Title	Incongruence in actual and preferred teaching activities in mathematics classrooms
Author(s)	Wong, Khoon Yoong
Source	6th International Congress on Mathematical Education, 27 July to 3 August 1988, Budapest, Hungary

..INCONG.PAP

INCONGRUENCE IN ACTUAL AND PREFERRED TEACHING ACTIVITIES IN MATHEMATICS CLASSROOMS

By

Khoon Yoong, WONG

Mathematics Education Department

Institute of Education

469, Bukit Timah Road, Singapore, 1025

Paper presented at the

Sixth International Congress on Mathematical Education

Budapest, Hungary

July 27 to August 3 1988

Abstract

Educators generally recommend that teachers should adapt their teaching styles to the needs and characteristics of their pupils. For this to be feasible, detailed information should be sought about the teaching style preferred by pupils. In this study, a sample of 216 Year 11 Brisbane (Australia) students completed a questionnaire on the actual and preferred teaching activities in their maths classrooms. Significant differences were found in classroom format, use of teaching aids, marking tests, and ways to achieve understanding. Pupils generally preferred a deep approach involving explaining ideas in different ways, use pupils' ideas in discussion, teaching them how to check the reasonableness of their answers. No differences were found with regards to a surface approach to teaching that emphasised rote learning and doing many similar examples. An overall incongruence score correlated -.27 with achievement and was related to less positive attitudes towards mathematics. The research points to the need to take pupils' preference into consideration when planning teaching activities.

Literature Review

It is obvious that pupils in a given class will differ in their abilities, personalities, and expectations about their learning. Teachers are generally well aware of these individual differences and the differential effects their ways of teaching may have on individual pupils within the same class. One way to think about adapting teaching approaches to a variety of pupils' characteristics comes under the paradigm of 'person-environment congruence.'

Investigations into the concept and effects of person - environment congruence have been undertaken by Lewin (1936), Pace & Stern (1958), Hunt & Sullivan (1974), Fraser (1981), and others. It has been found that congruency between students' needs and their perceptions of the educational environment is related to greater satisfaction though not necessary to better achievement (Walsh, 1973). A certain degree of congruence between personal needs and environment is desirable, but an exact fit between person and environment should be avoided so that there are opportunities for change and personal growth (Baird, 1974).

In an alternative conceptualisation, it is reasonable to treat what is perceived as the 'actual' environment, especially when the person is the unit of analysis. Measures of incongruence between ideal and actual (perceived) environments are computed by means of difference scores (Kulka, 1979; Wylie, 1974). Hall (1970) asked a sample of undergraduate students to indicate the actual teacher style and the ideal teacher style they preferred. Using different measures of student's perceptions of what they had learned as the criteria, it was found that the actual teacher style was a better predictor of learning than were the degree of fit or the ideal teacher style. Considerable variations among students in their perceptions of ideal learning environment were reported (Moos, 1979).

Attempts to match students with their preferred teaching styles are confounded by several problems:

(a) the students may prefer environment that are not sufficiently challenging

(b) the distinction between what they *need* and what they *prefer* is not obvious

(c) variations in preferences over time and different classroom settings.

Research studies attempting to match students with instructional approaches on various criteria have produced some puzzling findings (Cronbach & Snow, 1981; Hunt, 1975). For instance, among psychology students who wanted clarity of structure, males who perceived their instructor as giving structure did *worse* than males who perceived their instructor as not giving structure. No such difference was found for females. Hunt (1975) found evidence that, although students low on conceptual level, as expected, judged the lecture mode as more valuable for learning than did students high on conceptual level, there was no difference between the two groups when they were asked for their preference for instructional mode (lecture, discussion, discovery).

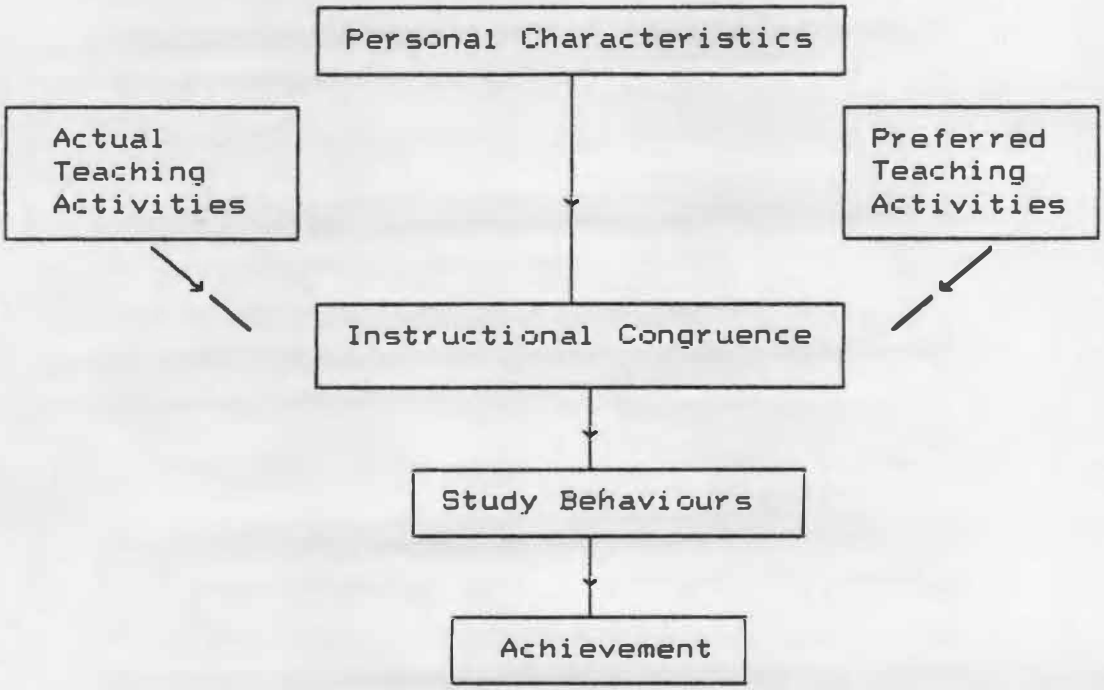
The studies have so far been conducted in disciplines other than mathematics. This study intends to fill a gap in applying the paradigm of person - environment congruence to teaching activities within the mathematics classrooms. It is assumed that actual teaching activities do *not* directly influence achievement, rather that they are mediated by instructional congruence and the study behaviours of the students. A conceptual model for school mathematics instruction is given in Figure 1.

Instrument Subjects and Administration

A questionnaire is constructed to cover the following aspects of teaching activities found in normal mathematics classrooms: classroom format, teaching aids, tests, logical activities, deep appoach, and surface approach. The 45-item questionnaire has an 'Actual' and a 'Prefer' column. Students were asked to respond to each item in two ways: first to indicate how often they perceived their mathematics teacher had actually carried out that activity; second, to indicate how frequently they preferred the activity to be used in their mathematics lessons. A 5-point Likert scale was used: 1 = never, 2 = seldom, 3 = sometime, 4 = often, 5 = all or most of the time. By using commensurate items, the discrepancies

between perceptions of actual and preferred teaching activities can provide measures of the degree of instructional *incongruence.*

Figure 1: A Model of Mathematics Instruction



The questionnaire and a Calculus test were administered to a sample of 216 Year 11 students from seven different high schools in Brisbane, Australia. Their ages ranged from 15 years to 17 years.

Results

The means of the Actual and Prefer ratings are reported in the following tables. Algebraic differences between Prefer and Actual ratings were tested for statistical significance at the .001 level. Most of the significant t-values related to classroom format, use of teaching aids, tests, and a deep approach. On these aspects, students generally were not satisfied with what their teachers were perceived to be doing. On the other hand, students were generally satisfied with activities relating to logic and a surface approach.

Table 1: Means of Actual and Prefer Ratings and their Differences

Item	A	P	P - A
Classroom Format			
Group work	1.3	2.0	0.7 *
Discussion	2.9	3.3	0.4 *
Individual work	3.2	3.3	0.1
Lecture	2.6	2.3	-0.3 *
Teaching Aids			
Computer	1.3	3.0	1.7 *
Film, TV	1.1	2.3	1.2 *
Maths puzzles	1.4	2.6	1.2 *
Workcards	1.7	2.7	1.0 *
Models	1.3	1.8	0.5 *
Cardboard etc for investigation	1.1	1.6	0.5 *
Overheads projector	1.6	1.8	0.2
Blackboard	4.8	4.7	-0.1
Tests			
Sets routine questions	3.4	3.8	0.4 *
Can use any method	4.0	4.3	0.3 *
Marks for method also	4.2	4.5	0.3 *
No marks for working	1.6	1.6	0.0
More marks for neatness than originality	2.0	1.9	-0.1
Marks for expected method only	2.6	2.4	-0.2 *
Sets original questions	3.5	3.0	-0.5 *
No explanation for error	2.0	1.5	-0.5 *
Logical Activities			
Allows use of own symbols	2.1	2.3	0.2 *
Teaches types of proof	2.9	3.1	0.2
Working presented logically	3.9	4.0	0.1
Must use symbols correctly	4.1	4.1	0.0
Teaches rules of logic	3.5	3.5	0.0

Individual seatwork and class discussions were more commonly used in lessons than lectures or group work. The students preferred more group work and class discussions.

Blackboard was used most of the time whereas other aids were used only occasionally. Strong preference was expressed for the use of computer and maths puzzles in mathematics lessons.

The teachers were reported to set a combination of routine and original questions. They frequently gave marks to working as well as answers and accepted any correct method rather than only

the ones they had taught. The students preferred fewer original questions and more routine questions.

The teachers generally stressed the correct use of symbols and logical presentation of solutions. However, there was little opportunity for students to express ideas using self-invented symbols, a practice which may not be feasible at this level.

Table 2: Means of Actual and Prefer Ratings and their Differences

Item	A	P	P - A
Deep Approaches			
Uses real-life examples	2.8	3.5	0.7 *
Teaches how to check answers	3.0	3.7	0.7 *
Allows students to learn at own pace	3.2	3.9	0.7 *
Revises to establish links in ideas	3.2	3.7	0.5 *
Revises to foster mastery of rules	3.8	4.3	0.5 *
Explains in different ways	3.4	3.7	0.4 *
Revises for understanding	3.7	4.1	0.4 *
Allows investigations	1.4	1.8	0.4 *
Teaches why and how of rule	4.0	4.3	0.3 *
Uses students' ideas in discussions	3.2	3.5	0.3 *
Allows students to experiment with ideas	2.8	3.0	0.2
Asks thinking questions	3.3	3.4	0.1
Uses history of maths	2.7	2.7	0.0
Different ways of solving	2.7	2.7	0.0
Expects students to do extra problems	3.2	3.0	-0.2 *
Expects student to try it first	2.5	2.3	-0.2
Surface Approaches			
Expects students to do given problems only	2.2	2.4	0.2
Students to do similar examples	3.8	4.0	0.2
Practice skills before theory	1.8	2.0	0.2
Does not allow suggestions	1.9	2.0	0.1
Explains everything	3.0	3.1	0.1
Does not relate topics together	3.0	3.0	0.0
Uses one method only	2.6	2.6	0.0
Definitions must be learnt exactly	2.8	2.7	-0.1
Asks only yes-no questions	2.8	2.7	-0.1
Students to imitate examples	3.6	3.3	-0.3 *

The large number of significant items in the Deep Approach category indicates that greater stress could be placed on making mathematics learning more meaningful to the students. In particular, students preferred more frequent use of the following activities: explain things in different ways, use students' ideas

during discussions, relate topics to real-life situations or to other school subjects, teach students how to check their answers before looking them up in the textbooks, link ideas together, and to allow students to learn at their own pace. However, the students preferred *not* to do extra questions.

Students were expected to practise skills on similar examples and to imitate worked examples.

Algebraic differences between Prefer and Actual ratings were reduced to 14 scales by means of factor analysis (see Wong, 1984 for details). An overall measure of instructional incongruence was obtained by finding the root mean square of these scales. The correlations of some interested variables are reported in Table 3.

Table 3: Correlations of Variables in the Model (N = 207)

	2	3	4	5
1. Prior achievement	.49	-.25	.43	.82
2. Personal characteristics		-.37	.72	.54
3. Incongruence			-.29	-.27
4. Study behaviour				.48
5. Calculus Test (Post)				

Note: All correlations are significant at .001 level.

In Table 3, Prior achievement was given by the student's mathematics score before beginning on the Calculus course. Personal characteristics was an overall measure of student's attitude and motivation towards mathematics. Study behaviour was an overall measure of desirable study habits. High scores on this measure indicated high incidence of being diligent, using a study plan, doing mathematics in different ways, linking ideas and so on. The correlations show that students who expressed dissatisfaction with the perceived teaching activities tended to have poorer achievement, less positive attitude, and less desirable study behaviours. Although instructional incongruence was the weakest predictor of achievement, its effect should be further studied in view of its links with other salient predictors.

Conclusion

This study was carried out before the release of the influential Cockcroft report (1982) that has spearheaded the so-called 'investigative mathematics.'. Based on students' preferences, the data provide some support for the inclusion of group work and discussion in mathematics lessons. More effort should be directed towards making mathematics learning more meaningful, for instance, by using real-life situations, allowing students to learn at own pace (which can be achieved with the use of computer-based learning), and helping students to link topics together. Even though it is not possible to specify specific teaching acts to meet all the preferences of the students, teachers should try to understand the needs of their students so that a better match can be attained.

References

Baird, L.L. (1974). The practical utility of measures of college environment. Review of Educational Research, 44, 307 - 329.

Cockcroft, W.H. (1982). Mathematics counts. London: Her Majesty's Stationery Office.

Cronbach, L.J. & Snow, R.E. (1981). Aptitudes and instructional methods: A handbook for research on interactions. New York: Irvington.

Fraser, B.J. (1981). Australian research on classroom environment: State of the art. Australian Journal of Education, 25, 238 - 268.

Hall, D.T. (1970). The effect of teacher-student congruence upon student learning in college classes. Journal of Educational Psychology, 61, 205 - 213.

Hunt, D.E. (1975). Person-environment interaction: A challenge found wanting before it was tried. Review of Educational Research, 45, 209 - 230.

Hunt D.E. & Sullivan, E.V. (1974). Between psychology and education. Hinsdale, Illinois: Dryden Press.

Kulka, R.A. (1979). Interaction as person-environment fit. In L.R. Kahle (Ed.), Methods for studying person-environment interactions. San Francisco: Jossey-Bass, 55 - 71.

Lewin, K. (1936). Principles of topological psychology. New York: McGraw Hill.

Moos, R.H. (1979). Evaluating educational environments. San Francisco: Jossey-Bass.

Pace, C.R. & Stern, G.G. (1958). An approach to the measurement of psychological characteristics of college environment. Journal of Educational Psychology, 49, 269 - 277.

Walsh, W.B. (1973). Theories of person-environment interaction. Iowa City: American College Testing Program.

Wong, K.Y. (1984). Mathematical understanding: An exploration of theory and practice. Unpublished Ph.D. thesis, Brisbane: University of Queensland.