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A Biology Attitude Scale

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EFFECTIVE CURRICULUM DEVELOPERS are seldom concerned only with the attainment of cognitive objectives. An important consequence of instruction is the students' attitude toward the subject. There is usually positive correlation between attitudes and achievement, but we *cannot* assume a positive attitude on the basis of achievement alone. It is possible for a student with low achievement to have developed a very positive attitude toward the subject matter, but it is also possible that a student who indicates on posttests that he has learned the subject matter well may also have learned to dislike or, worse yet, hate the content.

It is very important for teachers to be aware of the attitudinal characteristics of their students. As Mager (1968) puts it:

> The likelihood of the student putting his knowledge to use is influenced by his *attitude* for or against the subject. Things disliked have a way of being forgotten.... One objective toward which to strive is that of having the student leave your influence with as *favorable* an attitude toward your subject as possible. In this way you will help to maximize the possibility that he will *remember* what he has been taught, and will willingly *learn more* about what he has been taught.

Needless to say, it is impossible to measure attitudes directly, just as it is impossible to assess learning directly. As in the case of learning, educators must rely on observed behavior to infer attitudes.

Because of the difficulties inherent in determining attitudes by observing spontaneous action, most common evaluations of attitude rely on some form of verbal response. A direct question can be used, such as "Do you like biology?" This technique is very time-consuming both for the student who must write out his response and the teacher who must analyze the responses and report them objectively. Another consideration that must be kept in mind when asking direct questions is that the student may be reluctant to express his true feelings to the teacher. A student may say what he thinks the teacher wants to hear if he feels that his attitudes may have some influence on the grade he receives in the course. One way to get around the issue is to use an anonymous questionnaire. Questionnaires provide for more uniformity from one measure to another because of their standardized format.

In order to attempt to quantify attitudes it is possible to use attitude scales that provide a quantitative method for assessing an individual's relative position along a unidimensional attitude continuum.

Characteristics of Attitude Scales

When using paper-and-pencil attitude scales, the students respond in terms of their feelings about individual statements. There is no single correct answer. Each response indicates a degree of positive or negative feeling toward something. The statement used in constructing attitude scales should be clear, brief, and unambiguous. Each statement should contain only one complete thought or idea that is stated, if possible, in a simple rather than a compound sentence.

Because the purpose of an attitude scale is to differentiate between varying levels of attitudes, items should be included in the scale which reflect the entire range of feelings, from strongly favorable through neutral to strongly unfavorable. If a statement is equally likely to be endorsed by persons with favorable and unfavorable attitudes, then it obviously will be of no value in differentiating between the students and should not be included on the scale.

There are two kinds of attitude scales—the Likert-type scale and the semantic differential scale.

The Likert-type scale, named for the man who initiated the response method of scale construction, is the most widely used (Edwards 1957). The student indicates the *degree* to which he agrees or disagrees with a series of statements. The statements are either positive or negative, and there is an equal proportion of each. The student is assigned a total score, or attitude index, computed by totaling the adjusted scores on the individual items. The basic procedure is as follows:

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1. Collect a large pool of items that are either clearly favorable or clearly unfavorable to the concept being measured.

2. Administer these items to a pilot group of about 100 students who are representative of the population to whom the final scale will be applied.

3. Assign scores of 1 to 5 to the response categories such that 5 will reflect a strongly favorable attitude and 1 a strongly unfavorable attitude. For example, Item 11—*I have always enjoyed studying biology in school.* (Positive item)

Strongly Agree (5)	Agree (4)	Undecided (3)	Disagree (2)	Strongly Disagree (1)

Item 12—*It makes me nervous to even think about doing a biology experiment.* (Negative item)

Strongly Agree (1)	Agree (2)	Undecided (3)	Disagree (4)	Strongly Disagree (5)

4. Compute total score by totaling the individual scores for each item.

5. Identify high and low scores—upper 25% and lower 25%. Compute the difference between the means of the high and low scoring groups on each statement and retain those items (usually about 20) for which the difference is greatest.

The semantic differential was originally developed by Osgood, Suci, and Tannenbaum (1957). This scale uses a 5 or 7 point, bipolar rating scale with each pole defined by opposite adjectives. For example,

Good— — — — — — — — —Bad
Sad— — — — — — — — —Happy

1. Choose bipolar adjectives from the scale constructed by Osgood et al.

2. Assign values from 1 to 5 with the positive adjective as 5 and the negative adjective as 1.

3. The final scale is derived from those items that most clearly differentiate between persons holding a favorable (positive) attitude and those holding an unfavorable (negative) attitude.

The responses obtained on the semantic differential may be used to compare a student's attitude toward different concepts or subject matter areas. It may also be used to compare two individuals' rating of a given concept or, as we are doing, to assess changes in attitude that have taken place during a particular type of instruction.

The overall procedures for developing and using attitude scales during instructional development are outlined below:

1. Select or design an attitude scale early in the instructional development process. If designing a scale, follow the steps given above for the Likert-type scale or the semantic differential.

2. Determine the concurrent validity by comparing results with a previously validated scale.

3. Determine the test-retest reliability by using students from courses receiving neutral instruction (described in more detail below).

4. Revise scale if necessary and revalidate.

5. Administer scale during tryout with individual students.

6. Administer scale during field testing with groups of students.

7. Revise instructional materials if a significant decrease in attitude is detected.

Developing a Biology Attitude Scale

During the past four years the Minicourse Development Project at Purdue University has been designing and developing modular units of instruction for a core program in undergraduate biology. While various measures, including student achievement, have demonstrated that students can and do learn from minicourses in biology, there has been little indication of the effects of the minicourse approach upon the students' attitude toward biology. It is possible that while the students are learning biology as indicated by pre- and posttest measures, they also may be learning to dislike biology.

In order to properly measure students' attitudes toward biology, a reliable and valid instrument had to be developed since none could be located in the literature. With this initial goal in mind, we wrote a total of 30 Likert-type items. Sixteen of these items were selected for initial testing. These items were pretested on a sample of 54 nonbiology students. An item analysis indicated that 14 of the items were judged as measuring the same thing, that is, each item correlated .80 or better with the total score. These 14 items (table 1) are included in the final scale.

A second instrument using items of the semantic

Table 1. A Likert-type scale for measuring attitudes toward biology.

Each of the statements below expresses a feeling toward biology. Please rate each statement on the extent to which you agree. For each, you may (A) strongly agree, (B) agree, (C) be undecided, (D) disagree, or (E) strongly disagree.

After you have made your choice, blacken in the appropriate response in the columns on the IBM card corresponding to each item.

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

1. Biology is very interesting to me.
2. I *don't* like biology, and it scares me to have to take it.
3. I am always under a terrible strain in a biology class.
4. Biology is fascinating and fun.
5. Biology makes me feel secure, and at the same time it is stimulating.
6. Biology makes me feel uncomfortable, restless, irritable, and impatient.
7. In general, I have a good feeling toward biology.
8. When I hear the word biology, I have a feeling of dislike.
9. I approach biology with a feeling of hesitation.
10. I really like biology.
11. I have always enjoyed studying biology in school.
12. It makes me nervous to even think about doing a biology experiment.
13. I feel at ease in biology and like it very much.
14. I feel a definite positive reaction to biology; it's enjoyable.

Table 2. A semantic differential scale for measuring attitudes toward biology.

Below are some scales on which we would like you to rate your feelings toward biology. On each scale, you can rate your feelings toward biology as an A, B, C, D, or E. *There are no correct answers.* Also, some of the scales seem to make more sense than others. Don't worry about it. Just rate your feelings toward biology on these scales as best you can. Please don't leave any scales blank.

For your response to each scale, blacken in the appropriate box on the IBM card.

BIOLOGY IS:						
15. Good	A	B	C	D	E	Bad
16. Clean	A	B	C	D	E	Dirty
17. Worthless	A	B	C	D	E	Valuable
18. Cruel	A	B	C	D	E	Kind
19. Pleasant	A	B	C	D	E	Unpleasant
20. Sad	A	B	C	D	E	Happy
21. Nice	A	B	C	D	E	Awful
22. Fair	A	B	C	D	E	Unfair

differential format was developed to specifically tap the evaluative component of attitudes. Eight of the standard bipolar adjectival scales (table 2) as described by Osgood, Suci, and Tannenbaum (1957) were utilized.

In order to determine the concurrent validity and the test-retest reliability of each of the instruments, we administered both near the beginning of the semester to four independent education classes. There were approximately 30 students in each class. Since most of these students were not enrolled in a biology class during that semester, we expected their attitudes toward biology to remain rather constant.

For each of the four classes, the total scores on the two instruments were correlated as a measure of the concurrent validity of the instruments. The mean correlation for the two was .80.

One of the classes was retested at the end of one week, another at the end of three weeks, a third after six weeks, and the fourth at a seven-week interval. The stability coefficients for both instruments were very encouraging. The reliability of the semantic differential averaged about .80 over the seven weeks, while the reliability for the Likert scale was never under .90.

Using the Scales

The scales are not intended to measure absolute attitude toward biology but are designed to detect and measure *changes* in attitude toward biology. Hence the scales are designed to be used at the beginning and the end of a course. The class means or individual scores can be compared to determine if the students' measured attitudes toward biology have become more positive, remained the same, or became less positive.

To demonstrate the effectiveness of the biology attitude scale, we administered it to students in three introductory biology courses during the 1971-72 academic year. One course, designed for the biology major, is taught by the conventional lecture-laboratory method. The second course, for biology-related life science majors, is taught by the audiotutorial method. The third course, for nonbiology majors, is also taught by the audiotutorial method. Because the courses differ widely in method, content, difficulty, and characteristics of instructors, we felt it would be interesting to observe potential attitude changes among the various classes.

The biology attitude scale was administered independently to each of the three introductory biology classes as a pretest during the first week of instruction and as a posttest during the last week of the semester. Table 3 summarizes the results of this testing and indicates significant changes in attitude.

In the introductory course for biology majors (Class I) a significant decrease in attitude was detected. The scale measured no change of student attitude in the course for life science majors (Class II). As expected, the biology majors entered their course with a more positive attitude toward biology than did the nonbiology majors.

The students in the course for nonbiology majors (Class III) showed a very positive increase in their attitude toward biology during the course. Their initial attitude was comparable to that of the students in the course for life science majors, but they left the course with a more positive attitude than any of the other students in the four courses under study.

During the same semester, the scale was ad-

Table 3. Summary of results of administration of the biology attitude scale.

			PRE		POST		DIFFERENCES
Class	*N*		*Mean*	*S.D.*	*Mean*	*S.D.*	
I	241	Likert	52.05	8.37	49.36	9.78	- 2.69*
		Semant	30.02	4.82	28.80	4.30	- 1.22*
II	331	Likert	50.56	9.23	51.14	9.42	+ .58
		Semant	30.11	4.68	29.77	4.59	- .34
III	103	Likert	50.80	8.72	53.62	9.19	+ 2.82*
		Semant	30.30	4.44	32.13	4.48	+ 1.83*
IV	31	Likert	47.68	11.26	48.19	12.29	+ .51
		Semant	28.78	4.82	28.12	6.38	- .66

*Significant at .05 level

ministered to a group of students in education who were not taking any biology courses that semester (Class IV). As would be expected, there was no significant change in the group's attitude toward biology.

It should be emphasized that the purpose of this testing was not to compare three methodologies or courses in introductory biology. Each of the courses studied differs drastically in variables other than methodology. Rather, the purpose was to demonstrate the relative sensitivity of the instrument in measuring attitudinal changes. Since both Class I and Class III showed significant changes during one semester, it may be inferred that the instrument is sensitive to change.

The results of the testing were used to alert the instructors of the various courses as to the effect their courses appeared to have on the attitudes of their students toward biology. Several of the instructors plan to modify their courses to see what effect the changes might have on student attitudes.

Summary

The use of attitude scales during instructional development is often neglected or overlooked. It is possible to use previously developed attitude scales or to modify some skeleton scales for use in a variety of instructional situations. For example, the attitude scale described here could be modified by substituting another subject-matter area for the word biology. Of course, it would be necessary to revalidate the revised scale.

If students have a positive attitude about the subject after completing the materials but are not able to perform satisfactorily on the posttest, then the materials need to be revised so that the content and instructional activities relate to the stated objectives. It may also be necessary to add additional instructional questions and give the student more practice in the behavior called for in the objective. On the other hand, a negative attitude finding would suggest—even require—a different kind of revision in the instructional materials. Student interviews often reveal the specific difficulty with the materials, and many times it is necessary to change the narrative or modify the approach to the subject matter to make it more relevant to the students' needs and interests. When the students are demonstrating satisfactory achievement of the subject matter as a result of using the instructional materials and there is no decrease in their attitude toward the subject, the instructional program needs no further revision.

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A Matter of Priorities

I did not start out to be an educational heretic, and I was inwardly astonished at the fact that when I tried honestly to review my experience, *teaching* seemed of such little importance, and *learning* so vastly important. As I have continued to live with this emphasis, it no longer seems so startling as it did at that time.

From *Freedom to Learn,* by Carl Rodgers

What If . . .

The three million tons of fertilizer Americans put on lawns and the like would more than cover South Asia's whole fertilizer deficit. If Americans ate one less hamburger a week, the grain "saved" would amount in a year to ten million tons, roughly enough to feed a subsistence diet to fifty million people.

Washington Post, 11 May 1974

NABT Convention Calendar

The following are dates of seminars and conventions sponsored by the National Association of Biology Teachers. For additional information, write to NABT, 11250 Roger Bacon Dr., Reston, Va. 22090.

May 12–14, 1975. NABT-ICFAR Seminar, Indianapolis, Indiana.

October 23–26, 1975. NABT National Convention, The Portland Hilton, Portland, Oregon.

October 14–17, 1976. NABT National Convention, The Regency, Denver, Colorado.

October 20–24, 1977. NABT National Convention, The Anaheim Convention Center, Anaheim, California.