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AUTHOR Enochs, Larry G.; Riggs, Iris M.

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ABSTRACT

If elementary science education is to be improved, elementary teachers must be willing to devote more time and energy to the curriculum. Increased self-efficacy and outcome expectancy beliefs were predicted antecedents to the behavior change. This study was designed to provide a valid and reliable measure of the teacher self-efficacy of preservice elementary science teachers. In order to do this, the Riggs (1988) Science Teaching Efficacy Belief Instrument (STEBI) Form A was modified from an inservice orientation to measure the beliefs of elementary preservice teachers. Based upon Bandura's social learning theory, the two-sub scales of STEBI (Form B) measure constructs of self-efficacy and outcome expectancy with regard to science teaching and learning. Item and factor analyses revealed that the scales are homogeneous and distinct, and the new form (Form B) is consistent with the previous form. Twenty-two references, five tables and the survey instruments are attached. (YP)

Further Development of an Elementary Science Teaching Efficacy Belief Instrument: A Preservice Elementary Scale

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Further Development of an Elementary Science Teaching Efficacy Belief Instrument: A Preservice Elementary Scale

Larry G. Enochs
Center for Science Education
Kansas State University
Manhattan, KS 66506

and

Iris M. Riggs
School of Education
California State University, San Bernardino
San Bernardino, CA 92407

A paper presented at the annual meeting of the National Association of Research in Science Teaching, Atlanta, GA, April 8 - 11, 1990.

ABSTRACT

FURTHER DEVELOPMENT OF AN ELEMENTARY SCIENCE TEACHING EFFICACY BELIEF INSTRUMENT: A PRESERVICE ELEMENTARY SCALE

The Science Teaching Efficacy Belief Instrument (STEBI) Form A was revised to measure the beliefs of elementary preservice, rather than inservice, teachers. Based upon Bandura's social learning theory, the two sub-scales of STEBI (Form B) measure constructs of self-efficacy and outcome expectancy with regard to science teaching and learning.

Item and factor analyses revealed results consistent with previous research (Riggs, 1988). The scales are homogeneous and distinct.

The STEBI (Form B) should be helpful in future investigations of elementary preservice training. Behavior is based upon beliefs. If elementary science education is to be improved, elementary teachers must be willing to devote more time and energy to this curriculum. Increased self-efficacy and outcome expectancy beliefs are predicted antecedents to this behavior change.

Further Development of an Elementary Science Teaching Efficacy Belief Instrument: A Preservice Elementary Scale

Introduction

A national survey conducted by Weiss (1978) pointed out that elementary teachers' perceptions concerning their qualifications for teaching science were consistent with the amount of time they spent teaching it. The results of this survey also indicated that elementary teachers teach science an average of 17 minutes per day as opposed to about 90 minutes per day for reading. More recently, Schoenberger and Russell (1986) found that even when the official curricula prescribed the teaching of science, it was "...not taught regularly or effectively in many classrooms" (p. 536). Based on their case studies conducted across the United States, Stake and Easley (1978) suggested that fewer than half of the nation's youngsters are likely to have even"... a single elementary year in which their teacher would give science a significant share of the curriculum and do a good job of teaching it" (p. 19:3). Several reasons are given for this state of affairs. These include, lack of a strong background in science content (Franz & Enochs, 1982, and Hurd, 1982); inadequate facilities and equipment (Helgeson et al. 1977, and Weiss, 1978); the crowded curriculum (Helgeson et al. 1977, and Weiss, 1978); poor instructional leadership (Edmonds, 1979, and Fitch & Fisher, 1979); and teacher attitude (Morrisey, 1981, and Koballa & Crawley, 1985). Teacher belief systems, however, have not been a focus of studies which investigate behavior patterns of elementary science teachers.

Beliefs are part of the foundation upon which behaviors are based. Several studies investigating teacher efficacy beliefs indicate that these beliefs may account for individual differences in teacher effectiveness (Armor et al., 1976; Berman & McLaughlin, 1977; and Brookover et al., 1981). Beliefs have been closely associated with behavior in Bandura's theory of social learning (1977). Bandura suggests that people develop a generalized expectancy concerning action-outcome contingencies based upon life experiences. In addition, they develop specific beliefs concerning their own coping abilities. Bandura called this self-efficacy (1977). Behavior is enacted when people not only expect specific behavior to result in desirable outcomes (outcome expectancy), but they also believe in their own ability to perform the behavior (self-efficacy). If Bandura's theory of self-efficacy is applied to the study of teachers, we might predict that "...teachers who believe student learning can be influenced by effective teaching (outcome expectancy beliefs) and who also have confidence in their own teaching abilities (self-efficacy beliefs) should persist longer, provide a greater academic focus in the classroom, and exhibit different types of feedback than teachers who have lower expectations concerning their ability to influence student learning" (Gibson & Dembo, 1984, p.570).

Bandura (1981) defines self-efficacy as a situation-specific construct. Thus, if this theory is applied to elementary science teaching, it may help to explain elementary teachers' thought patterns, affective reactions, and behaviors in regard to science teaching. Bandura states that "from the social learning perspective, it is no more informative to speak of self-efficacy in global terms than to speak of nonspecific social behavior"(1981, p. 227). Specificity is especially necessary when studying elementary science teaching beliefs and behavior, since elementary teachers teach all subjects and may not be equally effective in teaching all of them. Thus, a specific measure of science teaching efficacy beliefs should more accurately predict science teaching behavior and help teacher educators effect more positive change. Denham and Michael (1981) summarize their discussion of teacher sense of efficacy by posing questions for future study. One question concerned how this construct could be measured. An instrument has been developed by Gibson and Dembo (1984) to measure teacher self efficacy in general terms. Using that measure as a model, Riggs (1988) developed an instrument to specifically assess science teacher self-efficacy and outcome expectancy beliefs of inservice elementary teachers. This instrument holds promise for staff development programs but does not address the needs of investigators of elementary teachers' preservice education.

Ashton (1984) suggested that teacher education programs might utilize teacher efficacy belief instruments to assist preservice teachers in clarifying their beliefs and "...develop a well-organized conception of how these beliefs would be represented in behavior"(p.29). According to Bandura (1981), "People tend to avoid situations they believe exceed their capabilities, but they undertake and perform with assurance activities they judge themselves capable of handling" (p. 201). Teacher education programs need to provide more than science content and methodology for future elementary teachers. Bandura (1981) suggests that self-efficacy can be enhanced through modeling and successful mastery experiences. These techniques are easily fitted into existing elementary programs through microteaching and field experiences.

Purpose of Study

This study was designed to provide a valid and reliable measure of the teacher self-efficacy of preservice elementary science teachers. In order to accomplish this, the Riggs (1988) Science Teaching Efficacy Belief Instrument Form A (STEBI A) was modified from an inservice orientation to that of preservice. The new instrument consisted of two scales that were consistent with

Bandura's theory (Bandura, 1981) as suggested by Gibson and Dembo (1984).

Description of the Original Scale

The two scales in the STEBI A, designed for inservice teachers, were entitled Personal Science Teaching Efficacy Belief Scale (self-efficacy dimension) and Science Teaching Outcome Expectancy Scale (outcome expectancy dimension). The STEBI A was a five choice, Likert-type scale for inservice teachers. A sample item from the STEBI A is shown below:

STEBI A (Inservice) Sample Item

3. Even if I try very hard, I do not teach science as well as I do most subjects. SA A UN D SD

There were 25 statements, 13 positively-written and 12 negatively-written. The coefficient alpha for the Personal Science Teaching Efficacy Belief Scale was 0.92 while the alpha for the Science Teaching Outcome Expectancy Scale was 0.77 (Riggs & Enochs, 1990).

Methodology

In order to develop the STEBI B (Preservice version), the items were reworded in the future tense. A sample item is depicted below:

STEBI B (Preservice) Sample Item

3. Even if I try very hard, I will not teach science as well as I will most subjects. SA A UN D SD

A panel of 5 science educators were consulted to ensure agreement in the new items, content validation, in terms of their integrity with the constructs measured in the first instrument (STEBI A). All agreed. The initial STEBI B instrument consisted of 25 items in the Likert-type scale format (see Figure A).

Insert Figure A

Response categories were "strongly agree", "agree", "uncertain", "disagree", and "strongly disagree". It was scored by assigning 5 to positively worded items receiving "strongly agree" down to 1 for "strongly disagree". Negatively phrased items had their scores reversed.

The Sample

The STEBI B was administered to 212 preservice elementary teachers in California and Kansas. Demographic characteristics of the study's sample are illustrated in Table 1.

Insert Table 1

A t-Test was run to determine if the California and Kansas teachers responded differently in the study. No significant difference was found between these populations on all instruments and the questionnaire used in this study. Thus, the populations were assumed to be equivalent.

Reliability

In order to assess the reliability of the STEBI B, Cronbach's alpha coefficient was used. In addition an item-total item correlation was also determined.

Validity

Construct validity was determined by way of factor analysis. Confirmatory factor analysis was utilized to determine the construct validity of each hypothesized scale. According to Kim & Mueller (1978), "The minimum requirement of any confirmatory factor analysis is that one hypothesize before hand the number of common factors (p. 55)." Considering Bandura's theory, 2 factors, outcome expectancy beliefs and self efficacy beliefs, were requested in the analysis. Since the two scales were found to modestly correlated (r = 0.46) an oblique minimum rotation was used (Kim & Mueller, 1978).

Additional criteria for establishing validity were selected. The Subject Preference Inventory (SPI) developed by Markle, (1978) was used to compare the 2 scales with the preference to teach science. It was expected that a high correlation would exist between both scales and the preference to teach science. The SPI requires a forced choice among all possible pairs of 7 subjects (mathematics, science, health, language arts, reading, social studies, and music). The highest possible score for any subject is 7. Only the results on science were used in this study. Validity for the SPI was assessed by comparing 28 preservice elementary teachers' SPI science scores with the science related teaching actions in the elementary classroom. The internal consistency of responses was determined to be 0.86.

Lastly, a study-specific questionnaire (Figure B) was administered to determine the number of college science courses, number of high school science courses, choice to teach science, use of activity-based science teaching, and science teaching self rating.

Insert Figure B

It was hypothesized and confirmed, for preservice teachers, that these factors were correlated with both scales (Riggs, 1988).

A significant correlation was expected between both scales and these variables.

Results

Results of the study indicate that the STEBI B is a valid and reliable measure of personal science teaching efficacy and science teaching outcome expectancy for preservice elementary teachers. The means and standard deviations for items and total scales are contained in Table 2.

Insert Table 2

Reliability analysis of the Personal Science Teaching Efficacy Scale produced an alpha coefficient of .90 with all thirteen items obtaining a corrected item-total correlation of .49 and above (See Table 3). Further analysis of this scale using factor analysis revealed that all 13 items loaded highly with their own scale (Table 3).

Insert Table 3

The Science Teaching Outcome Expectancy Scale produced an alpha coefficient of .76. The lowest corrected item-total correlation for an item from this scale was .30. Factor analysis results indicated that ten of the twelve items to load most highly with their own scale (Table 3). Items 20 and 25 cross loaded and were removed from the instrument.

Pearson correlations run on additionally collected self-report data produced positive correlations between both scales and students' number of college science courses taken, acceptance of responsibility for science teaching, opinion on how much time should be spent teaching science, advocacy of activity-based science instruction, subject preference as measured by the Subject Preference Inventory (Markle, 1978) and self-rating of effectiveness as a future teacher of elementary science. The number of high school science courses taken correlated only with the Personal Science Teaching Efficacy Belief Scale (Table 4).

Insert Table 4

A final analysis was made with items 20 and 25 removed. Results are depicted in Table 5.

Insert Table 5

The results indicate that factor loadings and item-total item correlations changed very little and, thus, the final version of the instrument contained homogeneous scales.

Discussion

Results of this study suggest the STEBI B is a valid and reliable instrument, ready to facilitate future investigation of elementary preservice training. Both scales are distinct and homogeneous. The slightly lower reliability of the Science Teaching Outcome Expectancy Scale is consistent with previous researchers' findings (Riggs & Enochs, 1990; and Gibson & Dembo 1984). Items 20 and 25 of the Science Teaching Outcome Expectancy Scale, were dropped from the instrument due to their cross-loading. Thus, the final version of the STEBI B is made up of 23 items, 13 on the Personal Science Teaching Efficacy Belief Scale, and 10 on the Science Teaching Outcome Expectancy Scale (Figure C).

Insert Figure C

Both scales should further enlighten the quest for understanding of why elementary teachers avoid the teaching of science. Teachers who devote less time to science teaching may not believe they have the ability to teach science, or they might believe it impossible for any teacher, effective or not, to effect science learning given external variables. Change in teacher behavior is dependent upon attention to the belief systems of teachers themselves. Teacher educators must be aware of their students' beliefs and plan for experiences which will have positive impact on teacher self-efficacy and outcome expectancy.

Finally, the assessment of science teaching efficacy can provide important insight into the training of elementary teachers. Early detection of low efficacy in science teaching can be valuable in providing specific activities for preservice students. Field experiences, peer teaching, and the self evaluation of microteaching have promise in the enhancement of science teaching self efficacy. Further research into the impact of such activities on efficacy needs to be done.

Scoring the STEBI B

In order to facilitate the use of the STEBI B, a scoring protocol is provided in Figure D.

Insert Figure D

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TABLE 1

Demographic Characteristics of Subject Sample (n = 212)

Variable		Frequency	%
Gender:			
	Female	184	87.2%
	Male	27	12.8%
Number of College Science Courses:			
	0	9	4.4%
	1	21	10.2%
	2	66	32.0%
	3	45	21.8%
	4	26	12.6%
	5	17	8.3%
	6	6	2.9%
	7	3	1.5%
	8	3	1.5%
	9	2	1.0%
	10	3	1.5%
	11	3	1.5%
	12	1	0.4%
	13	1	0.4%
Number of High School Science Courses:			
	0	4	2.0%
	1	26	12.7%
	2	81	39.7%
	3	43	21.1%
	4	47	23.0%
	5	2	1.0%
	6	1	0.5%

TABLE 2

Item Means and Standard Deviations:
Initial Instrument (n = 212)

	Measure	Pos-Neg	Mean	Std Dev
Personal Science Teaching Efficacy Belief Scale	Item 2	P	4.26	0.67
	Item 3	N	3.66	1.06
	Item 5	P	2.72	0.90
	Item 6	N	3.81	0.84
	Item 8	N	4.12	0.73
	Item 12	P	3.48	0.90
	Item 17	N	3.57	0.91
	Item 18	P	3.46	0.80
	Item 19	N	2.96	1.13
	Item 21[1]	N	3.41	1.05
	Item 22[2]	N	3.81	0.77
	Item 23[3]	P	4.32	0.68
	Item 24[4]	N	3.43	1.00
	Total Scale		47.00	7.74
Science Teaching Outcome Expectancy Scale	Item 1	P	3.79	0.87
	Item 4	P	4.22	0.66
	Item 7	P	3.34	0.96
	Item 9	P	3.92	0.82
	Item 10	N	2.83	0.95
	Item 11	P	3.77	0.80
	Item 13	N	3.40	1.03
	Item 14	P	3.50	0.78
	Item 15	P	3.55	0.86
	Item 16	P	3.86	0.72
	Item 20[5]	N	3.75	0.92
	Item 25[6]	N	2.90	1.11
	Total Scale		42.84	5.56

[1] Item 21 on initial instrument = Item 20 on final instrument
[2] Item 22 on initial instrument = Item 21 on final instrument
[3] Item 23 on initial instrument = Item 22 on final instrument
[4] Item 24 on initial instrument = Item 23 on final instrument
[5] Item 20 on initial instrument omitted on final instrument
[6] Item 25 on initial instrument omitted on final instrument

TABLE 3

Corrected Item-Total Correlations and Factor Loadings: Initial Instrument (n = 212)

	Measure	Pos-Neg	I-T Cor	Factor Loadings Fact 1	Fact 2
Personal Science Teaching Efficacy Belief Scale	Item 2	P	0.53	0.47	0.24
	Item 3	N	0.61	0.70	- 0.07
	Item 5	P	0.51	0.50	0.02
	Item 6	N	0.60	0.63	0.02
	Item 8	N	0.70	0.74	0.00
	Item 12	P	0.55	0.51	0.08
	Item 17	N	0.72	0.81	- 0.09
	Item 18	P	0.56	0.56	0.01
	Item 19	N	0.67	0.74	- 0.05
	Item 21	N	0.61	0.71	- 0.11
	Item 22	N	0.59	0.62	0.03
	Item 23	P	0.49	0.50	0.05
	Item 24	N	0.68	0.73	- 0.04
Total Scale Alpha = .90					
Science Teaching Outcome Expectancy Scale	Item 1	P	0.39	0.08	0.46
	Item 4	P	0.36	0.07	0.44
	Item 7	P	0.39	0.07	0.46
	Item 9	P	0.31	- 0.02	0.40
	Item 10	N	0.39	0.24	0.32
	Item 11	P	0.35	- 0.09	0.51
	Item 13	N	0.34	0.16	0.21
	Item 14	P	0.51	- 0.05	0.65
	Item 15	P	0.57	- 0.03	0.76
	Item 16	P	0.38	- 0.02	0.54
	Item 20*	N	0.36	0.27	0.20
	Item 25*	N	0.30	0.35	0.03
Total Scale Alpha = .77					

* These items cross loaded and were omitted in the final scale.

TABLE 4

Validity Coefficients: Final Instrument

(n = 212)

Validity Criteria	**SESCALE** r	**OESCALE** r
Number of College Science Classes	.27 **	.15 *
Number of High School Science Classes	.12 *	-.02
Choice to Teach Science	.58 **	.34 **
Use of Activity-Based Teaching	.13 *	.31 **
Science Teaching Self Ratings	.58 **	.24 **
Subject Preference	.45 **	.29 **
SESCALE		.46 **

* $p < .05$

** $p < .01$

TABLE 5

Corrected Item-Total Correlations and Factor Loadings: Final Instrument (n = 212)

	Measure	Pos-Neg	I-T Cor	Factor Fact 1	Loadings Fact 2
Personal	Item 2	P	0.53	0.47	0.24
Science	Item 3	N	0.61	0.69	- 0.06
Teaching	Item 5	P	0.51	0.51	0.03
Efficacy	Item 6	N	0.60	0.63	0.02
Belief	Item 8	N	0.70	0.74	0.01
Scale	Item 12	P	0.55	0.52	0.10
	Item 17	N	0.72	0.81	- 0.07
	Item 18	P	0.56	0.57	0.03
	Item 19	N	0.67	0.73	- 0.03
	Item 20	N	0.61	0.70	- 0.10
	Item 21	N	0.59	0.62	0.04
	Item 22	P	0.49	0.50	0.05
	Item 23	N	0.68	0.72	- 0.03
Total Scale Alpha = .90					
Science	Item 1	P	0.42	0.09	0.47
Teaching	Item 4	P	0.42	0.08	0.45
Outcome	Item 7	P	0.46	0.05	0.47
Expectancy	Item 9	P	0.31	- 0.02	0.39
Scale	Item 10	N	0.41	0.22	0.33
	Item 11	P	0.38	- 0.09	0.51
	Item 13	N	0.26	0.14	0.22
	Item 14	P	0.53	- 0.05	0.65
	Item 15	P	0.63	- 0.04	0.76
	Item 16	P	0.42	- 0.02	0.53
Total Scale Alpha = .76					

*Note: Item numbers correspond to items in Figure C (Final Scale).

Figure A

STEBI FORM B (Initial Instrument)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

SA = STRONGLY AGREE
A = AGREE
UN = UNCERTAIN
D = DISAGREE
SD = STRONGLY DISAGREE

1.	When a student does better than usual in science, it is often because the teacher exerted a little extra effort.	SA A UN D SD
2.	I will continually find better ways to teach science.	SA A UN D SD
3.	Even if I try very hard, I will not teach science as well as I will most subjects.	SA A UN D SD
4.	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	SA A UN D SD
5.	I know the steps necessary to teach science concepts effectively.	SA A UN D SD
6.	I will not be very effective in monitoring science experiments.	SA A UN D SD
7.	If students are underachieving in science, it is most likely due to ineffective science teaching.	SA A UN D SD
8	I will generally teach science ineffectively.	SA A UN D SD
9.	The inadequacy of a student's science background can be overcome by good teaching.	SA A UN D SD
10.	The low science achievement of some students cannot generally be blamed on their teachers.	SA A UN D SD
11.	When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	SA A UN D SD
12.	I understand science concepts well enough to be effective in teaching elementary science.	SA A UN D SD
13.	Increased effort in science teaching produces little change in some students' science achievement.	SA A UN D SD

14. The teacher is generally responsible for the achievement of students in science. SA A UN D SD

15. Students' achievement in science is directly related to their teacher's effectiveness in science teaching. SA A UN D SD

16. If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher. SA A UN D SD

17. I will find it difficult to explain to students why science experiments work. SA A UN D SD

18. I will typically be able to answer students' science questions. SA A UN D SD

19. I wonder if I will have the necessary skills to teach science. SA A UN D SD

20. Effectiveness in science teaching has little influence on the achievement of students with low motivation. SA A UN D SD

21. Given a choice, I will not invite the principal to evaluate my science teaching. SA A UN D SD

22. When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand it better. SA A UN D SD

23. When teaching science, I will usually welcome student questions. SA A UN D SD

24. I do not know what to do to turn students on to science. SA A UN D SD

25. Even teachers with good science teaching abilities cannot help some kids to learn science. SA A UN D SD

Figure B

Questionnaire

Gender ___F ___M Number of College Science Courses __________

Number of Years of High School Science (9th grade or above)__________

1. If you have your choice, will you choose to be the one to teach science to your elementary students?

   a. Definitely No
   b. Probably No
   c. Not Sure
   d. Probably Yes
   e. Definitely Yes

2. The major portion of my time in science instruction should be spent in:

   a. Textbook-Based Presentation Only
   b. More Textbook-Based Presentation Than Anything Else
   c. An Equal Amount of Textbook-Based Presentation and Activity-Based Instruction
   d. More Activity-Based Instruction Than Textbook-Based Presentation
   e. Activity-Based Instruction Only

3. Please rate how you think you will view your own effectiveness as a future teacher of elementary science.

   a. Superior--One of the Most Outstanding Teachers of Elementary Science in the Building; A Master Teacher of Elementary Science
   b. Above Average
   c. Average--A Typical Teacher of Elementary Science
   d. Below Average
   e. Low--One of the Least Effective Teachers of Elementary Science; In Need of Professional Improvement in This Area

Figure C

STEBI FORM B (Final Instrument)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

SA = STRONGLY AGREE
A = AGREE
UN = UNCERTAIN
D = DISAGREE
SD = STRONGLY DISAGREE

1.	When a student does better than usual in science, it is often because the teacher exerted a little extra effort.	SA A UN D SD
2.	I will continually find better ways to teach science.	SA A UN D SD
3.	Even if I try very hard, I will not teach science as well as I will most subjects.	SA A UN D SD
4.	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	SA A UN D SD
5.	I know the steps necessary to teach science concepts effectively.	SA A UN D SD
6.	I will not be very effective in monitoring science experiments.	SA A UN D SD
7.	If students are underachieving in science, it is most likely due to ineffective science teaching.	SA A UN D SD
8.	I will generally teach science ineffectively.	SA A UN D SD
9.	The inadequacy of a student's science background can be overcome by good teaching.	SA A UN D SD
10.	The low science achievement of some students cannot generally be blamed on their teachers.	SA A UN D SD
11.	When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	SA A UN D SD
12.	I understand science concepts well enough to be effective in teaching elementary science.	SA A UN D SD
13.	Increased effort in science teaching produces little change in some students' science achievement.	SA A UN D SD

14. The teacher is generally responsible for the achievement of students in science. SA A UN D SD

15. Students' achievement in science is directly related to their teacher's effectiveness in science teaching. SA A UN D SD

16. If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher. SA A UN D SD

17. I will find it difficult to explain to students why science experiments work. SA A UN D SD

18. I will typically be able to answer students' science questions. SA A UN D SD

19. I wonder if I will have the necessary skills to teach science. SA A UN D SD

20. Given a choice, I will not invite the principal to evaluate my science teaching. SA A UN D SD

21. When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand it better. SA A UN D SD

22. When teaching science, I will usually welcome student questions. SA A UN D SD

23. I do not know what to do to turn students on to science. SA A UN D SD

FIGURE D

STEBI FORM B SCORING INSTRUCTIONS

Step 1. Item Scoring: Items must be scored as follows: Strongly Agree = 5; Agree = 4; Uncertain = 3; Disagree = 2; and Strongly Agree = 1.

Step 2. The following items must be reverse scored in order to produce consistent values between positively and negatively worded items. Reversing these items will produce high scores for those high and low scores for those low in efficacy and outcome expectancy beliefs.

Item 3	Item 17
Item 6	Item 19
Item 8	Item 20
Item 10	Item 21
Item 13	Item 23

In SPSSx, this reverse scoring can be accomplished by using the RECODE command. For example, recode ITEM3 with the following command:

```
RECODE   ITEM3  (5=1) (4=2) (2=4) (1=5)
```

Step 3. Items for the two scales are scattered randomly throughout the STEBI B. The items designed to measure Personal Science Teaching Efficacy Belief are as follows:

Item 2	Item 12	Item 20
Item 3	Item 17	Item 21
Item 5	Item 18	Item 22
Item 6	Item 19	Item 23
Item 8		

Items designed to measure Outcome Expectancy are as follows:

Item 1	Item 10	Item 15
Item 4	Item 11	Item 16
Item 7	Item 13	
Item 9	Item 14	

Note: In the computer program, DO NOT sum scale scores before the RECODE procedures have been completed. In SPSSx, this summation may be accomplished by the following COMPUTE command:

```
COMPUTE  ESCALE=ITEM2+ITEM3+ITEM5+ITEM6+ITEM8+ITEM12+ITEM17+ITEM18+
     ITEM19+ITEM20+ITEM21+ITEM22+ITEM23
COMPUTE  OESCALE=ITEM1+ITEM4+ITEM7+ITEM9+ITEM10+ITEM11+ITEM13+
     ITEM14+ITEM15+ITEM16
```