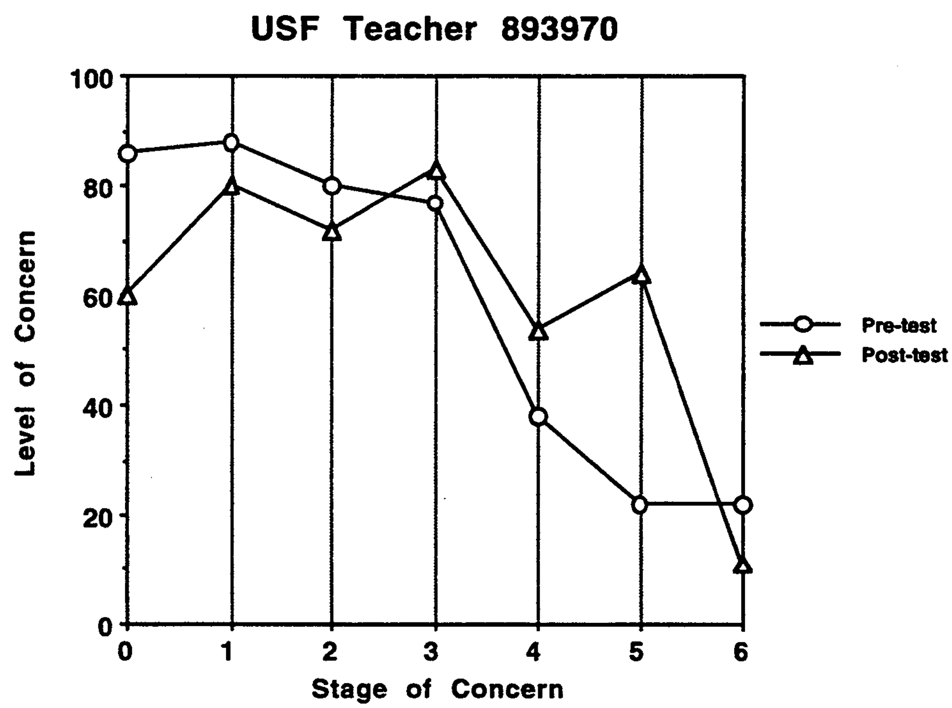
Stage of Concern
Pre-test
Post-test


USF Teacher 893970
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Level of Concern
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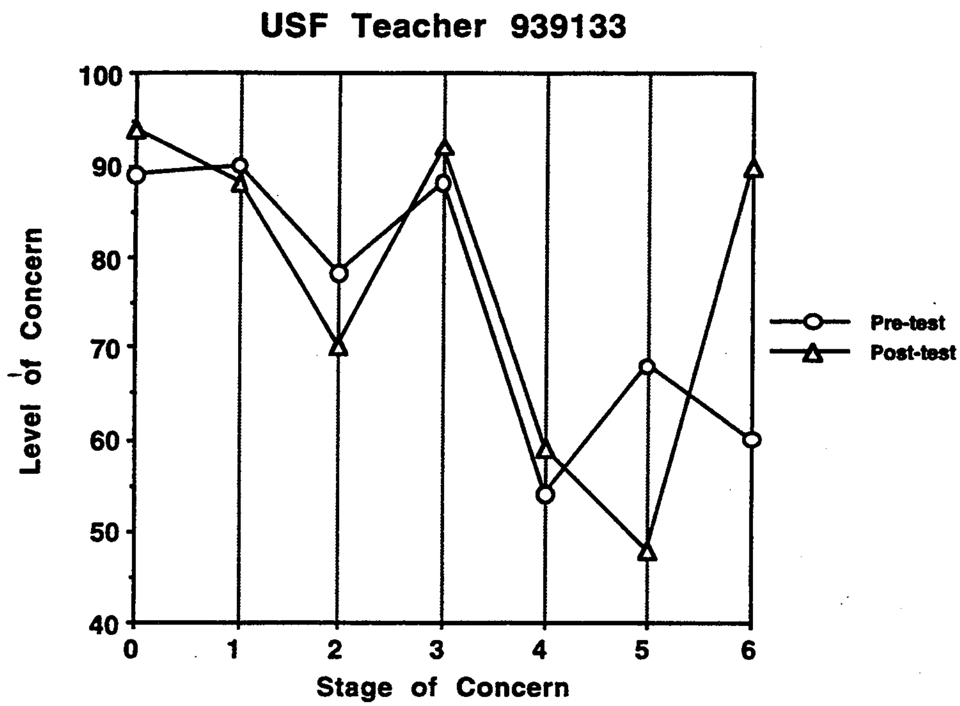
Stage of Concern
Pre-test
Post-test


USF Teacher 939133
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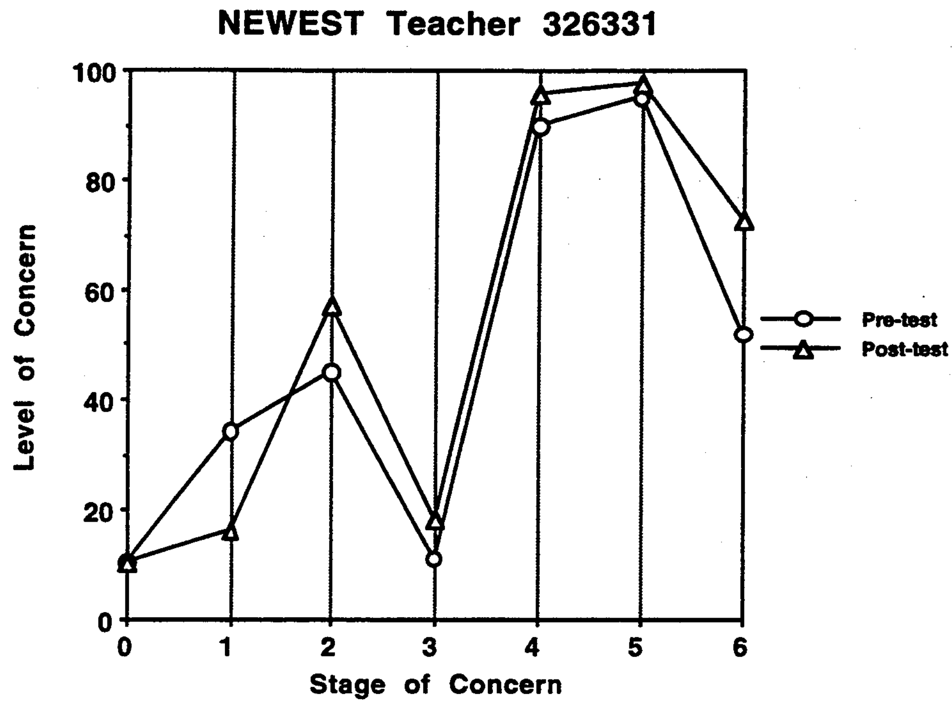
Level of Concern
Stage of Concern
Pre-test
Post-test



NEWEST Teacher 326331
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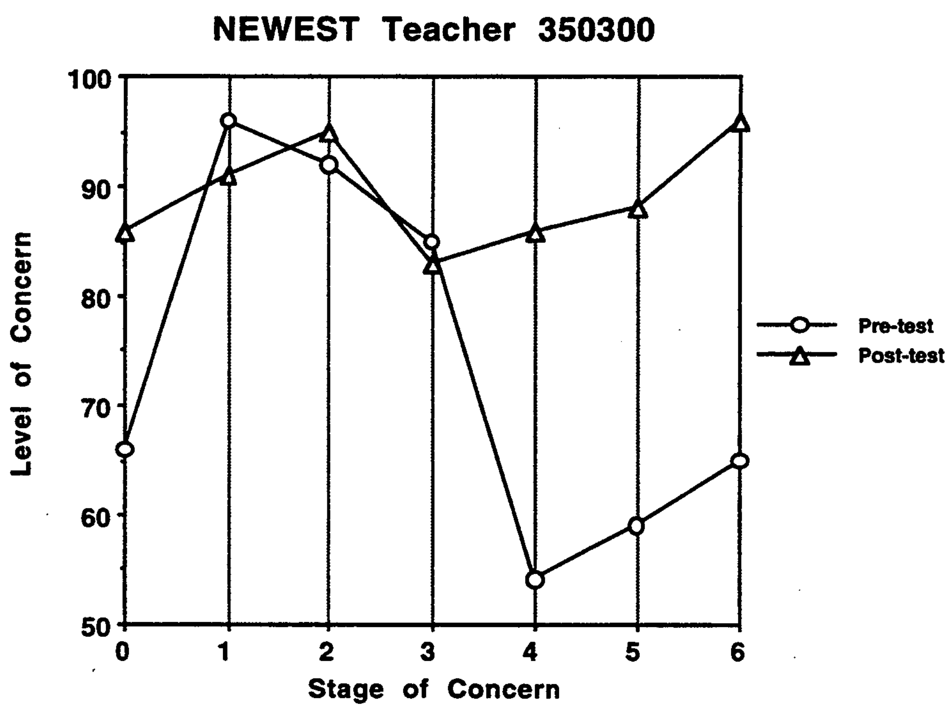
Stage of Concern
Pre-test
Post-test



NEWEST Teacher 350300
Level of Concern
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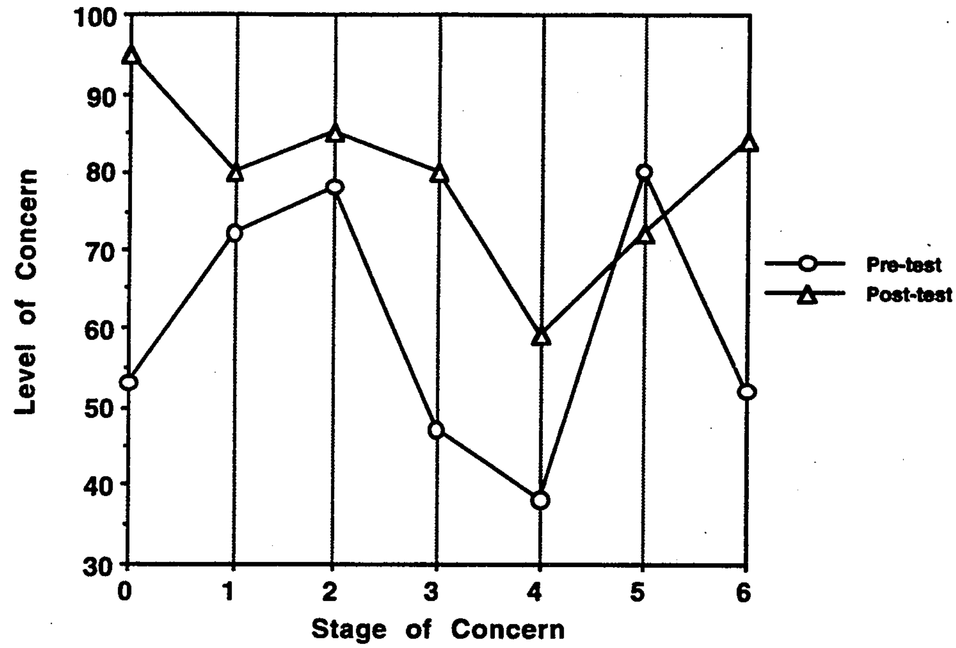
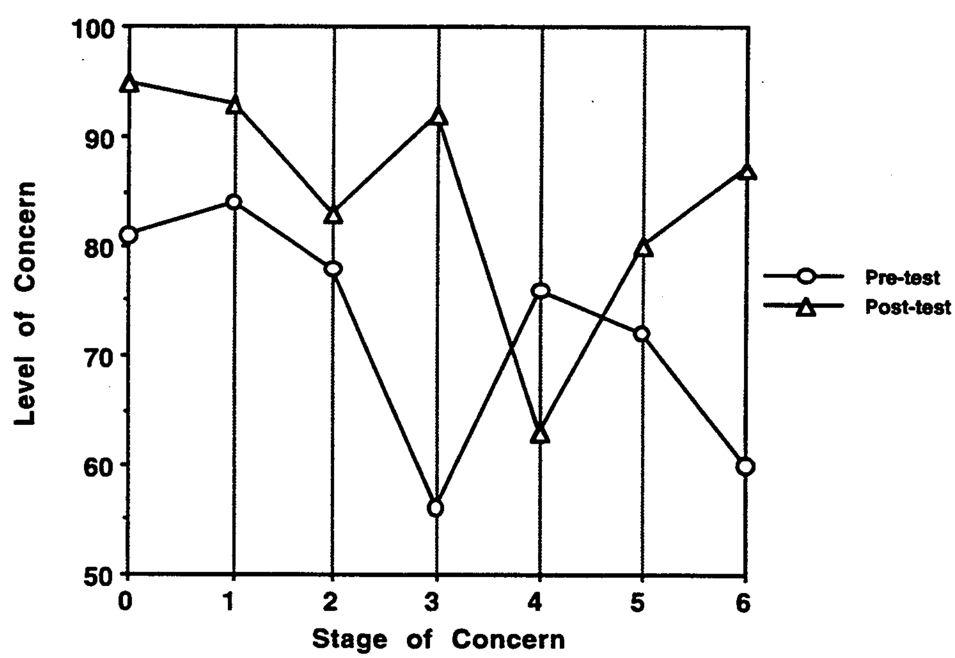
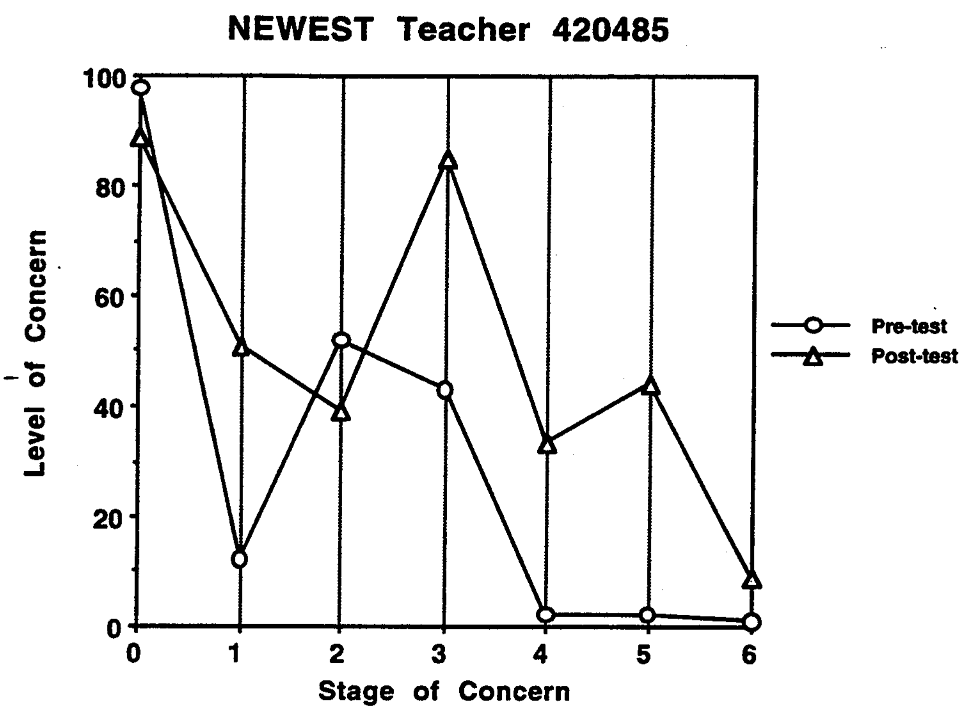
Stage of Concern
Pre-test
Post-test

NEWEST Teacher 384793



NEWEST Teacher 389599




NEWEST Teacher 420485
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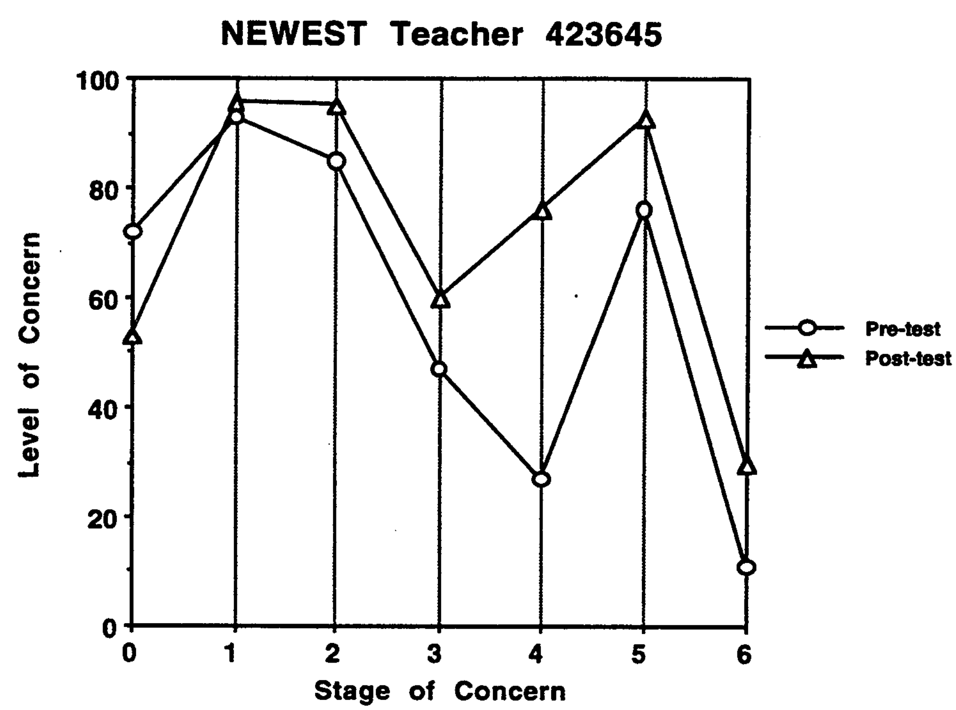
Stage of Concern
Pre-test
Post-test


NEWEST Teacher 423645
Level of Concern
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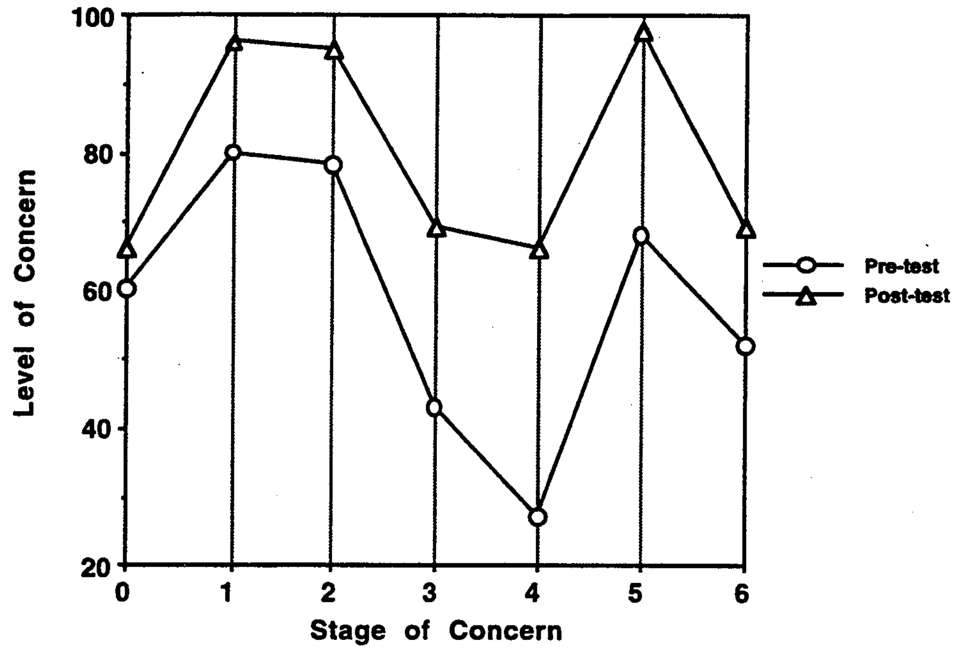
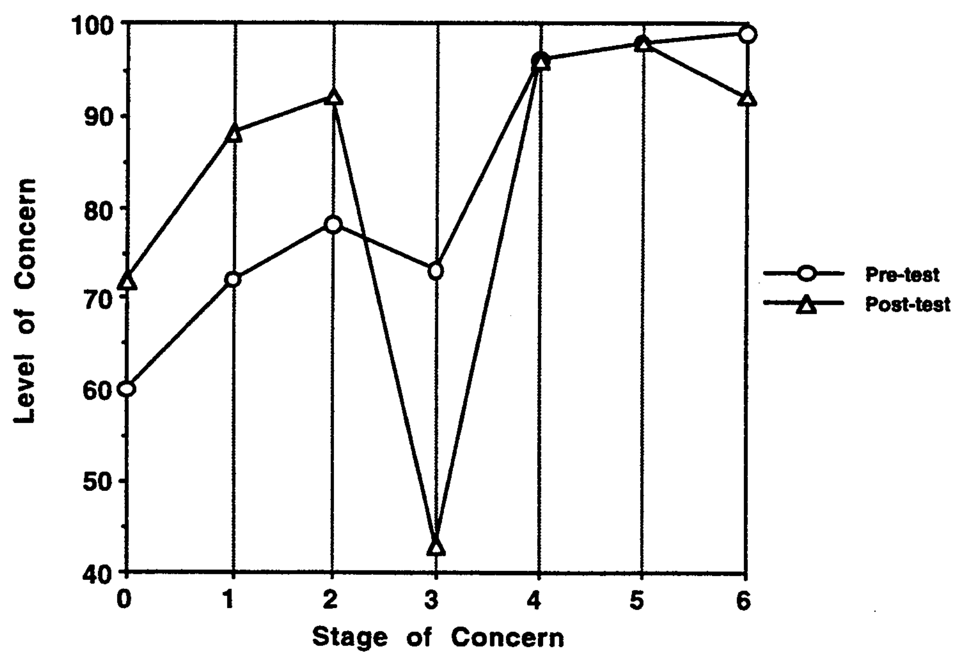
Stage of Concern
Pre-test
Post-test

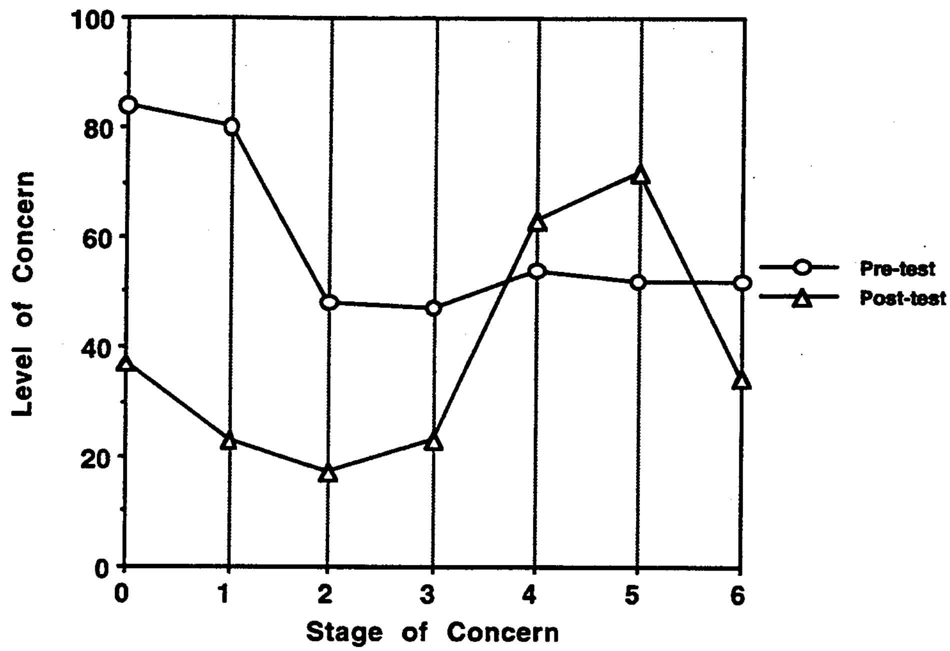
NEWEST Teacher 427514



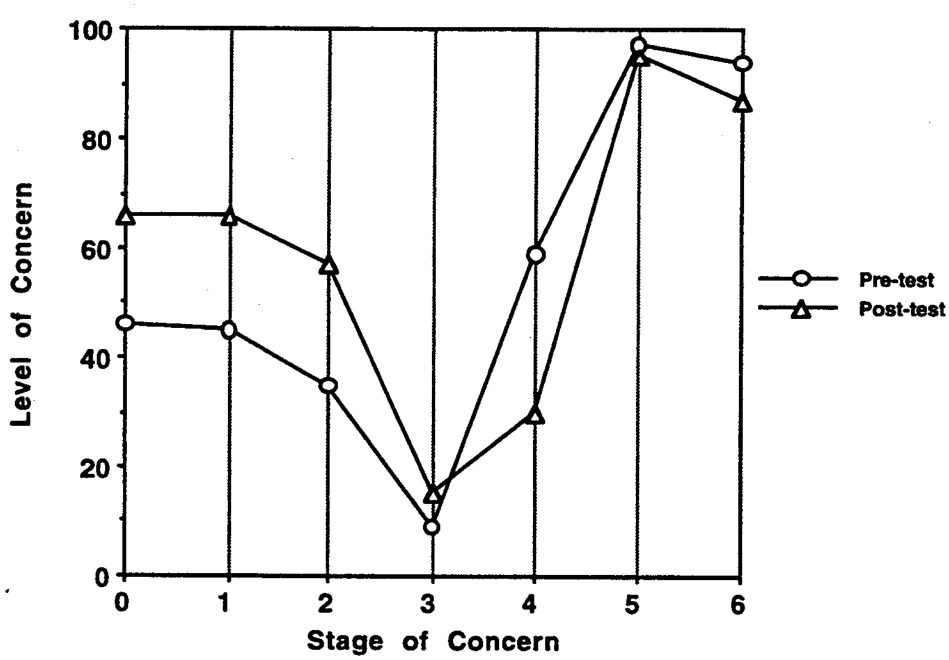
NEWEST Teacher 456938



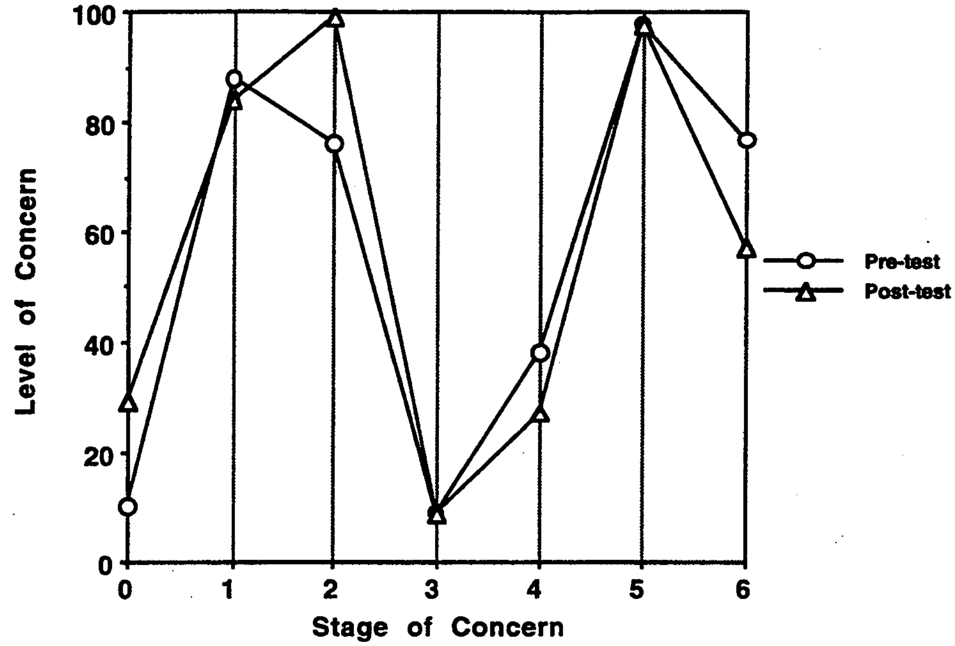
NEWEST Teacher 508689



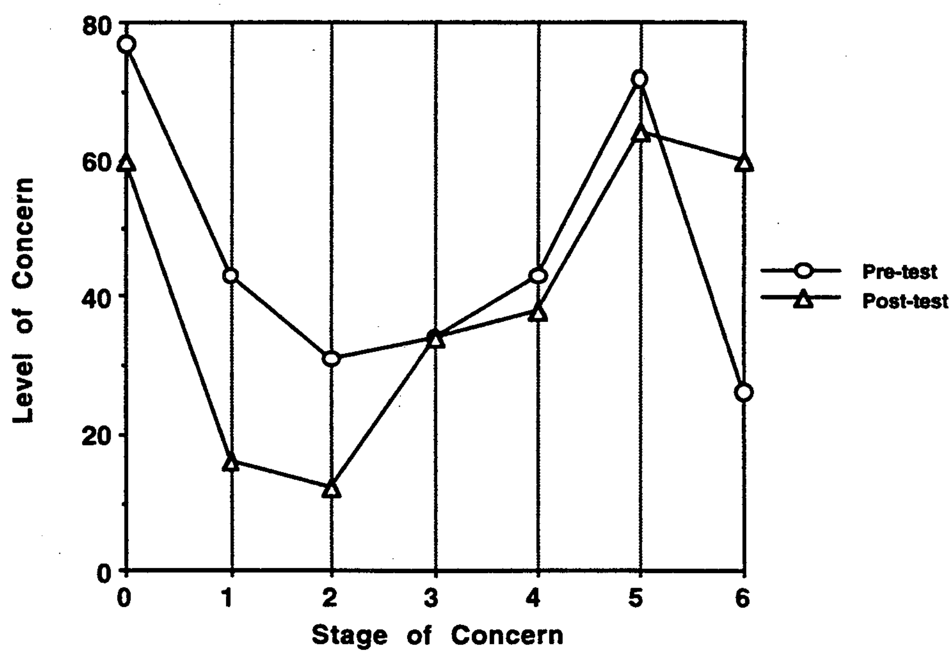
NEWEST Teacher 524520



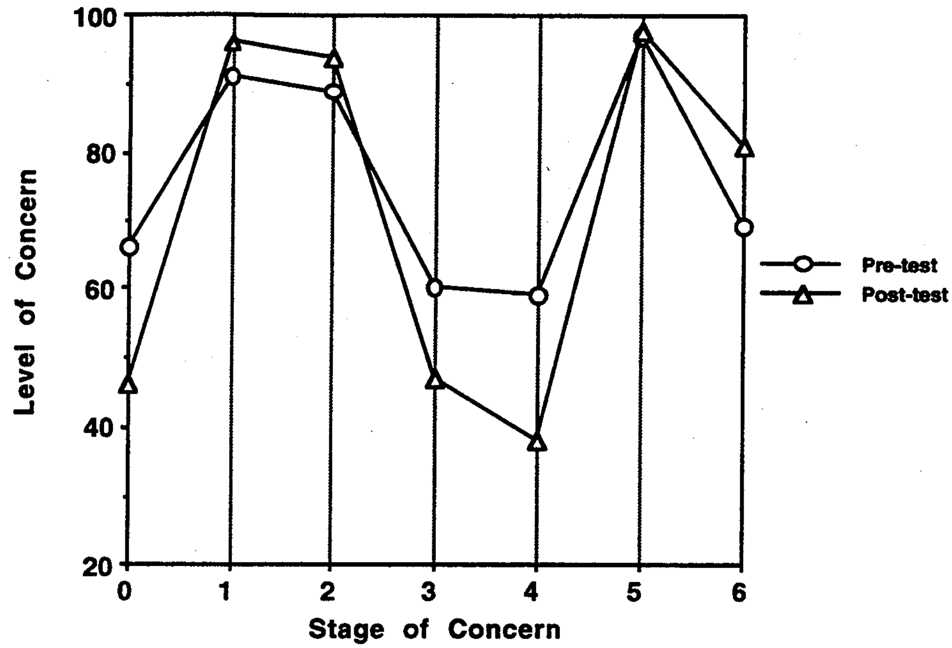
NEWEST Teacher 526198



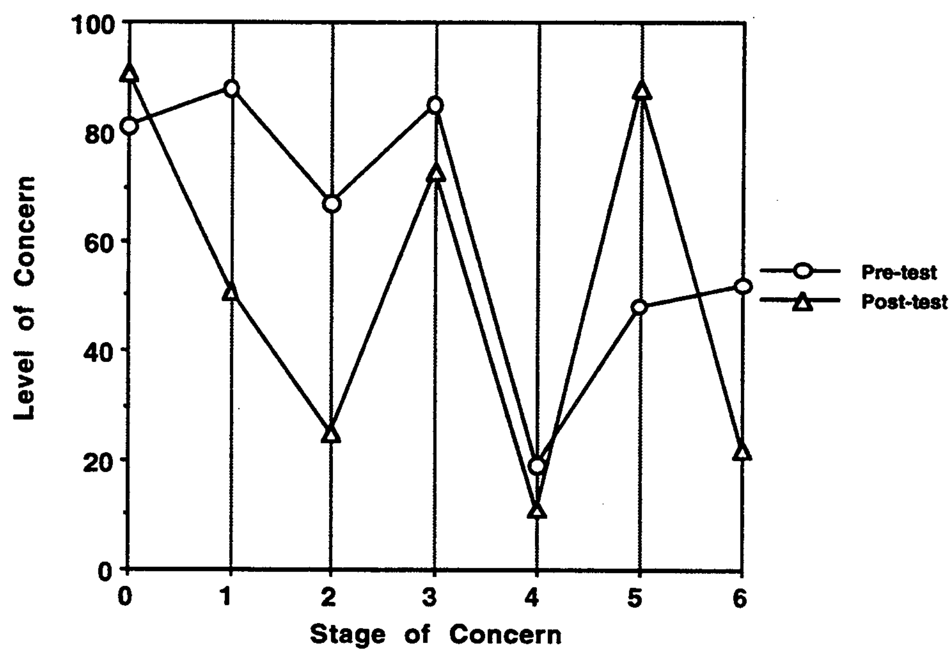
NEWEST Teacher 527290

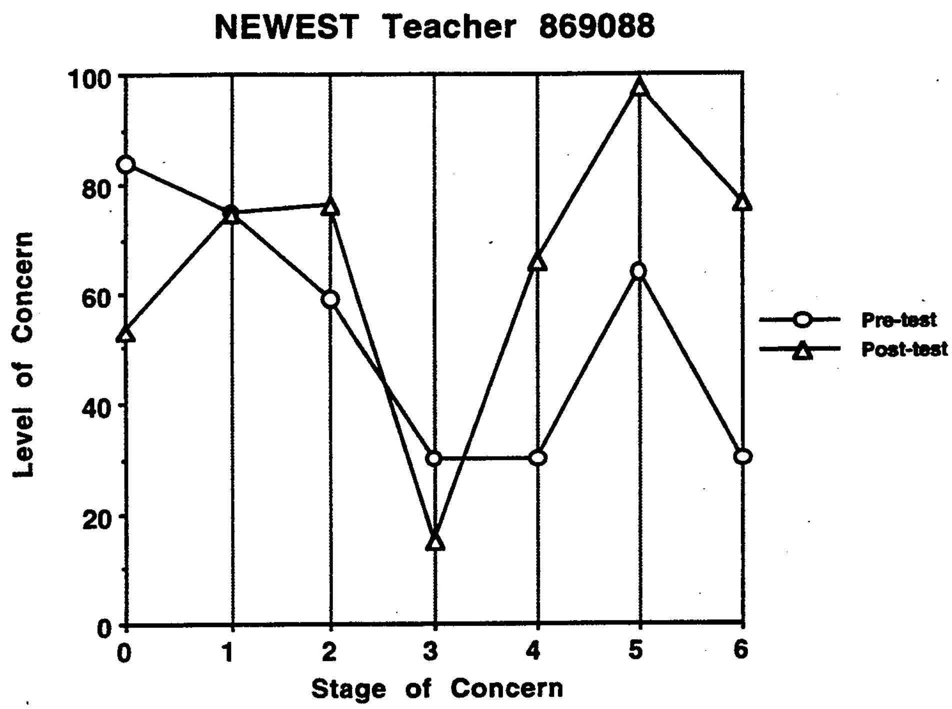


NEWEST Teacher 559975



NEWEST Teacher 702458




NEWEST Teacher 869088
Level of Concern
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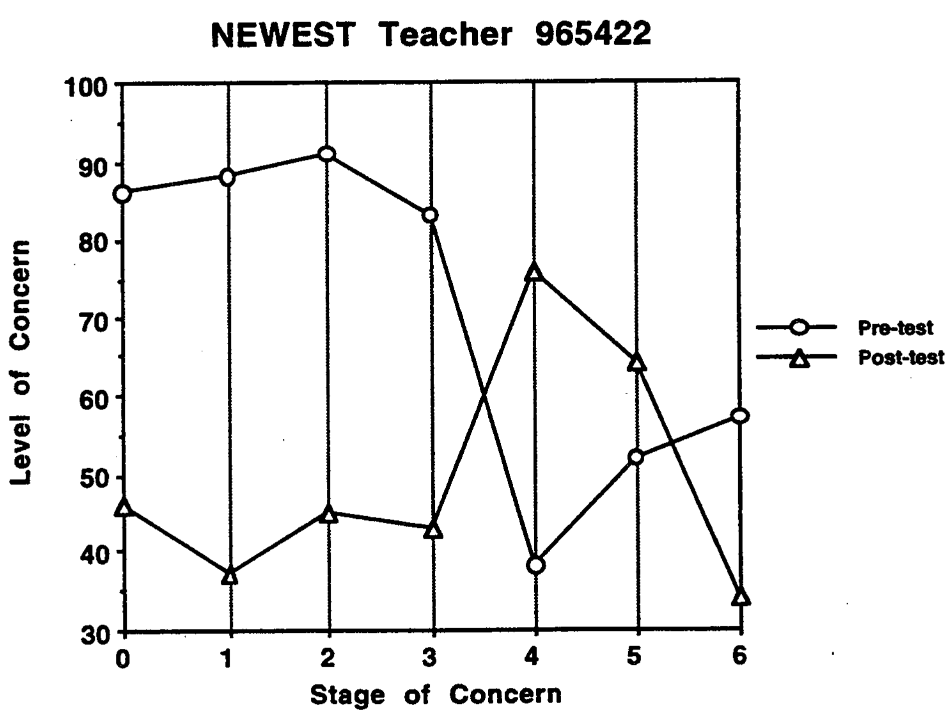
Stage of Concern
Pre-test
Post-test


NEWEST Teacher 965422
Level of Concern
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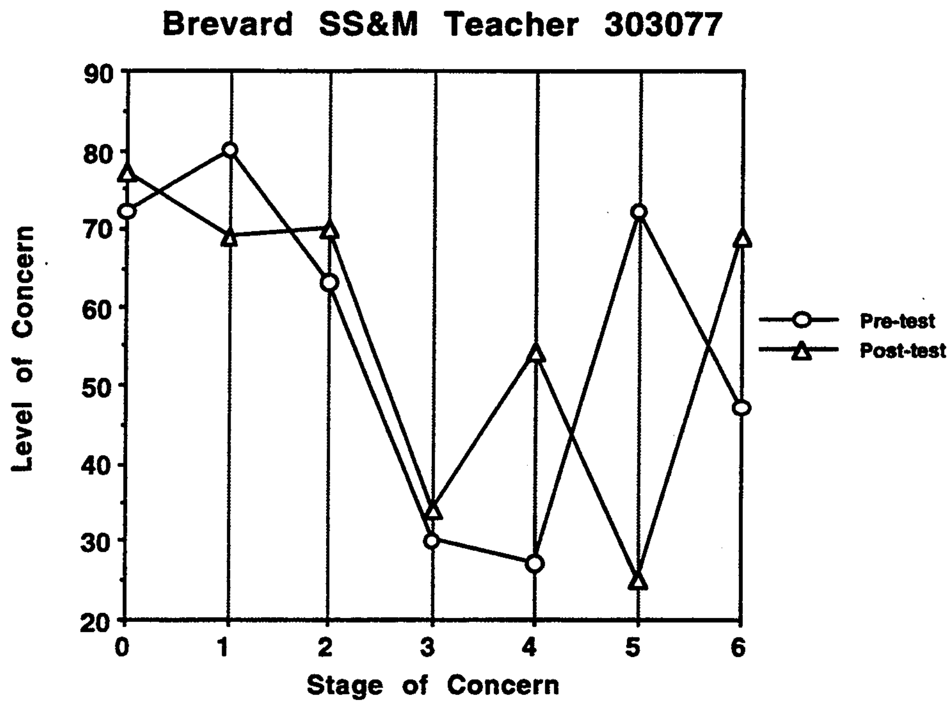
Stage of Concern
Pre-test
Post-test


Brevard SS&M Teacher 303077
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Level of Concern
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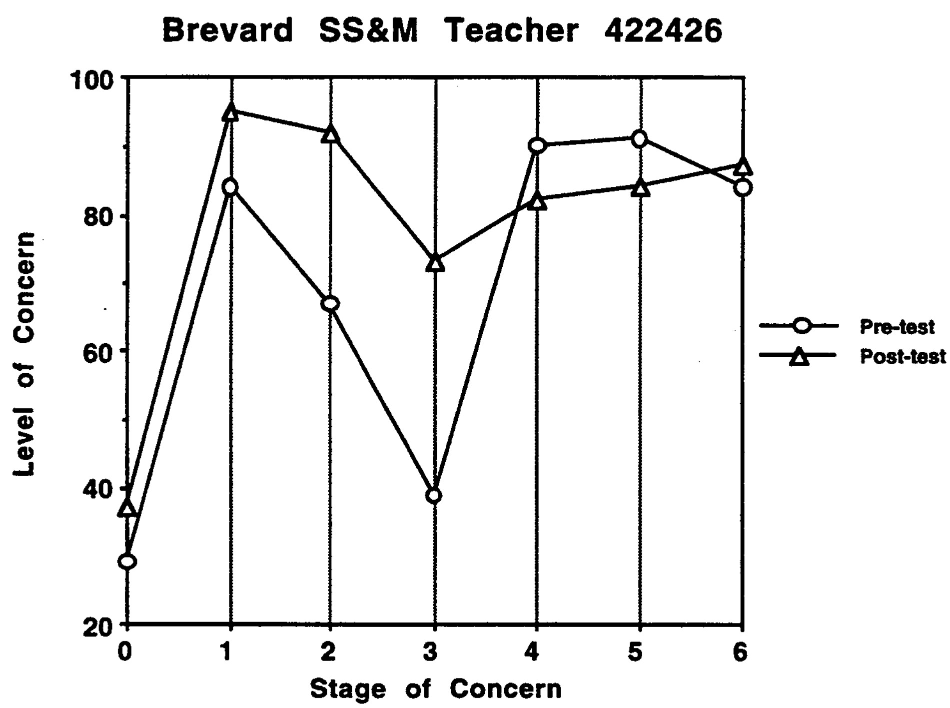
Stage of Concern
Pre-test
Post-test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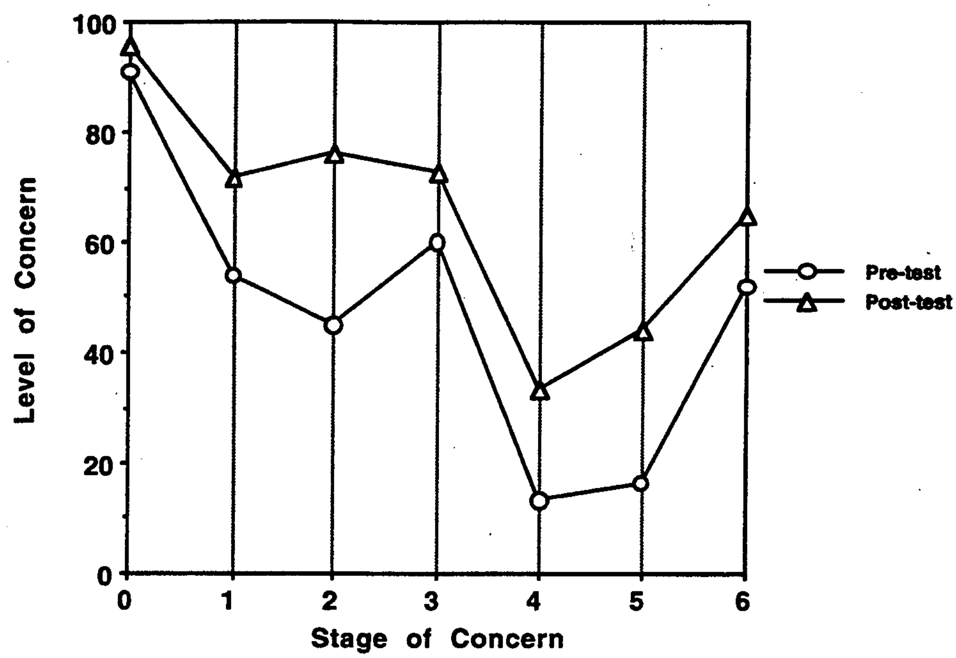
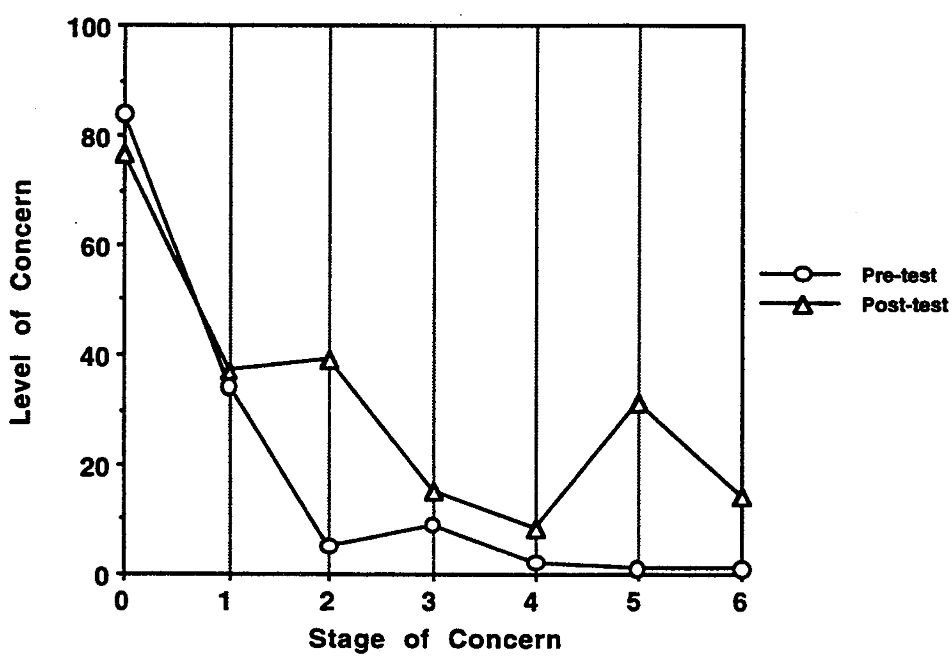
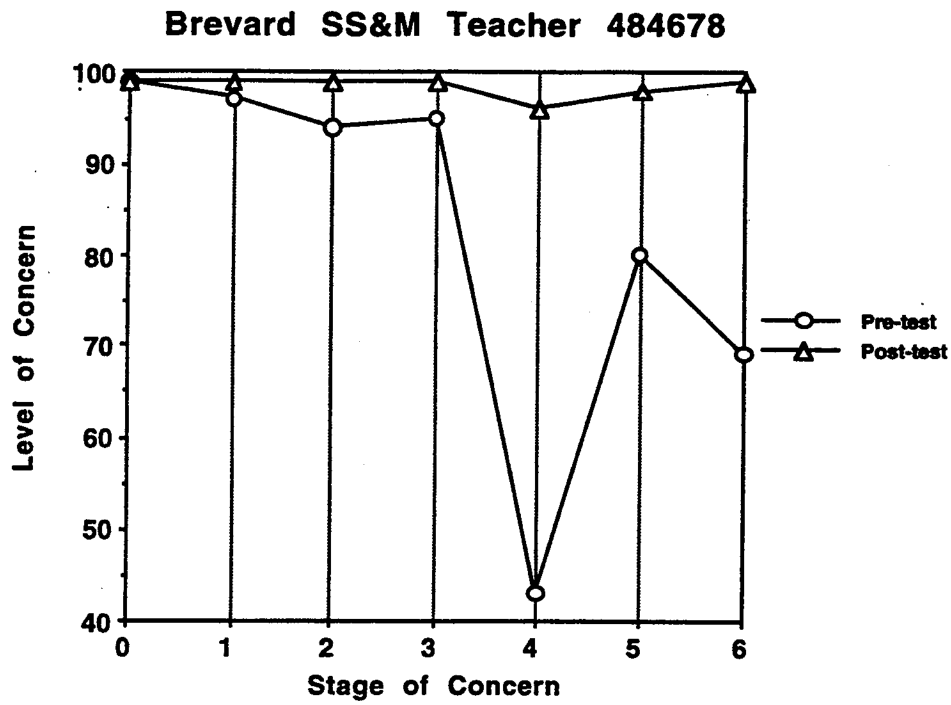
Stage of Concern
Pre-test
Post-test

Brevard SS&M Teacher 425964



Brevard SS&M Teacher 465561





Brevard SS&M Teacher 484678
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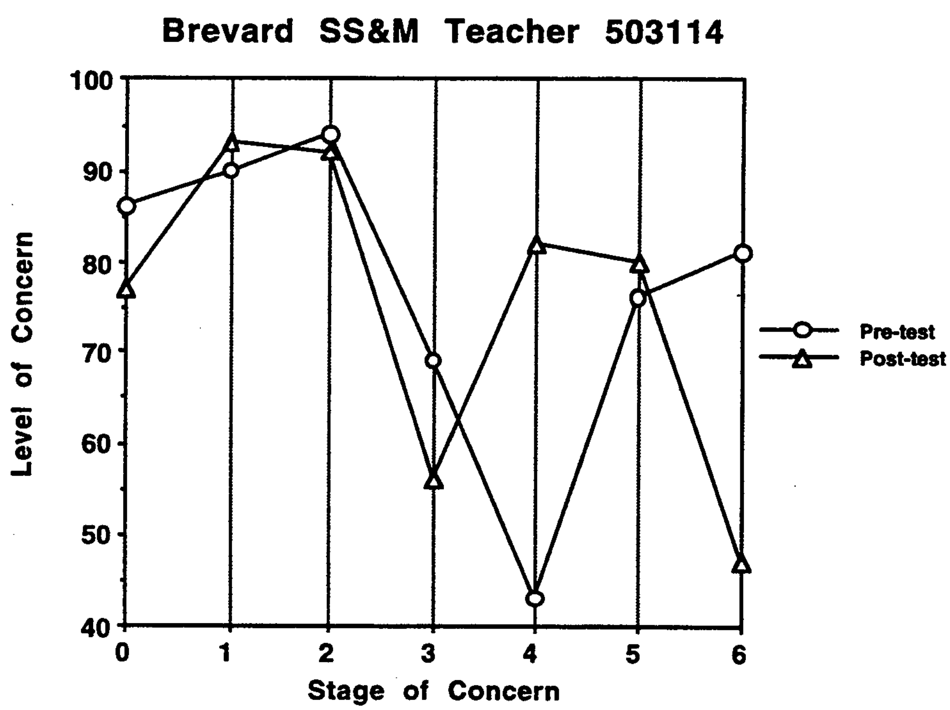
Level of Concern
Stage of Concern
Pre-test
Post-test



Brevard SS&M Teacher 503114
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Level of Concern
Stage of Concern
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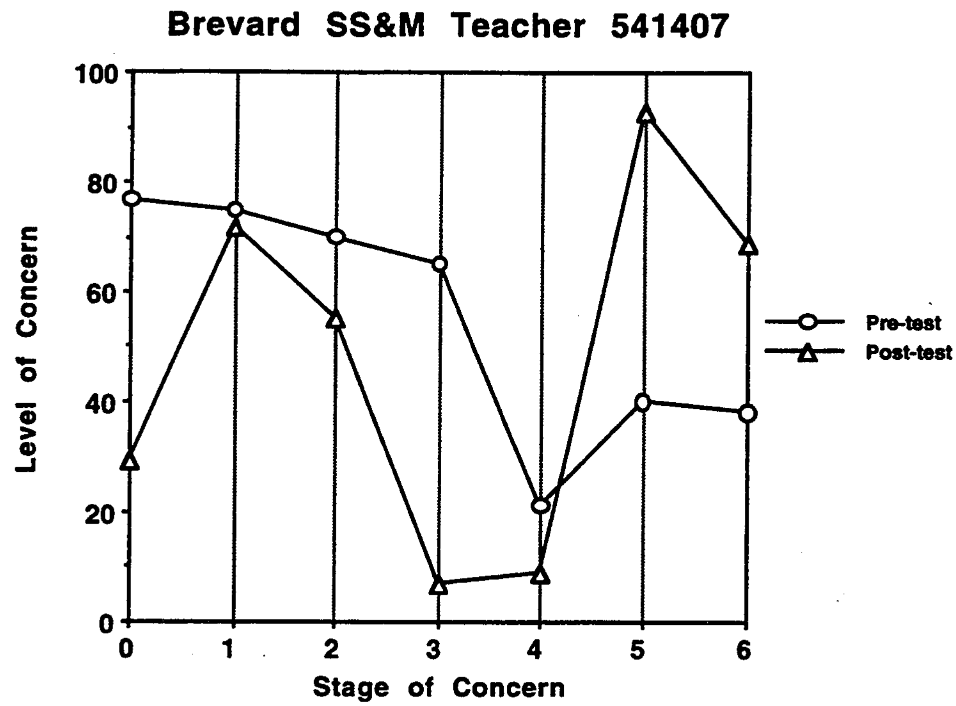
Post-test


Brevard SS&M Teacher 541407
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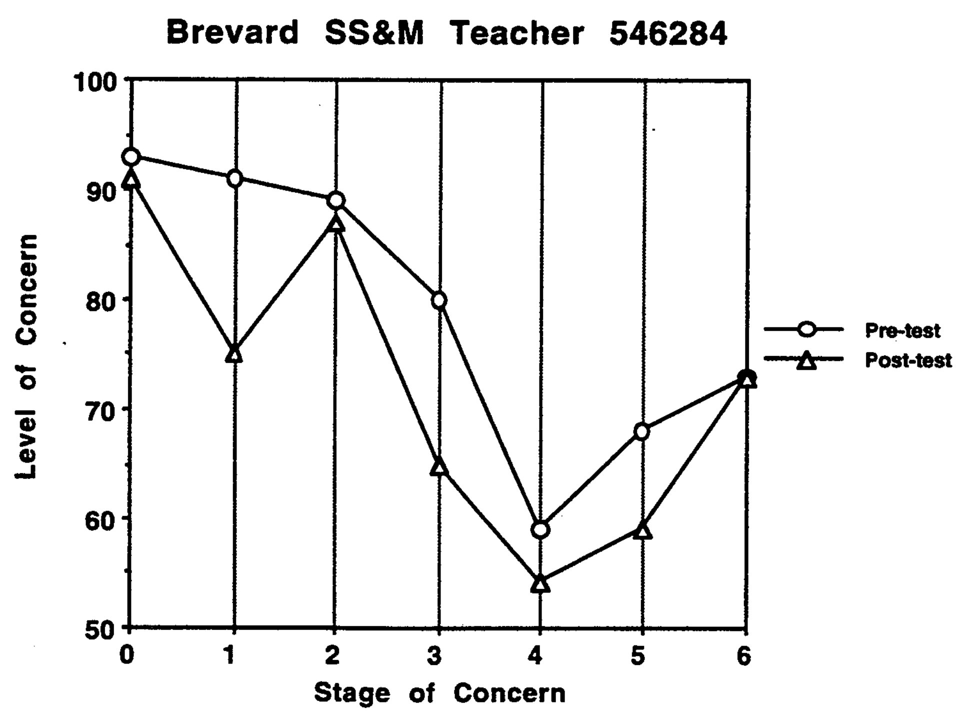
Stage of Concern
Pre-test
Post-test


Brevard SS&M Teacher 546284
Level of Concern
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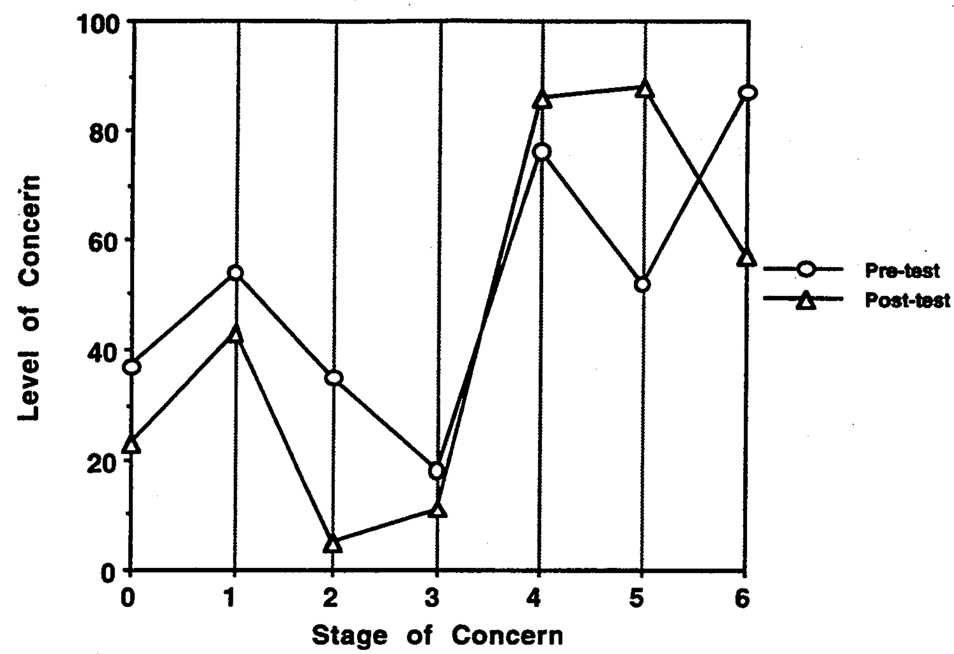
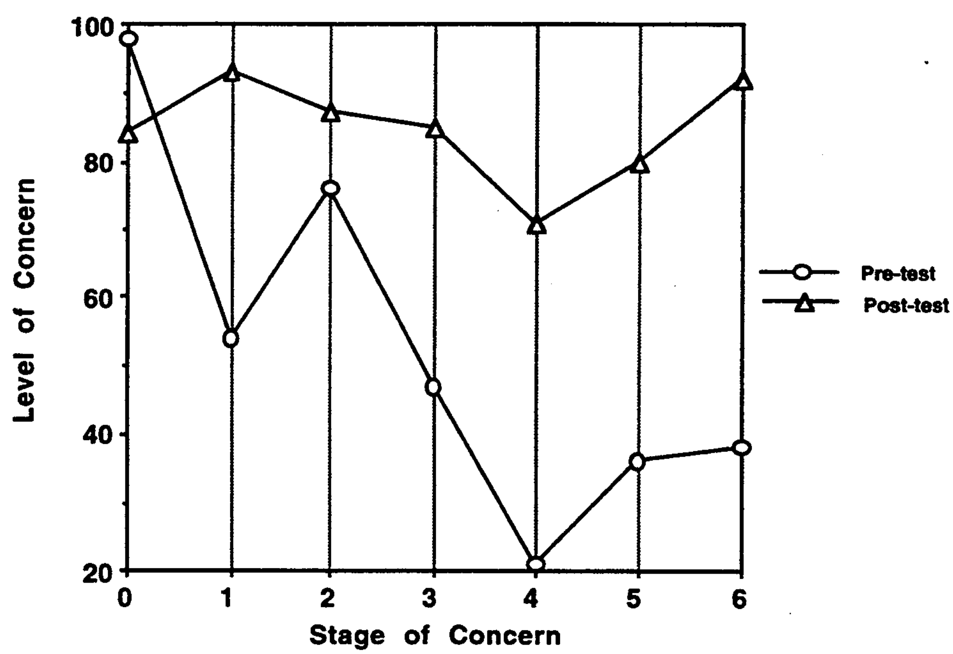
Stage of Concern
Pre-test
Post-test

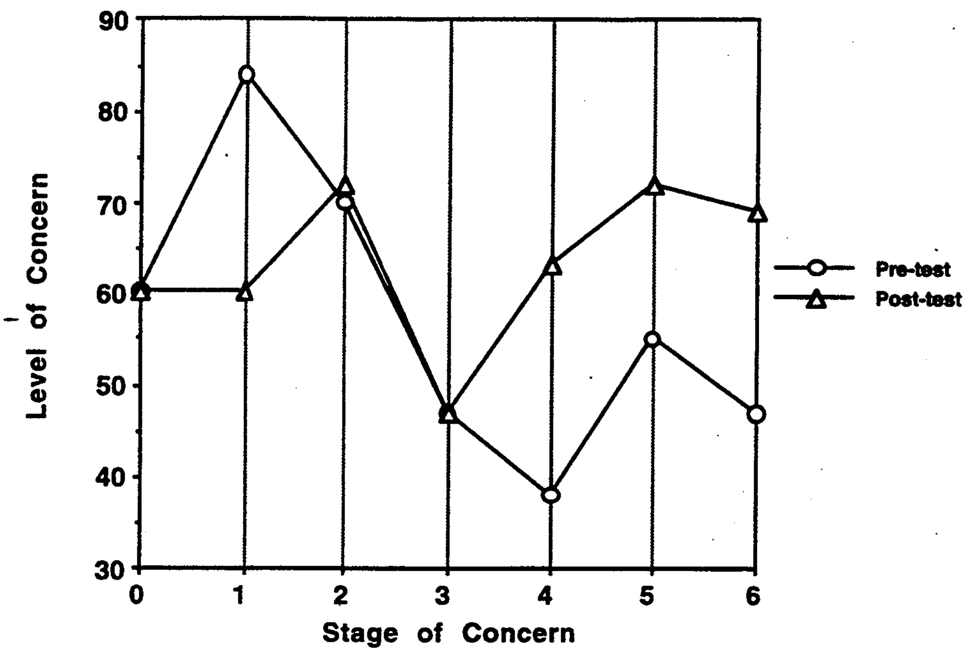
Brevard SS&M Teacher 548625



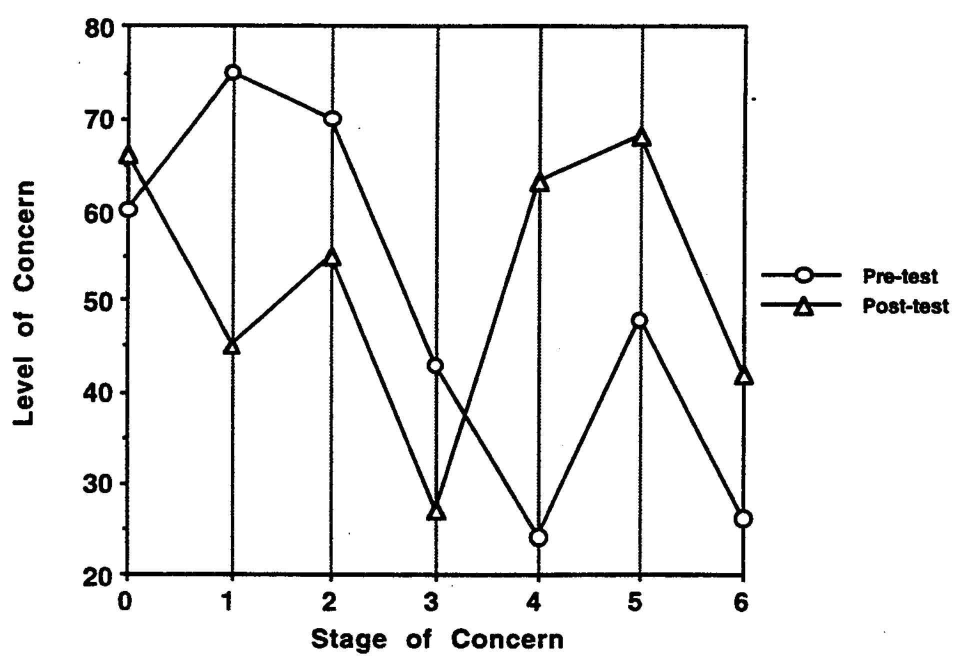
Brevard SS&M Teacher 600698



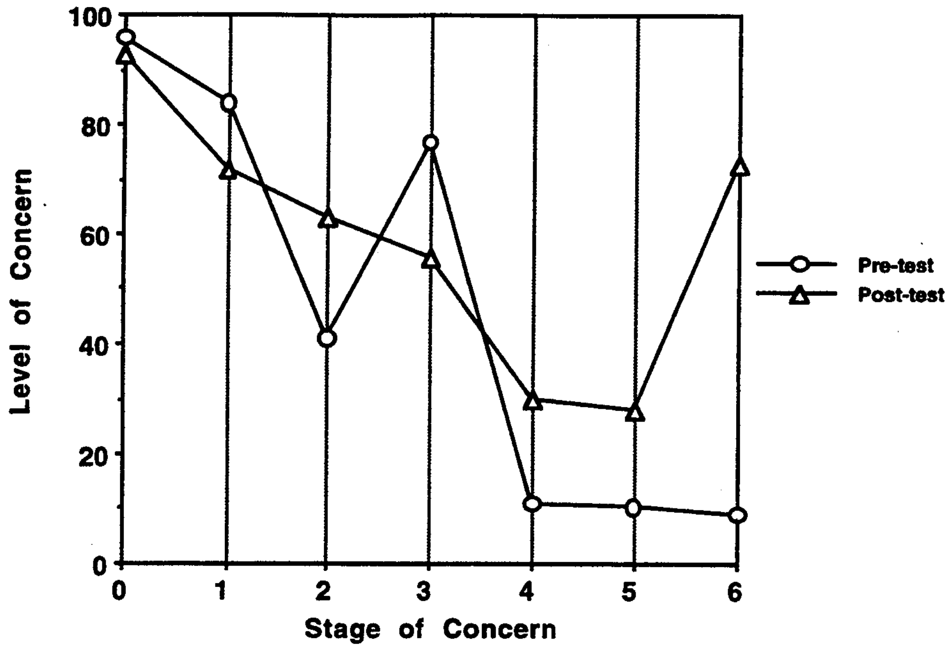
Brevard SS&M Teacher 667744



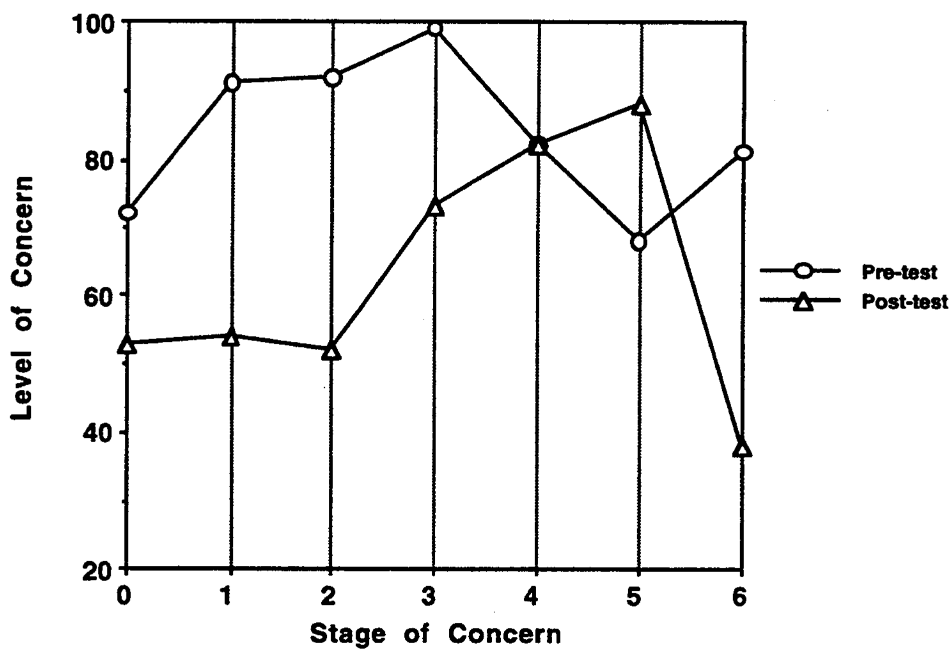
Brevard SS&M Teacher 694931



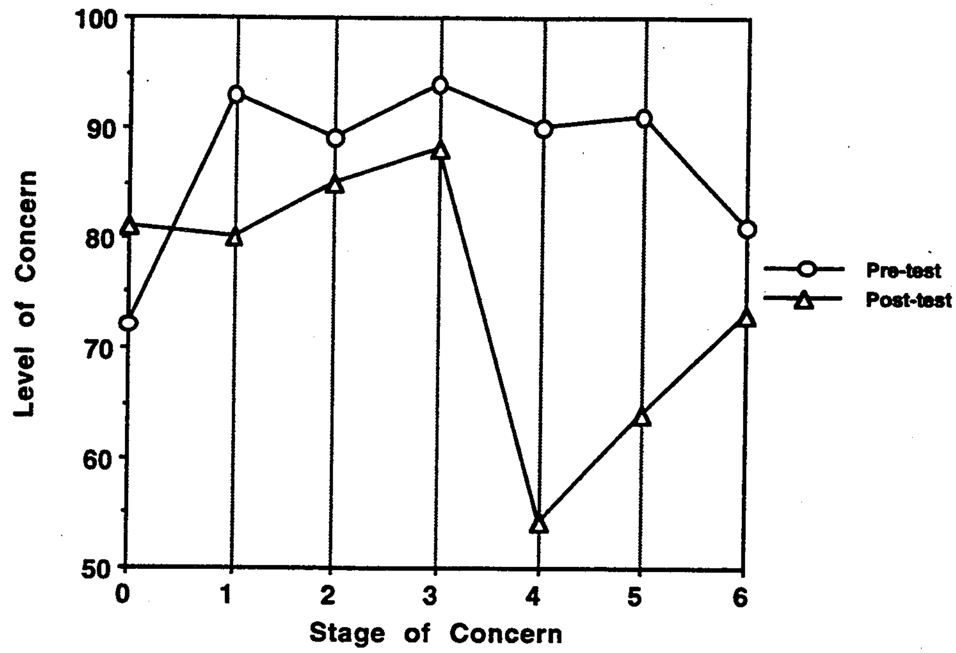
Brevard SS&M Teacher 707999



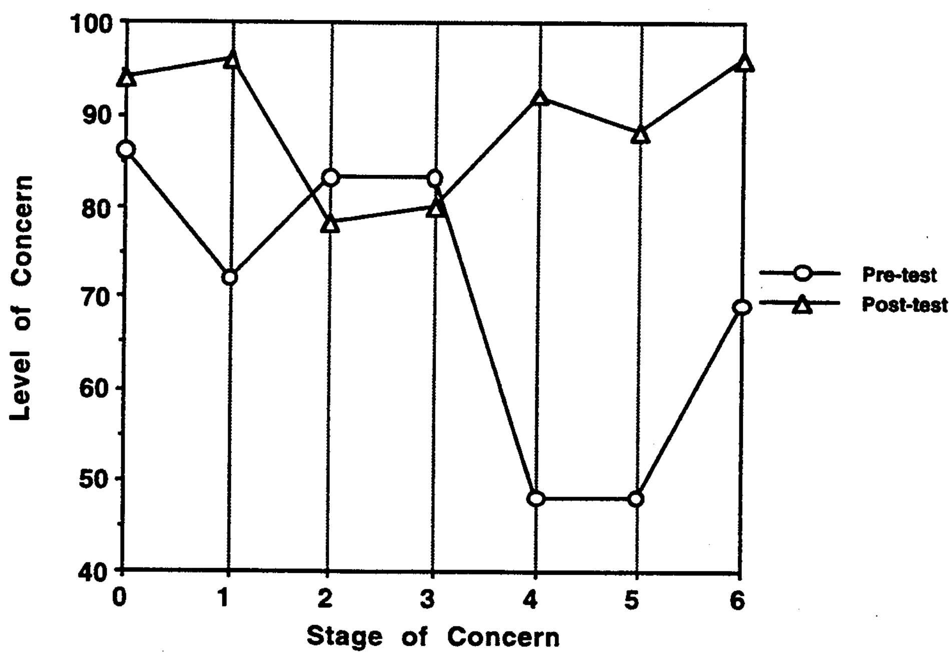
Brevard SS&M Teacher 744655

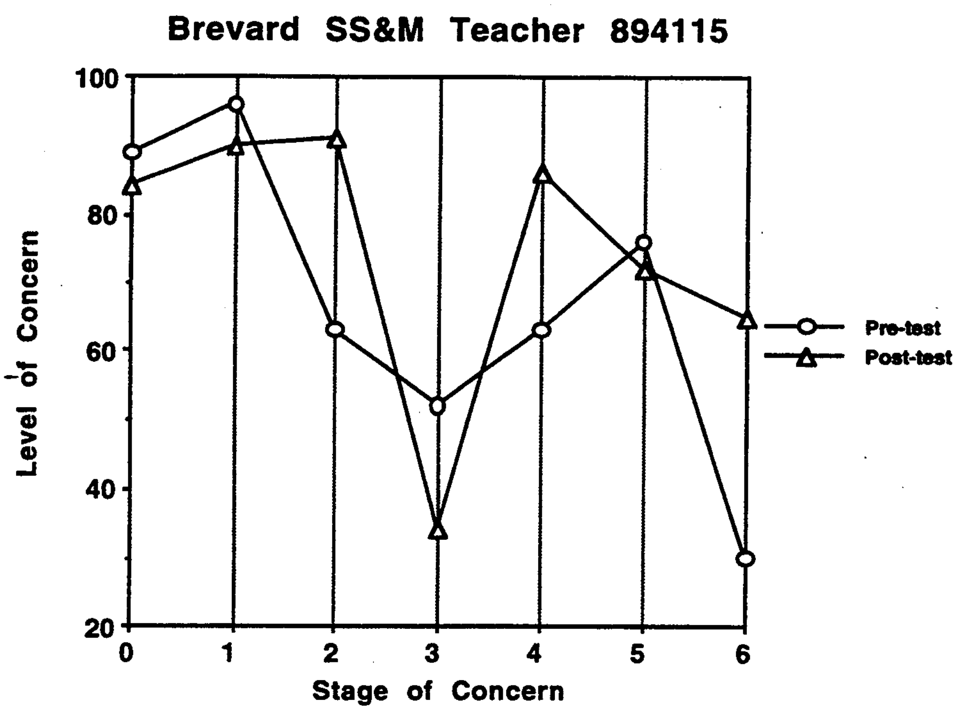


Brevard SS&M Teacher 823083



Brevard SS&M Teacher 862234




Brevard SS&M Teacher 894115
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Level of Concern
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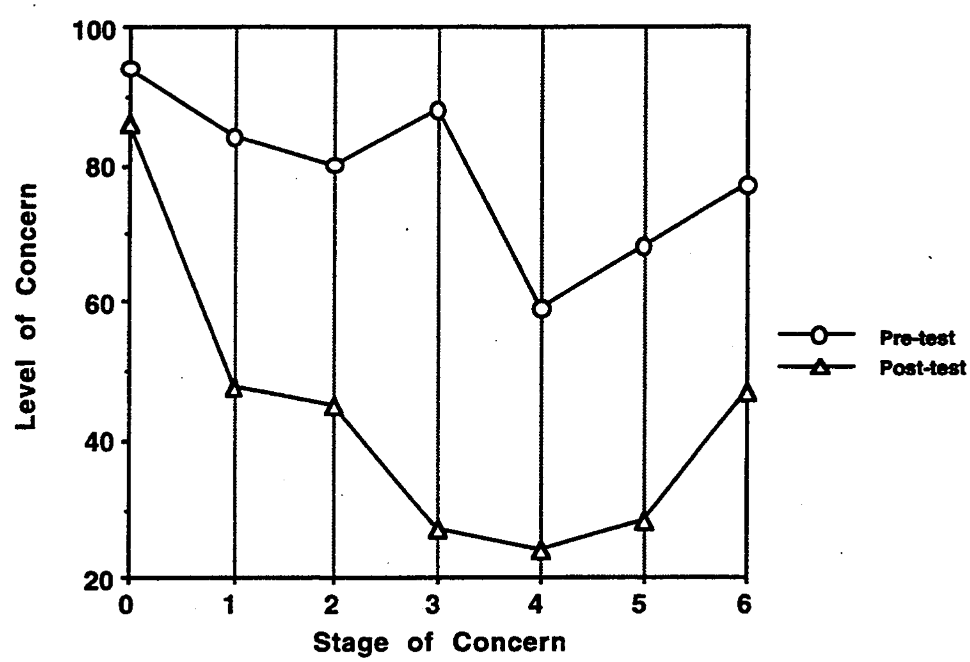
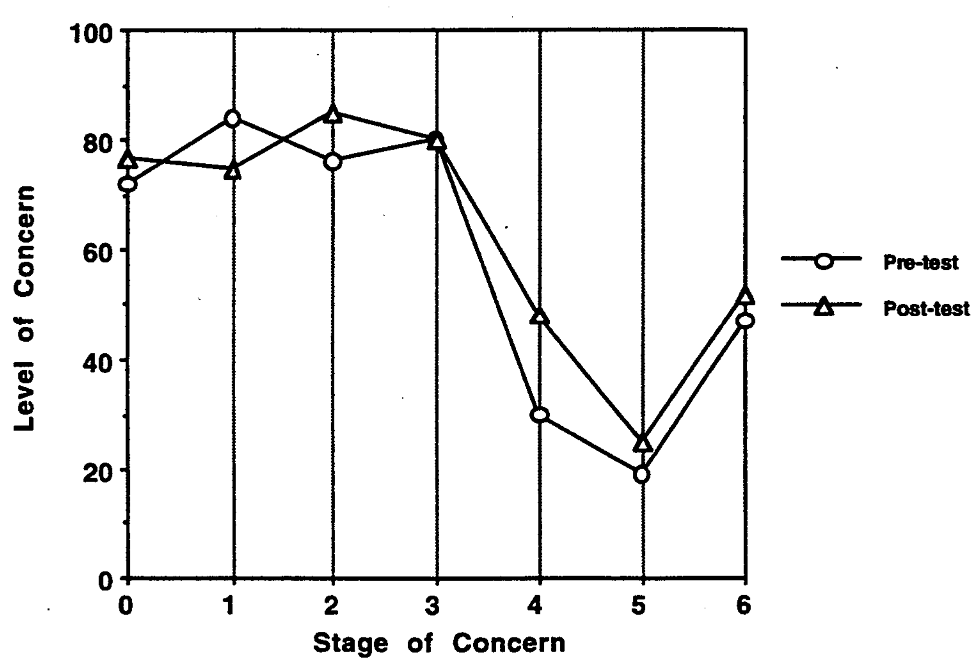
6
Stage of Concern
Pre-test
Post-test

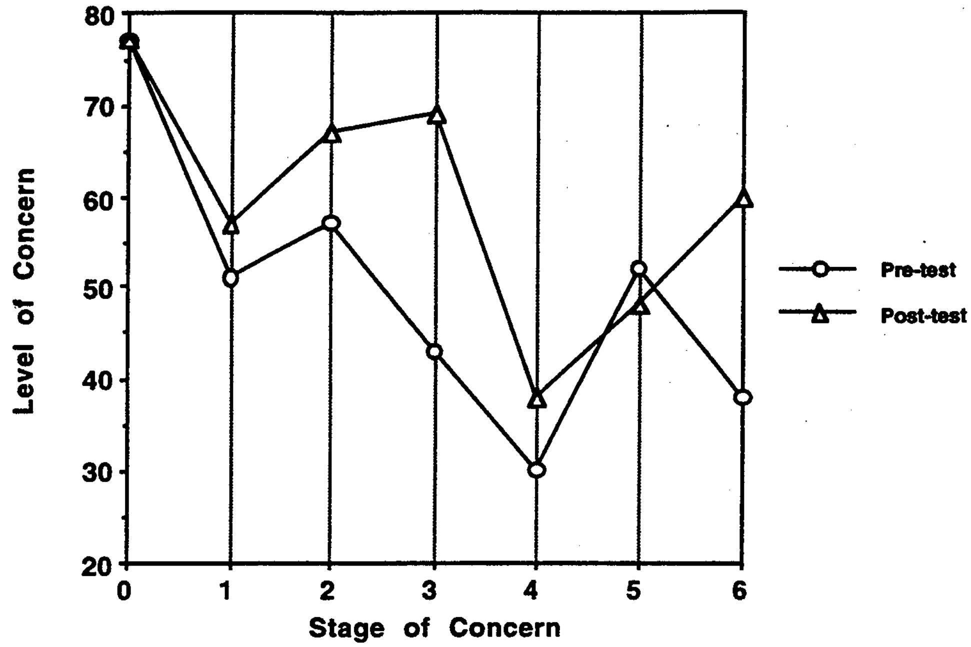
STEP Teacher 2650



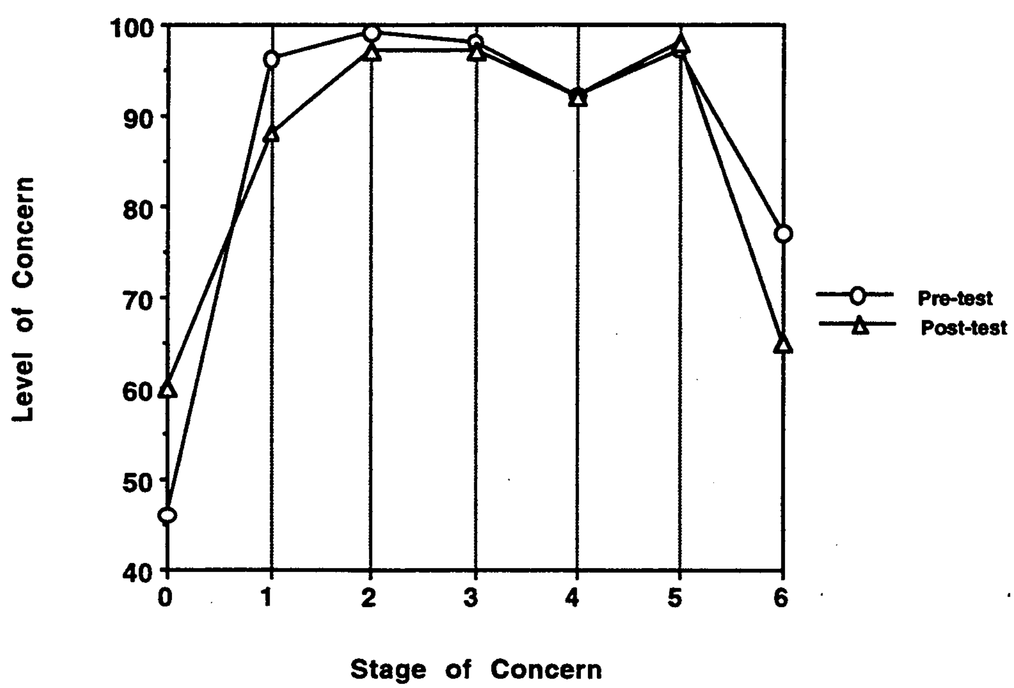
STEP Teacher 7790



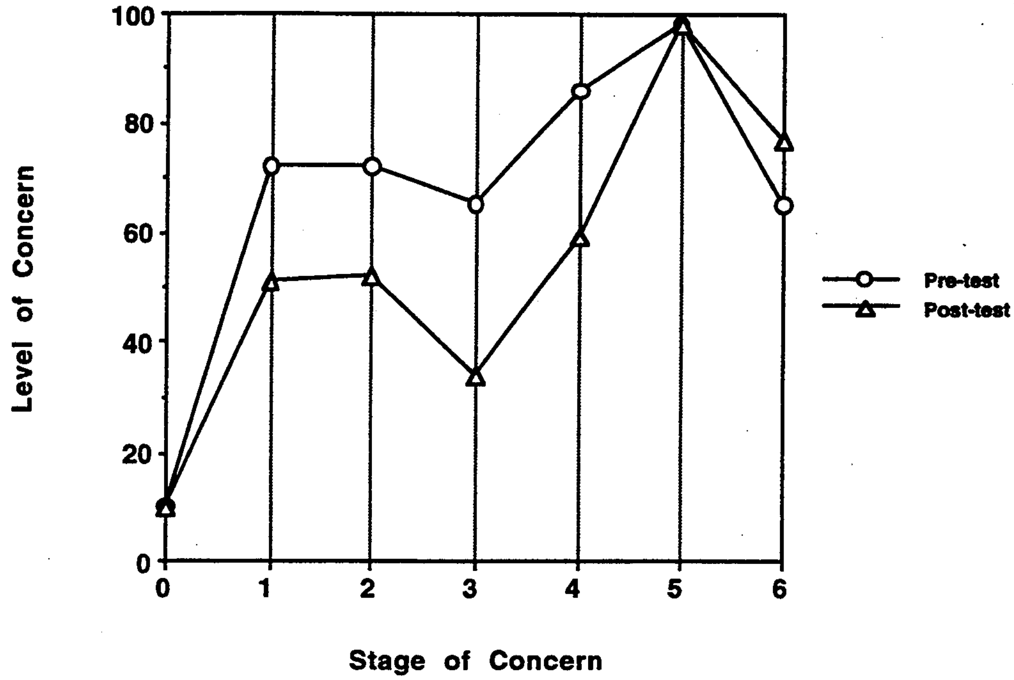
STEP Teacher 237816



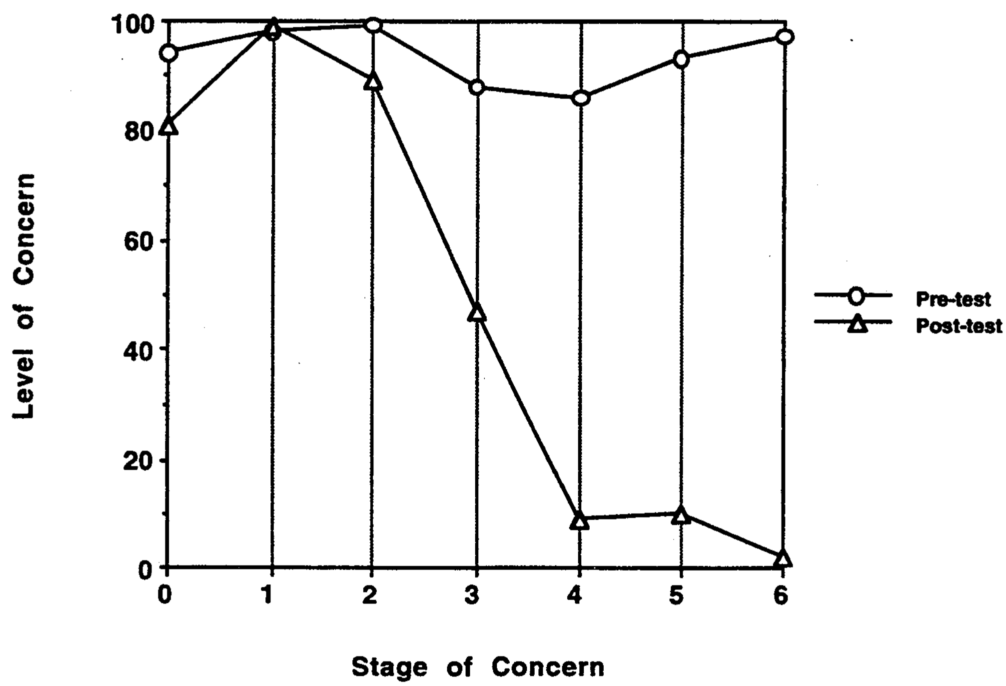
STEP Teacher 245482



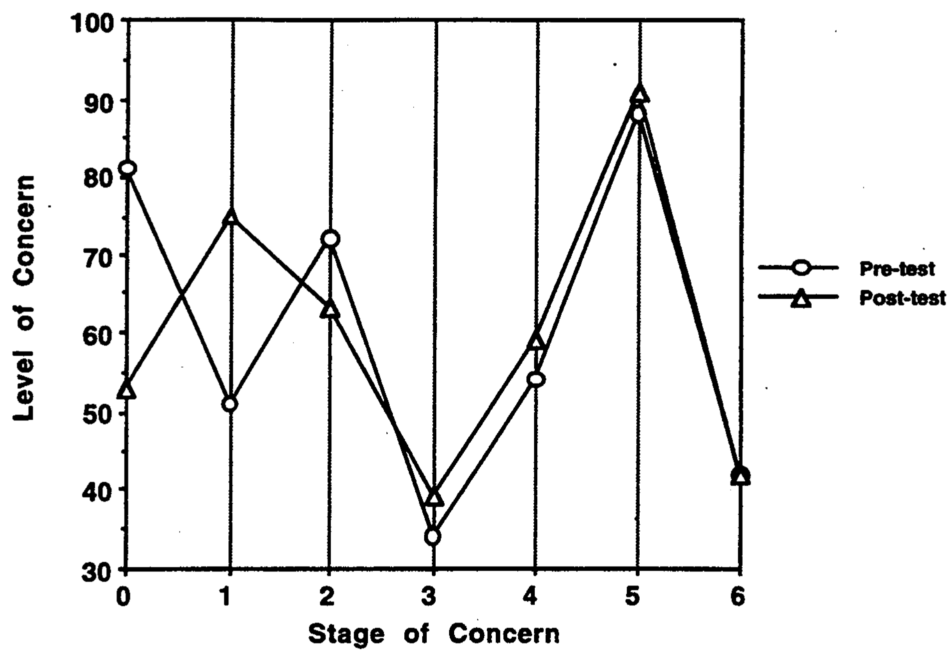
STEP Teacher 256482



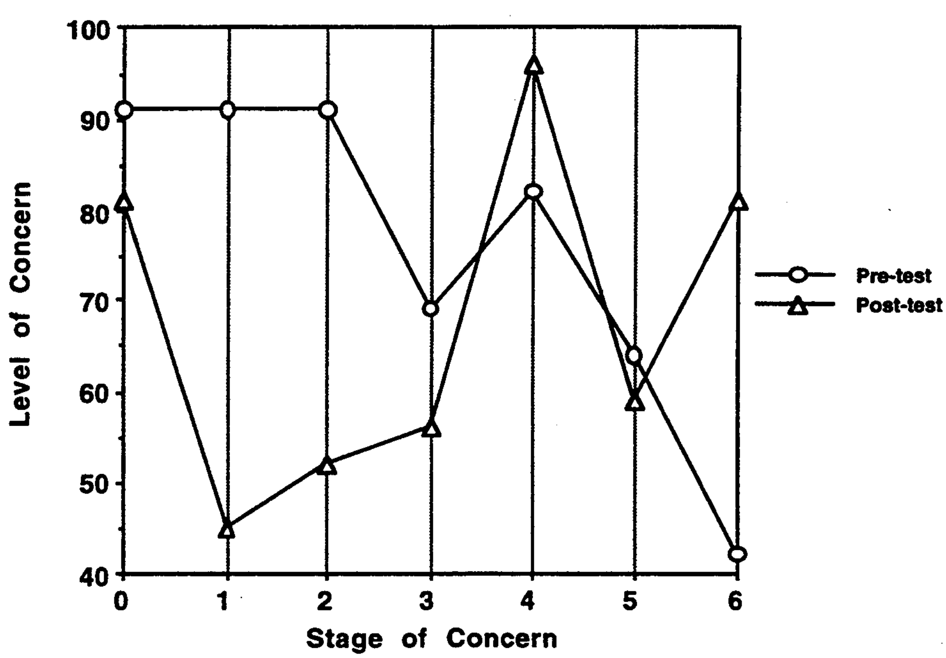
STEP Teacher 274285

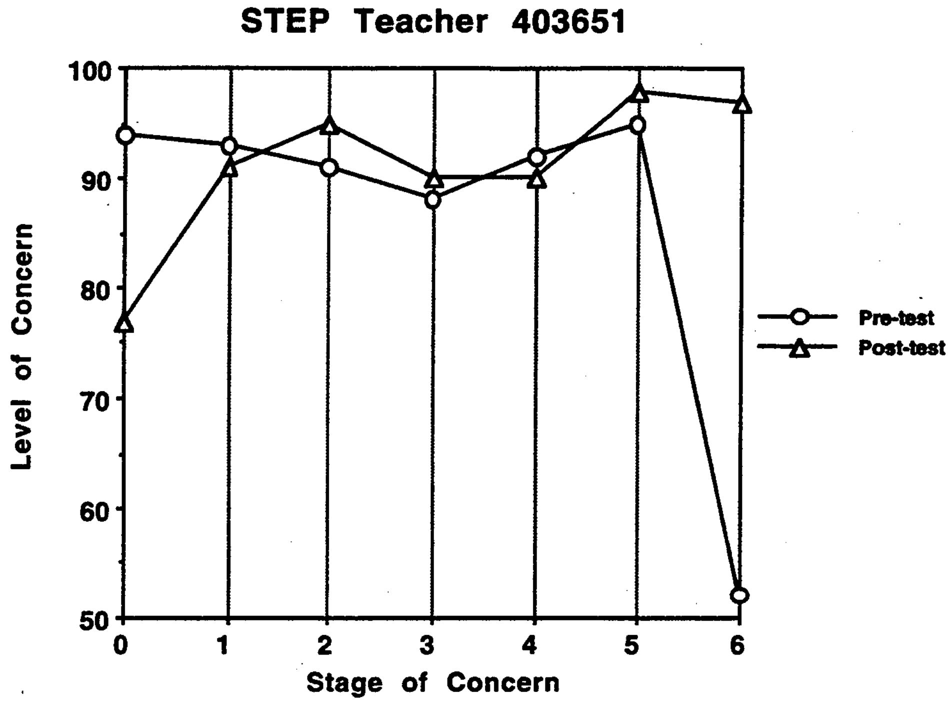


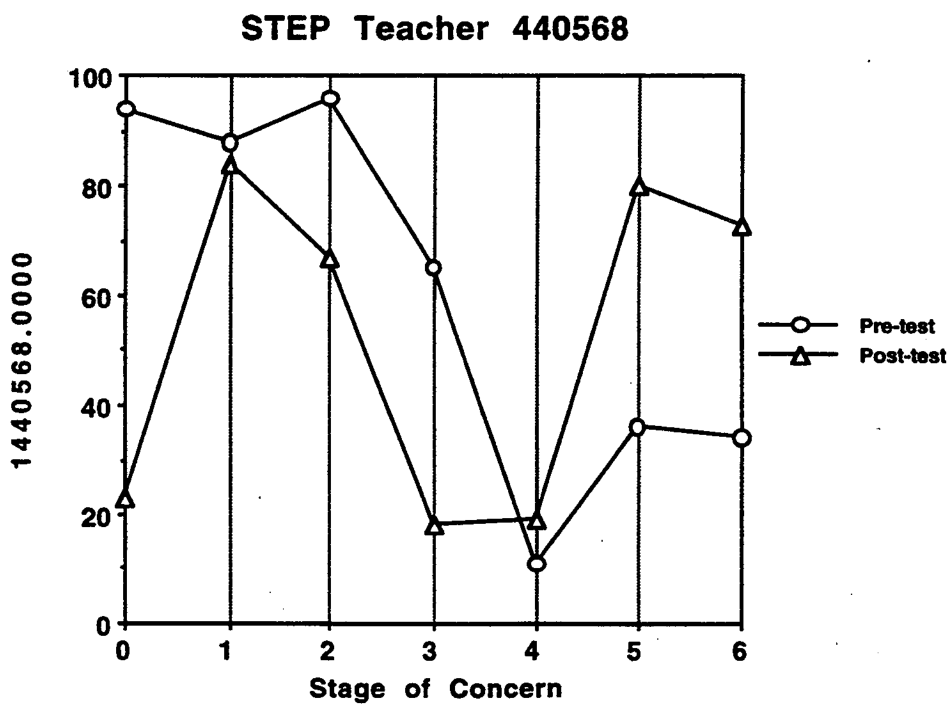
STEP Teacher 336370

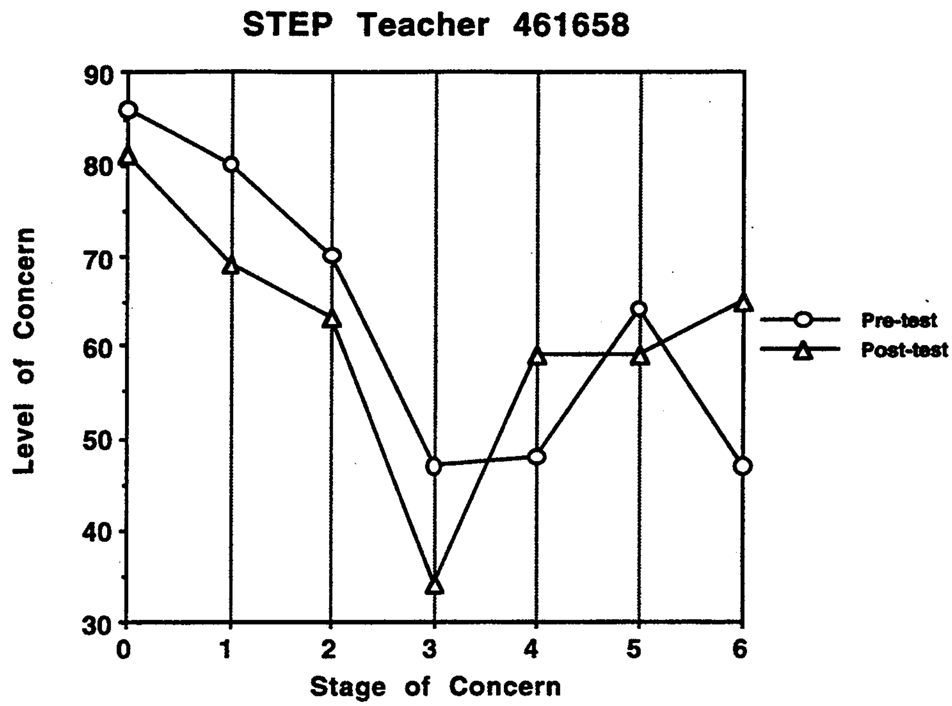


STEP Teacher 341221




STEP Teacher 403651
Level of Concern
100
90
80
70
60
50
0
1
2
3
4
5
6
Stage of Concern
Pre-test
Post-test


STEP Teacher 440568
1440568.0000
100
80
60
40
20
0
0
1
2
3
4
5
6
Stage of Concern
Pre-test
Post-test


STEP Teacher 461658
Level of Concern
Stage of Concern
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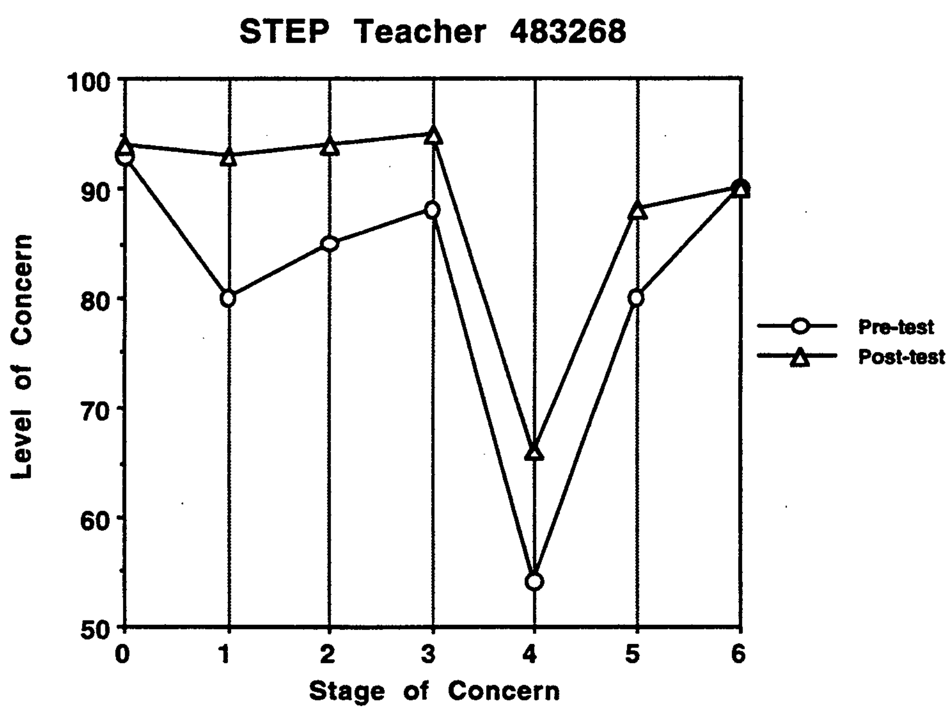
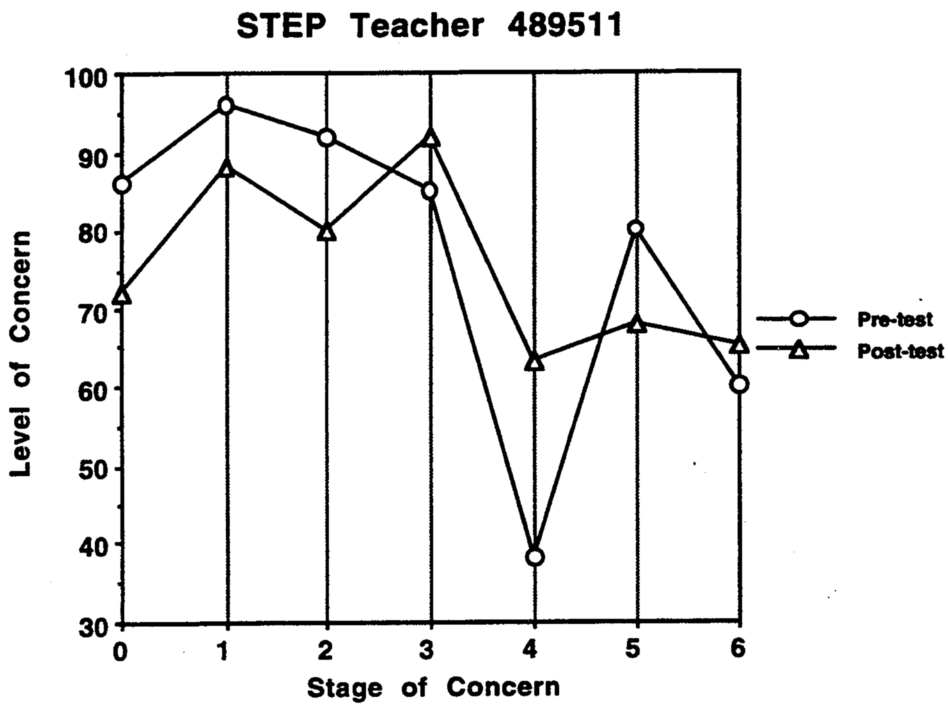
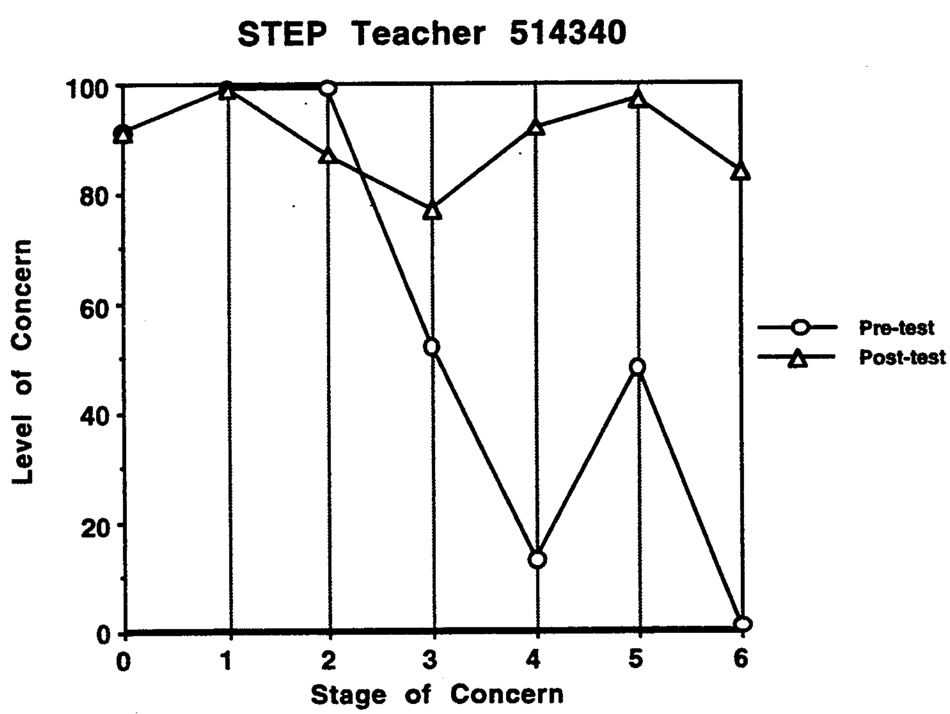
80
70
60
50
40
30
0
1
2
3
4
5
6
Pre-test
Post-test


STEP Teacher 483268
Level of Concern
Stage of Concern
100
90
80
70
60
50
0
1
2
3
4
5
6
Pre-test
Post-test


STEP Teacher 489511
100
90
80
70
60
50
40
30
0
1
2
3
4
5
6
Stage of Concern
Level of Concern
Pre-test
Post-test


STEP Teacher 514340
100
80
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40
20
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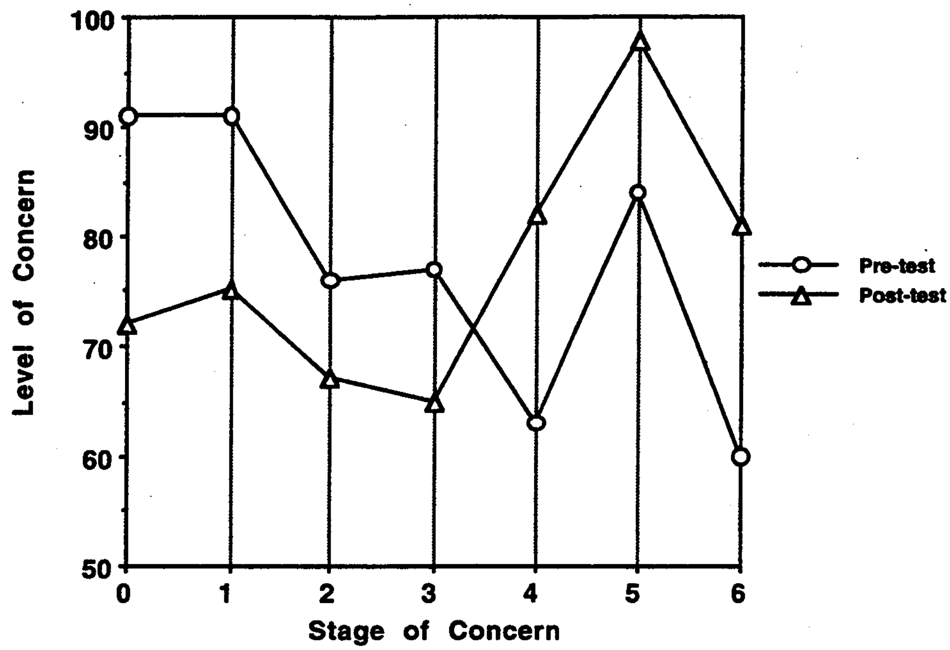
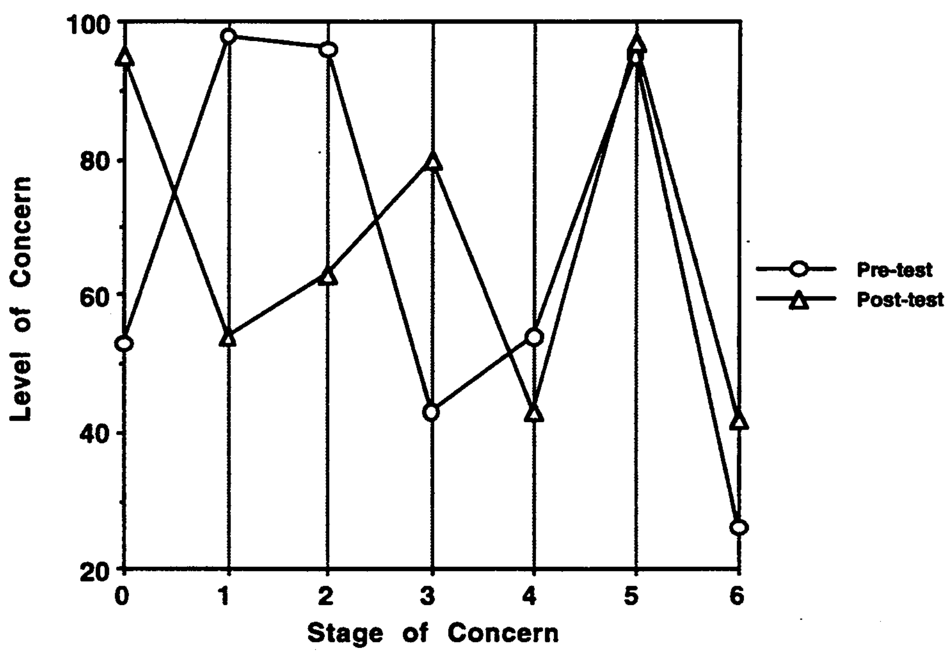
0
1
2
3
4
5
6
Stage of Concern
Level of Concern
Pre-test
Post-test

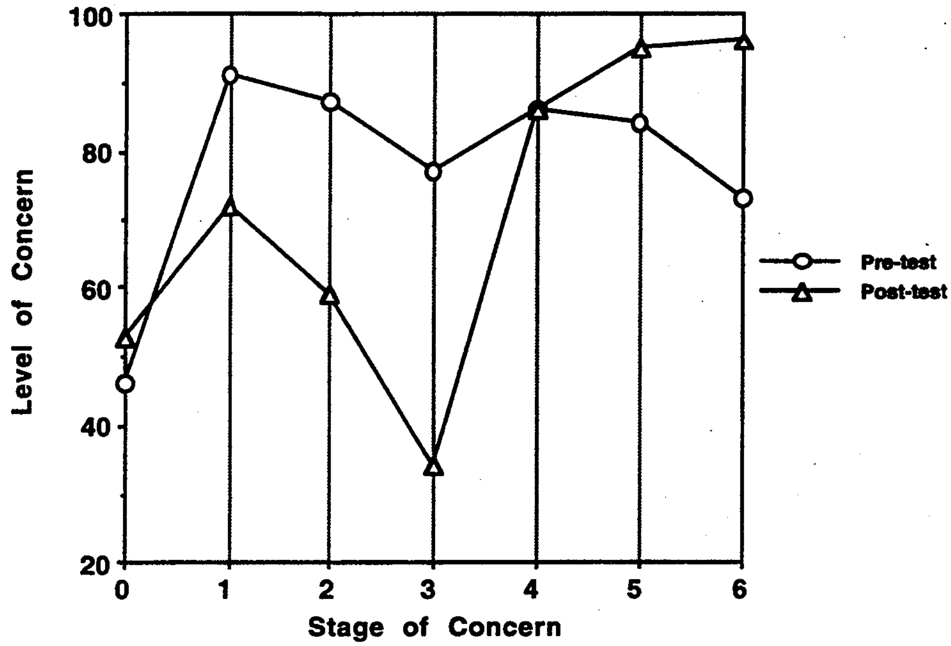
STEP Teacher 521513



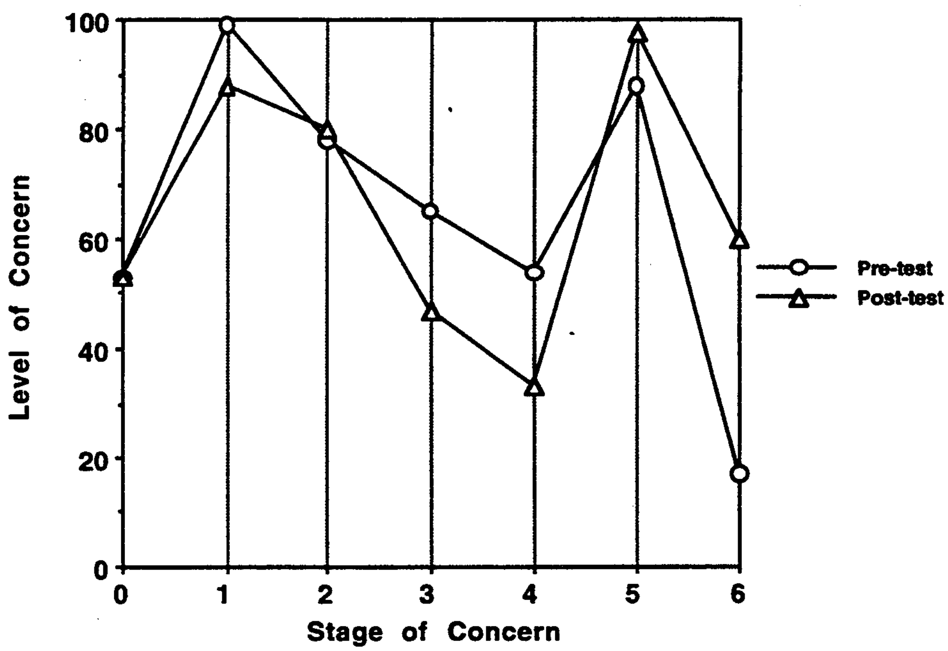
STEP Teacher 562303



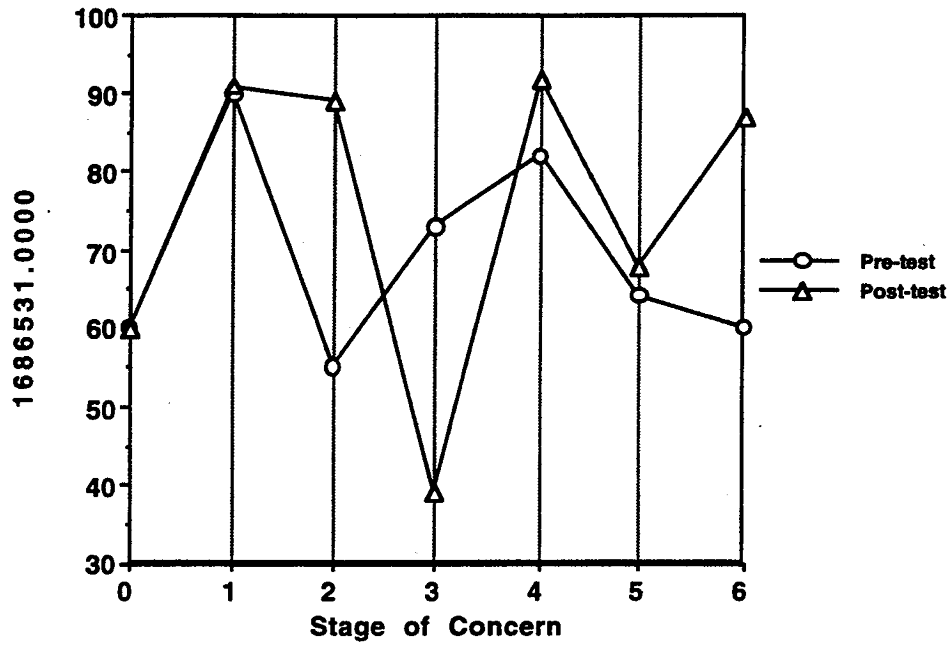
STEP Teacher 612371



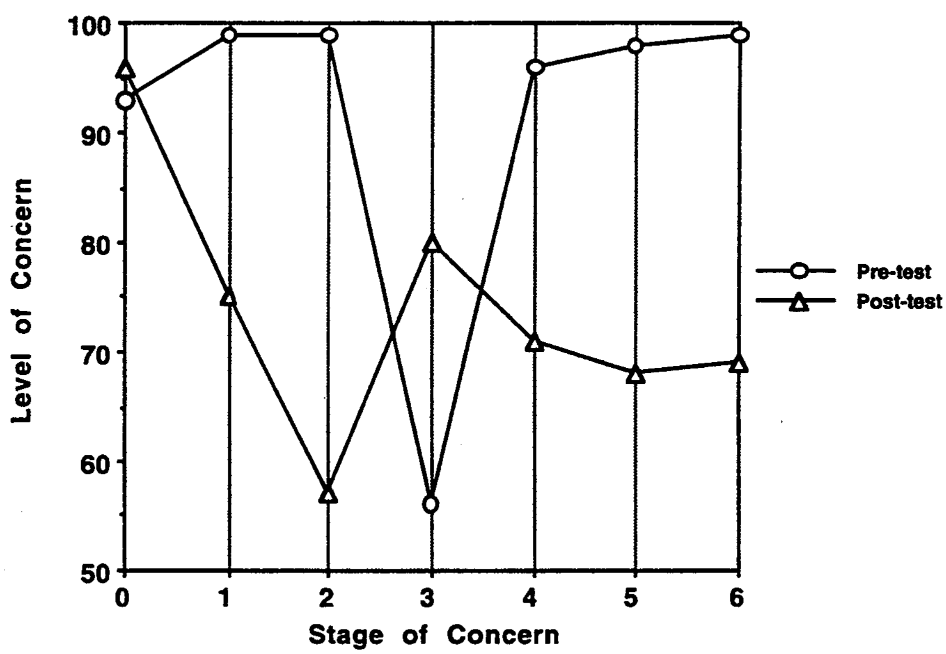
STEP Teacher 666084



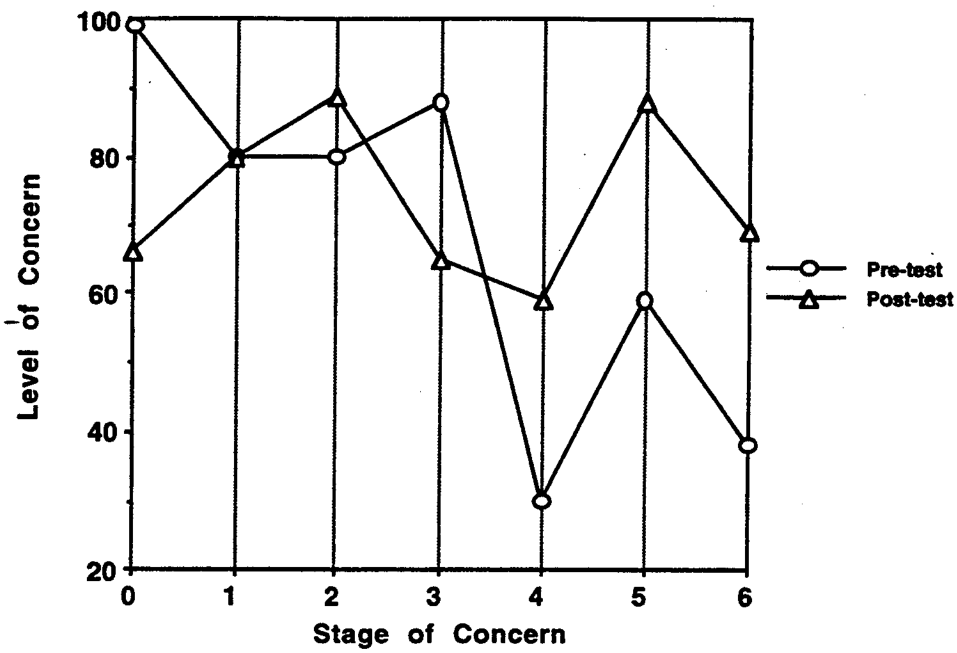
STEP Teacher 686531



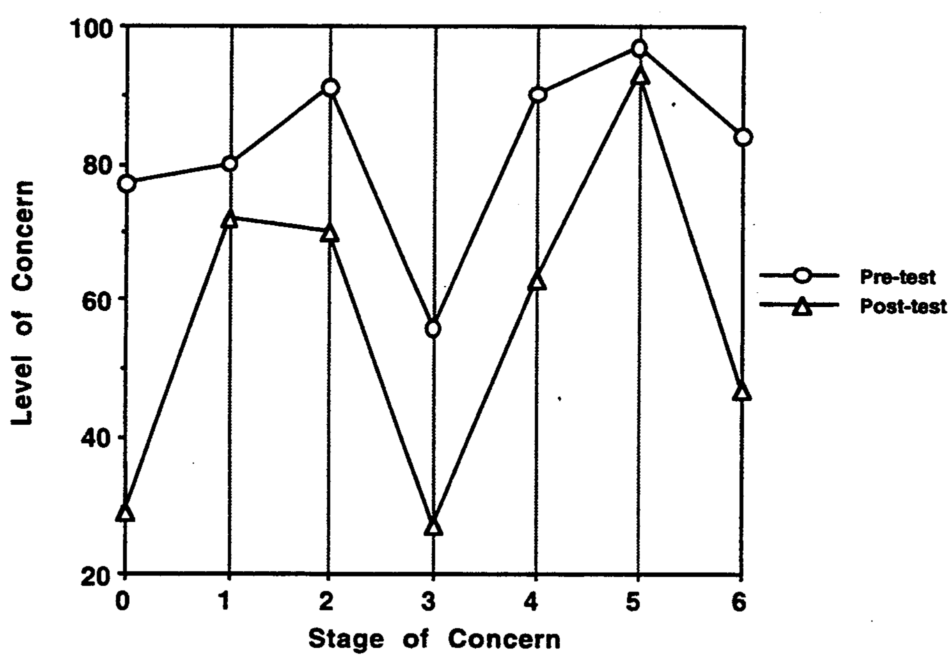
STEP Teacher 722123



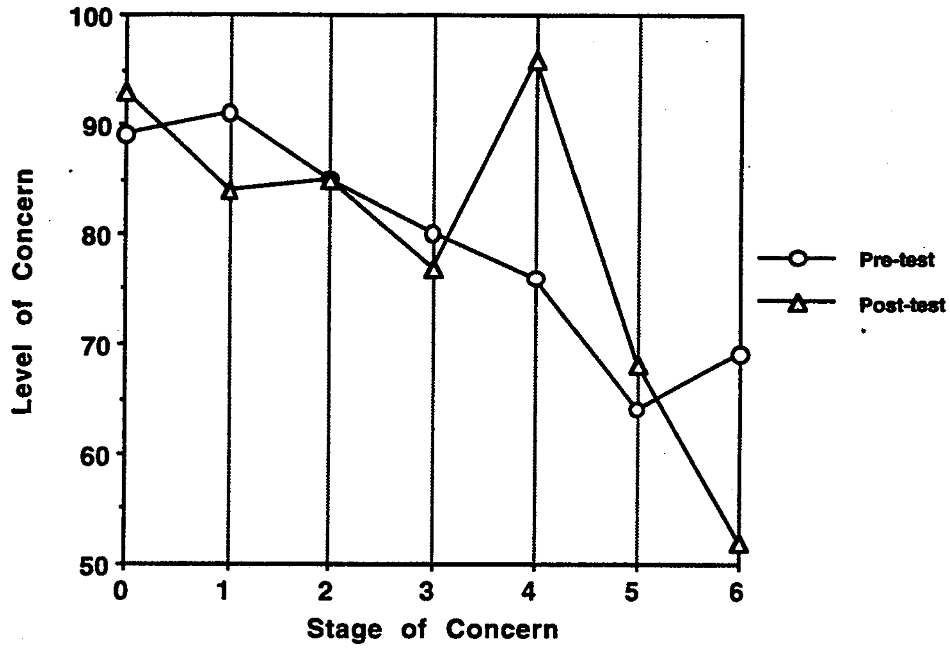
STEP Teacher 728648



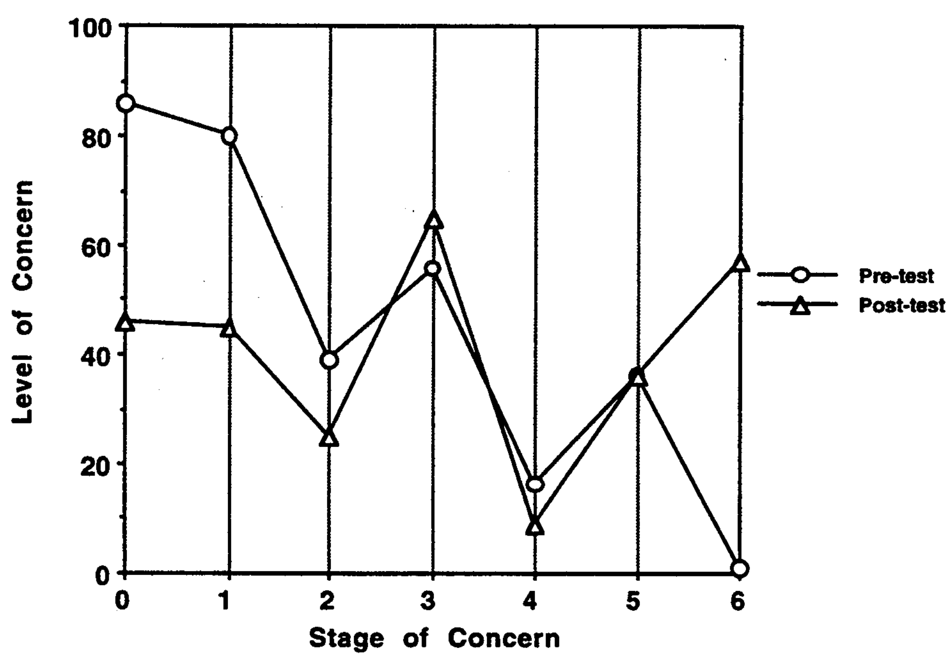
STEP Teacher 787964

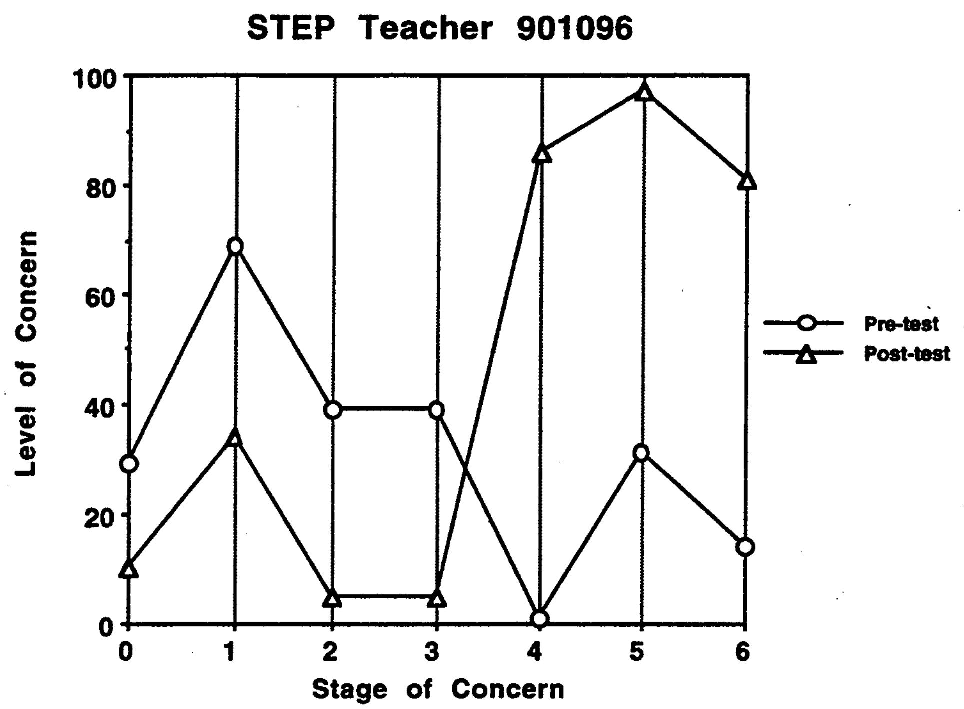


STEP Teacher 894115



STEP Teacher 899218



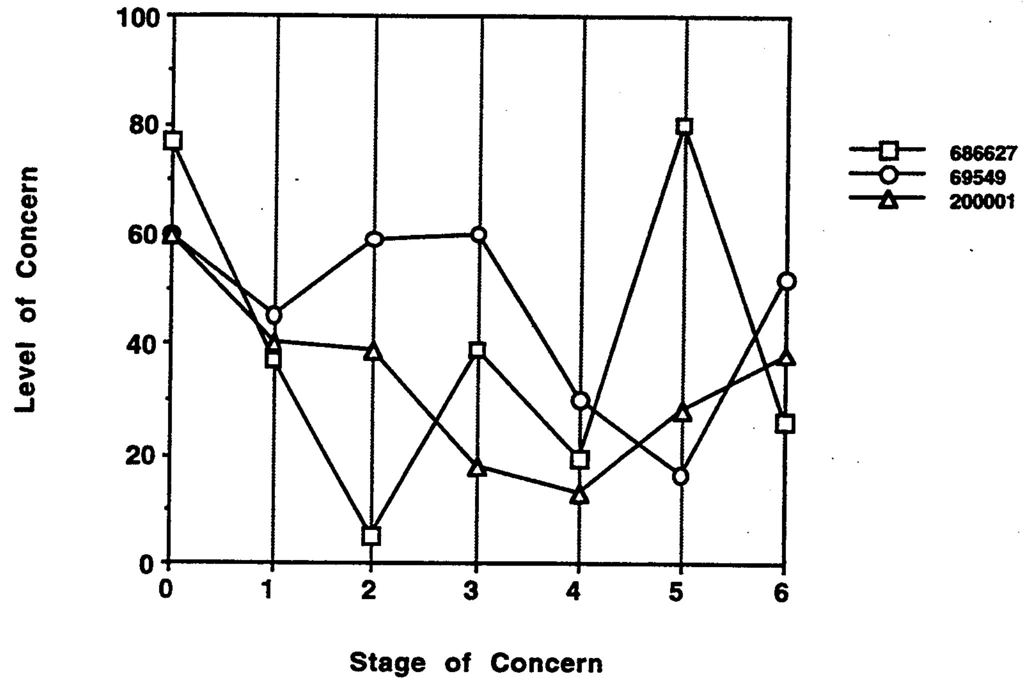

STEP Teacher 901096
Level of Concern
100
80
60
40
20
0
0
1
2
3
4
5
6
Stage of Concern
Pre-test
Post-test

APPENDIX G

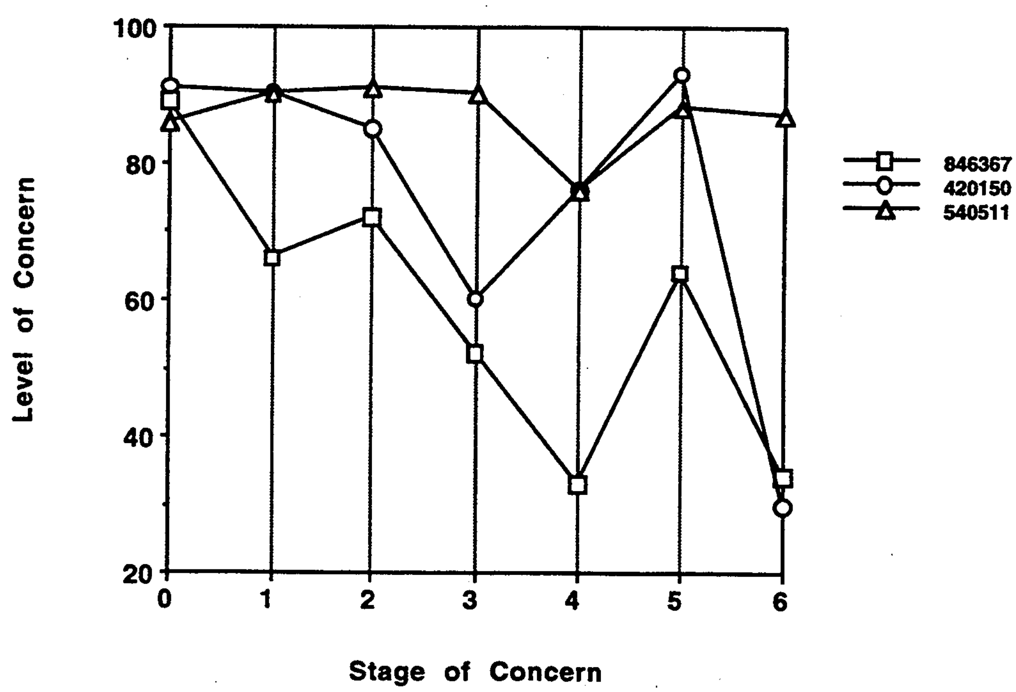
GRAPHS OF THE LEVELS OF CONCERN FOR
THE NO WORKSHOP TEACHERS AND THE PAST PARTICIPANTS
OF THE NASA-KSC TEACHERS WORKSHOPS

NO WORKSHOP
NEWMAST 1994
STEP 1994
NEWEST 1993
NEWEST 1992
NEWMAST 1991
NEWEST 1990
NEWMAST 1989
NEWMAST 1988
NEWEST 1988
NEWMAST 1987
NEWMAST 1986
NEWMAST 1985
NEWMAST 1984

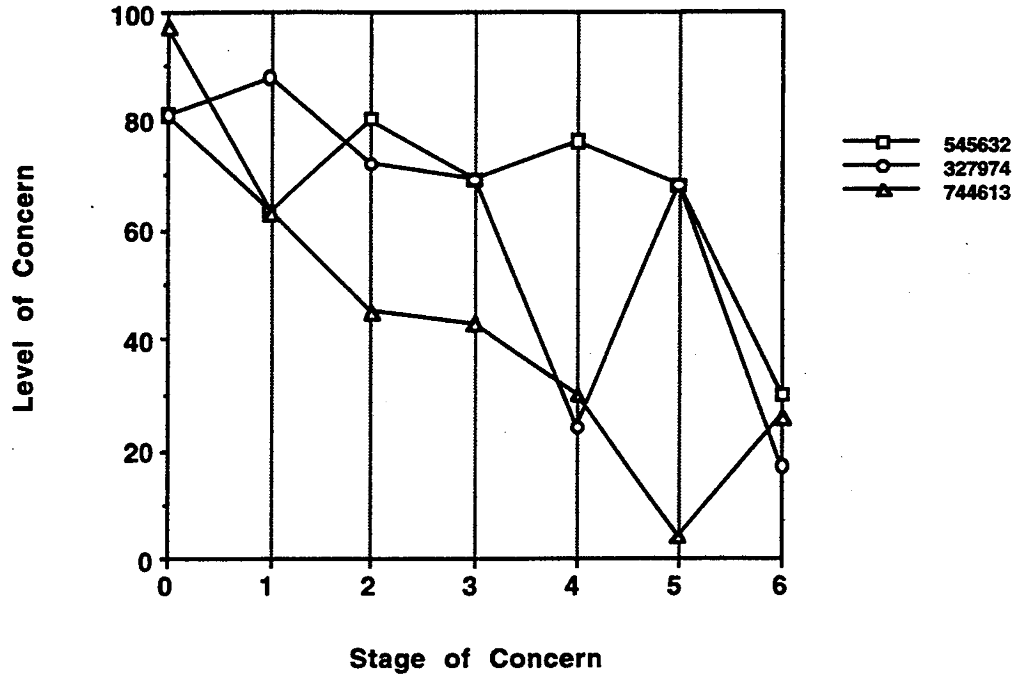
NO WORKSHOP



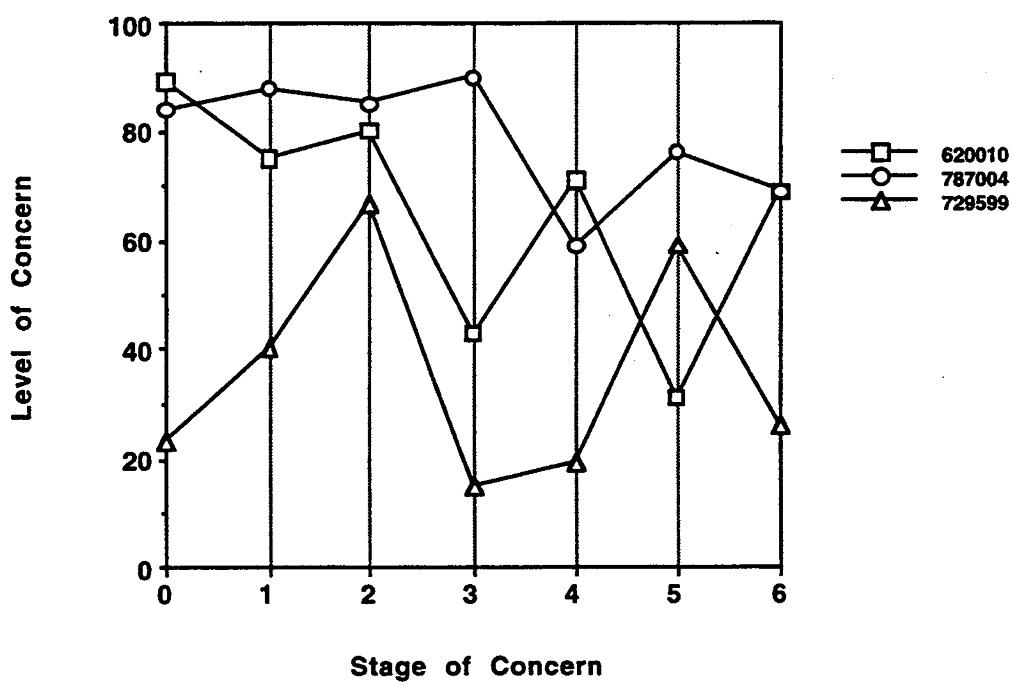
NO WORKSHOP

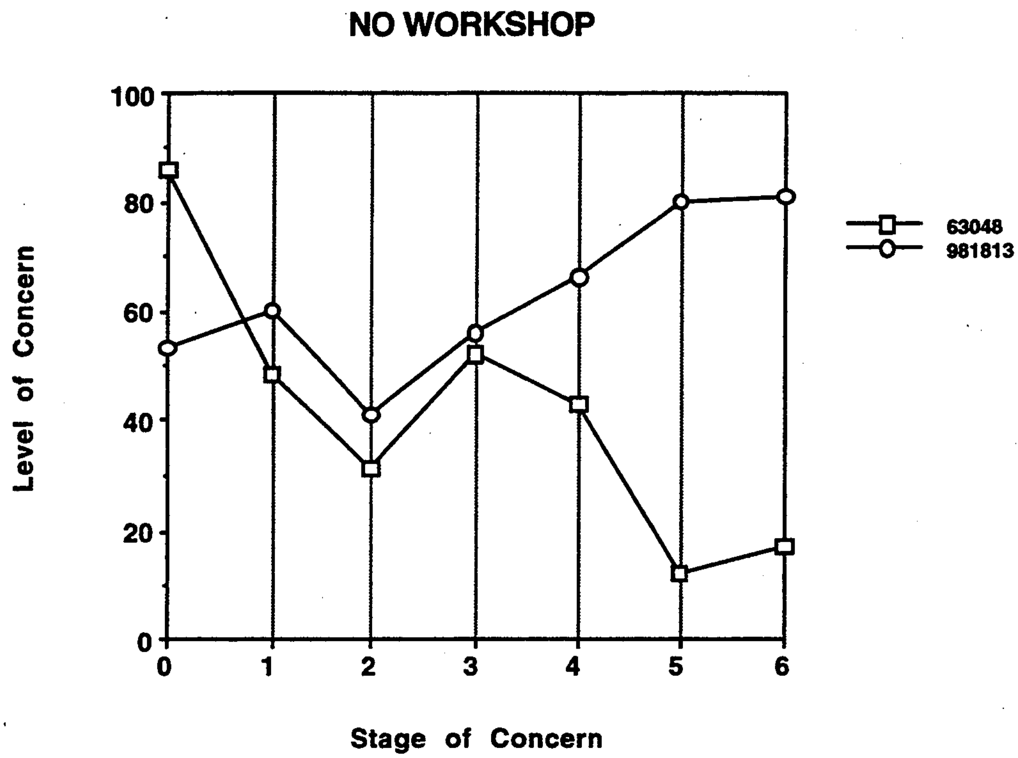


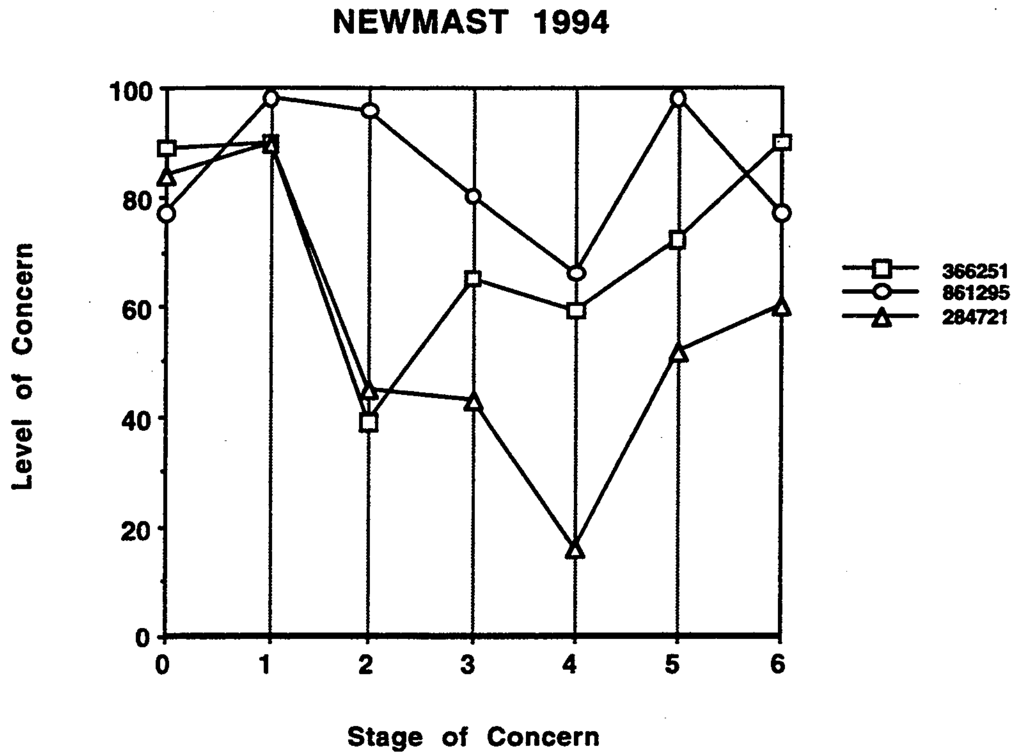
NO WORKSHOP

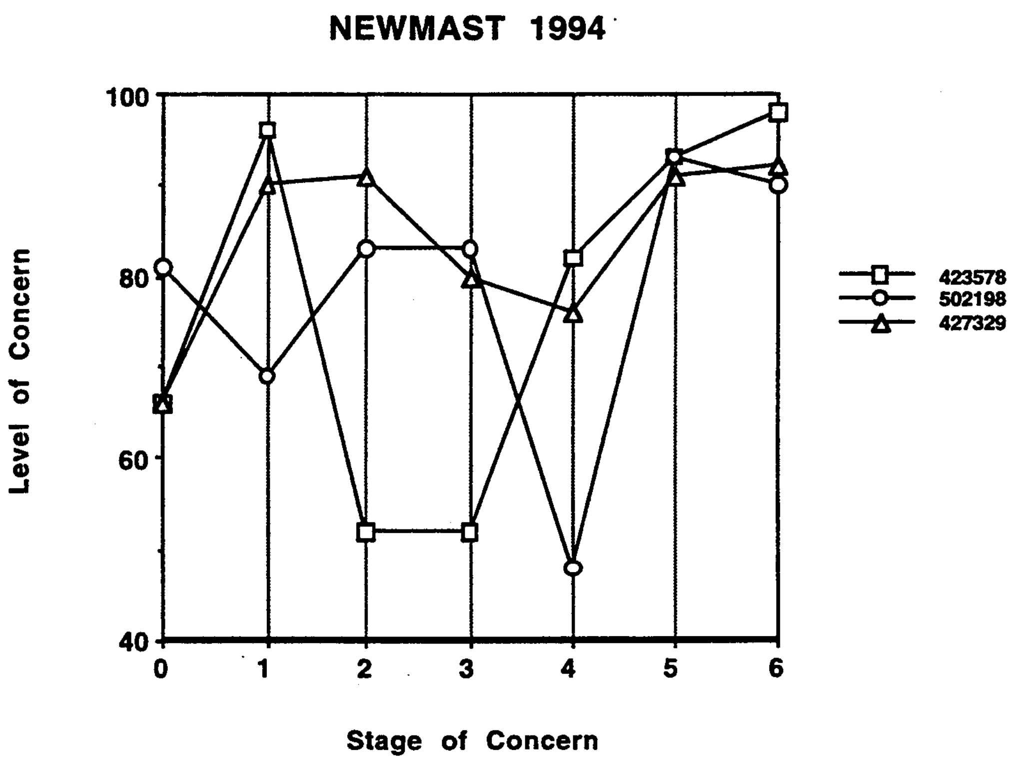


NO WORKSHOP

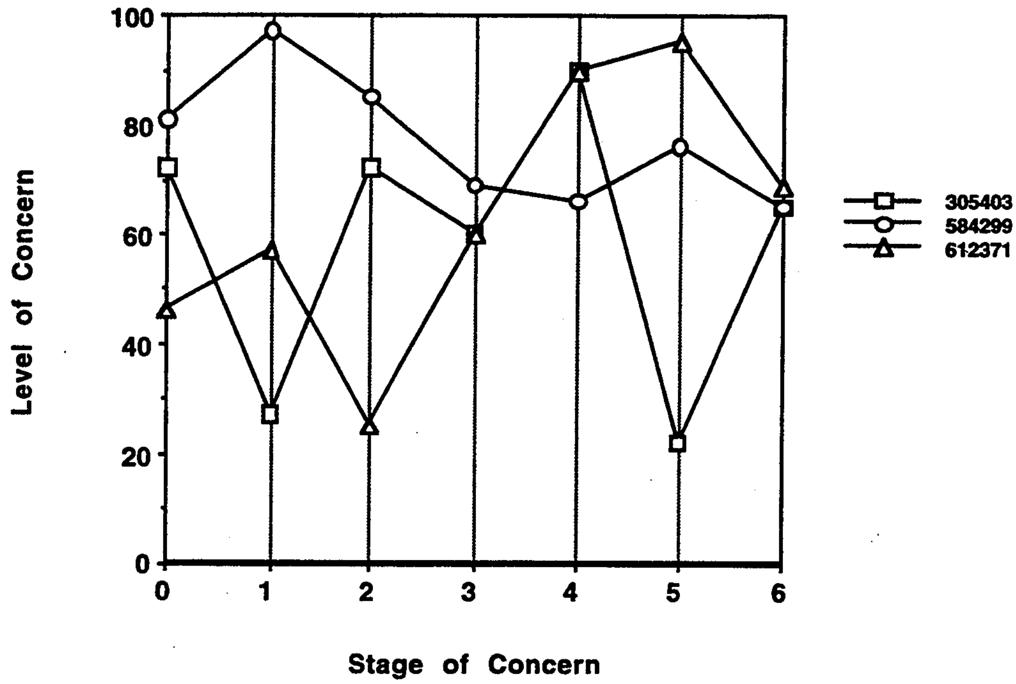



NO WORKSHOP
100
80
60
40
20
0
Level of Concern
0
1
2
3
4
5
6
Stage of Concern
63048
981813

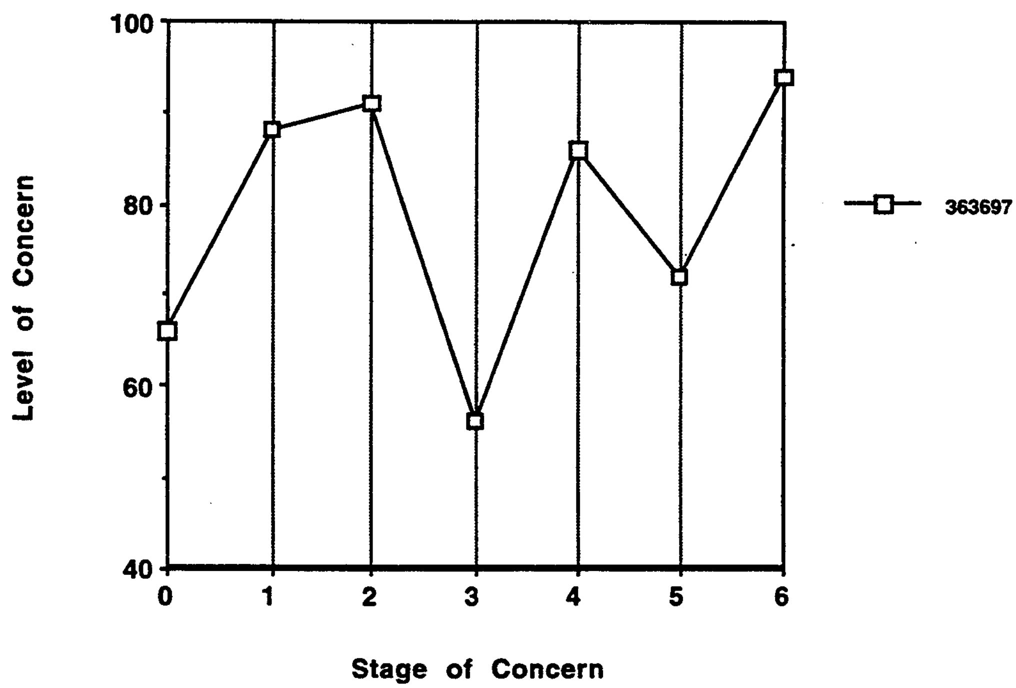

NEWMAST 1994
Level of Concern
Stage of Concern
366251
861295
284721

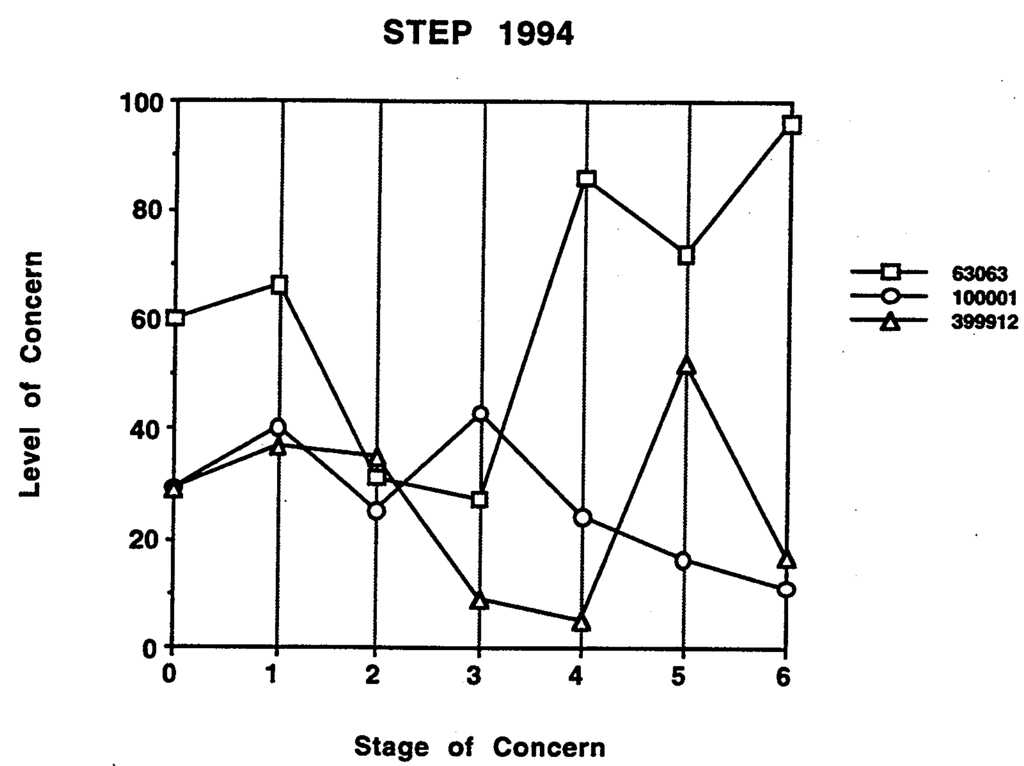

NEWMAST 1994
Level of Concern
Stage of Concern
423578
502198
427329

NEWMAST 1994



NEWMAST 1994




STEP 1994
Level of Concern
Stage of Concern
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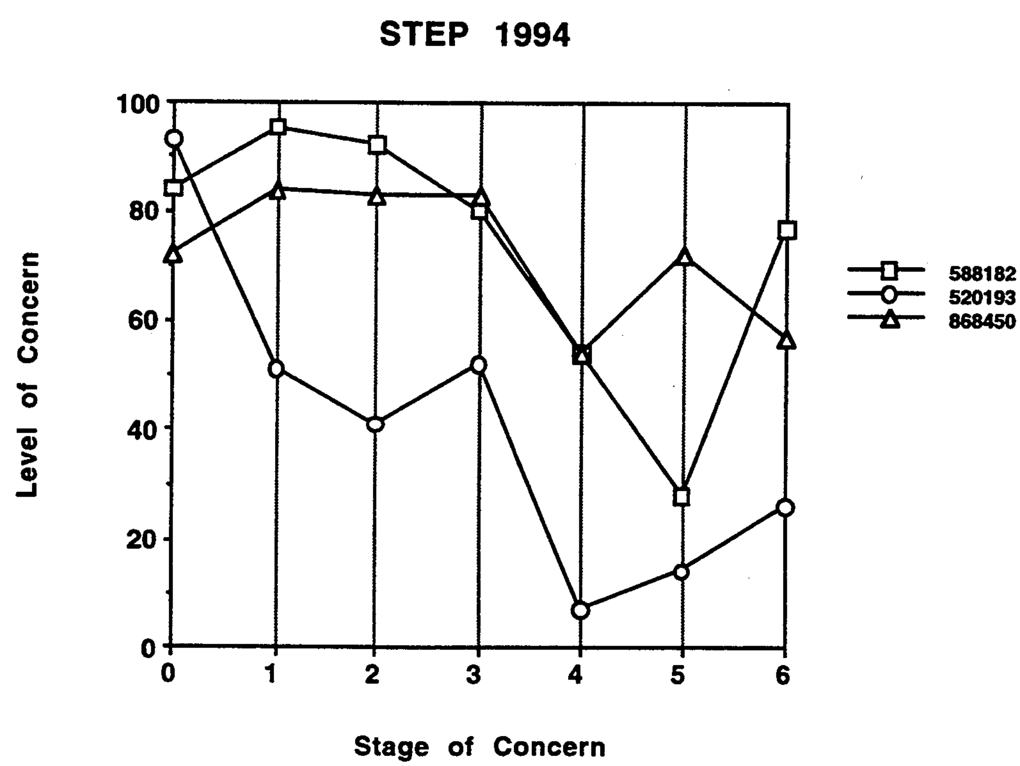
20
40
60
80
100
0
1
2
3
4
5
6
63063
100001
399912


STEP 1994
Level of Concern
Stage of Concern
0
20
40
60
80
100
0
1
2
3
4
5
6
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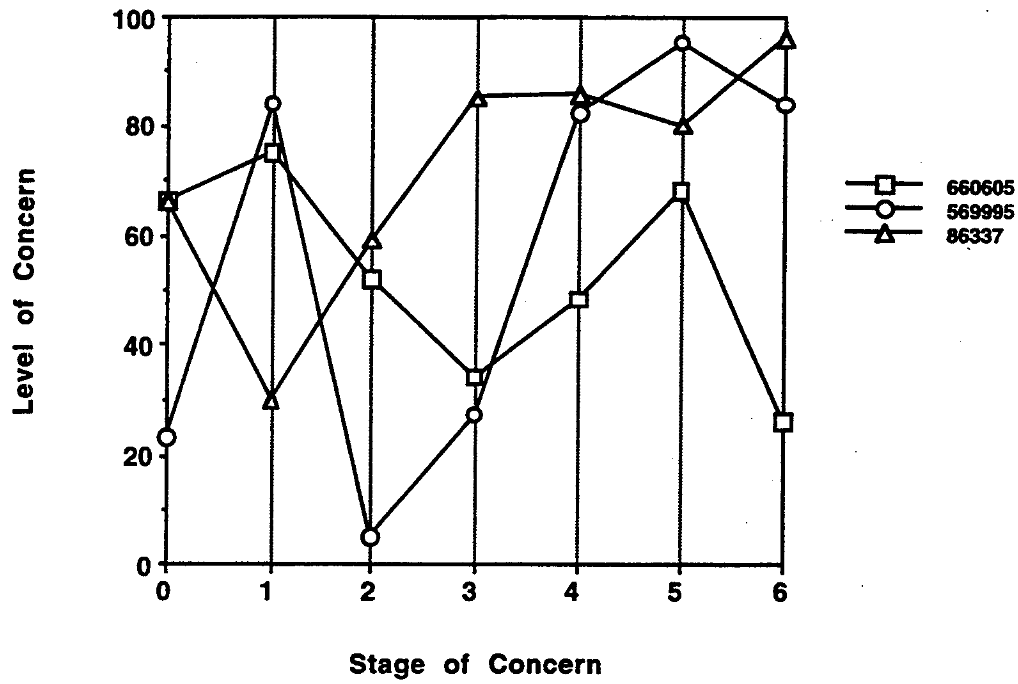
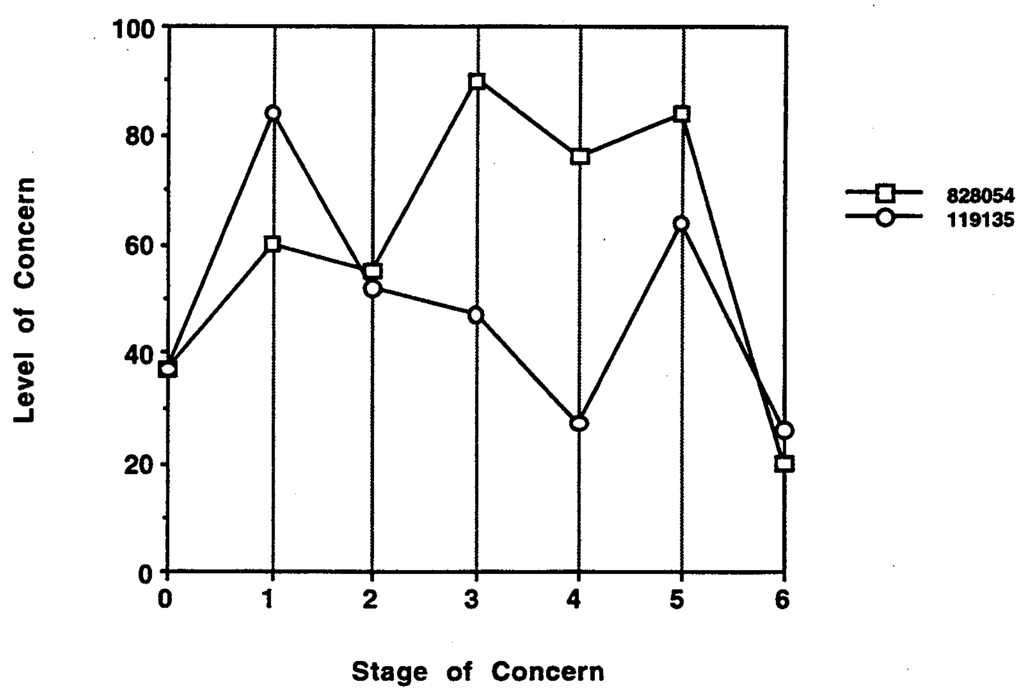
520193
868450

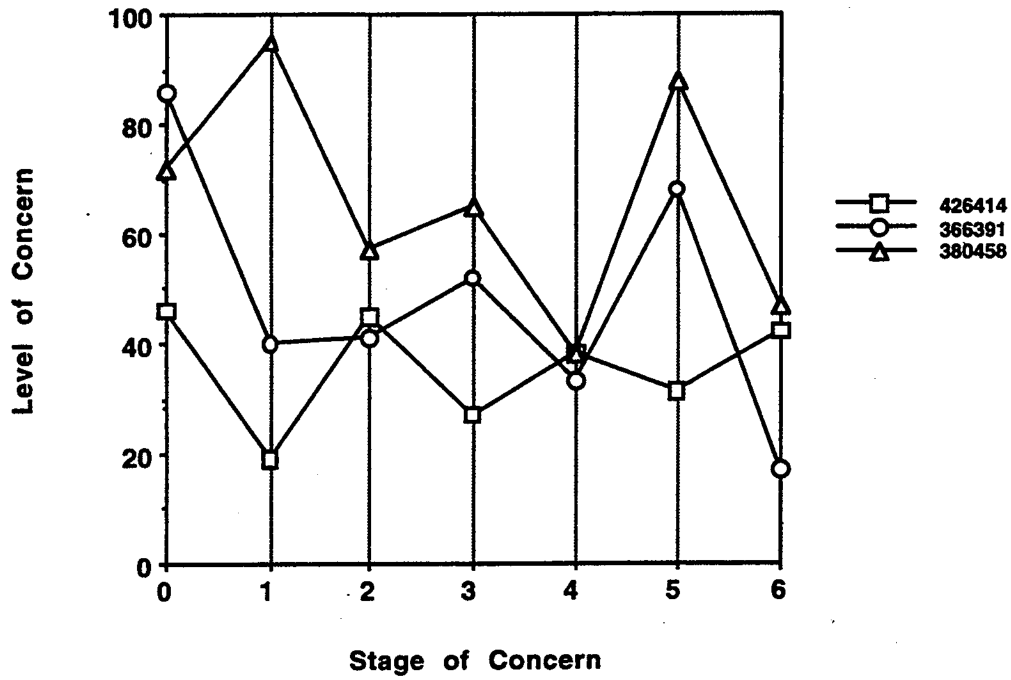
STEP 1994



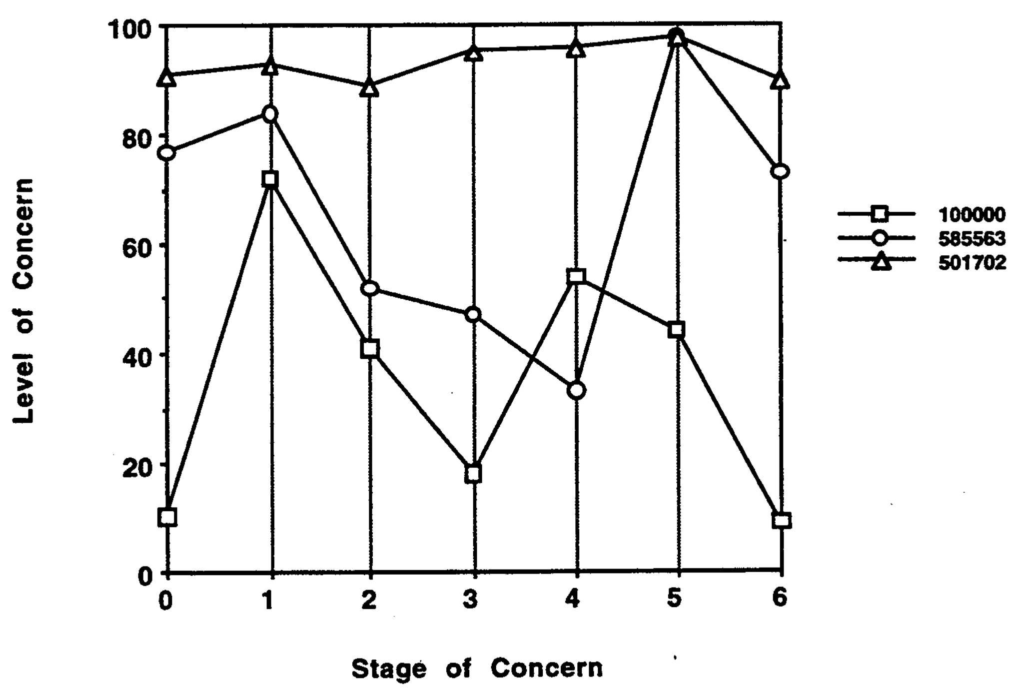
STEP 1994

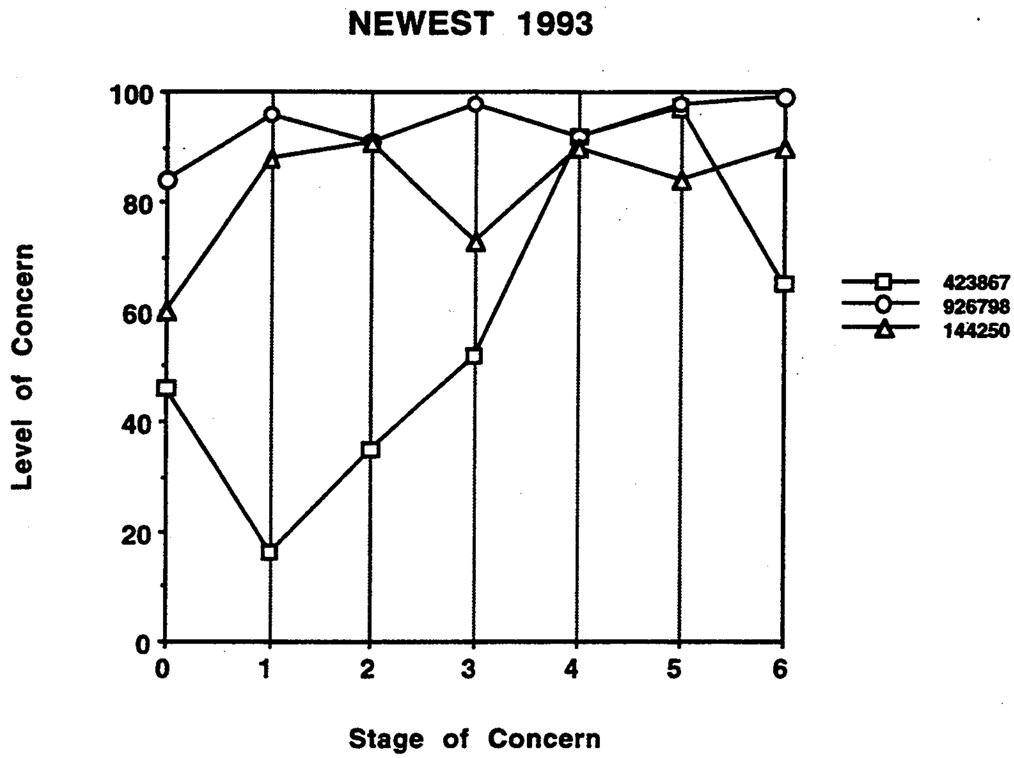


NEWEST 1993

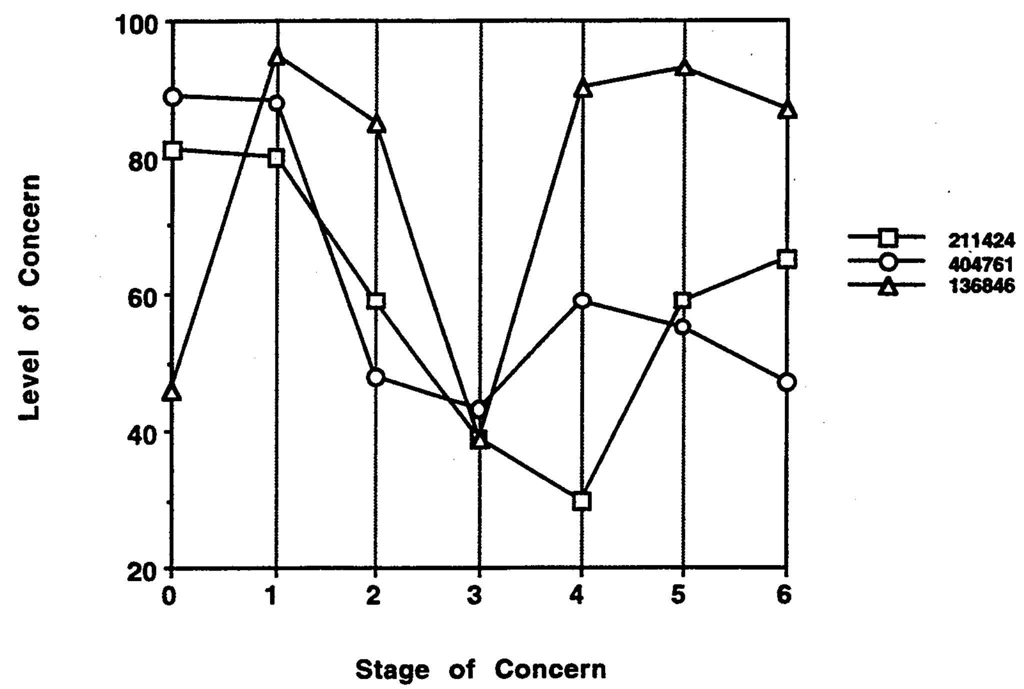


NEWEST 1993

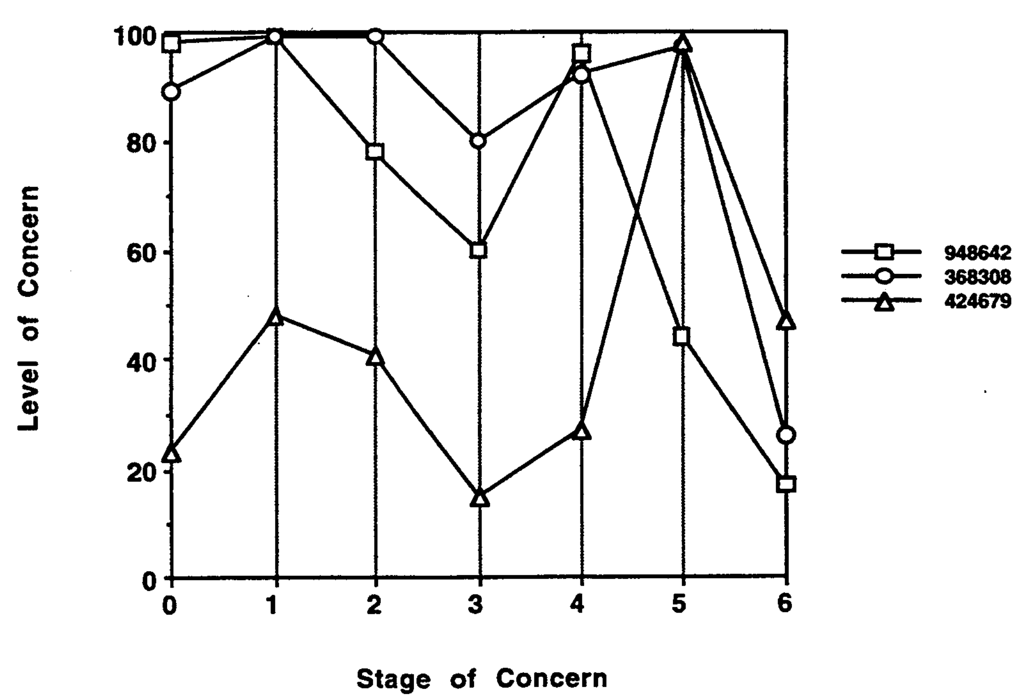



NEWEST 1993
Level of Concern
100
80
60
40
20
0
0
1
2
3
4
5
6
Stage of Concern
423867
926798
144250

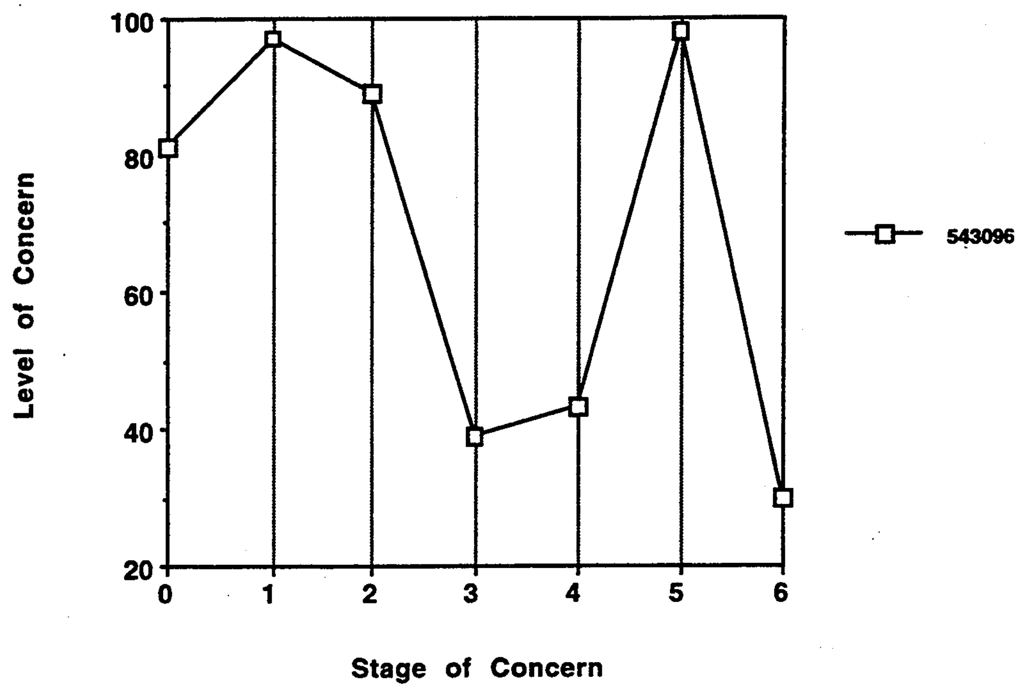
NEWEST 1992



NEWEST 1992



NEWEST 1992


100
80
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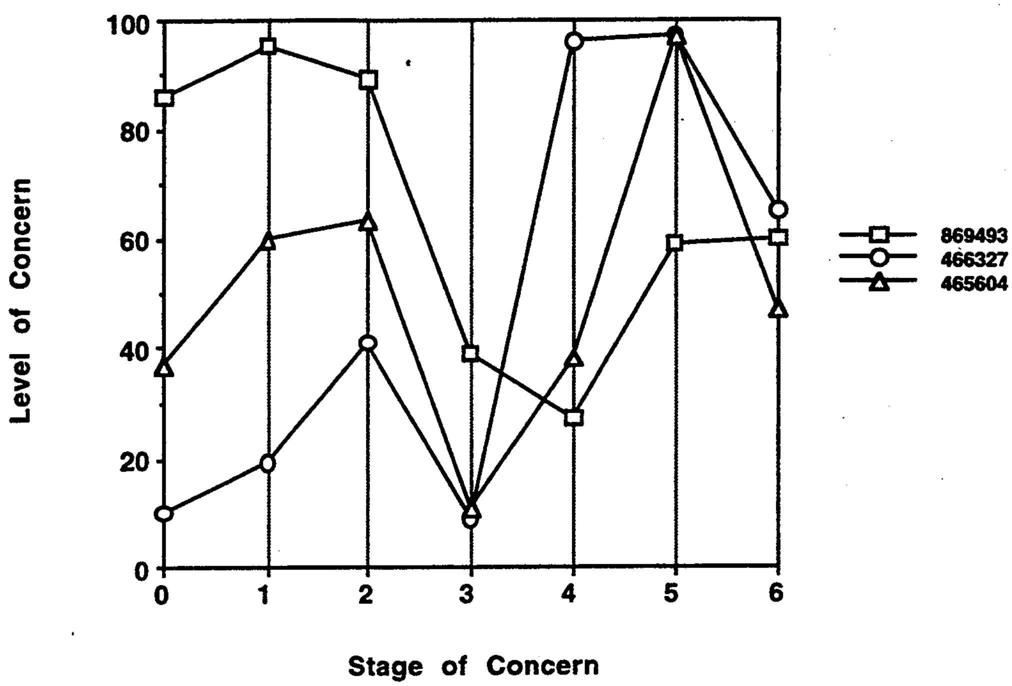
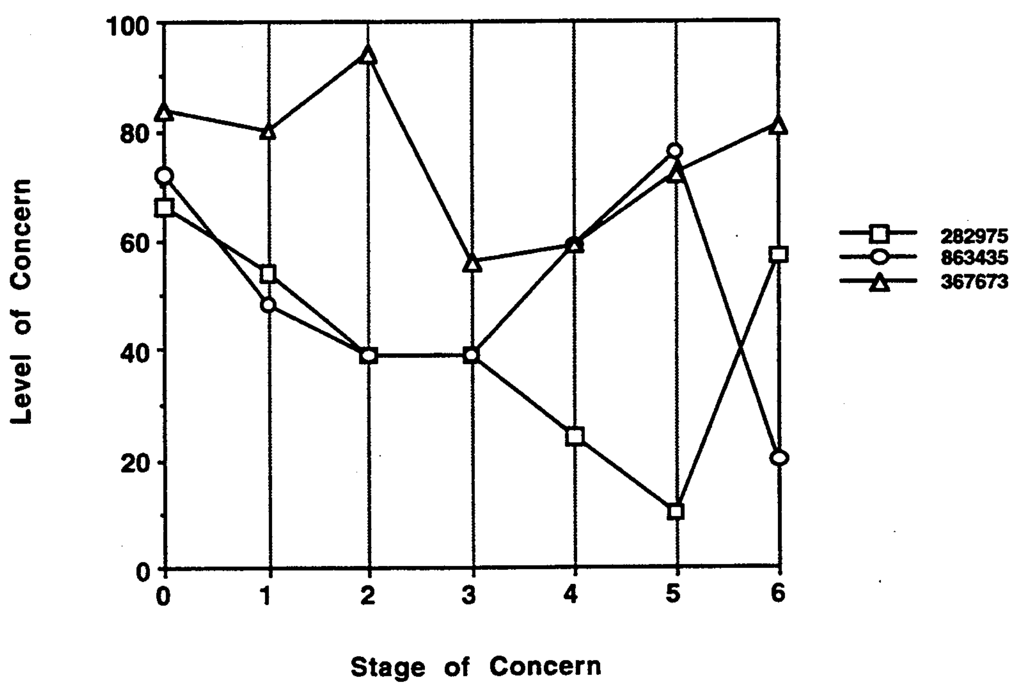
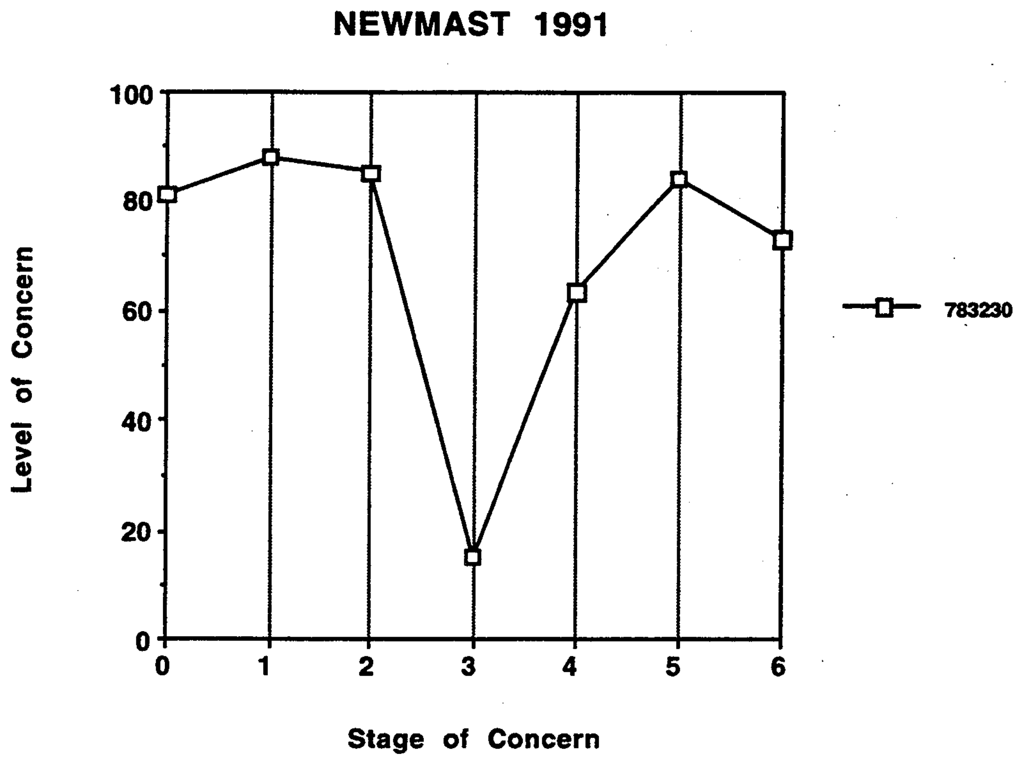
20
0
1
2
3
4
5
6
Level of Concern
Stage of Concern
543096

NEWMAST 1991



NEWMAST 1991




NEWMAST 1991
100
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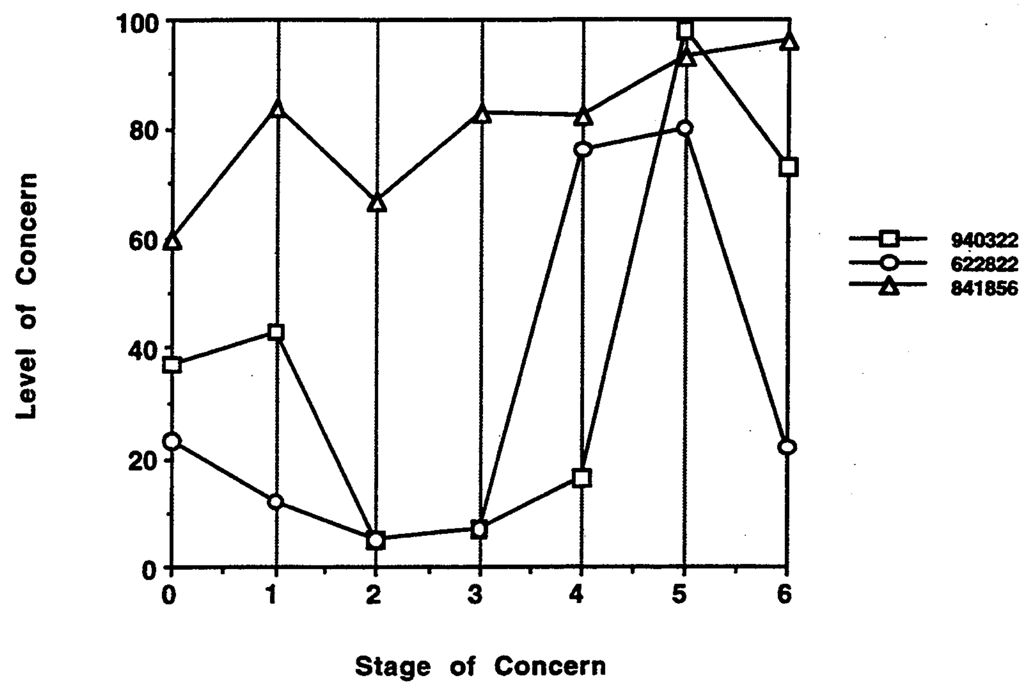
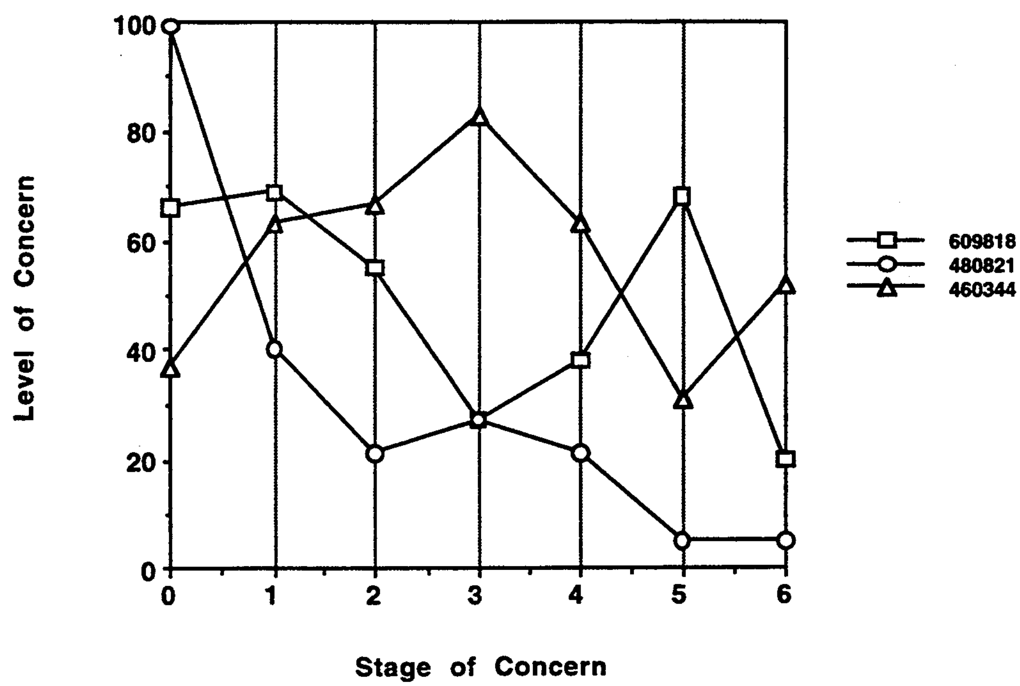
1
2
3
4
5
6
Level of Concern
Stage of Concern
783230

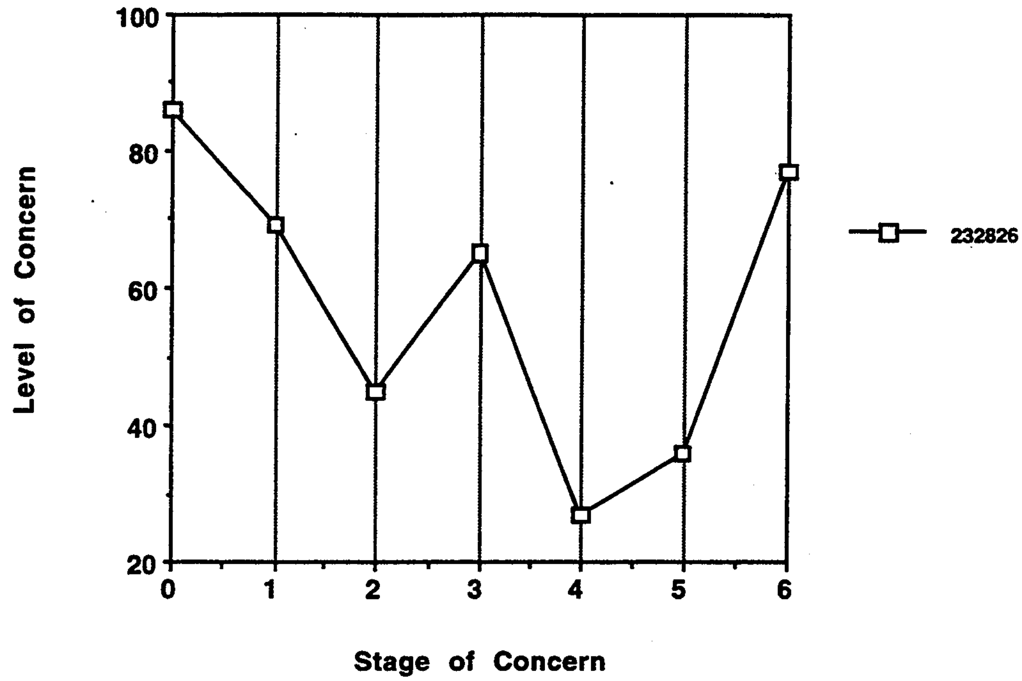
NEWEST 1990



NEWEST 1990

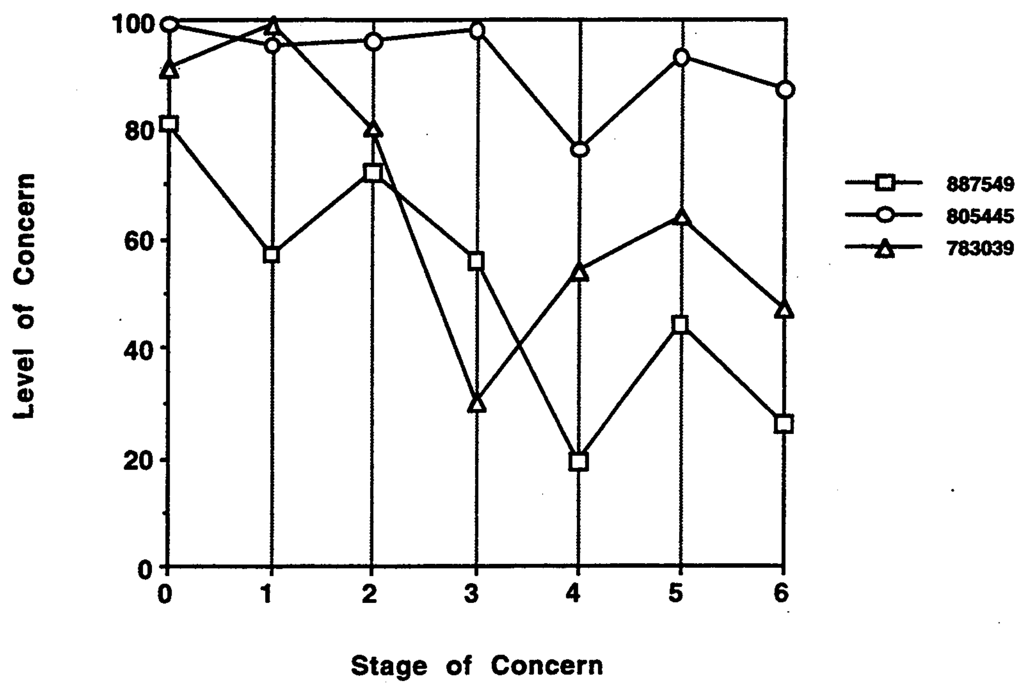


NEWEST 1990

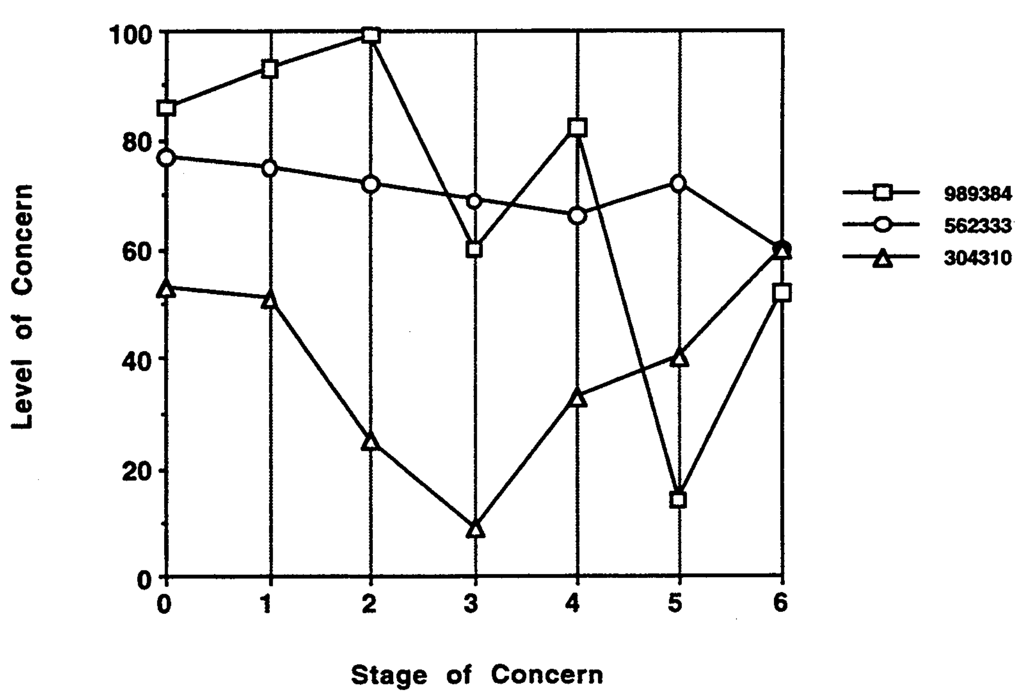


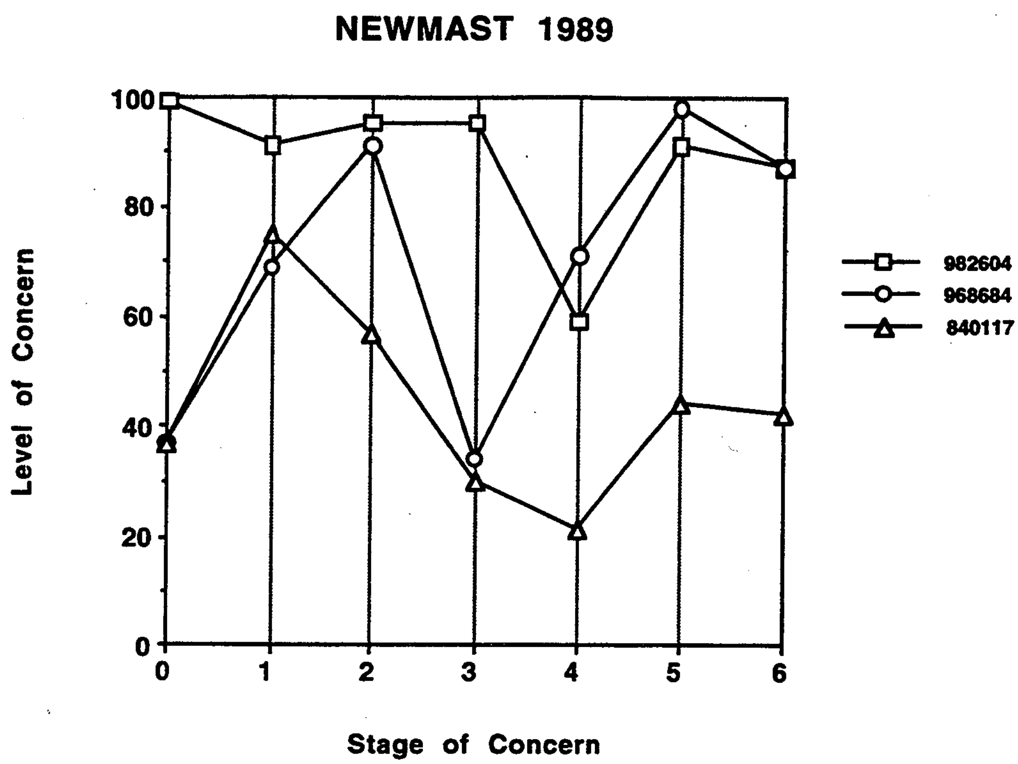
100
80
60
40
20
Level of Concern
0
1
2
3
4
5
6
Stage of Concern
232826

NEWMAST 1989

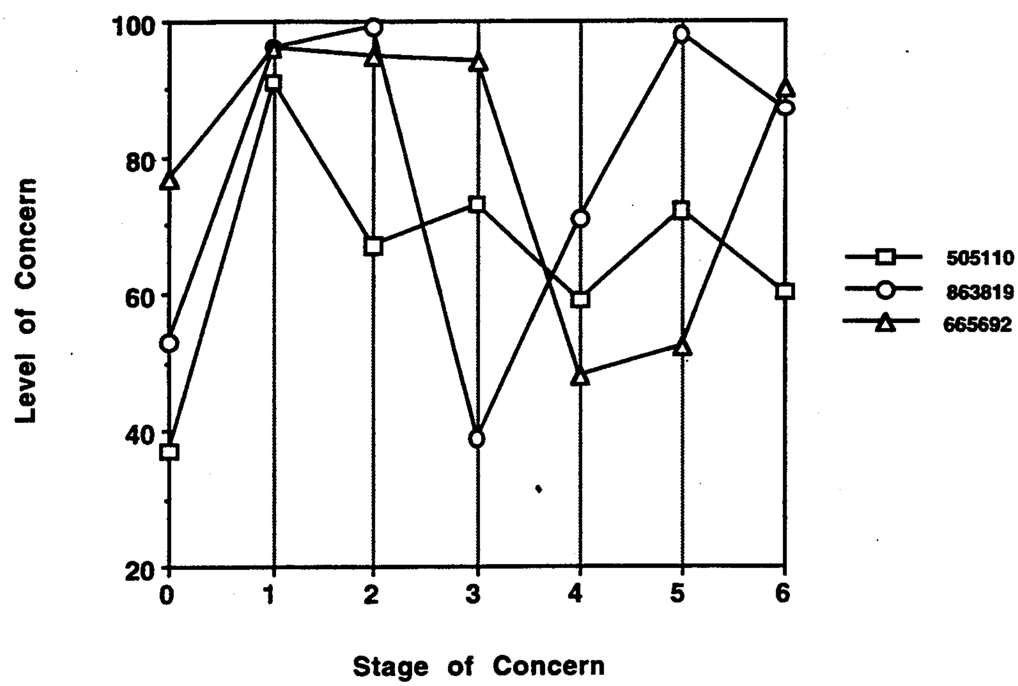


NEWMAST 1989

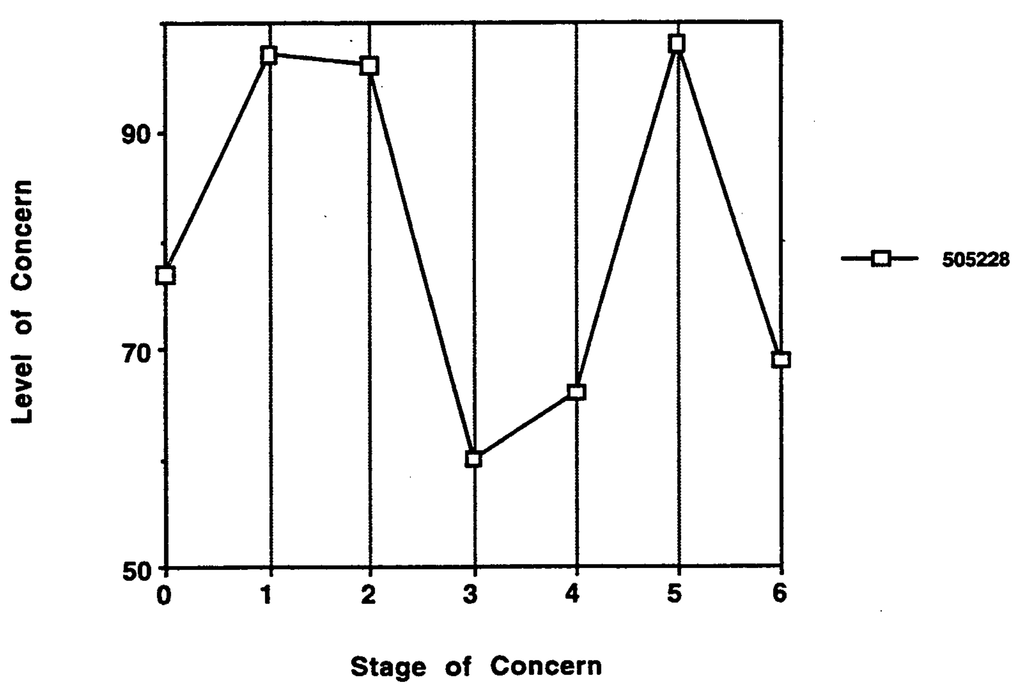



NEWMAST 1989
100
80
60
40
20
0
0
1
2
3
4
5
6
Level of Concern
Stage of Concern
982604
968684
840117

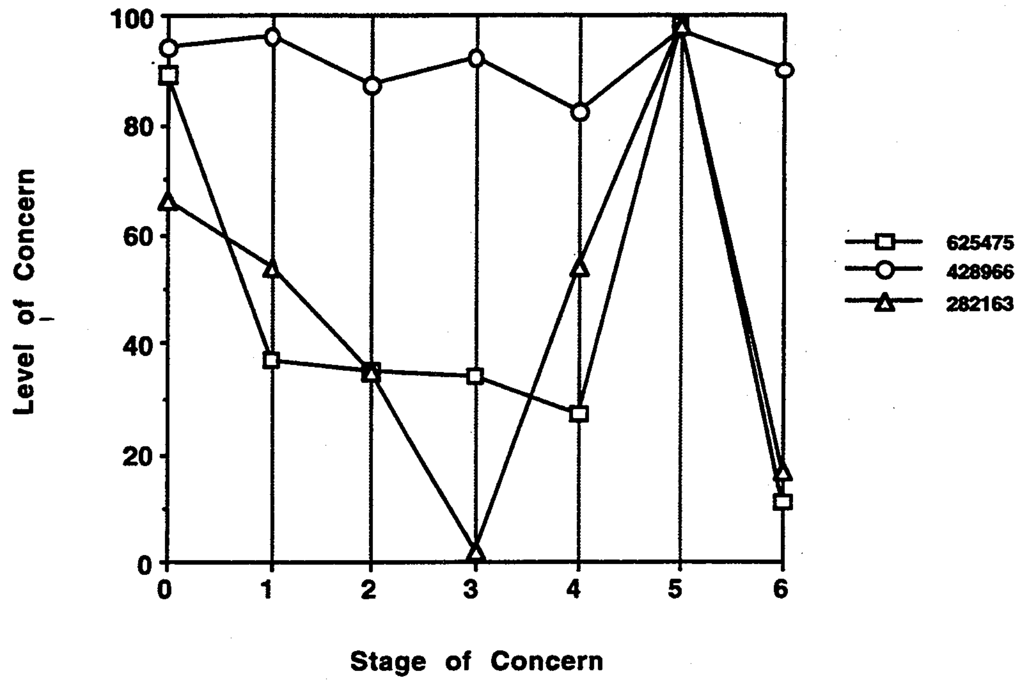
NEWMAST 1988



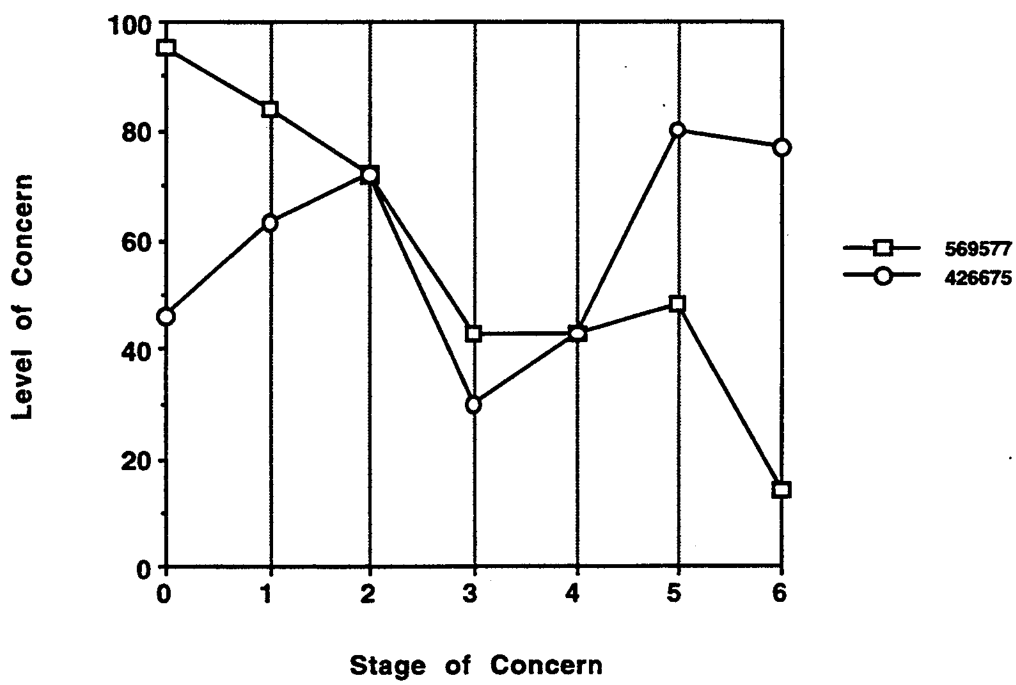
NEWMAST 1988



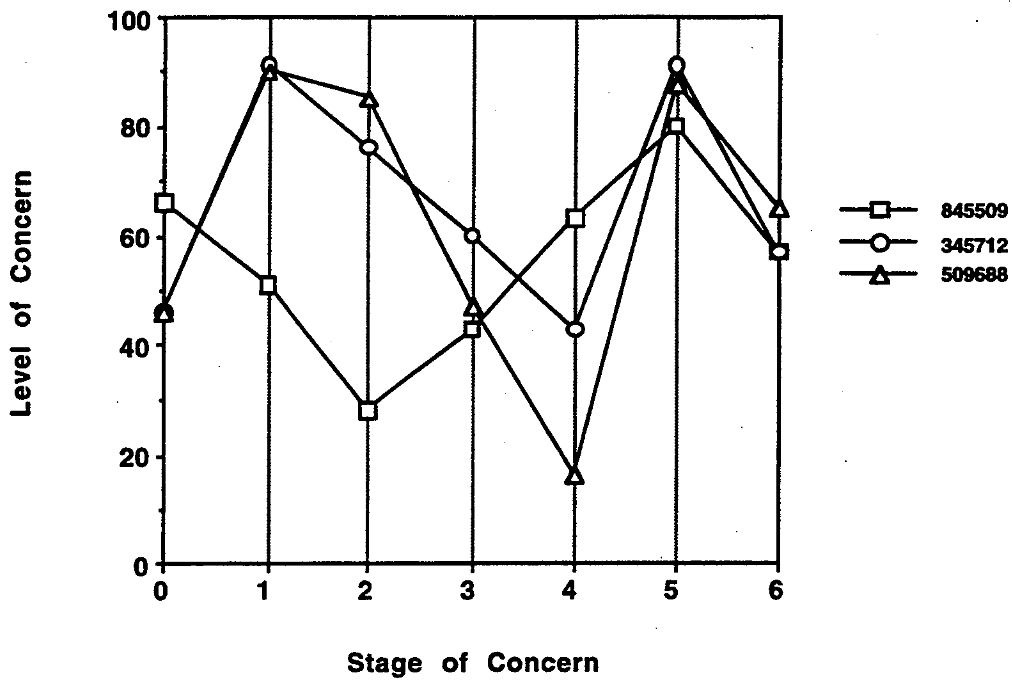
NEWEST 1988



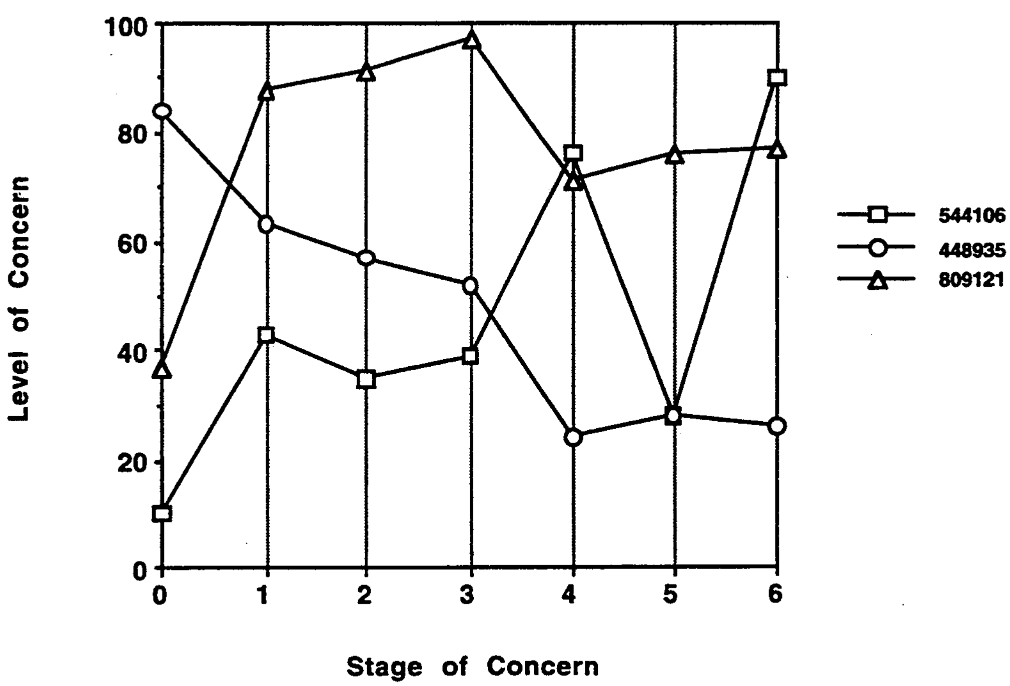
NEWEST 1988

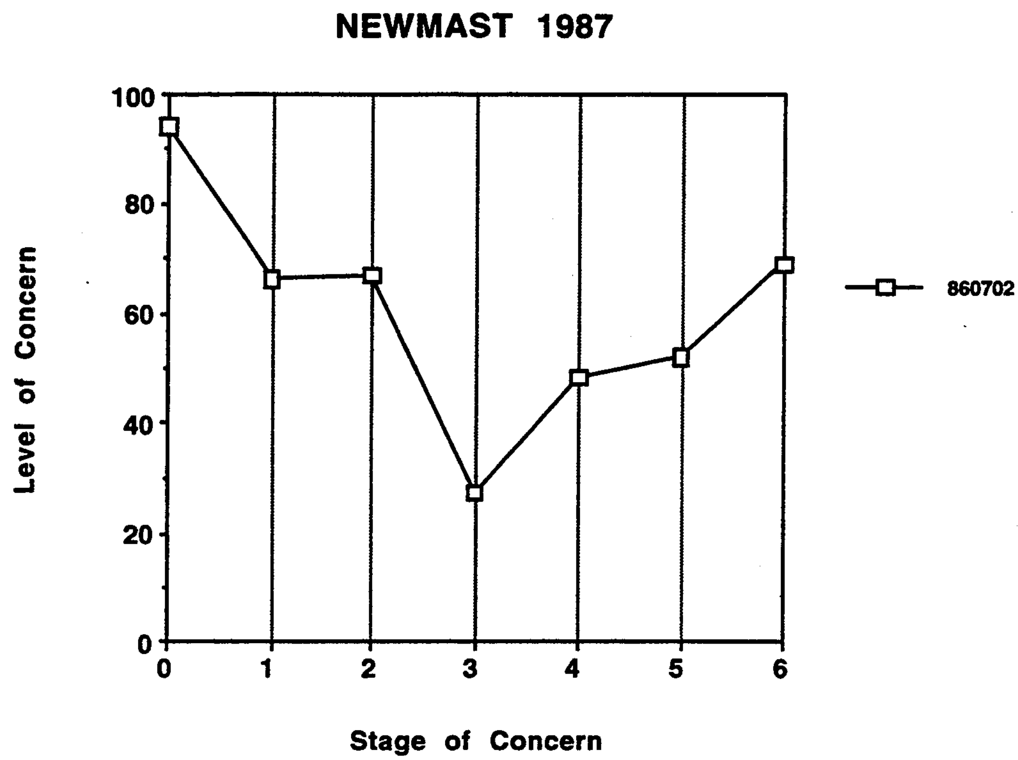


NEWMAST 1987

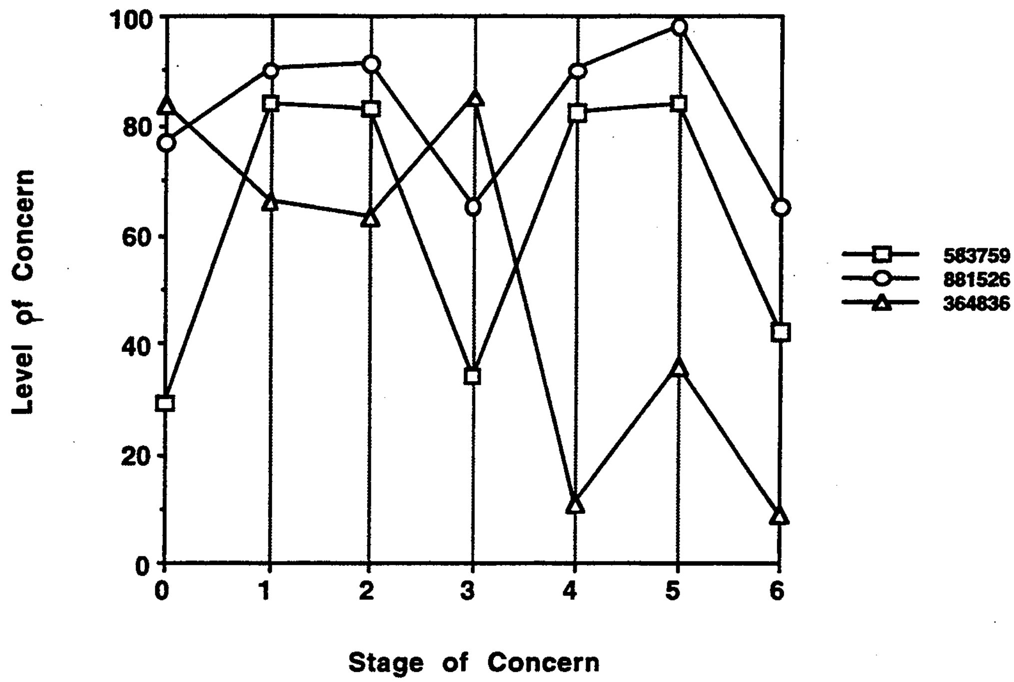


NEWMAST 1987

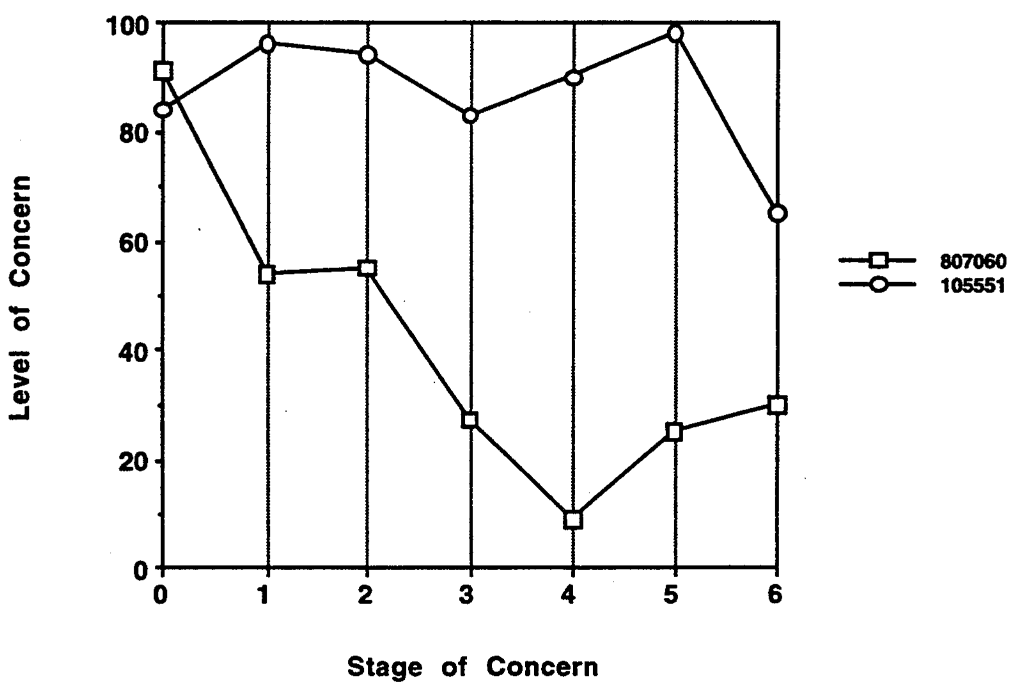


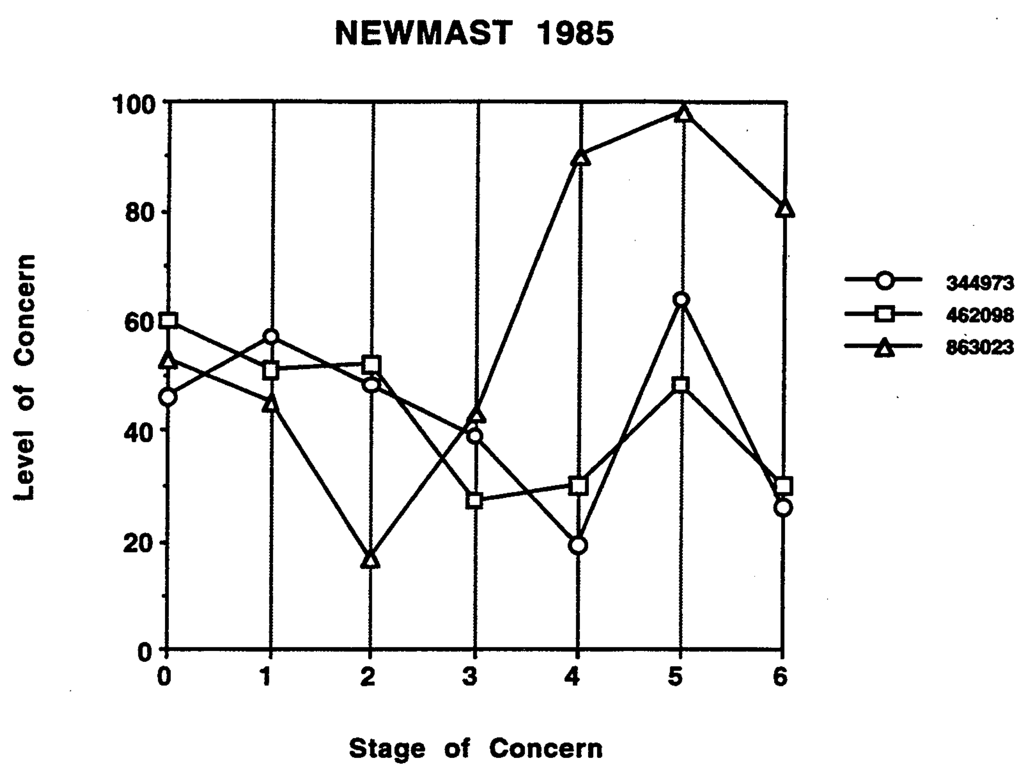

NEWMAST 1987
100
80
60
40
20
0
0
1
2
3
4
5
6
Level of Concern
Stage of Concern
860702

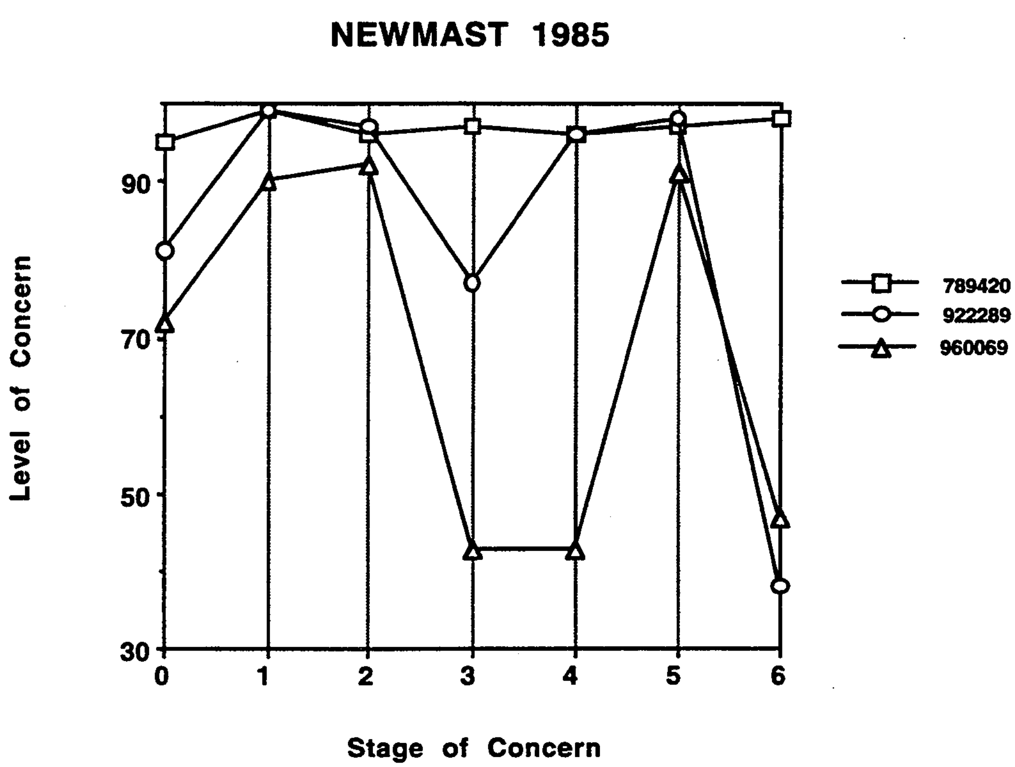
NEWMAST 1986



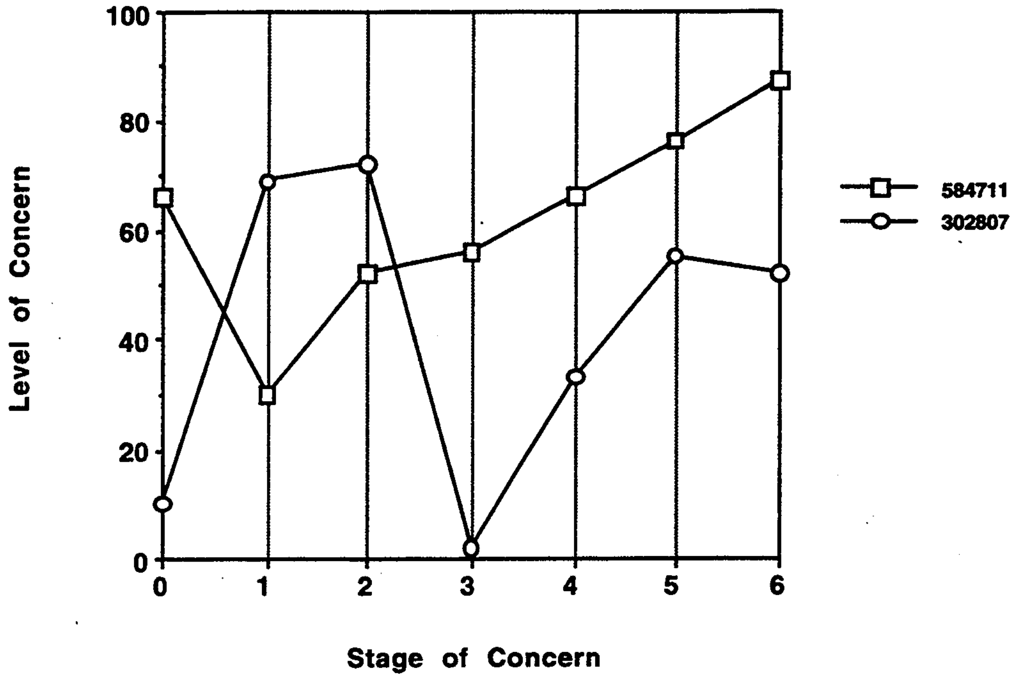
NEWMAST 1986



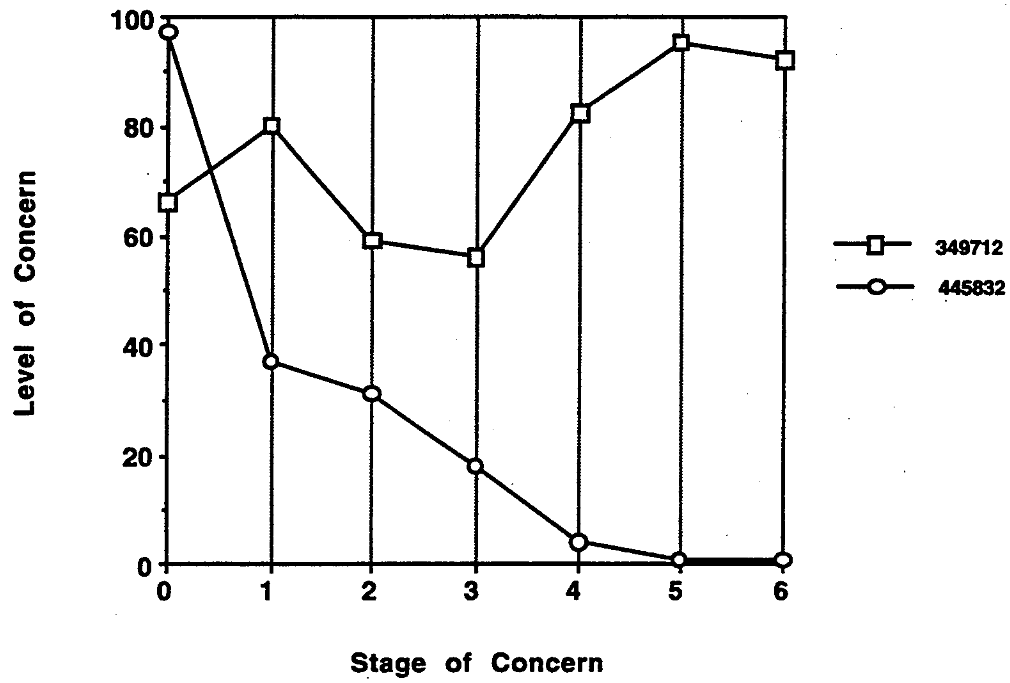

NEWMAST 1985
100
80
60
40
20
0
Level of Concern
0
1
2
3
4
5
6
Stage of Concern
344973
462098
863023


NEWMAST 1985
90
70
50
30
Level of Concern
0
1
2
3
4
5
6
Stage of Concern
789420
922289
960069

NEWMAST 1985



NEWMAST 1984



APPENDIX H

SPSS (1993) OUTPUT FROM THE PAIRED T-TESTS FOR THE STAGES OF CONCERN (1995 WORKSHOPS)

WEEKS: 1.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE0				11.3333	6.193	1.460
	18	.637	.004			
STAGE0				14.0556	3.827	.902

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-2.7222	4.775	1.125	-2.42	17	.027
95% CI (-5.097, -.348)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE1				20.5294	5.832	1.415
	17	-.220	.397			
STAGE1				19.2353	6.543	1.587

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.2941	9.674	2.346	.55	16	.589
95% CI (-3.680, 6.268)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE2				20.3529	7.382	1.790
	17	.568	.017			
STAGE2				19.3529	7.500	1.819

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.0000	6.919	1.678	.60	16	.560
95% CI (-2.558, 4.558)					

WEEKS: 1.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE3				17.3889	7.293	1.719
	18	.722	.001			
STAGE3				15.9444	7.448	1.755

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.4444	5.501	1.297	1.11	17	.281
95% CI (-1.291, 4.180)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE4				22.2105	6.680	1.532
	19	.189	.437			
STAGE4				20.6316	6.825	1.566

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.5789	8.598	1.972	.80	18	.434
95% CI (-2.565, 5.723)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE5				24.1765	5.525	1.340
	17	.488	.047			
STAGE5				23.2941	6.603	1.601

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
.8824	6.204	1.505	.59	16	.566
95% CI (-2.307, 4.072)					

WEEKS: 1.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE6				19.0556	6.932	1.634
	18	.705	.001			
STAGE6				16.3889	5.203	1.226

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
2.6667	4.923	1.160	2.30	17	.035
95% CI (.219, 5.115)					

WEEKS: 2.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE0				8.7143	4.906	1.311
	14	.067	.821			
STAGE0				9.0000	4.000	1.069

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-.2857	6.120	1.636	-.17	13	.864
95% CI (-3.819, 3.248)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE1				18.1250	9.838	2.459
	16	.568	.022			
STAGE1				19.4375	7.908	1.977

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-1.3125	8.420	2.105	-.62	15	.542
95% CI (-5.799, 3.174)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE2				19.7500	11.364	2.841
	16	.676	.004			
STAGE2				18.9375	7.047	1.762

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
.8125	8.400	2.100	.39	15	.704
95% CI (-3.664, 5.289)					

WEEKS: 2.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE3				13.6250	7.311	1.828
	16	.598	.014			
STAGE3				13.0938	6.522	1.631

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
.5313	6.244	1.561	.34	15	.738
95% CI (-2.796, 3.858)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean

PSTAGE4				25.9375	6.060	1.515
	16	.533	.033			
STAGE4				22.9375	7.178	1.795

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
3.0000	6.470	1.618	1.85	15	.083
95% CI (-.448, 6.448)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE5				30.1250	5.110	1.278
	16	.763	.001			
STAGE5				25.8125	8.440	2.110

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
4.3125	5.618	1.405	3.07	15	.008
95% CI (1.319, 7.306)					

WEEKS: 2.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE6				20.6667	6.275	1.620
	15	.521	.047			
STAGE6				18.4667	6.632	1.712

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
2.2000	6.327	1.634	1.35	14	.199
95% CI (-1.304, 5.704)					

WEEKS: 3.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE0				10.5294	7.559	1.833
	17	.832	.000			
STAGE0				11.1176	5.894	1.429

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-.5882	4.214	1.022	-.58	16	.573
95% CI (-2.755, 1.578)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE1				20.7059	7.363	1.786
	17	.495	.043			
STAGE1				21.3529	6.113	1.483

Paired Differences						
Mean	SD	SE of Mean		t-value	df	2-tail Sig
-.6471	6.855	1.663		-.39	16	.702
95% CI (-4.172, 2.878)						

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE2				22.5333	6.479	1.673
	15	.371	.174			
STAGE2				21.2000	6.439	1.662

Paired Differences						
Mean	SD	SE of Mean		t-value	df	2-tail Sig
1.3333	7.247	1.871		.71	14	.488
95% CI (-2.680, 5.347)						

WEEKS: 3.00

t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE3				15.2353	8.385	2.034
	17	.668	.003			
STAGE3				16.6471	7.945	1.927

Paired Differences						
Mean	SD	SE of Mean		t-value	df	2-tail Sig
-1.4118	6.662	1.616		-.87	16	.395
95% CI (-4.837, 2.014)						

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE4				26.0000	7.124	1.728
	17	.713	.001			
STAGE4				22.0000	7.818	1.896

Paired Differences						
Mean	SD	SE of Mean		t-value	df	2-tail Sig
4.0000	5.701	1.383		2.89	16	.011
95% CI (1.069, 6.931)						

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE5				25.8750	5.830	1.457
	16	.375	.152			
STAGE5				22.3125	6.570	1.642

Paired Differences						
Mean	SD	SE of Mean		t-value	df	2-tail Sig
3.5625	6.957	1.739		2.05	15	.058
95% CI (-.144, 7.269)						

WEEKS: 3.00

t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE6				21.9375	5.543	1.386
	16	.044	.871			
STAGE6				18.2500	6.050	1.512

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
3.6875	8.023	2.006	1.84	15	.086
95% CI (-.587, 7.962)					

WEEKS: 4.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE0				8.9565	4.656	.971
	23	.212	.332			
STAGE0				11.6087	4.727	.986

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-2.6522	5.890	1.228	-2.16	22	.042
95% CI (-5.199, -.105)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE1				20.5200	6.728	1.346
	25	.482	.015			
STAGE1				25.0000	5.759	1.152

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-4.4800	6.410	1.282	-3.49	24	.002
95% CI (-7.126, -1.834)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE2				20.6250	7.051	1.439
	24	.369	.076			
STAGE2				25.0833	7.174	1.464

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-4.4583	7.989	1.631	-2.73	23	.012
95% CI (-7.832, -1.085)					

WEEKS: 4.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE3				15.8400	7.180	1.436
	25	.491	.013			
STAGE3				18.4400	5.213	1.043

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-2.6000	6.481	1.296	-2.01	24	.056
95% CI (-5.275, .075)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE4				26.5200	6.826	1.365
	25	.247	.233			
STAGE4				25.0800	8.046	1.609

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.4400	9.175	1.835	.78	24	.440
95% CI (-2.347, 5.227)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE5				27.2400	7.726	1.545
	25	.373	.066			
STAGE5				26.2800	6.535	1.307

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
.9600	8.044	1.609	.60	24	.556
95% CI (-2.360, 4.280)					

WEEKS: 4.00
t-tests for Paired Samples

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PSTAGE6				20.3913	6.221	1.297
	23	-.201	.359			
STAGE6				18.6957	6.785	1.415

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.6957	10.083	2.103	.81	22	.429
95% CI (-2.665, 6.056)					

APPENDIX I

SPSS (1993) OUTPUT FROM THE WILCOXON MATCHED-PAIRS, SIGNED-RANKS TESTS FOR THE BELIEFS ABOUT SCIENCE AND SCIENCE EDUCATION (1995 WORKSHOPS)

```
WORKSHO1:              2.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B13
with BP13

     Mean Rank    Cases

          3.50        2  - Ranks (BP13 LT B13)
          4.20        5  + Ranks (BP13 GT B13)
                      9    Ties  (BP13 EQ B13)
                     --
                     16    Total

        Z =    -1.1832             2-Tailed P =  .2367

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B16
with BP16

     Mean Rank    Cases

          5.30        5  - Ranks (BP16 LT B16)
          4.63        4  + Ranks (BP16 GT B16)
                      7    Ties  (BP16 EQ B16)
                     --
                     16    Total

        Z =     -.4739             2-Tailed P =  .6356

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B21
with BP21

     Mean Rank    Cases

          5.17        3  - Ranks (BP21 LT B21)
          4.10        5  + Ranks (BP21 GT B21)
                      7    Ties  (BP21 EQ B21)
                     --
                     15    Total

        Z =     -.3501             2-Tailed P =  .7263


WORKSHO1:              2.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B27
with BP27

     Mean Rank    Cases

          3.00        3  - Ranks (BP27 LT B27)
          4.00        3  + Ranks (BP27 GT B27)
                      9    Ties  (BP27 EQ B27)
                     --
                     15    Total

        Z =     -.3145             2-Tailed P =  .7532
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B3
with BP3

     Mean Rank    Cases

          3.83        3  - Ranks (BP3 LT B3)
          4.90        5  + Ranks (BP3 GT B3)
                      8    Ties  (BP3 EQ B3)
                     --
                     16    Total

       Z =     -.9102            2-Tailed P =  .3627

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B30
with BP30

     Mean Rank    Cases

          5.13        4  - Ranks (BP30 LT B30)
          4.90        5  + Ranks (BP30 GT B30)
                      7    Ties  (BP30 EQ B30)
                     --
                     16    Total

       Z =     -.2369            2-Tailed P =  .8127


WORKSHO1:               2.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B33
with BP33

     Mean Rank    Cases

          4.75        6  - Ranks (BP33 LT B33)
          5.50        3  + Ranks (BP33 GT B33)
                      7    Ties  (BP33 EQ B33)
                     --
                     16    Total

       Z =     -.7108            2-Tailed P =  .4772

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B34
with BP34

     Mean Rank    Cases

          3.50        2  - Ranks (BP34 LT B34)
          4.20        5  + Ranks (BP34 GT B34)
                      9    Ties  (BP34 EQ B34)
                     --
                     16    Total

       Z =    -1.1832            2-Tailed P =  .2367
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B35
with BP35

     Mean Rank    Cases

          4.57        7  - Ranks (BP35 LT B35)
          4.00        1  + Ranks (BP35 GT B35)
                      8    Ties  (BP35 EQ B35)
                     --
                     16    Total

        Z =    -1.9604              2-Tailed P =  .0499


WORKSHO1:              2.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B7
with BP7

     Mean Rank    Cases

          3.50        2  - Ranks (BP7 LT B7)
          4.83        6  + Ranks (BP7 GT B7)
                      8    Ties  (BP7 EQ B7)
                     --
                     16    Total

        Z =    -1.5403              2-Tailed P =  .1235

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B8
with BP8

     Mean Rank    Cases

          2.75        4  - Ranks (BP8 LT B8)
          5.67        3  + Ranks (BP8 GT B8)
                      9    Ties  (BP8 EQ B8)
                     --
                     16    Total

        Z =     -.5071              2-Tailed P =  .6121

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B9
with BP9

     Mean Rank    Cases

          5.56        8  - Ranks (BP9 LT B9)
          7.17        3  + Ranks (BP9 GT B9)
                      5    Ties  (BP9 EQ B9)
                     --
                     16    Total

        Z =    -1.0225              2-Tailed P =  .3066
```

```
WORKSHO1:               3.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B13
with BP13


     Mean Rank    Cases

          7.30        5  - Ranks (BP13 LT B13)
          4.92        6  + Ranks (BP13 GT B13)
                     14    Ties  (BP13 EQ B13)
                     --
                     25    Total

         Z =     -.3112            2-Tailed P =  .7557

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B16
with BP16


     Mean Rank    Cases

          6.95       11  - Ranks (BP16 LT B16)
          7.25        2  + Ranks (BP16 GT B16)
                     12    Ties  (BP16 EQ B16)
                     --
                     25    Total

         Z =    -2.1665            2-Tailed P =  .0303

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B21
with BP21


     Mean Rank    Cases

          7.00        6  - Ranks (BP21 LT B21)
          6.00        6  + Ranks (BP21 GT B21)
                     13    Ties  (BP21 EQ B21)
                     --
                     25    Total

         Z =     -.2353            2-Tailed P =  .8139


WORKSHO1:               3.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B27
with BP27


     Mean Rank    Cases

          8.80        5  - Ranks (BP27 LT B27)
          6.78        9  + Ranks (BP27 GT B27)
                     11    Ties  (BP27 EQ B27)
                     --
                     25    Total

         Z =     -.5336            2-Tailed P =  .5936
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B3
with BP3

     Mean Rank    Cases

         10.20        5  - Ranks (BP3 LT B3)
          7.73       11  + Ranks (BP3 GT B3)
           .          9    Ties  (BP3 EQ B3)
                     --
                     25    Total

         Z =     -.8790            2-Tailed P =  .3794

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B30
with BP30

     Mean Rank    Cases

          6.50        4  - Ranks (BP30 LT B30)
          6.50        8  + Ranks (BP30 GT B30)
                     13    Ties  (BP30 EQ B30)
                     --
                     25    Total

         Z =   -1.0198             2-Tailed P =  .3078


WORKSHO1:              3.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B33
with BP33

     Mean Rank    Cases

          8.38        4  - Ranks (BP33 LT B33)
          7.86       11  + Ranks (BP33 GT B33)
                     10    Ties  (BP33 EQ B33)
                     --
                     25    Total

         Z =   -1.5051             2-Tailed P =  .1323

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B34
with BP34

     Mean Rank    Cases

          6.00        5  - Ranks (BP34 LT B34)
          5.00        5  + Ranks (BP34 GT B34)
                     15    Ties  (BP34 EQ B34)
                     --
                     25    Total

         Z =     -.2548            2-Tailed P =  .7989
```

```
 - - - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B35
with BP35


     Mean Rank    Cases

          4.30        5  - Ranks (BP35 LT B35)
          4.83        3  + Ranks (BP35 GT B35)
                     17    Ties  (BP35 EQ B35)
                     --
                     25    Total

         Z =     -.4901             2-Tailed P =  .6241


WORKSHO1:               3.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B7
with BP7


     Mean Rank    Cases

          7.07        7  - Ranks (BP7 LT B7)
          8.81        8  + Ranks (BP7 GT B7)
                     10    Ties  (BP7 EQ B7)
                     --
                     25    Total

         Z =     -.5964             2-Tailed P =  .5509

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B8
with BP8


     Mean Rank    Cases

          5.50        3  - Ranks (BP8 LT B8)
          4.75        6  + Ranks (BP8 GT B8)
                     16    Ties  (BP8 EQ B8)
                     --
                     25    Total

         Z =     -.7108             2-Tailed P =  .4772

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B9
with BP9


     Mean Rank    Cases

          8.55       11  - Ranks (BP9 LT B9)
          6.50        4  + Ranks (BP9 GT B9)
                      9    Ties  (BP9 EQ B9)
                     --
                     24    Total

         Z =    -1.9311             2-Tailed P =  .0535
```

```
WORKSHO1:             4.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B13
with BP13

     Mean Rank    Cases

          6.38         4  - Ranks (BP13 LT B13)
          5.79         7  + Ranks (BP13 GT B13)
                       8    Ties  (BP13 EQ B13)
                      --
                      19    Total

         Z =    -.6668             2-Tailed P =  .5049

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B16
with BP16

     Mean Rank    Cases

          2.25         2  - Ranks (BP16 LT B16)
          1.50         1  + Ranks (BP16 GT B16)
                      16    Ties  (BP16 EQ B16)
                      --
                      19    Total

         Z =    -.8018             2-Tailed P =  .4227

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B21
with BP21

     Mean Rank    Cases

          4.00         3  - Ranks (BP21 LT B21)
          5.50         6  + Ranks (BP21 GT B21)
                      10    Ties  (BP21 EQ B21)
                      --
                      19    Total

         Z =   -1.2439             2-Tailed P =  .2135

WORKSHO1:             4.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B27
with BP27

     Mean Rank    Cases

          3.13         4  - Ranks (BP27 LT B27)
          2.50         1  + Ranks (BP27 GT B27)
                      14    Ties  (BP27 EQ B27)
                      --
                      19  . Total

         Z =   -1.3484             2-Tailed P =  .1775
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B3
with BP3

     Mean Rank    Cases

          6.60        5  - Ranks (BP3 LT B3)
          6.43        7  + Ranks (BP3 GT B3)
                      7    Ties  (BP3 EQ B3)
                     --
                     19    Total

         Z =     -.4707              2-Tailed P =  .6379

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B30
with BP30

     Mean Rank    Cases

          6.00       11  - Ranks (BP30 LT B30)
         12.00        1  + Ranks (BP30 GT B30)
                      7    Ties  (BP30 EQ B30)
                     --
                     19    Total

         Z =    -2.1181              2-Tailed P =  .0342


WORKSHO1:              4.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B33
with BP33

     Mean Rank    Cases

          2.50        3  - Ranks (BP33 LT B33)
          4.50        3  + Ranks (BP33 GT B33)
                     13    Ties  (BP33 EQ B33)
                     --
                     19    Total

         Z =     -.6290              2-Tailed P =  .5294

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B34
with BP34

     Mean Rank    Cases

          4.40        5  - Ranks (BP34 LT B34)
          3.00        2  + Ranks (BP34 GT B34)
                     12    Ties  (BP34 EQ B34)
                     --
                     19    Total

         Z =    -1.3522              2-Tailed P =  .1763
```

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

```
     B35
with BP35


     Mean Rank    Cases

          6.00         8  - Ranks (BP35 LT B35)
          6.00         3  + Ranks (BP35 GT B35)
                       8    Ties  (BP35 EQ B35)
                      --
                      19    Total

         Z =    -1.3337            2-Tailed P =  .1823
```

WORKSHO1:   4.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

```
     B7
with BP7


     Mean Rank    Cases

          6.81         8  - Ranks (BP7 LT B7)
          7.30         5  + Ranks (BP7 GT B7)
                       6    Ties  (BP7 EQ B7)
                      --
                      19    Total

         Z =     -.6290            2-Tailed P =  .5294
```

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

```
     B8
with BP8


     Mean Rank    Cases

          3.33         3  - Ranks (BP8 LT B8)
          5.20         5  + Ranks (BP8 GT B8)
                      11    Ties  (BP8 EQ B8)
                      --
                      19    Total

         Z =    -1.1202            2-Tailed P =  .2626
```

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

```
     B9
with BP9


     Mean Rank    Cases

          5.43         7  - Ranks (BP9 LT B9)
          5.67         3  + Ranks (BP9 GT B9)
                       9    Ties  (BP9 EQ B9)
                      --
                      19    Total

         Z =    -1.0703            2-Tailed P =  .2845
```

```
WORKSHO1:               5.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B13
with BP13

     Mean Rank    Cases

          5.25         6  - Ranks (BP13 LT B13)
          4.50         3  + Ranks (BP13 GT B13)
                       8    Ties  (BP13 EQ B13)
                      --
                      17    Total

         Z =    -1.0662             2-Tailed P =  .2863

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B16
with BP16

     Mean Rank    Cases

          8.00         2  - Ranks (BP16 LT B16)
          4.14         7  + Ranks (BP16 GT B16)
                       8    Ties  (BP16 EQ B16)
                      --
                      17    Total

         Z =     -.7701             2-Tailed P =  .4413

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B21
with BP21

     Mean Rank    Cases

          4.00         5  - Ranks (BP21 LT B21)
          5.33         3  + Ranks (BP21 GT B21)
                       9    Ties  (BP21 EQ B21)
                      --
                      17    Total

         Z =     -.2801             2-Tailed P =  .7794

WORKSHO1:               5.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B27
with BP27

     Mean Rank    Cases

          4.80         5  - Ranks (BP27 LT B27)
          4.00         3  + Ranks (BP27 GT B27)
                       9    Ties  (BP27 EQ B27)
                      --
                      17    Total

         Z =     -.8402             2-Tailed P =  .4008
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B3
with BP3

     Mean Rank    Cases

          6.08        6  - Ranks (BP3 LT B3)
          4.63        4  + Ranks (BP3 GT B3)
                      7    Ties  (BP3 EQ B3)
                     --
                     17    Total

         Z =     -.9174             2-Tailed P =  .3590

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B30
with BP30

     Mean Rank    Cases

          3.00        3  - Ranks (BP30 LT B30)
          4.00        3  + Ranks (BP30 GT B30)
                     11    Ties  (BP30 EQ B30)
                     --
                     17    Total

         Z =     -.3145             2-Tailed P =  .7532


WORKSHO1:               5.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B33
with BP33

     Mean Rank    Cases

          2.50        1  - Ranks (BP33 LT B33)
          4.79        7  + Ranks (BP33 GT B33)
                      9    Ties  (BP33 EQ B33)
                     --
                     17    Total

         Z =    -2.1704             2-Tailed P =  .0300

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B34
with BP34

     Mean Rank    Cases

          3.00        4  - Ranks (BP34 LT B34)
          4.50        2  + Ranks (BP34 GT B34)
                     11    Ties  (BP34 EQ B34)
                     --
                     17    Total

         Z =     -.3145             2-Tailed P =  .7532
```

```
- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B35
with BP35


     Mean Rank    Cases

          3.00        3  - Ranks (BP35 LT B35)
          4.00        3  + Ranks (BP35 GT B35)
                     11    Ties  (BP35 EQ B35)
                     --
                     17    Total

         Z =     -.3145            2-Tailed P =   .7532


WORKSHO1:               5.00

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B7
with BP7


     Mean Rank    Cases

          4.50        3  - Ranks (BP7 LT B7)
          5.25        6  + Ranks (BP7 GT B7)
                      8    Ties  (BP7 EQ B7)
                     --
                     17    Total

         Z =    -1.0662            2-Tailed P =   .2863

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B8
with BP8


     Mean Rank    Cases

          3.50        4  - Ranks (BP8 LT B8)
          5.50        4  + Ranks (BP8 GT B8)
                      9    Ties  (BP8 EQ B8)
                     --
                     17    Total

         Z =     -.5601            2-Tailed P =   .5754

- - - - - Wilcoxon Matched-Pairs Signed-Ranks Test

     B9
with BP9


     Mean Rank    Cases

          5.88        4  - Ranks (BP9 LT B9)
          4.30        5  + Ranks (BP9 GT B9)
                      8    Ties  (BP9 EQ B9)
                     --
                     17    Total

         Z =     -.1185            2-Tailed P =   .9057
```

APPENDIX J

SPSS (1993) OUTPUT FROM THE ONE-WAY ANALYSIS OF VARIANCE TESTS FOR THE STAGES OF CONCERN (ALL GROUPS)

----- ONEWAY -----

Variable PSTAGE0
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	479.9976	119.9994	3.9295	.0041
Within Groups	254	7756.6742	30.5381		
Total	258	8236.6718			

----- ONEWAY -----

Variable PSTAGE1
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	148.0562	37.0141	.6109	.6551
Within Groups	254	15388.9013	60.5862		
Total	258	15536.9575			

----- ONEWAY -----

Variable PSTAGE2
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	244.4462	61.1116	.7582	.5534
Within Groups	254	20471.9553	80.5982		
Total	258	20716.4015			

----- ONEWAY -----

Variable PSTAGE3
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	226.1443	56.5361	1.1000	.3571
Within Groups	254	13054.7032	51.3965		
Total	258	13280.8475			

----- ONEWAY -----

Variable PSTAGE4
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	668.2593	167.0648	3.4663	.0089
Within Groups	254	12242.1577	48.1975		
Total	258	12910.4170			

----- ONEWAY -----

Variable PSTAGE5
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	787.6637	196.9159	3.1917	.0140
Within Groups	254	15670.8073	61.6961		
Total	258	16458.4710			

----- ONEWAY -----

Variable PSTAGE6
By Variable WEEKS

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	395.2392	98.8098	1.8837	.1137
Within Groups	254	13323.4867	52.4547		
Total	258	13718.7259			

----- ONEWAY -----

Variable PSTAGE0
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	361.8910	120.6303	3.9062	.0094
Within Groups	255	7874.7808	30.8815		
Total	258	8236.6718			

----- O N E W A Y -----

Variable PSTAGE1
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	158.0232	52.6744	.8734	.4554
Within Groups	255	15378.9343	60.3095		
Total	258	15536.9575			

----- O N E W A Y -----

Variable PSTAGE2
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	687.8339	229.2780	2.9191	.0347
Within Groups	255	20028.5677	78.5434		
Total	258	20716.4015			

----- O N E W A Y -----

Variable PSTAGE3
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	173.4940	57.8313	1.1251	.3394
Within Groups	255	13107.3535	51.4014		
Total	258	13280.8475			

----- O N E W A Y -----

Variable PSTAGE4
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	239.7123	79.9041	1.6081	.1880
Within Groups	255	12670.7047	49.6890		
Total	258	12910.4170			

----- O N E W A Y -----

Variable PSTAGE5
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	311.6536	103.8845	1.6406	.1805
Within Groups	255	16146.8175	63.3209		
Total	258	16458.4710			

----- O N E W A Y -----

Variable PSTAGE6
By Variable TIME_SIN Time Since Workshop

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	377.5980	125.8660	2.4058	.0678
Within Groups	255	13341.1278	52.3181		
Total	258	13718.7259			

----- O N E W A Y -----

Variable PSTAGE0
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	260.2845	86.7615	2.7737	.0420
Within Groups	255	7976.3873	31.2800		
Total	258	8236.6718			

----- O N E W A Y -----

Variable PSTAGE1
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	171.8545	57.2848	.9507	.4167
Within Groups	255	15365.1030	60.2553		
Total	258	15536.9575			

----- O N E W A Y -----

Variable PSTAGE2
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	580.7851	193.5950	2.4517	.0639
Within Groups	255	20135.6165	78.9632		
Total	258	20716.4015			

----- O N E W A Y -----

Variable PSTAGE3
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	88.0088	29.3363	.5670	.6372
Within Groups	255	13192.8386	51.7366		
Total	258	13280.8475			

----- O N E W A Y -----

Variable PSTAGE4
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	89.0411	29.6804	.5903	.6219
Within Groups	255	12821.3759	50.2799		
Total	258	12910.4170			

----- O N E W A Y -----

Variable PSTAGE5
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	707.5177	235.8392	3.8181	.0106
Within Groups	255	15750.9533	61.7684		
Total	258	16458.4710			

----- O N E W A Y -----

Variable PSTAGE6
By Variable GRADE_CO grade code

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	96.1122	32.0374	.5997	.6157
Within Groups	255	13622.6136	53.4220		
Total	258	13718.7259			

APPENDIX K

SPSS (1993) OUTPUT FROM THE KRUSKAL-WALLIS ONE-WAY ANALYSIS OF VARIANCE TESTS FOR THE BELIEFS ABOUT SCIENCE AND SCIENCE EDUCATION (ALL GROUPS)

- - - - - Kruskal-Wallis 1-Way Anova

BP3
by WEEKS

Mean Rank	Cases	
134.17	93	WEEKS = 0
173.76	19	WEEKS = 1
137.06	96	WEEKS = 2
148.09	17	WEEKS = 3
112.04	36	WEEKS = 4
182.57	15	WEEKS = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
12.7868	5	.0255	13.9208	5	.0161

- - - - Kruskal-Wallis 1-Way Anova

BP7
by WEEKS

Mean Rank	Cases	
133.83	93	WEEKS = 0
120.39	19	WEEKS = 1
142.72	96	WEEKS = 2
143.38	17	WEEKS = 3
138.43	36	WEEKS = 4
158.03	15	WEEKS = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
2.5264	5	.7725	2.7432	5	.7395

- - - - - Kruskal-Wallis 1-Way Anova

BP8
by WEEKS

Mean Rank	Cases	
135.95	93	WEEKS = 0
119.89	19	WEEKS = 1
142.71	96	WEEKS = 2
138.03	17	WEEKS = 3
171.07	36	WEEKS = 4
73.27	15	WEEKS = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
17.4082	5	.0038	19.7934	5	.0014

- - - - - Kruskal-Wallis 1-Way Anova

BP9
by WEEKS

Mean Rank	Cases		
145.73	92	WEEKS =	0
134.00	19	WEEKS =	1
139.82	94	WEEKS =	2
114.00	17	WEEKS =	3
112.28	36	WEEKS =	4
154.93	15	WEEKS =	99

	273	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.0199	5	.2192	7.7088	5	.1730

- - - - - Kruskal-Wallis 1-Way Anova

BP13
by WEEKS

Mean Rank	Cases		
133.61	93	WEEKS =	0
107.66	19	WEEKS =	1
150.37	94	WEEKS =	2
104.68	17	WEEKS =	3
157.43	36	WEEKS =	4
108.13	15	WEEKS =	99

	274	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
12.6540	5	.0268	14.8564	5	.0110

- - - - - Kruskal-Wallis 1-Way Anova

BP16
by WEEKS

Mean Rank	Cases		
144.41	93	WEEKS =	0
134.00	19	WEEKS =	1
135.02	94	WEEKS =	2
180.35	17	WEEKS =	3
113.50	36	WEEKS =	4
123.67	15	WEEKS =	99

	274	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance

9.5672	5	.0885	11.3181	5	.0454

----- Kruskal-Wallis 1-Way Anova

BP21
by WEEKS

Mean Rank	Cases	
129.25	93	WEEKS = 0
138.47	19	WEEKS = 1
149.87	95	WEEKS = 2
140.26	17	WEEKS = 3
116.93	36	WEEKS = 4
164.47	15	WEEKS = 99

	275	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
7.4431	5	.1897	8.3359	5	.1387

----- Kruskal-Wallis 1-Way Anova

BP27
by WEEKS

Mean Rank	Cases	
124.06	93	WEEKS = 0
102.53	19	WEEKS = 1
160.34	95	WEEKS = 2
116.44	17	WEEKS = 3
150.54	36	WEEKS = 4
122.23	15	WEEKS = 99

	275	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
16.8656	5	.0048	19.8450	5	.0013

----- Kruskal-Wallis 1-Way Anova

BP30
by WEEKS

Mean Rank	Cases	
130.04	93	WEEKS = 0
94.32	19	WEEKS = 1
156.43	96	WEEKS = 2
144.88	17	WEEKS = 3
149.18	36	WEEKS = 4
99.30	15	WEEKS = 99
	---	

276 Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
16.0841	5	.0066	17.5362	5	.0036

- - - - - Kruskal-Wallis 1-Way Anova

BP33
by WEEKS

Mean Rank	Cases	
130.92	93	WEEKS = 0
98.74	19	WEEKS = 1
146.85	96	WEEKS = 2
157.68	17	WEEKS = 3
166.43	36	WEEKS = 4
93.67	15	WEEKS = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
16.7263	5	.0050	18.7076	5	.0022

- - - - - Kruskal-Wallis 1-Way Anova

BP34
by WEEKS

Mean Rank	Cases	
135.84	93	WEEKS = 0
102.74	19	WEEKS = 1
158.57	96	WEEKS = 2
102.21	17	WEEKS = 3
151.42	36	WEEKS = 4
81.97	15	WEEKS = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
21.9715	5	.0005	25.7434	5	.0001

- - - - - Kruskal-Wallis 1-Way Anova

BP35
by WEEKS

Mean Rank	Cases	
134.76	93	WEEKS = 0
129.95	19	WEEKS = 1

Mean Rank	Cases		
148.06	96	WEEKS =	2
174.59	17	WEEKS =	3
96.97	36	WEEKS =	4
170.10	15	WEEKS =	99

	276	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
17.3693	5	.0039	19.1222	5	.0018

- - - - - Kruskal-Wallis 1-Way Anova

BP3
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
139.32	77	TIME_SIN =	0
126.40	51	TIME_SIN =	1
145.89	40	TIME_SIN =	2
134.17	93	TIME_SIN =	9
182.57	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
6.3686	4	.1733	6.9334	4	.1395

- - - - - Kruskal-Wallis 1-Way Anova

BP7
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
142.16	77	TIME_SIN =	0
144.13	51	TIME_SIN =	1
127.81	40	TIME_SIN =	2
133.83	93	TIME_SIN =	9
158.03	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
2.3497	4	.6717	2.5514	4	.6355

- - - - - Kruskal-Wallis 1-Way Anova

BP8
by TIME_SIN Time Since Workshop

Mean Rank Cases

146.97	77	TIME_SIN =	0
160.98	51	TIME_SIN =	1
123.91	40	TIME_SIN =	2
135.95	93	TIME_SIN =	9
73.27	15	TIME_SIN =	99

	276	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
16.3632	4	.0026	18.6052	4	.0009

- - - - - Kruskal-Wallis 1-Way Anova

BP9
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
119.71	77	TIME_SIN =	0
140.86	50	TIME_SIN =	1
138.69	39	TIME_SIN =	2
145.73	92	TIME_SIN =	9
154.93	15	TIME_SIN =	99

	273	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
5.7308	4	.2202	6.2932	4	.1783

- - - - - Kruskal-Wallis 1-Way Anova

BP13
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
131.51	77	TIME_SIN =	0
158.12	50	TIME_SIN =	1
143.47	39	TIME_SIN =	2
133.61	93	TIME_SIN =	9
108.13	15	TIME_SIN =	99

	274	Total	

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
6.3324	4	.1757	7.4345	4	.1146

- - - - - Kruskal-Wallis 1-Way Anova

BP16
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
130.19	77	TIME_SIN =	0
134.76	50	TIME_SIN =	1

144.29	39	TIME_SIN =	2
144.41	93	TIME_SIN =	9
123.67	15	TIME_SIN =	99

---

274 Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
2.1662	4	.7052	2.5626	4	.6335

- - - - - Kruskal-Wallis 1-Way Anova

BP21
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
129.48	76	TIME_SIN =	0
144.74	51	TIME_SIN =	1
156.01	40	TIME_SIN =	2
129.25	93	TIME_SIN =	9
164.47	15	TIME_SIN =	99

---

275 Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
6.0761	4	.1935	6.8049	4	.1466

- - - - - Kruskal-Wallis 1-Way Anova

BP27
by TIME_SIN Time Since Workshop

Mean Rank	Cases		
130.30	76	TIME_SIN =	0
176.59	51	TIME_SIN =	1
141.75	40	TIME_SIN =	2
124.06	93	TIME_SIN =	9
122.23	15	TIME_SIN =	99

---

275 Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
16.2546	4	.0027	19.1260	4	.0007

- - - - - Kruskal-Wallis 1-Way Anova

BP30
by TIME_SIN Time Since Workshop

Mean Rank	Cases	
133.55	77	TIME_SIN = 0
160.44	51	TIME_SIN = 1
154.43	40	TIME_SIN = 2
130.04	93	TIME_SIN = 9
99.30	15	TIME_SIN = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
10.4051	4	.0341	11.3446	4	.0230

- - - - - Kruskal-Wallis 1-Way Anova

BP33
by TIME_SIN Time Since Workshop

Mean Rank	Cases	
144.73	77	TIME_SIN = 0
162.73	51	TIME_SIN = 1
130.06	40	TIME_SIN = 2
130.92	93	TIME_SIN = 9
93.67	15	TIME_SIN = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
11.1849	4	.0246	12.5098	4	.0139

- - - - - Kruskal-Wallis 1-Way Anova

BP34
by TIME_SIN Time Since Workshop

Mean Rank	Cases	
133.38	77	TIME_SIN = 0
155.56	51	TIME_SIN = 1
153.99	40	TIME_SIN = 2
135.84	93	TIME_SIN = 9
81.97	15	TIME_SIN = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
11.7800	4	.0191	13.8024	4	.0080

- - - - - Kruskal-Wallis 1-Way Anova

BP35
by TIME_SIN Time Since Workshop

Mean Rank	Cases	
116.68	77	TIME_SIN = 0
127.92	51	TIME_SIN = 1
190.84	40	TIME_SIN = 2
134.76	93	TIME_SIN = 9
170.10	15	TIME_SIN = 99

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
26.4054	4	.0000	29.0703	4	.0000

- - - - - Kruskal-Wallis 1-Way Anova

BP3
by GRADE_CO grade code

Mean Rank	Cases	
188.38	20	GRADE_CO = 0
110.79	95	GRADE_CO = 1
150.99	144	GRADE_CO = 2
128.82	17	GRADE_CO = 3

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
23.0321	3	.0000	25.0747	3	.0000

- - - - - Kruskal-Wallis 1-Way Anova

BP7
by GRADE_CO grade code

Mean Rank	Cases	
143.40	20	GRADE_CO = 0
144.44	95	GRADE_CO = 1
128.56	144	GRADE_CO = 2
183.76	17	GRADE_CO = 3

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.3042	3	.0401	9.0168	3	.0291

----- Kruskal-Wallis 1-Way Anova

BP8
by GRADE_CO grade code

Mean Rank	Cases	
82.80	20	GRADE_CO = 0
167.39	95	GRADE_CO = 1
126.76	144	GRADE_CO = 2
142.06	17	GRADE_CO = 3

	276	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
25.3351	3	.0000	28.8064	3	.0000

----- Kruskal-Wallis 1-Way Anova

BP9
by GRADE_CO grade code

Mean Rank	Cases	
147.05	20	GRADE_CO = 0
127.18	94	GRADE_CO = 1
142.55	142	GRADE_CO = 2
133.09	17	GRADE_CO = 3

	273	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
2.5221	3	.4713	2.7697	3	.4285

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BP13
by GRADE_CO grade code

Mean Rank	Cases	
108.35	20	GRADE_CO = 0
151.23	95	GRADE_CO = 1
129.73	142	GRADE_CO = 2
160.00	17	GRADE_CO = 3

	274	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.2933	3	.0403	9.7367	3	.0209

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BP16

by GRADE_CO grade code

Mean Rank	Cases	
125.72	20	GRADE_CO = 0
120.95	95	GRADE_CO = 1
147.16	142	GRADE_CO = 2
163.18	17	GRADE_CO = 3

	274	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
8.4814	3	.0370	10.0337	3	.0183

- - - - - Kruskal-Wallis 1-Way Anova

BP21
by GRADE_CO grade code

Mean Rank	Cases	
162.68	20	GRADE_CO = 0
122.77	94	GRADE_CO = 1
145.20	144	GRADE_CO = 2
132.18	17	GRADE_CO = 3

	275	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
6.6437	3	.0842	7.4406	3	.0591

- - - - - Kruskal-Wallis 1-Way Anova

BP27
by GRADE_CO grade code

Mean Rank	Cases	
120.28	20	GRADE_CO = 0
148.98	94	GRADE_CO = 1
130.28	144	GRADE_CO = 2
163.53	17	GRADE_CO = 3

	275	Total

			Corrected for ties		
Chi-Square	D.F.	Significance	Chi-Square	D.F.	Significance
5.8929	3	.1169	6.9339	3	.0740

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BP30
by GRADE_CO grade code

Mean Rank	Cases	
101.35	20	GRADE_CO = 0
158.37	95	GRADE_CO = 1
126.00	144	GRADE_CO = 2
177.03	17	GRADE_CO = 3

	276	Total

Chi-Square	D.F.	Significance	Corrected for ties Chi-Square	D.F.	Significance
17.7097	3	.0005	19.3086	3	.0002

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BP33
by GRADE_CO grade code

Mean Rank	Cases	
91.03	20	GRADE_CO = 0
166.89	95	GRADE_CO = 1
124.41	144	GRADE_CO = 2
155.03	17	GRADE_CO = 3

	276	Total

Chi-Square	D.F.	Significance	Corrected for ties Chi-Square	D.F.	Significance
24.3143	3	.0000	27.1945	3	.0000

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BP34
by GRADE_CO grade code

Mean Rank	Cases	
78.03	20	GRADE_CO = 0
159.22	95	GRADE_CO = 1
130.08	144	GRADE_CO = 2
165.21	17	GRADE_CO = 3

	276	Total

Chi-Square	D.F.	Significance	Corrected for ties Chi-Square	D.F.	Significance
21.3855	3	.0001	25.0568	3	.0000

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BP35
by GRADE_CO grade code

Mean Rank	Cases	
167.93	20	GRADE_CO = 0
104.06	95	GRADE_CO = 1
152.28	144	GRADE_CO = 2
179.65	17	GRADE_CO = 3
	—	
	276	Total

Chi-Square	D.F.	Significance	Corrected for ties Chi-Square	D.F.	Significance
29.2150	3	.0000	32.1634	3	.0000

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13. ABSTRACT *(Maximum 200 words)*
The National Aeronautics and Space Administration holds summer teacher workshops to motivate teachers to use space science in their lessons. In evaluating these workshops, the areas of interest were participant beliefs about science and science teaching and concerns about educational change and innovation. The teachers attending workshops in 1995, past participants, teachers that received materials but had not attended a workshop, and science researchers were surveyed using the Beliefs about Science and Science Education Survey and/or the Stages of Concern Questionaire. Comparisons were made by workshop length, time since workshop, and highest grade taught. Reductions in concerns were most evident in the four week workshop. Changes in beliefs were also abserved relative to teaching approach and ability. Differences in beliefs were observed between teachers and science researchers. Differences were also observed relative to time since attendance and by grade level taught. It is recommended that the workshops be at least four weeks in length and in length and target specific grade levels, that refresher workshops be offered

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