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ABSTRACT

This study was planned to develop and evaluate an assessment component to measure student attitudes on science as influenced by subject matter presented via telecommunication. Use of technology to introduce varying, exciting, and effective education is becoming commonplace, and assessment of student attitudes is essential to evaluating, updating, and refining curriculum. This research examined the "Integrated Science" teaching process, involving known teaching techniques integrated with a video lesson. A questionnaire was developed, analyzed, tested, revised, and then given to 299 sixth-, seventh- and eighth-grade students in 14 Integrated Science classes at 3 schools which received the video lessons via telecast from a major southern U.S. university. The questionnaires established a means for evaluating the Integrated Science program as determined by attitude toward science monitoring. Variables affecting the study might include positive or negative feelings toward a teacher, subject matter, classroom environment, or classroom activities. The study results are being used to revise the Integrated Science curriculum. (Contains 23 references.) (BEW)

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Educational Telecommunication: Does it work? (An attitude study)

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Abstract

This study was planned to develop and evaluate an assessment component to measure student attitudes on science as influenced by subject matter presented via telecommunication. Use of technology to introduce varying, exciting, and effective education in a large number of schools is becoming common place. The assessment of student attitudes is important and essential to evaluating, updating, and refining curriculum. The results of an attitude study of students who were engaged in a year-long telecommunication course from a major southern university are discussed. An instrument for measuring students perception of their educational experience through their attitude towards science was developed. Factor analysis was used to refine the final instrument through three successive evaluations with high reliability as an outcome. The results of the study are being used to revise the curriculum for an educational program that is being telecast to over 700 sites.

There has always been a need to measure of the learning progress among individuals and groups. Measurement of pure achievement is normally used as an indication, but requires the passage of time. When the groups or individuals are not equated for age, factors that interact with maturation will hamper accurate evaluation (Campbell & Stanley, 1963). The problem of measurement in the field of education can be considerably more complicated than in the fields where physical measurements are made. The psychological disposition of the learner as well as cognitive ability plays a significant role in the learner's progress (Carroll, 1993).

The need is evident for an instrument capable of easily and quickly measuring these underlying factors which are important to maximizing the learning curve. Advances in communications technology have further created demands for measurement to be conducted with relative ease. The proliferation of new teaching methods and systems facilitated by new technology demands better and faster ways to measure indications of success or failure.

The *Integrated Science* teaching process comprises of known teaching methods and techniques integrated with video technology. Its major mission is providing aural, visual, and kinesthetic opportunities to help teachers reach students in all types of school configurations. The heart of the program is an *Integrated Science* video lesson that provides students with a professionally prepared, colorful, and graphic lesson. The effect of the lessons is not contingent on merely showing the students the video, but relies on a mix of aural, visual and kinesthetic learning opportunities provided by the curriculum through the facilitation of the classroom teacher. The classroom setup, the teacher's movements, manipulation of the videos, and the use of the coursework materials contribute to the learning success (Haladyna, Olson, & Shaughnessy, 1982). The teacher's effort in directing, encouraging, and creating an atmosphere of comfort and ease in group experiments or activities related to the video lesson is another important part of the complex equation of the student-centered middle school curriculum. Underlying this coordinated teaching activity is the necessity for the central staff and the classroom teacher to measure and understand the level of involvement and motivation generated by the *Integrated Science* program. Student self-esteem and confidence building is encouraged through the students experiencing increasing success in their content efforts. The proponents of the program posit changes in self-esteem and confidence in the students through learning science will nurture positive attitudes towards technology related careers, additional science courses, improved attendence, and increased participation in school work.

The *Integrated Science* program is currently developed for the 6th, 7th, and 8th grades. An underlying structure for success must be the attitudes of the students towards science inside and outside of the classroom. In addition the instrument must be usable with the groups that are youngest and/or disadvantaged as well as the more mature grades and/or priviledged.

Research on the attitudes toward science has been generally described as lacking integrative findings (Ramsey & Howe, 1969; Peterson & Carlson, 1979; Haladyna & Shaughnessy, 1982). Attitude towards science is not a clearly defined construct and can take on different meanings to different people in different contexts (Munby, 1983). Some researchers lay the blame on inadequate instrumentation (Pearl, 1973) while others are concerned with definitions or lack thereof (Aiken & Aiken, 1969). Germann (1988) argued that the ambiguity plaquing the terms *attitude* and *science* could be explained by the inconsistencies of attitude assessment instrument constructs. Specifically, a distinction must be made between scientific attitude and attitude towards science. Munby (1983) characterized scientific attitude as a cognitive approach to solving problems, a disciplined pursuit, and evaluation of evidence. Blosser (1984) on the other hand, considers attitude towards science may address scientific interest, scientific attitudes, scientific careers, and the like as beliefs about the processes. Haladyna, Olsen, & Shaughnessy (1982) suggested that variables affecting student attitudes were both internal and external to the school but found that several factors strongly influenced student attitudes: student perception of the importance of science, overall teacher quality, enjoyment of classmates, school and class environment, and classroom organization and the conduct of instruction. Solving the complex and multidimentional nature of *attitude* was not within the purpose of this study but it is necessary to recognize the major contributions to the construct. For the purpose of this investigation the definition of attitude considered was a "tendency to act or react in a certain manner when confronted with certain stimuli" (Oppenheim, 1966). A person's attitude towards a subject will have a tendency to be expressed when the subject of the attitude is perceived, either by being seen or brought to mind in some way (Page, Nash, & Orr, 1978). Haladyna & Shaughnessy (1982) posits the teacher, the environment, and the method of presentation are the endogenous variables that work mainly together to affect the attitude of the student. The instrument, then, was addressed to illicit responses on a series of statements related to the aspects most likely to influence attitude in the students: video technology, workbook and assessment sheets, video teacher, classroom activities, and the classroom teacher. Diversity necessitates the instrument to be capable of measuring the same attributes across the various ability, maturity, and acheivement levels. The underlying theories of survey research and methods of survey construction are well known in the literature (de

Vaus, 1986: Kline, 1986; Magnuson, 1966; Nunnally, 1967), but the process of all-round development of an instrument is not addressed in the literature.

Instrument Development

A Likert-type instrument was developed through a process similar to that described by Burry-Stock & Coussement (in press) and the cycle modeled in figure 1. The purpose of the questionnaire and the definition of objectives preceded all other construction operations. The behaviors and attitudes formed the construct and was translated into a set of test items that became an integral part of this conceptualization. The items created formed the the stimuli for the measurement. The issues identified for consideration were:

1. Attitude towards science class;
    - A. the television teacher;
    - B. the classroom teacher;
    - C. the classroom activities; and
    - D. the handbook and assessment sheets;
2. Attitude towards the technology used;
3. Attitude towards lesson content; and
4. Students' interest in science.

The instrument was broken down into three separate segments. These segments concerned (1) student demographics, (2) *Integrated Science* teaching activity in the classroom, and (3) the attitude inventory. This process was characterized by Lindquist (1936) as a task requiring the abilities of knowing what to measure and how to measure it. The writing method considered the selection of an appropriate item format. In this case the format required practicality and workability within the limitations imposed by the age and grade level of the intended examinees. A pool of 52 items was generated for possible inclusion into the instrument and reduced to 25 items for piloting. To this point in the cycle the process is relatively linear.

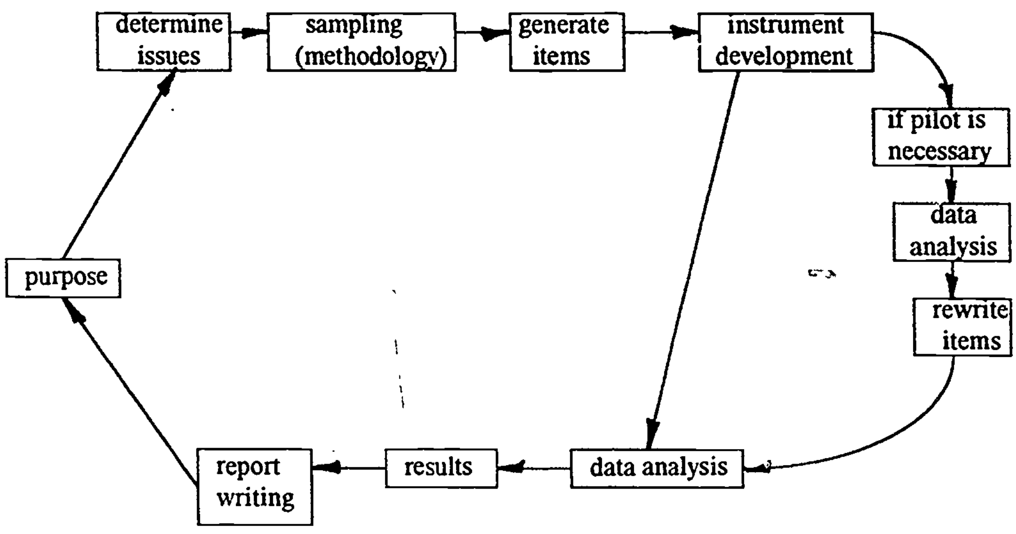

Figure 1. A model of a cycle for instrument development (Burry-Stock & Coussement, in press).

Following a review of the wording and ambiguity in each item, the instrument was examined for response sets that can effect the behavior or examinees in responding to the items. Crocker and Algina (1986) cautioned about response sets and the effects of anchor points. Classic identification of response sets and suggestions for reducing their effects was provided by Guilford (1954). Analysis of the pilot data was conducted for reliability and consistency and any items not conforming with the objectives were rewritten or eliminated. The process of testing and analyzing the instrument was repeated three times. The first was administered to a 6th and a 7th grade (n = 53), the second to two 6th grade classes (n = 51), and the third revision was administered to all three grades (n = 276). The number of variables used in the pilots were in acccordance with the number of items recommended for the number of issues investigated. The sample size recommended in factor analysis has come under discussion. Kline (1986) reported Nunnally to favor a ratio of 10:1 of examinees to items while Guilford (1954) showed a ratio of 2:1 sufficient for main factors to emerge with clarity. Kline (1986) also reported essentially identical loadings using ratios of 3:1 to loadings resulting from ratios of 10:1.

A criterion for determining the impact of the program on student attitudes was equal understandability for participants in the 10-13 range. The level of maturity and cognitive development of the students and the time (not to exceed 15 minutes) required to take the test were to be the the guides. The diversity of the schools (from low population, poor, rural counties to wealthy urban systems) presented additional requirements to simplify the instrument to a lowest common denominator without loosing reliability or validity.

The Likert-type scale developed consisted of statements rated on a 5 point scale. The scale definitions used for the first pilot instrument were *no or none, a little, sometimes, most of the time, and a lot.* The maximum number of 25 items were chosen to stay within the time element of 15 minutes and have a sufficient number of items for analysis.

The first instrument was administered to a sixth-grade class (n=22) and a seventh-grade class (n=31). The approximate time required for the students to answer the questionnaire was about 22 minutes. The data were analyzed using factor analysis. Six factors emerged with total variance explained at 64% (Cronbach alpha = .84). Factor loading ranged from 0.83 to 0.43 on nine items in the first factor. Fourteen items received particular scrutiny resulting in the rewriting of three and changes made to the remaining 11 to allow conformity with the modification of the response format. The response format was changed to read *never, a little, sometimes, most of the time,* and *always.*

The revised questionnaire was administered to a 6th grade class in the southern part of the state (n = 23) and a 6th grade class in the northern section of the state (n = 35). The time required for administration was approximately 17 and 14 minutes, respectively. There were seven observations omitted due to missing values leaving a total n = 51 for the analysis. The internal consistency of the second instrument improved with a Cronbach alpha of .91. Inspection of scree-test plot again suggested six factors. Factor loading for the principle factor ranged from 0.76 to 0.51 on six items with loadings on multiple factors in three items. Items numbered 11, 13 and 20, loaded on at least two factors and were inspected. The intertotal correlation indicated these items supported the theoretical construct of the instrument and were retained without modification. Two items showed low intertotal correlation values (5 and 22) but were deemed not to be at variance with the purpose of the survey. Instead, it is suspected that these statements indicate areas of opportunity for the *Integrated Science* program. The total variance accounted for was 69%.

This version of the questionnaire was administered to 14 *Integrated Science* classes at three schools in communities having distinctly different populations. There were 299 students (145 females and 154 males) that responded to the questionnaire, of which 22 students were omitted for various causes (12 females and 10 males). Orthogonal rotation was applied and six factors emerged under the minimum .50 loading criterion. Five items not differentiating and/or not meeting the concept of a factor were dropped and the solution rerun. Two concerned science activities, one addressed science instruction, and the remaining two tended to address science occupational interests. The program was rerun on the remaining 20 items. In determining labels for the factors, it was realized that each factor represented an attitude towards a segment of the *Integrated Science* class. The first factor accounted for 15.9% of the variance. As can be seen on Table 1, items with substantial loadings were 3, 8, 14, 18, and 22. As all scales in this factor represent statements on liking science, having fun in science class, liking to take more science classes, and so on, it was labeled *science*. The second factor variables that showed significant loading dealt with the student comfort or ease of

Table 1
Item Intertotal Correlation and Loading on Six Orthogonal Factors

Item	Inter-total Corr.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Communality
		Factor Loading						
1	.66	.18	.13	<u>.75</u>	.19	.17	.09	.68
2	.59	.17	<u>.60</u>	.44	.32	.16	-.07	.72
3	.38	<u>.89</u>	.02	.13	-.08	0	0	.81
4	.57	.22	<u>.55</u>	.39	.36	.09	.08	.66
5	.53	.07	.11	.11	<u>.89</u>	.11	.09	.85
7	.65	.30	-.06	.37	.15	.28	<u>.53</u>	.62
8	.49	<u>.84</u>	.10	.11	.13	.10	.10	.76
9	.59	.13	.15	.24	<u>.80</u>	.20	.11	.79
10	.60	.09	.30	<u>.75</u>	.14	.18	.15	.74
11	.62	.14	.40	.16	.18	.09	<u>.71</u>	.75
12	.43	.04	.33	.11	.12	<u>.77</u>	-.01	.73
13	.47	.24	.07	.12	.17	<u>.73</u>	.13	.66
14	.58	<u>.71</u>	.15	.08	.17	.23	.25	.68
15	.40	.10	.05	.26	.09	<u>.61</u>	.14	.49
16	.66	.12	-.01	<u>.62</u>	.04	.21	.47	.67
18	.72	<u>.50</u>	.27	.06	.45	.29	.20	.66
20	.70	.23	.44	.14	.06	.05	<u>.69</u>	.75
21	.42	.13	<u>.71</u>	0	-.04	.16	.24	.60
22	.72	<u>.72</u>	.25	.16	.16	.16	.19	.69
25	.64	.12	<u>.62</u>	.18	.25	.16	.26	.58
Percent of total variance		15.9	11.7	11.5	10.9	10.0	9.3	

Note: Underlining indicates that an item loads above .50 on one factor.

learning from and understanding the television teacher. The label *TV lessons* accounted for 11.5% of the variance with constituent scales that concerned the enjoyment by the student of working in and learning from the handbook and assessment sheets, and hence, was labeled *written work*. The fourth factor accounted for 10.9% of the variance. Its constituent scales were both addressed to in-class group activities and was labeled *group activities.* The three scales with high loading on the fifth factor revolved around the classroom teacher and accounted for 10.0% of the variance. This factor was labeled *teacher.* The sixth factor, finally, accounted for 9.3% of the variance. It was labeled *video* because it is based on the scales expressing the enjoyment of viewing science videos. Coefficient alpha reliability estimates were .91 for the final instrument, and exceeded .74 for each subscale dimension except for the *teacher* dimension (alpha = .66).

Discussion and Recommendations

The focus of this study was to establish a means for evaluating the effect of the *Integrated Science* program as determined by attitude towards science monitoring. The learner's general attitude towards a specific subject part of the domains of learning; cognitive, conative, and affective. The variables that constitute the latter are the drivers for the general attitude towards science. The more specific affective variables are classroom atmosphere, the manner in which the subject matter is presented, the teacher that presents the subject matter, the classroom teacher, laboratory activities, laboratory and workbook reports, and the science text and readings. Each of these variables subsists in a particular or a more general sense. A learner may have a positive or negative feeling for a teacher in particular or subject in general. The construct of the attitude addressed by this study concerned that of a general attitude toward science and as such is the result of particular attitudes. Although additional variables such as home, peers, social pressures, behavior options, competing attitudes and conflicting beliefs and values can influence the learner, the most proximate cause of attitudinal changes will remain entrenched in the daily environment in which the learner attends.

The presentation of the curriculum and the manner in which the classroom activities are conducted have a profound effect on the classroom environment, and classroom environment has a strong influence on attitude toward science (Simpson & Oliver, 1990). Sinclair (1994) reported achievement motivation significantly and positively correlated with attitude toward science. This instrument recognizes the relationship that might exist between attitude and student, classroom, teachers, and subject presentation. Further assessment of student attitudes toward science programs and how specifically these variables can be impact the attitude measurement would be useful.

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