CHAPTER 3

METHODOLOGY

3.0 Introduction

This study was designed to investigate the relationships between the Form Two students' perception of their science laboratory environment and their science achievement, attitude toward science and gender.

3.1 Subjects of the Study and their Science Laboratory.

The subjects of the study comprised 255 Form Two students of Sekolah Menengah Hulu Kelang, Selangor. The subjects were selected from Form Two level so that information gathered from them can shed some light as to whether there exists any relationship between the students' perception of the science laboratory environment and their science achievement and their attitude toward science. This information would be useful for science educators so that every effort can be taken to enhance science learning at lower secondary level, thereby leading to more students entering the science stream at upper secondary level.

The school is coeducational and has eight Form Two classes. The distribution of the subjects according to gender in each class and the ranking of the classes in terms of academic achievement are shown in Table 3.1
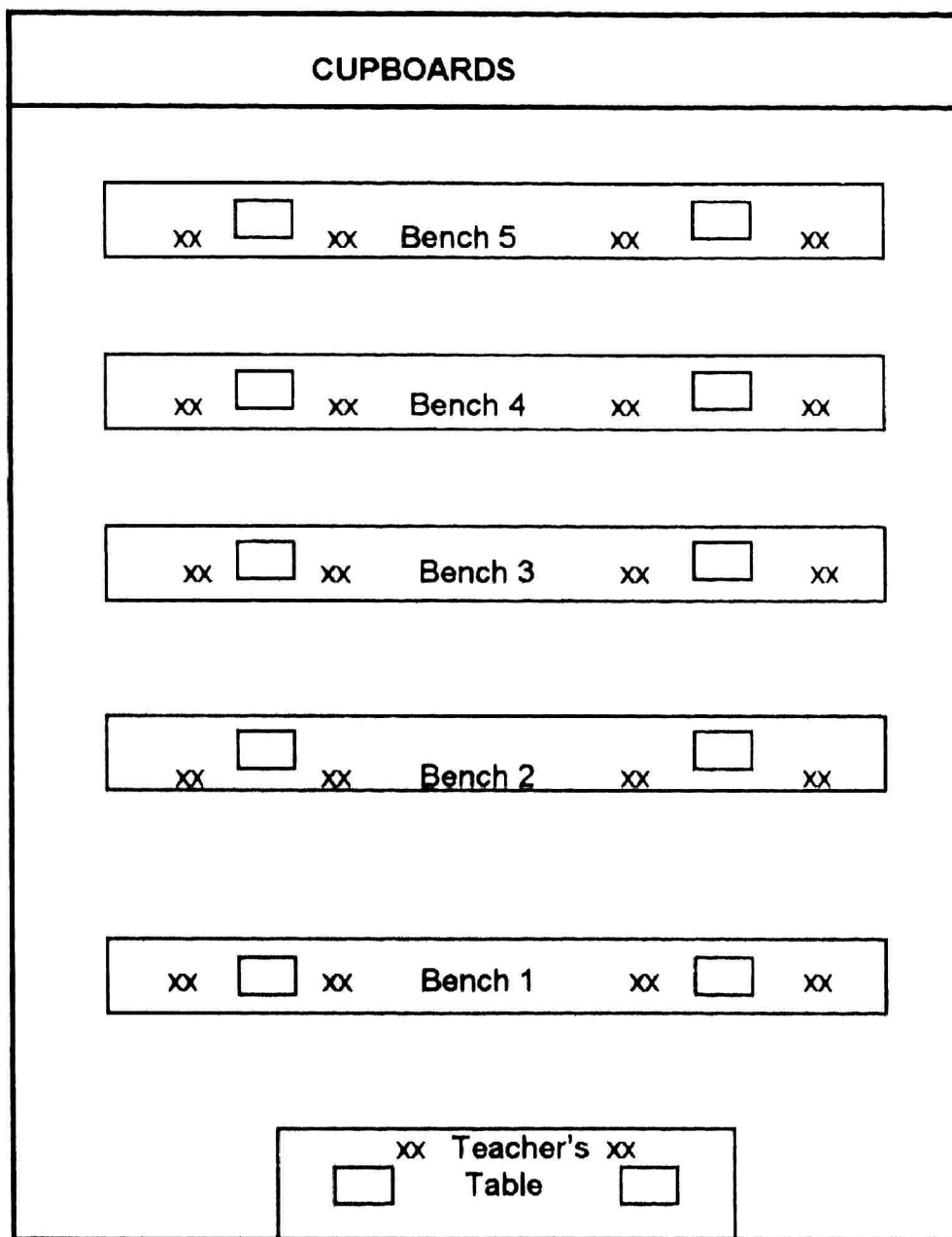
The students were streamed based on the results of the school's previous final examination for Form One. In addition, other aspects like gender and ethnicity of the students were also taken into account in the streaming.

Each of the two identical science laboratories used by the students in the school academic year 1996 consisted of five parallel benches (refer Figure 3.1) with the teacher's bench slightly raised higher than that of the students' benches. Each bench had two sinks and eight bunsen burners. There were four ceiling fans and eight fluorescent lamps in each of the laboratory. The dimensions of the laboratory were 12.2 m by 7.5 m, and each of the benches was 5.8 m long and 0.76 m wide.

Both of the laboratories had two doors each and they were facing the ground used for school assembly. The upper halves of the two side walls of the laboratories were lourved windows.

Table 3.1

Distribution of Subjects According to Gender.

Name of Form Two Classes	Number of Boys	Number of Girls	Total
2 Jujur	20	18	38
2 Ikhlas	19	16	35
2 Setia	15	19	34
2 Gigih	18	18	36
2 Tabah	19	14	33
2 Tekun	16	14	30
2 Usaha	21	13	34
2 Amanah	5	10	15
Total	133	122	255

35

CUPBOARDS

xx ▢ xx Bench 5 xx ▢ xx

xx ▢ xx Bench 4 xx ▢ xx

xx ▢ xx Bench 3 xx ▢ xx

xx ▢ xx Bench 2 xx ▢ xx

xx ▢ xx Bench 1 xx ▢ xx

xx Teacher's xx
▢ Table ▢

Key: ▢ Sink   ▢x Bunsen Burner

Figure 3.1. Laboratory Plan showing arrangement of benches.

3.2 Instrumentation

3.2.1 Adaptation of the SLEI and ATSSA

In this study, some of the items from the original SLEI and ATSSA were modified to suit the local context and the level of understanding of the Form Two students.

The SLEI, using a Likert-type rating scale with a 5-point response continuum ranging from 'Almost Never' to 'Very Often', consists of five subscales. The ATSSA is unidimensional, with a 5-point response scale ranging from 'Strongly Disagree' to 'Strongly Agree'. A summary of the corresponding items of each of the SLEI subscales and the items of the ATSSA is shown in Table 3.2 and Table 3.3.

The SLEI and ATSSA were translated into Bahasa Melayu by the researcher and the accuracy of the translation was checked by two Bahasa Melayu teachers of Sekolah Menengah Hulu Kelang. One of the teachers is the Head of the school's Bahasa Melayu Department. The other teacher with a specialised qualification of Dewan Bahasa dan Pustaka diploma in translation, taught Malay Literature at Form Six level. These teachers were proficient in both Bahasa Melayu and English. Based on their comments and feedback some changes and modifications were made before the instruments were sent for checking to see whether the items had been well adapted to the local context.

Table 3.2

Items in the SLEI Subscales

SLEI Subscale	No. of Items	Corresponding Item Number	Maximum Possible Scores
Student Cohesiveness	7	1, <u>6</u>, 11, 16, 21, <u>26</u>, 31	35
Open-endedness	7	2, 7, 12, 17, 22, <u>27</u>, 32	35
Integration	7	<u>3</u>, <u>8</u>, 13, 18, <u>23</u>, 28, <u>33</u>	35
Rule Clarity	7	4, <u>9</u>, 14, 19, <u>24</u>, 29, 34	35
Material Environment	7	<u>5</u>, 10, <u>15</u>, <u>20</u>, <u>25</u>, 30, 35	35
Total	35		175

Note: Items without their numbers underlined are scored 1, 2, 3, 4, and 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often, and Very Often. Underlined items are scored in the reverse manner. Omitted or invalidly answered items are scored 3.

Table 3.3

Items in the ATSSA

ATSSA Scale	No. of Items	Corresponding Item Number	Maximum Possible Score
General attitude toward science	14	1, <u>2</u>, 3, 4, <u>5</u>, 6, <u>7</u>, 8, 9, <u>10</u>, 11, 12, 13, <u>14</u>	70

Note: Items without their item numbers underlined are scored 1, 2; 3, 4, and 5, respectively, for the responses Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree and Strongly Agree. Underlined items are scored in the reverse manner. Omitted or invalidly answered items are scored 3.

The original and the refined versions of the SLEI and ATSSA
(see Appendixes 1 and 3) together with the definition of the subscales
were then presented to two school science teachers (with more than
fourteen years of teaching experience in science) to check whether the
items had been well adapted to the local context. These educators were
selected as members of the checking panel based on the following criteria:

    (a)   They are science graduates, and

    (b)   They have experience teaching science
            at the lower secondary level.

After checking the SLEI and the ATSSA, the science teachers were
generally of the opinion that the items were suitable for the understanding
of lower secondary students. Only two minor changes were made based
on their feedback.

3.2.2 Reliability of the SLEI

The SLEI has been subjected to cross-national validation in six
countries (Australia, the USA, Canada, England, Israel, and Nigeria)
involving 3727 senior high school students in 198 classes in 40 schools
(Fraser et al.,1993).

As shown in Table 3.4, by using either the student or class mean as
the unit of analysis for each SLEI subscale, acceptable Cronbach alpha

coefficients were obtained.

Table 3.4

Cronbach Alpha Reliability Coefficients of SLEI Subscales

SLEI Subscale	Unit of Analysis	Alpha Reliability
Student Cohesiveness	Individual	.56 - .81
	Class Mean	.70 - .92
Open-endedness	Individual	.49 - .78
	Class Mean	.70 - .92
Integration	Individual	.65 - .89
	Class Mean	.78 - .96
Rule Clarity	Individual	.61 - .84
	Class Mean	.78 - .95
Material Environment	Individual	.56 - .83
	Class Mean	.71 - .94

Source: Fraser et al. (1993)

In this study, the item-total correlations were computed for all the items of the SLEI. The purpose of computing the item-total correlations was to establish the internal consistency of the items with their respective subscales. In addition, Cronbach alpha coefficients were computed for each SLEI subscale to estimate the internal consistency of the subscales.

3.2.3 Reliability of the ATSSA

Cronbach alpha estimates of reliability of the ATSSA were found to be greater than .95 in four studies comprising 492 students (Germann, 1988). In addition, the instrument was able to discriminate significantly (at $p < .001$) between two groups of students, one group which fostered a negative attitude and the other which fostered a more positive attitude when the group means were compared using t-test analysis.

To provide a measure of the reliability of the ATSSA, Cronbach alpha reliability coefficient of this instrument will be computed in this study.

3.2.4 Science Achievement Test (SAT)

The Science Achievement Test (SAT) was used to assess the students' achievement in science. The test items were either constructed or adapted by the teacher assigned by the school to set the test. These items were based on the KBSM Form One and Form Two Science syllabi (Kementerian Pendidikan, 1988). The SAT questions were constructed at the first three cognitive levels of Bloom's taxonomy, namely, Knowledge, Understanding and Application. The number of questions for each topic was approximately based on the length of time used for teaching the topic, and on the popularity of questions that appeared in the examination of Penilian Menengah Rendah (see Table 3.5).

The SAT comprised 75 multiple choice items, each with four options of A, B, C, and D. A score of one point was awarded for each item correctly answered. No point was added or subtracted if the item was omitted by the student or answered incorrectly. The reliability of the SAT was estimated by computing the K-R 20 coefficient.

3.2.5   Content Validation of Science Achievement Test

Content validation of the SAT was carried out by the previously mentioned science educators involved in the checking of the SLEI and ATSSA. The process was guided by the table of specification (see Table 3.5) for the construction of the test. The science content tested covered Form One and Form Two KBSM Science syllabi.

Table 3.5

Table of Specification for Science Achievement Test

Topik	Soalan Aneka Pilihan			Soalan Aneka Pelengkap		
	Tahap Kognitif			Tahap Kognitif		
Tingkatan 1	I	II	III	I	II	II
1. Memperkenalkan Sains	2	2		1		1
2. Kepelbagaian Benda Hidup.		1	4	1	1	
3. Kepelbagaian Sumber Di Bumi	1	1	1		3	
4. Bentuk Dan Sumber Tenaga	1		2			1
5. Udara Di Sekeliling Kita	1	2	2		1	
6. Haba Dan Pemindahnya	3		1			1
Jumlah Soalan Tingkatan 1 (45 %)	24			10		
Tingkatan 2	I	II	III	I	II	III
7. Dunia Melalui Deria Kita	3	2	1		1	1
8. Air Dan Larutan		2	3	1	1	2
9. Makanan Dan Pembebasan Tenaga	5	2	2	1	1	2
10. Saling Bersandaran Antara Benda Hidup Dengan Alam Sekitar	2	1			2	
11. Daya Dan Gerakan	1	1	1		1	2
Jumlah Soalan Tingkatan 2 (55 %)	26			15		

Petunjuk : Tahap Kognitif : I - Tahap Pengetahuan (31%);

II - Tahap Kefahaman (33%);

III - Tahap Aplikasi (36%).

3.3 Pilot Study of the SLEI and ATSSA

The refined Bahasa Melayu version of the SLEI and ATSSA were pilot tested on a few students chosen randomly from one of the Form Two classes in a neighbouring school. The main purpose of the pilot study was to identify the difficulties, if there were any, faced by the respondents in understanding the SLEI and ATSSA items.

The SLEI was administered first, followed by the collection of the students' response to the SLEI. This was followed by administering the ATSSA. The responses to the ATSSA were then collected after the questionnaire had been answered.

The results of the pilot study indicated that the students did not encounter any difficulty in reading and understanding the SLEI and ATSSA items. Thus, no further changes and modifications were made to the translated instruments.

The time taken by the respondents to answer the questionnaires in the pilot study was approximately twenty minutes.

3.4   Data Collection

The SLEI and ATSSA were administered to the subjects of the study, class by class, by the researcher. Both the questionnaires were administered on the same day and this was carried out in the last week of December 1996. The SLEI was administered first, followed by the ATSSA. As in the pilot study, the respondents took about twenty minutes to complete both questionnaires.

The SAT was the common test taken by all the subjects of the study in the first week of November 1996. The date for the test was specified by the school.