CHAPTER 3

METHODOLOGY

3.1 Introduction

This research of co-relational study objectives was to determine the students' perceptions of their mathematics classroom environment based on the eight scales using the Personal form of WIHIC questionnaire which has been developed for the purpose of measuring the secondary classroom learning and to investigate associations between the students' perception of the mathematics classroom environment and their achievement in mathematics. Neither classroom learning environments nor teacher-student interpersonal behaviour can be held constant, controlled or manipulated in the scientific sense for the duration of the research. The researcher has no control over all the variables in the research. Thus, this research is ex post facto. Kerlinger (1970) defines such research as, 'systematic, empirical enquiry in which the scientist does not have direct control of independent variables because the manifestations have already occurred or because they are inherently not manipulable'. The study employed a survey approach for collecting data. The methodology outlined in these chapters involves a description of sampling procedures, test for cognitive outcomes, gathering of the learning environment data and data analysis procedure.

3.2 The research sample.

The sample for this study were drawn from Form Two mathematics students in a district in Selangor. There are only three secondary schools here. Two schools were taken as subjects for the actual study and the third school was as pilot for the two main

instruments in the study. The schools involved are all public coeducational schools and the schools were requested to provide a broad cross section of classes that would ensure a range of ability. Both schools in the study streamed the students into their respective classes based on their academic performance in Form one at the end of last year. School X has six Form Two classes. Three Class 2AX, 2CX and 2EX totaling 121 students were provided by School X. School Y is a larger school with eight Form Two classes. Four classes 2AY, 2CY, 2EY and 2GY totaling 129 students from school Y were involved in this study. The class ability (with reference to the students in it) range from high to low and this range are given by the respective schools based on their own criteria for streaming. The number of students from each class and the class ability range is given in Table 3.1.

Table 3.1

Number of students in each class and class ability range

School	Class	Ability range	Total
School Y	2AY	High	33
(N=129)	2CY	Average	39
	2EY	Below Average	31
	2GY	Low	36
School X	2AX	High	41
(N=121)	2CX	Average	43
	2EX	Low	37
	Total		250

A total of 68 students were involved in the pilot study and 250 students were in the final sample. The students are about 13 to 14 years old. This batch of students are the first batch of students whom had gone through six years of primary mathematics in *Bahasa Melayu* (Malay language) and their secondary mathematics in English due to a recent education reform for the teaching and learning of mathematics and science in Malaysia. This account the need for one of the instrument in this study, the Mathematics Achievement Test (MAT) to be written in both English and Malay Language so as to reduce reading error in the study.

Permission from Ministry Of Education (Appendix C) was obtained prior to the study. Schools principals were contacted to make arrangements for the study and letters sent to parents (given through the schools involved) to all students whose classes were to participate in the survey both during the pilot and the actual study (Appendix D). These letters explained the study and gave assurances of confidentiality, and seek parent's consent for their child's participation. To the encouragement of this study, all students agree to take part.

3.3 Data collection

Two main instruments were used in the study. They are the Personal form of WIHIC questionnaire and the Mathematics Achievement Test (MAT) for the quantitative data. Qualitative data were obtained through a short open-ended question questionnaire. Data were collected on five occasions during the whole study. The time scheme is represented in Table 3.2. All the instruments were administered by the researcher herself, class by class. Every student's response sheet for the questionnaires was named so that

the data collected could be collated with the corresponding MAT scores. Students were given confidentiality assurance, both during the pilot and actual study that no actual names will be used in the final report. Over the period of study, seven student's results were not included due to their absences on either the WIHIC survey or mathematics test as their scores could not be collated.

Table 3.2

Data gathering timeline

2nd Week of February 2004	Administration of Malay Version of the Personal Form of WIHIC Questionnaire in pilot School
3rd Week of June	Administration of Mathematics Achievement Test in pilot school
3rd Week of July	Administration of Malay version of the Personal Form of WIHIC Questionnaire in School X and School Y.
1st Week of August	Administration of mathematics test MAT in School X and School Y.
4th Week of August	Administration of the Questionnaire for qualitative data

3.4 Test for cognitive outcomes

3.4.1 Mathematics Achievement Test (MAT)

Schools in Selangor do not practice a common exam across schools at the end of each semester unlike in some other states in Malaysia. Students' grades from both schools for the first semester are thus inappropriate and lack validity to be used as a

standard measurement of mathematics achievement for this study. Therefore, the researcher constructed the Mathematics Achievement Test (Appendix B) covering the first five chapters in Form Two Mathematics. These five chapters are chosen because at the time of study, the students had been taught on only these five chapters.

In order that the test would permit a fuller coverage of the first five chapters and hence reduce an important source of chance errors in total scores, multiple-choice items were constructed. The other advantages of the objective items are the ease, rapidity and objectivity of scoring. According to Gay (1986 p.233), multiple-choice tests tend to be more valid and reliable than other tests, and the scoring reliability is practically perfect. Each item carries four possible options, that is A, B, C, and D. The students were required to mark only the one choice in each item. For each item with the correct option, a score of one point was awarded. No point was awarded for items with wrong option or omitted by the students.

A thorough and systematic examination of the current Form Two mathematics syllabus and the textbooks used for the course and the consultation with two mathematics teachers was made prior to the construction of the multiple-choice items. The test item in the instrument must be able to detect just the types of behaviour that the learning outcome aimed. Each item must be constructed according to the mathematical concepts the pupils are expected to learn and the kinds of problems they are being trained to handle. So, Bloom's Taxonomy was also referred as to the behavioural objectives of the Form Two mathematics test. A classification of the total test items is given in Table 3.3. On this basis the number of items of each kind to be constructed for each topic was established. In order to construct an instrument with high content validity, test

specifications table (Appendix N) were drawn up. The test specifications show the content areas to be covered and the instructional objectives or the processes to be tested.

Table 3.3

Classification Of Test Items

Level	Bloom's Taxonomy	Total Item	Content by %
Level 1 (Low)	Knowledge (Remembering facts, patterns, setting, and method)	12	30%
Level 2 (Medium)	Comprehension (Understanding what is being communicated)	18	45 %
Level 3 (High)	Application (Using previously learned information in new and concrete situations to solve problems that have single or best answers)	10	25 %
		N =40	100%

The test was further refined after an item analysis of the responses given by the pilot sample pretest on this instrument. Based on the discrimination index and the level of item difficulty, items were summarized into an item performance chart (Appendix G). Two items, Q1 and Q6, are found to have low discrimination power and should be rejected while Q8; Q9, Q16 and Q21 needed to be revised. Item Q1 was retained for psychological reason, that the first question being low in difficulty is a positive motivation factor for the test. The other five items were revised and rewritten and the Mathematics Achievement Test was given to two experienced teachers for content validation.

3.4.2 Content Validation of the MAT

The Mathematics Achievement Test was given to two experienced mathematics teacher who has been teaching Form Two mathematics for more than fifteen years and are proficient in English Language and Malay language for content validation.

The purpose of the content validation was to check whether the items constructed were based on the content specified in the first five chapters of the new form two mathematics syllabuses. The teachers had given suggestions on the phrasing of the items in MAT and modifications were made accordingly.

The MAT was constructed in both English and *Bahasa Melayu* (Malay Language). This was to follow the local public examination format (*Penilaian Menengah Rendah*) for this batch of students whom have had their six years of primary mathematics in Malay Language as the medium of instruction and their secondary mathematics in English. The final MAT is given in Appendix B

3.5 Classroom learning environment data

Both quantitative and qualitative data were collected. Researchers now have advocated the use of both types of data in order to provide complementary perspectives on the research problem (Fraser & Fisher, 1994). The quantitative data were gathered using the Personal Form of WIHIC Questionnaire, the MAT and the qualitative data were gathered from students' response to an open-ended response questionnaire (Appendix E).

3.5.1 The Personal Form of WIHIC Questionnaire

The original 90 item-nine scale WIHIC questionnaire was developed by Fraser; Fisher & McRobbie (1996) and has a separate Class form (which assesses a student's perceptions of the class as a whole) and Personal form (which assesses a student's personal perceptions of his or her role in a classroom). The WIHIC questionnaire has been used successfully in its original form or in modified form in Singapore, Taiwan, Brunei and Australia. Rawnsley (1997) piloted both the Class Form and the Personal Form of WIHIC and remove one scale, the Autonomy Scale which was found not relevant to mathematics classes. The personal form of WIHIC questionnaire adapted from Rawnsley's work in this study has eight scales and each scales with 8 items. The sixty-four item questionnaire carry a five point Likert-type response. Students are asked to respond to each item by indicating if the statement in the item represented a situation which 'Almost Never Happens', 'Seldom Happens', 'Sometimes happens',' Often Happens' or 'Almost Always Happens'. Table 3.4 shows the eight scales of the instrument with its descriptor and a sample of the items in the instrument.

Table 3.4

Scales, descriptor and sample item of The Personal Form Of WIHIC questionnaire.

Scales	Descriptor	Sample item
1. Student Cohesiveness	Students show friendship and help each other with their work.	I work with other students on projects in this class
2. Teacher Support.	The teacher is friendly, helpful, and supportive and interested in his/her students.	The teacher takes a personal interest in me.
3. Involvement.	Students are involved in questioning, answering and discussing their work.	I give opinions during class discussions
4. Investigation	Students investigate mathematical problems in a variety of ways to find solutions.	I explain the meaning of statements, diagram and graphs.
5. Cooperation	Students work cooperatively rather than competitively.	When I work in groups in this class, there is teamwork.
6. Task Orientation	Students are focused on their mathematics work in class	I know what has to be done in this class
7. Equity	All students are treated equally in their work and their class contributions.	The teacher is as friendly to me as to other students.
8. Emphasis Understanding	The teacher questions, explain and emphasizes student understanding of work	I discuss different answers to a question.

Adapted from 'Associations between classroom learning environments, teacher interpersonal behaviour and student outcomes in secondary mathematics classrooms' by Rawnsley, D. G. (1997). p. 70

3.5.2 The translation and contextual suitability of the Personal Form of WIHIC

The Personal Form of WIHIC would be administered to the students in schools where the medium of instructions is Malay Language (with exception for mathematics and science); therefore the instrument was translated into *Bahasa Melayu* (Malay Language) by the researcher. The Malay language version of WIHIC (See Appendix A) was then given to an English teacher who is proficient in both English and Malay Language for back translation of the instrument. Later, the educator was shown the original version of the instrument to compare the equivalence of the two English versions of the instrument. Those items that were not equivalent were adjusted to produce the final Bahasa Melayu version of the instrument. In situation where direct translation is not possible, contextual translation was applied and these items appears in both Malay language and English in the instrument. One example of these items is item G3 (refer to Section G, Appendix A) which reads like this

G3: *Dalam kelas ini, ada pelajar lebih bersuara daripada saya.*
(Some other students have more say in this class than me)

The original Personal Form of the WIHIC questionnaire and its translated version (see appendices) were then given to two other mathematics teachers for checking whether the items had been suitably contextualized for use in the local setting. The two different mathematics graduate teachers had a minimum of 15 years experience in teaching mathematics and were proficient in Malay Language and English.

Their task was to check whether the adapted items were technically sound and whether the translated items conveyed the ideas and meaning in the original items. All the members of the panel found that the items were contextualized to suit the local setting. Hence no major change was made by members of the panel and the translated WIHIC is as presented in Appendix A. In this instrument, itemsA7, B7, C7, D7, E7, F7, G1, G2, G3, G5, H1 and, H7 were reversed to minimize the risk of students' response set bias.

3.5.3 Pilot study of the Personal Form of WIHIC

The Personal Form of WIHIC questionnaire was pilot tested on 68 students. Piloting was to explore whether the students are or not able to understand the Malay version of the Personal Form of WIHIC questionnaire without much difficulties and to obtained a time estimate for students to complete the questionnaire. The students were requested to underline the words and sentences that they found difficult to understand. The students were given response sheet to key in their response. The students took about 20 to 30 minutes to complete the instrument.

The result of the pilot study indicated that the student did not encounter any difficulties in understanding the items of the Personal Form of WIHIC questionnaire. Thus, no further change was made to the instrument and the same instrument was used for collecting data.

The Cronbach's Alpha Reliability of the instrument during the pilot was 0.80. Reliability analysis of the scales found low reliability for Task orientation scale and Equity scale. Analysis using inter-item correlation found the deletion does not affect

much of the Alpha value and thus the two scales were retained. The result of pilot study also indicated that there is variance in mean values of the scales between classes that can be used to create the class profiles as in the Figure 1. This indicated the instrument could detect differences in class environment even from within the same school.

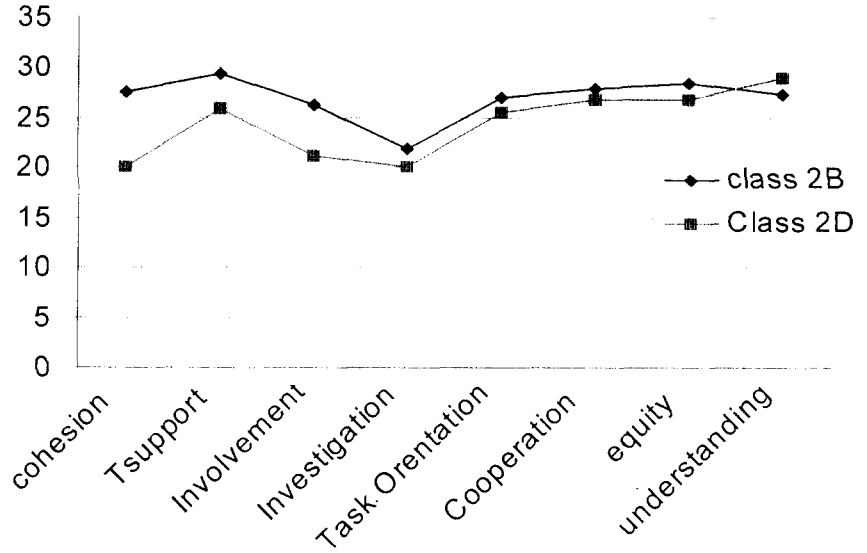

Figure 1 Profiles of Class 2B and 2D (Pilot)

3.5.4 Qualitative Data

Qualitative data were collected to complement the quantitative data. The instrument (Appendix E) to collect the data consists of an open-ended response question regarding the affects in their mathematics classroom environment. The students were informed that it is not compulsory for them to return the questionnaire. Qualitative data may help to pick up specific details about the class environment as it allows the students to voice out their opinions regarding issues that it closer or important to them. It also

allows the students to amplify and elaborate and debate their views about their classroom environment. In this study, students were asked to write about their enjoyment or dissatisfaction about their mathematics classroom environment. This was carried out on day the MAT papers were handed back to the students. The written response was then examined and the scales for which the comments are relevant to, in the study were noted (Appendix F). These comments were used to strengthen the findings of the study based on the data analysis or clarify nuances that the data analysis found contradicting.

3.6 Data Analysis

Four areas of statistical validation were carried out for description, analysis and interpretation of the results. The first was the item analysis and the reliability of the mathematics achievement test (MAT) using Kuder Richardson 20 formula followed by test of normality for the score distribution.

The discriminate validity of the Personal Form of WIHIC questionnaire was established by calculating the mean correlation of each scale with the other scale and the internal consistency of the instrument was established using the Cronbach's alpha coefficient

The perceptions of students' mathematics classroom environment were analysed using simple descriptive statistic and the associations between students' perceptions of their mathematics classroom environment to their achievement were analysed using the Pearson product-moment technique. In this analysis, the independent variable is the students' perception of their mathematics classroom environment as measured by the WIHIC Questionnaire and the dependent variables is the mathematics achievement as

measured by the MAT. The ninety-five percent confidence level ($p < .05$) was used as the criterion level for determining statistical significance.