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ABSTRACT

Reported is the development and field testing of the Science Classroom Observation Form (SCOF), an instrument focusing on the interactive characteristics among students, the environment, and teacher in elementary and junior high school science classrooms. This instrument was developed to be used in research investigations of openness and inquiry orientation. The data from field tests resulted in SCOF IV which consists of 39 statements or questions about characteristics of science classroom interactions, each rated on a 5-point scale following classroom observation. Items are grouped into "environment," "teacher," and "student" for observer convenience. SCOF has been used in 43 junior high school science classrooms in the Province of Saskatchewan. This report includes descriptive statistics of those data as well as a discussion of the results of factor analysis of the SCOF instrument. Validity and reliability are also discussed. A copy of the instrument is included. (PEB)

THE DEVELOPMENT AND FIELD TESTING OF A SCIENCE CLASSROOM OBSERVATION FORM (SCOF)

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A paper to be presented at the

Annual Meeting of the National Association

of Research in Science Teaching

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INTRODUCTION

Background

The researching of what happens to students as a result of natural classroom learning environments as an alternate research strategy to more classical research involving quasi-experimental "treatments" is being encouraged (Shulman, 1970) for several reasons.

Classroom learning environments, it is acknowledged, accrue due to many interactions between student(s), teacher, and materials, besides many other influencing variables. The amalgam which makes up the whole, one suspects, is more than the sum of the parts. There is a need, therefore, to examine classrooms and learning as it happens, utilising multivariate instruments, which allow description and assessment of the parts as well as the total milieu.

Crude "treatment" umbrellas of quasi-experimental designs such as "text-book approach" versus "traditional lab" approach versus "inquiry/discovery" approach probably serve well in initial forays into student outcomes. However, problems thwart more than a superficial look at the complex phenomena of classrooms, when one utilises the experimental approach. For example, one fundamental problem is to obtain congruence between theoretical and actual treatment, furthermore to monitor and maintain a significant difference between treatments (Charters and Jones, 1973). Even if one can manage treatments effectively, these crude catch-alls may conceal many uncontrolled but active non-experimental variables. These are just a couple of problems which plague quasi-experimental comparative research.

Thus, the need to describe what goes on in classrooms "as they are" as an improvement over treatment descriptions of "what we hope is going on", is underlined.

If we can succeed in reliably and validly describing classroom environments in a multivariate manner then we can better consider such questions as what mix of what types of activities or interactions are better for what types of students?

When one brings these arguments to bear on the area of science education, the question arises as to how one can describe qualitatively and quantitatively the many facets of science learning environments?

Basically, science education is a fruitful area for this type of endeavour, having a relatively well developed philosophical and theoretical framework, with very visible and discrete notions and constructs for which operational and observable criteria can be derived. This philosophy espouses the inquiry/discovery approach within child and material centred classrooms. The authors felt, therefore, that it should be possible to build an instrument capable of describing such environments.

Purpose

The purpose of this study was to develop and field test an instrument focusing on the interactive characteristics among students, the environment, and teacher in elementary and junior high school science classrooms. It was developed as a research instrument to provide a measure of openness and inquiry orientation.

CONSTRUCTION OF THE SCALE

Synopsis of Inquiry Approach

The literature on inquiry/discovery, material and child-centred science was examined and theoretical constructs were identified. These were translated into characteristics of classroom interaction.

Briefly put, it might be expected that a teacher who had implemented a science program with a student-centred inquiry approach would act as a guide to learning, ask divergent questions and treat science as a tentative rather than absolute discipline. Emphasis would be given to the use of materials as students experiment, observe, interpret, and draw conclusions. The teacher would stimulate and challenge the students in a psychological atmosphere of freedom and openness, where they interact with the materials and each other. Implicit within such a situation is that materials, apparatus, and other learning aids should be available for each lesson enabling the student to develop the "big ideas" and see science as a way of Knowing. The student needs to touch, feel, observe, and manipulate materials to provide external referents for internal processes.

Development of Items

A pool of over two hundred items were generated representing observable manifestations of the theoretical constructs.

A panel of judges, consisting of the authors, teachers, faculty members, and members of the Provincial Science Education Curriculum Committee, assessed the items and fifty modified statements

were placed on the first version of SCOF.

Refinement of the Scale

SCOF(I) was circulated to as wide an audience of professionals, in the Province of Saskatchewan, as possible, including teachers, principals, superintendents, University and Department of Education personnel to provide an initial reaction to the instrument. The feedback obtained from this exercise was reviewed by the research team and gave rise to SCOF(II).

The original panel of judges then reviewed each item very intensely searching for ambiguity and variance in semantic interpretation. This provided for agreement of stipulated semantic interpretations of statements and behaviours (SCOF III).

The panel made several visits to several local science classrooms representing different degrees of inquiry/discovery orientation where seven observers completed a SCOF. Responses for each item were later compared, with each observer providing some rationale for his response. This enabled further development in consistent interpretation of items and behaviour. Several items were rewritten at this time giving rise to the present version of the instrument (SCOF IV).

SCOF (IV)

The present version of the scale is included in the appendix to the paper. It consists of thirty-nine statements or questions about characteristics of science classroom interactions between student(s), teacher, and environment, which are rated on a five point scale following

a classroom observation. These items, for observer convenience, were placed in one of three categories: "environment", "teacher", or "student". These are not subscales.

FIELD TESTING

Training of Observers

Obviously, successful use of the instrument needs reliable and consistent individuals as observers. In order that observers may interpret SCOF correctly it is desirable that they have a reasonably good knowledge and understanding of the theory and practice of inquiry oriented science. Specialist science teachers, science consultants or animators, graduate students and faculty involved in science education, make good candidates. Therefore some screening of potential observers is probably helpful.

Personnel utilised for the field testing of SCOF were graduate students and faculty. The first phase of training involved an intensive discussion and analysis of each item of SCOF on a seminar basis, similar to that followed by the panel of judges in the development of the scale mentioned previously. The objective of this session was to enable observers to declare their individual interpretation of each item and note perceived ambiguity. Difference in interpretation and ambiguity were minimised by discussion and agreement to follow stipulated interpretations consistent with science education theory.

Phase two of training involved a pilot try-out of SCOF in several real classrooms representing different degrees of inquiry orientation, similar to the piloting of SCOF mentioned previously.

Observers verbalized responses with a rationale for each rating in a training seminar later. This enabled further development of consistency of rating and also provided a spectrum of recent experience which gave a backdrop for further observations and ratings. Videotape would be a useful addition to this part of training enabling replays of actual situations.

Observations and Ratings

To strike an optimum balance between number of observations and resources it was decided that a classroom to be assessed by SCOF would be observed by at least two observers on at least three separate occasions. An observation consisted of one whole lesson.

SCOF forms were completed and ratings made after each lesson had concluded. If an item was not observable or not appropriate for a particular lesson (e.g. "students conducted experiments" for a lesson which did not involve an experiment) it was still rated - the low point on the scale, since the assessment a particular classroom received was a composite of a number of observations.

Scoring

The scoring plan developed for SCOF is tentative pending further analysis and development of the instrument. Only total scale scores are utilized at the moment. It is anticipated that sub-scale scores with items loading positively and negatively on different scales will be developed from factors reported later in this paper.

Items 6 (used a text-book), 8 (engaged in disruptive behaviour), 24 (depended on the teacher for direction), 25 (appeared to be just going through the motions), 27 (teacher provided answers throughout the lesson), 29 (stressed content), 32 (shows and tells) contribute negatively to total scale score whereas all other items are positively scored.

Gathering of Data

SCOF was utilised to rate the interactions and milieu of forty-three junior-high science classrooms in the Province of Saskatchewan, following the guidelines outlined previously. These classrooms were scattered throughout the Province and ranged from a very traditional approach in science through to highly individualized inquiry programs. A measure of students perception of their science classroom was administered at the same time.*

DATA ANALYSIS

Descriptive Statistics

The data was gathered from 43 classrooms involving some 1165 students of which 596 were male and 568 female. There were 478 students in grade 7 classrooms, 369 in grade 8 classrooms and 317 in grade 9.

A reliability of .74 (Hoyt) and an interobserver consistency of .86 were obtained using total SCOF scores. The mean score over 43

*The instrument utilised was adapted from Students Perceived Science Classroom developed at New School, University of North Dakota.

classrooms was 107.9 with a standard deviation of 11.5. Total SCOF scores correlated positively (0.39, p 0.1) with students perceptions of their own classrooms.

FACTOR ANALYSIS

As part of the secondary development of the instrument SCOF was explored for coherent factors which might provide useful subscales and composite variables. The data from all observations of the forty three classrooms were subjected to principal factoring with iterations followed by oblique rotation.* This produced eight primary factors; similar factors were produced by orthogonal rotation. The data from the initial orthogonal rotation were rotated a second time (obliquely) and produced three second order factors.

Interpretation of Primary Factors

The initial rotation produced a set of factors having typical characteristics: the first tending to be a general factor which accounted for a good portion of the variance with other factors accounting for smaller portions; some being mirror images of others. Table I displays the eigenvalues and associated variance accounted for by each of the eight primary factors. Table II gives the main loadings of variables on these eight factors plus their communalities. Tables III through X give the ranked major loadings on each factor.

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* The program used was subprogram FACTOR from "Statistical Package for the Social Sciences" by N.H. Nie, Dale H. Bent, and C.H. Hull, McGraw-Hill, 1970.

TABLE I

EIGENVALUES, PERCENTAGE

AND

CUMULATIVE PERCENTAGE OF VARIANCE

FOR FACTORS

FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
1	15.0729	58.2	58.2
2	3.2162	12.4	70.6
3	2.1582	8.3	78.9
4	1.6138	6.2	85.2
5	1.3114	5.1	90.2
6	0.9500	3.7	93.9
7	0.8384	3.2	97.1
8	0.7444	2.9	100.0

TABLE II

MAJOR LOADINGS ON FACTORS ($X10^{-2}$)

VAR	PRIMARY FACTORS I	II	III	IV	V	VI	VII	VIII	COMMUNALITY ($X10^{-2}$)
1	78			32	50				67
2	66		34	46	50			-39	69
3	86				61	40			85
4	85				58	39		-30	82
5	79				55	47		-52	81
6					-36		-49		44
7	79			37	70	44		-43	81
8				-50					27
9	63				36	50		-53	62
10	45			35	47	62		-55	59
11	51	30		51	56	52		-69	79
12	49	32		48	49	60		-69	77
13		33				63		-51	61
14	56				90	31			90
15	58				81				71
16	41				84			-39	73
17	37			36	53	42		-59	61
18	33					75	33		61
19	62			58	55	56		-58	82
20	39				33	77		-47	66
21	76			41	68	50		-53	83
22	42				85			-31	73
23	83			37	63	50		-47	82
24	-32	47	39				-43		53
25	-30			-72			-45		67
26				32	33	51		-77	64
27			54				-63		57
28		47							31
29							-60		33
30				32	33	44		-75	62
31	48		41	34				-47	57
32			84						73
33		48							32
34	47			53	53	46		-74	78
35	50	31		55	58	43		-73	83
36		-30		52	47	44		-71	85
37	62				56	49		-68	73
38	31	34						-73	59
39	49				72			-47	68

For each factor the variable loadings were examined, highest to lowest, to determine the approximate dividing line between variables which load higher on a particular factor than on any other factor and variables which load more highly on other factors. In this way the variables which most uniquely characterise each factor were determined. Therefore, in interpreting each factor (i.e. labelling or inventing a concept to fit each particular factor) the variables above the division were the main consideration with variables below the division assisting in confirming or denying a possible interpretation.

FACTOR I. This general factor which accounted for most of the variance is primarily concerned with students and the way they interacted---dynamically, in an open and rich environment. The inputs and consequences which are associated with this interaction are vividly portrayed by the variables below the dividing line in Table II - coherent groups of these are brought to prominence by other factors.
This factor was interpreted and labelled as STUDENT INTERACTIVE DYNAMISM.
FACTOR II. This factor proves the most difficult to interpret. It is always possible that it could be an artifact of the data. The teacher's honesty (variable 33) about lack of knowledge plus the neutral response to students (variable 28) could be interpreted as part of a good inquiry approach - the students depending on the teacher for direction(variable 24) because they are puzzled; this is backed up by the next few variables (38, 13, 12, and 35). So perhaps this factor represents a "discrepant event" or "cognitive dissonance"? On the other hand, it may represent a "laissez-faire" situation or "putting on the dog" for the researcher. Perhaps the teacher doesn't know much, doesn't care much, but is trying

TABLE III

RANKED MAJOR LOADINGS ON FACTOR I

Variable	Description	Loading
3	Students worked as (a whole class ⟷ individuals/groups)	86
4	Student mobility (fixed ⟷ flexible)	85
23	Students interacted freely and purposefully	83
5	The classroom environment was (closed ⟷ open)	79
7	Students were purposefully active	79
1	Materials were in evidence	78
21	Students co-operated with each other	76
2	AV/TV in room	66
9	Students engaged in group and/or class discussion	63
19	Students were curious and inquisitive	62
37	Teacher was approachable	62
15	Students handled materials responsibly	58
14	Students touched, operated, and manipulated materials	56
11	Students appeared enthusiastic	51
35	Teacher aroused curiosity and interest	50
39	Teacher provided material	49
12	Students appeared responsive	49
31	Teacher used AV/TV	48
34	Teacher was enthusiastic	47
10	Students asked questions	45
22	Students demonstrated competence in using apparatus	42
16	Students conducted experiments	41
20	Students engaged in making decisions	39
17	Students developed their own conclusions	37
18	Students made choices of activity	33
24	Students depended on teacher for direction	-32
38	Teacher gave students time to think and ponder	31
25	Students appeared to be just going through the motions	-30

TABLE IV

RANKED MAJOR LOADINGS ON FACTOR II

Variable	Description	Loading
33	Teacher said or imputed "I don't know"	48
28	Teacher responded in a neutral way to students	47
24	Students depended on teacher for direction	47
38	Teacher gave students time to think and ponder	34
13	Students proposed alternative theories, ideas, etc.	33
12	Students appeared responsive	32
35	Teacher aroused curiosity and interest	31
36	Teacher encouraged examination of how something was learned	-30
11	Students appeared enthusiastic	30

inquiry - the kids are more used to teacher directed activity therefore are dependent or alternatively the "laissez-faire" milieu lacks the necessary structure. The fact that the teacher does not encourage thinking about the process of "finding out" (variable 36) plus the dependency of the students makes an optimistic interpretation of this factor hard - it does not "ring true". Therefore this factor is tentatively interpreted as PSEUDO-INQUIRY as a result of either a "laissez-faire" approach or "putting on the dog" for the researcher. Only further investigation of whether and how this factor correlate with other variables will resolve this interpretation.

FACTOR III. Teacher "shows and tells", "provides answers throughout the lesson", and uses AV/TV equipment (guess how!); backed up by dependency of students, neutral teacher, and a heavy use of a text-book smacks of TEACHER AND SUBJECT CENTREDNESS.

FACTOR IV. Table VI shows that the students are certainly not in a state of anomie (variable 25) but are curious and inquisitive (variable 19), enthusiastic (variable 11), and definitely not disruptive in their behaviour (variable 8); likewise the teacher in his attitudes and personal interest in the problem at hand (variables 35, 34) together with his concern for the development of the students "knowing process" (variable 36).

This factor was labelled COHESIVE AFFECT; applying to both teacher and students.

FACTOR V. This factor must obviously be called STUDENT ENVIRONMENT INTERACTION - environment meaning the physical or material environment. (See Table VII).

TABLE V

RANKED MAJOR LOADINGS ON FACTOR III

Variable	Description	Loading
32	Teacher shows and tells	84
27	Teacher provides answers	54
31	Teacher used AV/TV	41
24	Students depended on teacher for direction	39
2	AV/TV in room	34
28	Teacher responded in a neutral way to students	28
6	Teacher used text book	26
33	Teacher said or imputed "I don't know"	-24

TABLE VI

RANKED MAJOR LOADINGS ON FACTOR IV

Variable	Description	Loading
25	Students appeared to be just going through the motions	-72
19	Students were curious and inquisitive	58
35	Teacher was curious and inquisitive	55
34	Teacher was enthusiastic	53
36	Teacher encouraged examination of how something was learned	52
11	Students appeared enthusiastic	51
8	Students engaged in disruptive behavior	-50
12	Students appeared responsive	48
2	AV/TV in room	46
21	Students co-operated with each other	41
7	Students were purposefully active	37
23	Students interacted freely and purposefully	37
17	Students developed their own conclusions	36
10	Students asked questions	35
31	Teacher used AV/TV	34
1	Materials present	32
30	Teacher asked divergent questions	32
26	Teacher encouraged students to question and theorize	32

TABLE VII

RANKED MAJOR LOADINGS ON FACTOR V

Variables	Descriptions	Loading
14	Students touched, operated, and manipulated materials	90
22	Students showed competence in using apparatus	85
16	Conducted experiments	84
15	Handled materials responsibly	81
39	Teacher provided materials	72
7	Students were purposefully active	70
21	Students co-operated with each other	68
23	Students interacted freely and purposefully	63
3	Students worked as a (whole class ↔ indivdually/in groups)	61
35	Teacher aroused curiosity and interest	58
4	Student mobility was (fixed ↔ flexible)	58
11	Students appeared enthusiastic	56
37	Teacher was approachable	56
19	Students were curious and interested	55
5	Classroom environment was (closed ↔ open)	55
34	Teacher appeared enthusiastic	53
17	Students developed their own conclusions	53
1	Materials in evidence	50
2	AV/TV in classroom	50
12	Students appeared responsive	49
36	Teacher encouraged examination of how something was learned	47
10	Students asked questions	41
6	Students used a text-book	-36
9	Students engaged in discussion	36
20	Students engaged in making decisions	33
[illegible]	Teacher asked divergent questions	33
26	Teacher encouraged students to question and theorize	33

FACTOR VI. Students engaged in making decisions, made choices of activity, proposed alternative ideas etc., asked questions (variables 20, 18, 13 & 10 respectively) was dubbed STUDENT AUTHENTICITY (in the existential sense of the word).

FACTOR VII. The teacher did not provide answers, stress content or overly use the text-book; this scenario is supplemented by students who are very much "together" (variable 45) and independent (variable 24). Perhaps STUDENT CENTREDNESS.

FACTOR VIII. This general negative factor emphasizes negative teacher traits. The teacher does not encourage students to question, theorise, etc.; does not ask divergent questions, give students time to think and ponder, or encourage examination of how something was learned (variables 26, 30, 38, 36) and predictably was not approachable or enthusiastic, nor did he arouse enthusiasm and interest (variables 37, 34, 35)!! Needless to say, the students were neither enthusiastic nor responsive (variables 12, 11). These prime loadings were backed up by many other appropriate negative loadings; it is to be expected that the first "positive" loading on this factor state that - yes, the students were just going through the motions, and indeed, they used a text-book a great deal! How about AUTHORITARIAN NON-INTERACTIVE ANOMIE?

Interpretation of Second Order Factors.

A Primary factors V (STUDENT-ENVIRONMENT INTERACTION), I (STUDENT INTERACTIVE DYNAMISM), VI (STUDENT AUTHENTICITY), IV (COHESIVE AFFECT) load higher on secondary factor A than they do on any other (in that order) as does primary factor VIII (AUTHORITARIAN NON-INTERACTIVE ANOMIE) in the opposite direction. (See Table XII) Reversing the negative signs for convenience and optimism, one comes up with the concept of AUTHENTIC INTERACTION for A - a low score meaning "non-interactive anomie".

TABLE VIII

RANKED MAJOR LOADINGS ON FACTOR VI

Variable	Description	Loading
20	Students engaged in making decisions	77
18	Students made choices of activity	75
13	Students proposed alternative ideas, etc.	63
10	Students asked questions	62
12	Students appeared responsive	60
19	Students were curious and inquisitive	56
11	Students appeared entl siastic	52
26	Teacher encouraged students to question, theorize, etc.	51
23	Students interacted freely and purposefully	50
21	Students co-operated with each other	50
9	Students engaged in group or class discussion	50
37	Teacher was approachable	49
5	Classroom environment (closed ⟷ open)	47
34	Teacher was enthusiastic	46
36	Teacher encouraged examination of how something was learned	44
30	Teacher asked divergent questions	44
7	Students were purposefully active	44
35	Teacher aroused curiosity and interest	43
17	Students developed their own conclusions	42
3	Students worked as (a whole class ⟷ individuals/groups)	40
4	Student mobility (fixed ⟷ flexible)	39
14	Students touched, operated, and manipulated materials	31

TABLE IX

RANKED MAJOR LOADINGS ON FACTOR VII

Variable	Description	Loading
27	Teacher provided answers	-63
29	Teacher stress content and process	-60
6	Students used a text book (little ↔ a great deal)	-49
25	Students appeared to be just going through the motions	-45
24	Students depended on the teacher for direction	-43
18	Students made choices of activity	33
16	Students conducted experiments	29
5	Classroom environment (closed ↔ open)	28
4	Student mobility (fixed - flexible)	27

TABLE X

RANKED MAJOR LOADINGS ON FACTOR VIII

Variable	Description	Loading
26	Teacher encouraged students to question and theorize, etc.	-77
30	Teacher asked divergent questions	-75
34	Teacher was enthusiastic	-74
38	Teacher gave students time to think and ponder	-73
35	Teacher aroused curiosity and interest	-73
36	Teacher encouraged examination of how something was learned	-71
12	Students appeared responsive	-69
11	Students appeared enthusiastic	-69
37	Teacher was approachable	-68
17	Students developed own conclusions	-59
19	Students were curious and inquisitive	-58
10	Students asked questions	-55
9	Students engaged in class or group discussion	-53
21	Students co-operated with each other	-53
5	Classroom environment (closed ↔ open)	-52
13	Students proposed alternative ideas, theories, etc.	-51
23	Students interacted freely and pruposefully	-47
20	Students engaged in making decisions	-47
39	Teacher provided materials	-47
31	Teacher used AV/TV	-47
7	Students were pruposefully active	-43
2	AV/TV in room	-39
16	Students engaged in disruptive behaviour	-39
22	Students showed competence in using apparatus	-31
4	Student mobility (fixed ↔ flexible)	-30

*N.B. Variable 25 (students appeared to be just going through the motions) +24

Variable 6 Students used a textbook (little ↔ great deal) +18

B Primary factor III (TEACHER AND SUBJECT CENTREDNESS) and VII (STUDENT CENTREDNESS) load negatively and positively on secondary factor B. We can optimistically name this secondary factor STUDENT CENTREDNESS also.

C This factor consists mainly of our primary factor II (PSEUDO-INQUIRY) which is the only primary order variable which loads higher on this secondary factor than any other. Its final interpretation therefore is qualified by the same comments made for primary factor II. It may very well be a residue or artifact in the data.

Discussion.

The factor analysis revealed an interesting set of factors consistent with the theory of science education but certainly not unique to it. The broad spectrum of factor could equally apply to any classroom activity in any subject area. This is encouraging as it points to a possible broader use of the instrument and common elements of learning environments. It seems that the concept of authentic interaction between student, teacher and environment as represented by secondary factor A and its contributing primary factors are important composite variables in classroom situations; the focus of activity, whether the student or the teacher (student-teacher centredness) being another significant variable. The pseudo-inquiry factor must remain a puzzling mystery until further work has been done.

RELIABILITY AND VALIDITY

Reliability

The interobserver consistency (0.86) obtained during the field testing and following training is good, although future work should also gather data on stability coefficients for observers which should be based on groups of observa-

TABLE XI

EIGEN VALUES AND PERCENT OF VARIANCE FOR SECOND ORDER FACTORS

FACTOR	EIGENVALUE	PERCENT OF VARIANCE	CUMMULATIVE PERCENT
1	1.68	55.1	55.1
2	0.76	24.9	80.0
3	0.61	20.0	100.0

TABLE XII

LOADINGS OF PRIMARY FACTORS ON SECONDARY FACTORS

PRIMARY FACTORS	SECONDARY FACTORS (X10-2)			COMMUNALITY (X10-2)
	A	B	C	
I	-60	12	02	37
II	-01	-08	-71	50
III	-05	-71	02	52
IV	-38	-02	16	18
V	-67	21	11	48
VI	-50	10	-27	32
VII	-22	35	14	17
VIII	63	16	23	49

tions of a classroom by the same observer at different times. From experience in this field testing, one would suspect that the stability coefficients on average would be at least as good if not better than the value obtained for the interobserver consistency.

A pilot trial of SCOF had yielded a very high reliability on SCOF itself although this dropped to 0.74 (Hogt) during the field test. This could be attributed to the broader range of behaviours to be rated? Whereas 0.74 is satisfactory, particularly if the predictive validity of SCOF proves to be good, it should be higher. Perhaps some pruning or improvement of items would assist here.

The communalities of each of the thirty-nine variables are conservative estimates of reliability; there is one variable $<.3$ & four $<.4$. Table II gives the details - the set of communalities seems satisfactory for this type of scale. Some of the lower values will provide for pruning and improvement of items in the next phase of development of SCOF.

Validity

The face and content validity of the instrument were borne in mind during the development of the instrument. The factor analysis strongly supports face and content validity as well as the construct validity of the instrument.

The only evidence so far which contributes towards criterion-oriented validity is the significant relationship between SCOF scores and student perception of classrooms. The kids agreed to a notable degree with SCOF.

Further work on the validity of the instrument is currently underway, involving the relationships of subtests (factors) with various student outcomes.

SUMMARY

This paper has described the development and field testing of the Science Classroom Observation Form (SCOF) which focuses on the interactive characteristics among students, the environment and teacher in elementary and junior-high school science classrooms.

The instrument seems to have promise for describing classroom learning environments as they actually are in a general sense - not only during science classes. The factor analysis revealed a number of composite variables which may be utilised as well as the general SCOF rating and thus provide a discriminatory sensitivity about classroom environments. The reliability, validity, interrelationships, and relationships of the subtests with student outcomes are currently being investigated.

Hopefully this will result in a useful instrument for researchers needs, and a self-evaluative device for teachers and student-teachers.

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SCIENCE CLASSROOM OBSERVATION FORM

(Draft 4)
April, 1974

A. DEMOGRAPHIC INFORMATION

1. Observer _____

2. Teacher Code _____

3. Date _____

4. Duration (minutes) _____

5. Grade Level _____

6. Course _____

7. Size of Class _____

8. School and Location _____

If an item is not observable, circle 1.

B. ENVIRONMENT

	No					Yes
1. Were materials, equipment, kits, live specimens, etc. in evidence?.....	1	2	3	4	5	
2. Were there audio visual aids in the room? (E.G. tape recorder, film strip viewers, loop projectors, charts, film strips, etc.).....	1	2	3	4	5	
	A whole class			Individually or in small groups		
3. The students worked as	1	2	3	4	5	
	Fixed			Flexible		
4. Student mobility was	1	2	3	4	5	
	Closed				Open	
5. The classroom environment was	1	2	3	4	5	

C. STUDENTS ....

	A little				A great deal
6. used a textbook	1	2	3	4	5
7. were "purposefully" active in the classroom (messing about with material ok)	1	2	3	4	5

C. STUDENTS....
(continued)

		A little				A great deal
8.	engaged in disruptive behavior.....	1	2	3	4	5
9.	engaged in organized group and/or class discussion.....	1	2	3	4	5
10.	asked questions (not counting simple requests for direction).....	1	2	3	4	5
11.	appeared enthusiastic.....	1	2	3	4	5
12.	appeared responsive	1	2	3	4	5
13.	proposed alternative ideas, interpretations, theories	1	2	3	4	5
14.	touched, operated, and manipulated materials.....	1	2	3	4	5
15.	handled materials and specimens responsibly.....	1	2	3	4	5
16.	conducted experiments.....	1	2	3	4	5
17.	developed their own "conclusions".....	1	2	3	4	5
18.	made choices of activity.....	1	2	3	4	5
19.	were curious and inquisitive.....	1	2	3	4	5
20.	engaged in making decisions about the lesson.....	1	2	3	4	5
21.	co-operated with each other.....	1	2	3	4	5
22.	showed competence in using apparatus...	1	2	3	4	5
23.	interacted freely and purposefully with each other.....	1	2	3	4	5
24.	depended on the teacher for direction..	1	2	3	4	5
25.	appeared to be just going through the motions (disengaged as opposed to involved).....	1	2	3	4	5

D. THE TEACHER .....

		A little				A great deal
26.	encouraged students to question, theorize, etc.....	1	2	3	4	5
27.	provided answers throughout the lesson (not teachable moment answer or IDP yes/no).....	1	2	3	4	5
28.	responded in a neutral way to student responses.....	1	2	3	4	5
29.	stressed content (versus process)....	1	2	3	4	5
30.	asks divergent questions (openended).	1	2	3	4	5
31.	used AV/TV equipment.....	1	2	3	4	5
32.	shows and tells	1	2	3	4	5
33.	said or implied "I don't know".....	1	2	3	4	5
34.	was enthusiastic.....	1	2	3	4	5
35.	aroused curiosity and interest.....	1	2	3	4	5
36.	encouraged examination of how something was learned.....	1	2	3	4	5
37.	was approachable.....	1	2	3	4	5
38.	gave students time to think and ponder.....	1	2	3	4	5
39.	provided materials.....	1	2	3	4	5

OTHER COMMENTS

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