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## Paper Session II-C - Measuring the Concerns of Teachers: A Possible Means for Evaluating the Efficacy of Kennedy Space Center Teacher Enhancement Workshops

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## Measuring the Concerns of Teachers: A Possible Means for Evaluating the Efficacy of Kennedy Space Center Teacher Enhancement Workshops.

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### EXECUTIVE SUMMARY

In-service teacher enhancement workshops are held as part of the NASA teacher preparation and enhancement programs. For these workshops, teachers are brought to NASA field centers during summer months for training in various aerospace related areas. The National Research Council, Committee on NASA Education Program Outcomes (NEPO) has recommended comprehensive data collection to show program efficacy. Teacher workshops are a part of the nearly 300 NASA educational programs for students and teachers from pre-school through post-graduate, and NEPO has made specific recommendations for the evaluation of the teacher workshops. In accordance with one recommendation, a questionnaire was administered during four of the summer 1995 teacher workshops to measure participant concerns about using workshop material (space science) in their classes. Participant responses to the questions reflect changes in concerns relative to using workshop materials in teaching. (Work performed under NASA contract: NAS10-12180)

### INTRODUCTION

#### NASA Education Programs

There is a persistent national concern for 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). The National Aeronautics and Space Administration (NASA) administers educational programs encompassing all age groups from preschool through graduate school and post-doctoral research (NASA, 1993). The National Research Council (NRC) Committee on NASA Education Program Outcomes (NEPO) reports that almost 300 of these programs exist (NRC, 1994).

Inservice teacher workshops are held as part of Teacher Preparation and Enhancement Programs. Teachers are brought to NASA field centers during the summer months for training in various aerospace related areas. Each summer, since 1984, teacher workshops have been hosted by the NASA Public Affairs Office, Education Services Branch (PA-ESB), at Kennedy Space Center (KSC). As with other NASA programs, the effectiveness of educational programs is of concern due to the time and funds involved.

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. They recommended comprehensive data collection 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).

### Teacher Concerns about Change

Teacher concerns have become of particular interest because of their impact on the classroom. The Concerns Based Adoption Model (CBAM) was developed to describe the effect of educational change and the use of innovations in teaching. Seven stages of concern make up this model (Hall, George and Rutherford 1977). These stages of concern are listed with the NEPO goal or outcome indicators that they relate to in Table 1. Hall, George, and Rutherford (1974) developed the Stages of Concern Questionnaire (SoCQ) which is intended to provide a framework and diagnostic tools for the development and enhancement of inservice training. This has been found to be valuable in evaluating curriculum and staff development activities (O'Brien, 1992). The stage of concern varies relative to exposure (O'Brien, 1987), peaking at the level of concern that is exhibited most strongly. This can be used to predict use of the innovation, which in this case is the use of space science in teaching. Prior research indicates that this can be done with a better than 900/0 accuracy (Rutherford and George, 1978).

Lombard, Konicek and Schultz (1985) used the SoCQ with secondary science teachers. They observed a shift during the workshop from concerns about awareness to concerns about collaboration. In a study with teachers of various grade levels, O'Brien (1987) found that the workshop was successful in advancing the level of teachers' concerns about chemical demonstrations. Showers, Joyce, and Bennett (1987) evaluated over 200 research studies and found that teacher characteristics such as self-esteem, enthusiasm, and flexibility contribute significantly to teacher effectiveness.

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 concerns pertaining to educational innovations.

### RESEARCH QUESTIONS

Two research questions were investigated in this study:

- 1) Is there a difference in the level and degree of concern for using Space Science in teaching before and after participation in the workshops?
- 2) Are differences dependent on workshop length?

Table 1. Stages of Concern and NASA Education Programs Outcomes (NEPO) Committee-Indicators and Goals

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

## METHODS AND MATERIALS

The target population is southeastern United States teachers and accessible population was teachers involved in NASA-Kennedy Space Center teacher workshops. Teachers participated in summer 1995 NASA-Kennedy Space Center workshops of varying lengths. The workshop samples were teachers completing the instruments while attending: 1) The Summer Teacher Enhancement Program (Step) with 25 kindergarten through high school teachers for four weeks; 2) The Brevard Summer Science and Mathematics Institute (SS&M), consisting of 17 Brevard County teachers with a length of three weeks; 3) The NASA Educators Workshop for Elementary School Teachers (Newest) consisting of 16 elementary school teachers from across the U. S. (two weeks) and; 4) a University of South Florida (USF) teachers workshop with 19 teachers for one week.

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 of me /Somewhat true of me /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.

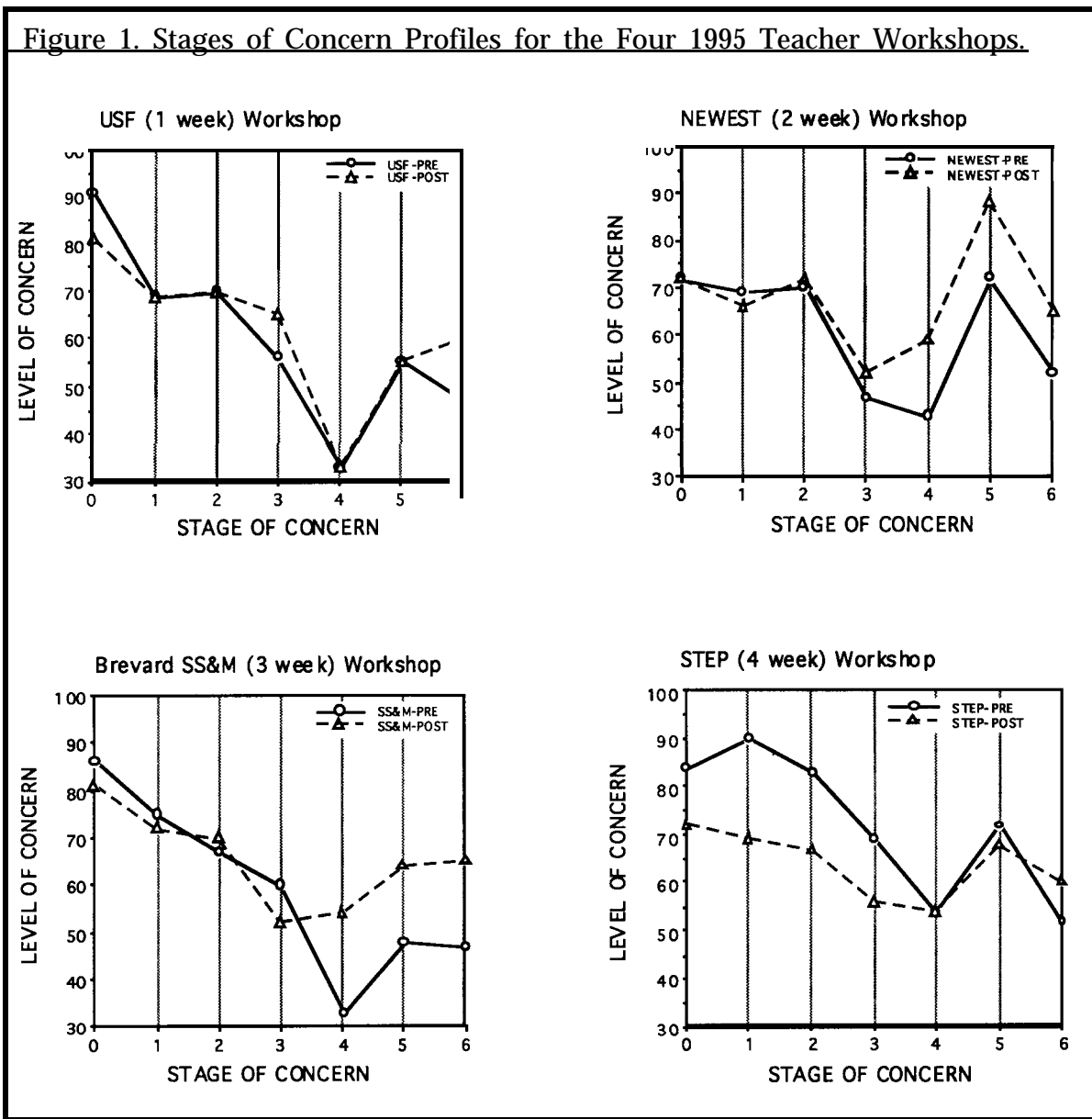
Differences between the pretest and posttest from the 1995 workshops were used to identify changes that occurred during the workshop. Changes in the level of concern over using workshop materials indicate areas where program content and instructional approaches facilitate changes in teacher concerns 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).

## RESULTS AND DISCUSSION

The Stages of Concern mean values for each workshop, 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 Figure 1. These profiles are 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 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.

Figure 1. Stages of Concern Profiles for the Four 1995 Teacher Workshops.



Inferential statistics were performed on the raw scores taken from the SoCQ, 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 in this study, 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 the paired t-test for each Stage of Concern by workshop are presented in Table 2.

**Table 2. Results of 2-Tailed t-test (t-values) for the Stages of Concern**

<u>Workshop</u>	<u>Stage 0</u>	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>	<u>Stage 4</u>	<u>Stage 5</u>	<u>Stage 6</u>
	<u>Awareness</u>	<u>Informational</u>	<u>Personal</u>	<u>Management</u>	<u>Consequence</u>	<u>Collaboration</u>	<u>Refocusing</u>
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  $\alpha= 0.05$ .

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).

The results of this study indicate that there was an effect of the length of the workshop on the understanding of and confidence in using the workshop materials. When the samples were pooled and participation in the workshops was examined (total), 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.

## CONCLUSIONS AND RECOMMENDATIONS

The Concerns-Based Adoption Model (CBAM) was used in this study to answer the two research questions. Differences were demonstrated in the levels of the seven Stages of Concern before and after participation. Differences were also demonstrated between workshop lengths as indicated by different changes in the levels of the Stages of Concern in each workshop. The change in responses indicate that a four-week workshop facilitated greater change in the levels of the Stages of Concern than one-, two-, and three-week workshops, particularly in the areas that would indicate workshop success (awareness, informational, and personal). The shifts in the Stages of Concern observed from the pooled data set are consistent with observations made by other researchers.

The current study demonstrates the utility of the CBAM in evaluating the NASA teacher workshops held at Kennedy Space Center. It is recommended that this tool continue to be utilized to evaluate these programs. The increase in concerns over consequence, collaboration and refocusing indicate that greater emphasis should be placed on facilitating teacher networking and on demonstrating how the materials might be incorporated into lesson plans. Activities such as lesson plan development near the end of the workshop, with collaboration between participants should be given greater emphasis. Follow-up inservice training or participation in a second-year workshop may help to address these concerns.

## LIMITATIONS

This study was pre-experimental in design. The lack of random selection and random assignment limits the ecological validity (application to other teacher populations). 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 this form of training. The conclusions from this study must be limited to teachers with this characteristic. 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 and covered different time frames. Thus, the amount of material and the emphasis on the various workshop materials differed. This fact may limit the degree to which comparisons are made between the different workshops.

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