TEACHER AND STUDENT VIEWS OF LEARNING ENVIRONMENTS

by

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The Study

An intriguing issue raised by the use of instruments such as the Learning Environment Inventory (Anderson, 1971) and the Classroom Environment Scale (Trickett and Moos, 1974) to assess school or class environments, is the extent to which students' and teachers' perceptions of the same environment are congruent. In view of the different roles of student and teacher in a typical classroom, there might be expected to be some difference in their perception of the same environment. Certainly some studies of science classrooms (Beam and Horvat, 1975) have suggested that students' views of their science lessons differ from those of their teachers.

The present study arises from one part of a larger evaluation of the Australian Science Facilities Program. It involves an examination of some relationships between students' and teachers' views of science lessons in Year 9 in Australian secondary schools. In this examination the dimensions through which teachers and students viewed the same lessons are compared, and the extent to which those views were similar is examined.

The Context

As indicated above this paper is based upon one facet of a larger study which set out to evaluate the influence of the Australian Science Facilities Program on science education in secondary schools (Ainley, 1977a). Under that Program the Australian government made available some $123 million for the improvement of science facilities in schools. This money was spent on laboratories and apparatus and was applied in government and non-government schools. The Program had the immediate objective of improving facilities, the intermediate objective of influencing the processes of science teaching, and the ultimate objectives of effecting such outcomes of science teaching as student achievement in and attitudes to science.

The evaluation encompassed four main aspects of the Australian Science Facilities Program: the extent to which the Program raised the standard of facilities in schools, (Ainley, 1976), the influence of the standards facilities on science teaching and learning processes (Ainley, 1977b), the effect of facilities on such outcomes as student achievement, and interest, in science (Ainley, 1978), and a consideration of the Program's administration.

Of central interest in the evaluation were the assumptions that the standard of science facilities available was related to certain aspects of science teaching. It was generally assumed that better facilities would result in improved science lessons. One of the approaches used to assess the relationship between the standard of facilities and what happened in science lessons involved the development and use of a questionnaire to obtain student views about their science lessons. Student responses to the questionnaire were averaged within classes to give class mean scores for each scale. These mean scores were then used in subsequent analyses. In the main analyses the class mean scores on each scale were the dependent variables for a series of regression analyses in which four measures of the standard of science facilities available to the class were the independent variables. The purpose was to determine whether differences in these objective measures of the standard of facilities were associated with differences in the students perceptions of their science lessons.

As part of that investigation teachers were asked to complete the same questionnaire as the science classes which they taught. By this means it was possible to examine the extent to which teacher and learner shared similar perceptions of the science lessons which they experienced.

The Questionnaire

The questionnaire sampled views of six aspects of science lessons, chosen after an analysis of the objectives of the Commonwealth Government Science Facilities Committee. The stated objectives of this Committee concerned both the environment in which science was studied and the activities which were involved in science lessons.

The environment for learning about science

In this section of the questionnaire three concepts concerning the learning environment were stressed: involvement, organization, and stimulation through variety. These corresponded with three principal concerns of the Science Facilities Committee.

1 The views of the committee about the design and provision of science rooms were based on a belief that <u>individual involvement</u> in science learning was valuable. It particularly related this view to the need to accommodate new curricula, to allow students to do experiments themselves, and to foster participation in group discussions (Commonwealth of Australia, 1976:15, 1973:11).

2 A second premise was that the learning environment should be <u>well organized</u> so that students could work effectively. Published design brochures gave considerable attention to space requirements of rooms in which orderly work and effective management of resources were possible.

3 The third concern of the Committee was that science lessons should be <u>stimulating through the variety</u> of methods used. Stimulation was seen as coming through two facets of variety: through the use of varied and flexible instruction and in the use of a wide variety of stimulating materials in the room. In its final report the Committee stated that a science room should be suitable for all kinds of activity including, inter alia, demonstrations, pupil experiments, group discussions, films, or a mixture of activities at the one time (Commonwealth of Australia, 1976:16).

These aspects of the learning environment had been used in other studies of teaching behaviour and classroom process variables. For example one study of some 6000 teachers (Ryans, 1960) identified three patterns of teacher behaviour.

Pattern X - warm, understanding, friendly versus aloof, egocentric, restricted behaviour

Pattern Y - responsible, businesslike, systematic, versus evasive, unplanned, slipshod, teacher behaviour

Pattern Z - stimulating, imaginative, surgent, versus dull, routine, teacher behaviour (Ryans, 1960:382).

Pattern Y and Pattern Z seemed to be analogous to two of the concepts discerned in the work of the Science Facilities Committee. Pattern Y seemed closely related to the notion of organization. In fact Rosenshine (1971) saw Ryans' Pattern Y as overlapping with both goal directed and organized behaviour.

Pattern Z was very similar to the classroom process variable which Anthony (1967) called Stimulation. Anthony's measure of stimulation included assessing variety in materials, techniques, and feedback to

Table 1 Scales Included in the Views of Science Lessons Questionnaire

Scale	Description	Sample Item
Involvement:	An analogue of Anthony's (1967) self involvement opportunities, as found in a classroom process study.	I would learn more science if I could do some of the experiments myself. (-)
Organization:	An environmental analogue of Ryans' (1960) Pattern Y (businesslike behaviour) which was intended as a measure of the orderliness and convenience of the workplace in having space to work and being able to obtain the necessary apparatus and services when required.	The science room always seems to have enough space for everyone to work effectively.
Stimulation through Variety:	An environmental analogue of Ryans' (1960) Pattern Z but refined in the manner suggested by Anthony (1967) and Keeves (1971) to mean variety in materials and techniques of teaching.	In science we are sometimes able to grow things and study how they grow.
Encouragement to Explore:	The extent to which students are given encouragement to participate in exploratory science activities in and outside school.	In class we are encouraged to devise our own projects and experiments, either individually or in groups.
Textual:	The degree to which science teaching is based upon textbooks.	The main aim of our science lessons is to understand our textbooks.
Practical:	The emphasis upon practical work in science classes.	We learn most of our science through practical work and experiments.

students. Keeves (1971) also used a variable called 'stimulation for learning' which incorporated measures of the variety of methods used.

Ryans' (1960) Pattern X did not quite correspond to the notion of involvement which was being sought. A much closer analogue was the second process variable which Anthony (1967) related to achievement: Self Involvement Opportunities. Keeves (1971) included two process variables similar to this: Affiliation with Class and Interaction with Students.

Hence, the three concepts discerned in the stated and implied intentions of the Commonwealth Standards Committee when designing rooms were also found in studies of teacher behaviour and classroom processes. The three major concepts around which the science room environment section of the questionnaire was structured have been summarized in Table 1.

Activities in Learning Science

The principal justification for building laboratories in schools must surely be that students are thereby able to conduct experiments. It was therefore considered desirable to ascertain whether students enjoying better facilities than their peers in other schools would report different emphases in the science teaching which they experienced. There is little doubt that first hand experience and original investigations have become accepted as crucial elements in modern science curricula (Lee Dow, 1971; Ramsay, 1972).

Science rooms built under the aegis of the Australian Science Facilities Program were intended to accommodate and foster these teaching methods. Standards were set so that schools would have sufficient science rooms of suitable design to allow student experimental work, as appropriate, in any science lesson.

The development of instruments through which students can report upon the emphases in the science teaching was based upon the IEA 'Description of Science Teaching' scales (Comber and Keeves, 1973). Modifications of them by Coxhead (1974) and by Kelly (1976) were also considered for possible use in this study.

The results of a trial questionnaire in Victorian schools prior to the main study suggested that the most promising approach was to use the items which had been used by the IEA. Two changes were made to the format. A five point, rather than a three point, response key was used. In addition to this, the instructions were modified so that a more specific meaning was given to each of the five categories.

The three factors which emerged from the analysis of the questionnaire were of direct relevance to the Science Facilities Project. They resembled the concepts of laboratory work, enquiry learning, and textbook learning around which the original IEA scales were formed but did not assume the same bipolarity. Scales which were able to be formed from these three factors had sufficiently good reliabilities to be used as measures of class activity in science. The interpretation of the factors and hence the attributes assumed to be measured by the scales have been shown in Table 1.

Properties of the scales

Reliabilities of the scales were calculated in two ways. First, the values of coefficient alpha were calculated using student responses. Second, the class means for each item were calculated for each class and the reliability

Table 2 Scale Statistics for the Student Questionnaire Views of Science Classrooms

Scale[a]	I	O	V	E	T	P
Number of Items	7	7	7	9	6	6
Between Students (N = 2991)						
Reliability (Coefficient α)	0.59	0.75	0.55	0.64	0.66	0.66
Mean	19.6	23.8	19.0	24.1	17.7	18.8
Standard Deviation	4.7	5.7	4.6	5.3	4.8	4.4
Range from	7	7	7	9	6	6
to	34	35	34	43	29	30
Between Classes (N = 105)						
Reliability (Coefficient α)	0.82	0.89	0.68	0.73	0.84	0.85
Mean	19.5	23.6	18.9	24.3	17.7	19.0
Standard Deviation	2.3	3.3	2.6	2.6	3.3	3.1
Range from	11.0	15.6	14.0	17.9	7.8	11.0
to	25.7	31.0	27.9	30.6	28.0	25.4
Kolmogorov-Smirnov Z	0.87	0.76	0.85	0.70	0.90	0.79

[a] I = Involvement
O = Organization
V = Stimulation through Variety
E = Encouragement to Explore
T = Textual
P = Practical

of the scale using class means was calculated. As suggested by Kane and Brennan (1977) the reliability of the class means was higher than that of the individuals though not as high as would be calculated by Shaycoft (1962) or Wiley (1971). Reliabilities and other relevant statistics are presented in Table 2. The reliabilities of these scales appeared to meet the criteria specified by Nunally (1967) for research instruments. It is also worth noting that the student responses covered most of the range for each of the scales and that the distribution of class means did not differ significantly from normal.

Table 3 A Comparison of Students' and Teachers' Views on Six Science Classroom Scales

Scale	Means		Sig. of Difference	Correlation Coefficients	Sig. of Coefficient
	Students	Teachers			
Involvement	19.56	21.46	ns	.39	<.001
Organization	23.63	22.60	ns	.59	<.001
Stimulation	19.06	20.26	<.01	.39	<.001
Exploration	24.30	24.54	ns	.08	ns
Textual	17.80	18.65	<.05	.43	<.001
Practical	18.95	19.75	ns	.60	<.001

Note: A two tailed test of significance was used.

Administration

In its final form the questionnaire was administered to almost 3000 students from 105 science classes in Year 9 in Australian secondary schools. The classes studied were chosen from 29 schools which a previous survey (Ainley, 1976) had shown to encompass a wide variety of standards of available facilities. At the same time that the class completed the questionnaire each science teacher was asked to do the same.

Analysis and Results

Two techniques were used to compare the two sets of evidence from classrooms. One involved a simple comparison by correlating teachers' and students' views on the scales. The other used canonical variate analysis to examine whether the underlying perceptions of students and teachers were congruent.

Correlations. The results of the correlational analysis have been recorded in Table 3. Significant positive correlations were obtained for five of the six scales.

The exception was the scale concerned with the amount of encouragement to explore. It may be that students and teachers had a different understanding of what was meant by the encouragement given to students to explore and to work independently on investigatory activities. The two scales on which there was closest agreement concerned the emphasis on practical work, and the organization of science lessons.

Another issue which arose from a comparison of teachers' and students' views was that of whether there was a systematic difference between teachers' and students' views on any of the scales. As indicated in Table 3 the difference between class means and teacher scores was significant in two cases: Stimulation through Variety and the Emphasis on Text Books.

Teachers' ratings of Involvement and Stimulation through Variety were higher than those of students, but students, surprisingly rated the use of text books lower than did their teachers. A plausible explanation for this latter result could lie in the fact that there was some confusion about what constituted a text book. In classes where a wide range of books were used in science lessons, students may have been uncertain about what was meant by the questions.

Canonical Analysis. The second technique used to assess the congruence between teacher and student views of their science lessons was Canonical Variate Analysis (Darlington et al, 1973). This is a statistical procedure for studying relations between two sets of variables. Though its application has in practice largely involved the study of relations between a set of independent variables and a set of dependent variables, there is no necessity for a preconception of causality when using the technique. It appears to be equally well suited to examining the associations between two sets of variables which are thought to be measures of the same underlying dimensions. The important condition is that there is a theoretical justification for forming the two sets of variables. In the present application there was a clear justification for this in that one set comprised class mean scores for students on six scales while the other set contained their teachers' scores on the same six scales.

The canonical analysis was performed using the program CANON developed by Cooley and Lohnes (1971) and incorporating the method of partitioned redundancy (Cooley and Lohnes, 1975). The two sets of variables were the students' and teachers' scores on each of the six Views of Science Lessons scales. In Table 4 the results are presented for the testing of successive latent roots in the canonical analysis of these data. Three latent roots were significant at the five per cent level. Thus the teachers' and students' views of science lessons were associated in three significant ways.

Table 4 Canonical Analysis Between Student and Teacher Responses to the Views of Science Classrooms Questionnaire: The Significance of Successive Canonical Variates

Number	Eigen value	Canonical Correlation	ψ^2	df	Significance
1	.59	.76	185.5	36	<.001
2	.40	.64	99.0	25	<.001
3	.30	.55	49.5	16	<.001
4	.11	.33	14.8	9	ns
5	.03	.17	3.4	4	ns
6	.00	.06	0.4	1	ns

The significant canonical variates can be interpreted by using the transformation weights and the structure coefficients. Table 5 contains the transformation weights and structure coefficients for the two sets of variates related by significant canonical correlations. Tatsuoka (1973) and Keeves (1974) have both argued that structure coefficients generally provide a better guide to the interpretation of canonical variates than do transformation weights. An additional advantage of the use of structure coefficients is that the sum of their squared values provides the basis for an estimate of the proportion of the variance in each set that is extracted by each factor.

From the structure coefficients in Table 5 it can be seen that the three significant canonical variates in both the student and teacher data have the same interpretation.

For each canonical variate the structure coefficients of the variables in the student set were similar to the structure coefficients of the variables in the teacher set. This has been represented pictorially in Figure 1. Even where there were small differences in the actual values the pattern in one set matched the pattern in the other set. This provided important evidence that teachers and students described their science classrooms in terms of similar underlying dimensions.

It was also possible to infer specific interpretations of the three canonical variates. The first appeared to be concerned with a practical activity associated with an enriched environment. An enriched environment was one which was involving, well organized, and stimulating. An

Table 5 Transformation Weights and Structure Coefficients for Canonical Analysis Between Student and Teacher Responses to the Views of Science Classrooms Questionnaire

	Transformation Weights			Structure Coefficients		
Students	V_1	V_2	V_3	U_1	U_2	U_3
Involvement	-09	-10	49	43	-53	34
Organization	18	-82	64	55	-73	31
Stimulation	03	-35	65	32	-55	-38
Exploration	02	22	40	21	-31	-13
Textual	-37	12	70	-15	41	52
Practical	95	63	-18	91	27	19
Variance Extracted				.25	.25	.11
Redundancy				.14	.10	.03
Total Redundancy for Students (Given Teacher) = .293						
Teachers						
Involvement	-11	-03	16	34	-25	50
Organization	18	-70	76	42	-67	57
Stimulation	20	-10	-65	39	-42	-28
Exploration	-34	-14	16	-02	-16	05
Textual	-44	38	48	-33	57	57
Practical	91	58	06	80	42	30
Variance Extracted				.20	.20	.18
Redundancy				.12	.08	.05
Total Redundancy for Teachers (Given Students) = .265						
Canonical R	0.76	0.64	0.55			
Canonical R^2	0.59	0.40	0.30			

Note: In reporting transformation weights and structure coefficients decimal points have been omitted.

interpretation of the second canonical variate was that it represented a poor environment which was not involving, organized, or stimulating and was associated with text book based learning. The third canonical variate involved learning from textual materials in association with an involving and well organized, but not stimulating environment. With some risk of oversimplification the interpretations of these three canonical variates

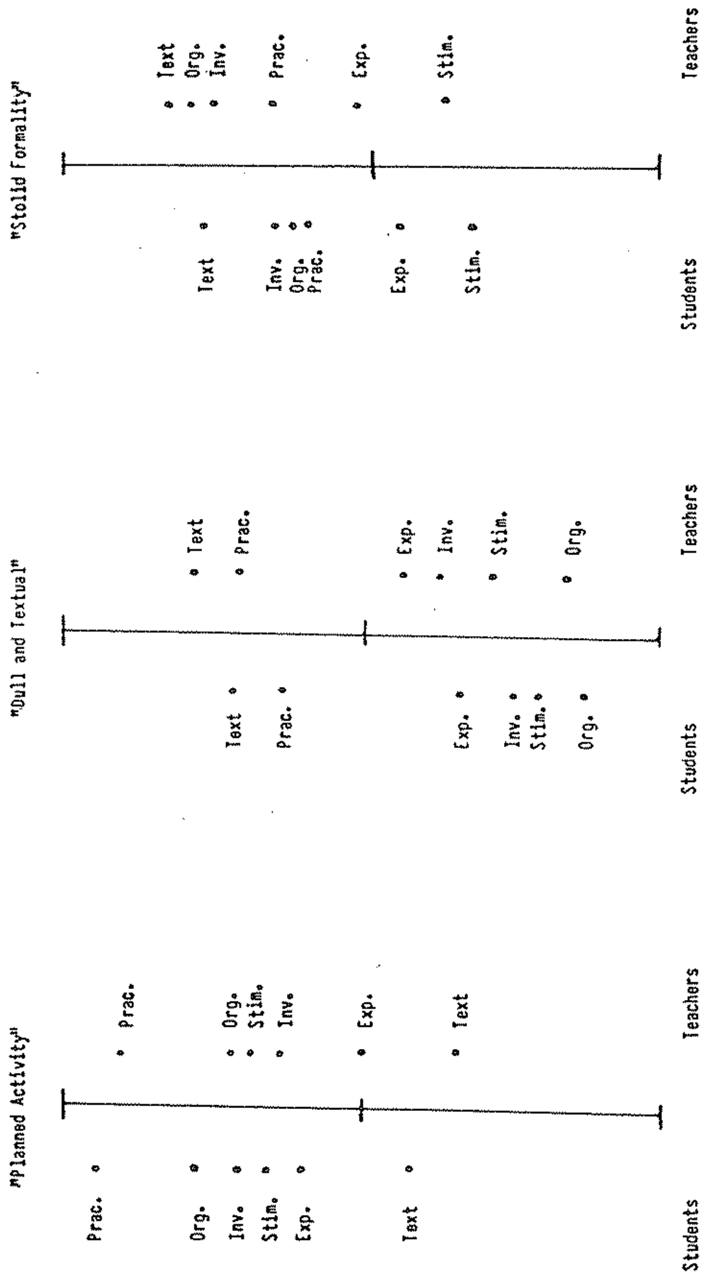

Figure 1 Canonical Variates Linking Student and Teacher Views of Science Lessons

could be paraphrased as planned activity, dull disorganized study of a text book, and stolid formality. It is important to emphasize that the same interpretation emerged from the student and teacher sets of variables. The canonical correlation between the first pair of canonical variates was 0.76, that for the second pair was 0.64, while for the third pair a canonical correlation of 0.55 was obtained. It would appear that the teachers and students agreed about the dimensions which were involved in science teaching and agreed in their assessments of those dimensions for their classrooms.

The three canonical variates accounted for appreciable proportions of the total variance in both the set of student variables and the set of teacher variables. In the student set the three factors accounted for 25, 24 and 11 per cent of variance respectively. Similarly they accounted for 25, 20 and eight per cent of the variance in the teacher scores on the six scales. From the computer program CANON (Cooley and Lohnes, 1971) it was possible to obtain measures of redundancy. Redundancies indicate how much variance in one set of variables is predictable from the other. It can be seen from Table 5 that 29 per cent of the variance in student scores was associated with variance in teacher scores. Conversely 26 per cent of the variance in teacher scores could be predicted from student scores. In brief, these results confirmed that there was a substantial measure of agreement between students and their teachers on the matters raised in this questionnaire.

One further comment seems warranted. The canonical factors which emerged from this analysis may provide a guide for further research into the processes in science classrooms. However they were not used in subsequent analyses in the main study. The six scales originally developed around a theoretical framework, and whose use was supported by factor analyses, were retained for subsequent work. The purpose of this canonical variate analysis was not to achieve greater parsimony but to validate the scales by seeking corroborative evidence from the students and their teachers.

Conclusion

Of special concern in the present study was the issue of whether the average student perceptions recorded on the six scales provided a valid description of what actually happened in the science classrooms. Of course in an empirical study it was only possible to compare data from different sources as a means of obtaining an answer to this issue. As the results derived from different sources matched each other there was evidence that the perceptions were shared by more than one type of informant. While it does not necessarily follow that a widely shared perception is equivalent to what existed in the classroom, it is true that lack of agreement among different observers would have raised questions about the validity of an instrument.

The results of this analysis suggest that teachers and students shared some common perceptions of the lessons in which they mutually engaged. In spite of the different roles which they were assigned they apparently emphasized similar aspects in their lessons when they reported. In addition there seemed to be some agreement in the extent to which teachers and students reported that those dimensions were important components of their science lessons.

The present study was restricted to science lessons at one age level. It would be interesting to see whether similar results could be obtained by using such instruments as the Learning Environment Inventory (Anderson, 1971) and the Classroom Environment Scales (Trickett and Moos, 1974) in a wider range of disciplines and with different age levels.

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An Experiment in Extending Teaching Versatility

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