CHAPTER 5

SUMMARY OF FINDINGS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER STUDY

5.0 Introduction

The purpose of this study was to investigate the relationships between the students' perception of the science laboratory environment and the dependent variables of science achievement, attitude toward science and gender.

This study utilised the survey approach to collect data. The subjects of this study comprised 133 boys and 122 girls from Sekolah Menengah Hulu Kelang, situated in a semi-urban area in Selangor. The subjects were all from the eight Form Two classes of the school.

The instruments used for this study were in Bahasa Melayu. The SLEI was used to measure the students' perception of the science laboratory environment, whereas the students' general attitude toward science was measured by the ATSSA. The science achievement of the students was assessed by the SAT.

A number of statistical analysis was employed to analyse the data gathered. They included item-total correlation, Cronbach alpha reliability, Pearson product-moment correlations, and *t*-tests.

The findings of this study are grouped in the following three sections:

(i) Instrumentation.

(ii) The students' perception of the science laboratory environment.

(iii) Relationships between the students' perception of the science laboratory environment and science achievement, attitude toward science and gender.

5.1 Summary of Findings

5.1.1 Instrumentation

(1) The validated Bahasa Melayu version of the SLEI consists of 32 items. This instrument has item-total correlations that range from .34 to .73 which were significant at $p < .001$.

(2) The SLEI subscales have satisfactory internal consistency. The Cronbach alpha reliability coefficients of the subscales range from .29 to .66 (see Table 4.4).

(3) The Cronbach alpha reliability of the ATSSA was found to be .87. This indicates that the ATSSA has satisfactory internal consistency.

(4) The K-R 20 reliability coefficient of the SAT was .84 and hence the SAT was considered reliable.

5.1.2 Students' Perception of Science Laboratory Environment

(1) The rank order of the SLEI subscales based on the students' perception of the science laboratory environment is as follows:

Rule Clarity > Integration > Material Environment > Student Cohesiveness > Open-endedness

(2) The means of the SLEI subscales range from 2.85 to 3.77. The students perceived that their science laboratory activities were often guided by clear rules and related to the theory classes. They also perceived that the laboratory equipment and materials were often adequate and that the students know, help and were supportive of one another. However, the students were of the opinion that the science laboratory classes had a low level of open-endedness.

5.1.3 Relationship between Science Achievement and Students' Perception of the Science Laboratory Environment.

(1) Science achievement was found to be significantly related ($r = .41$, $p < .001$) to the students' perception of the science laboratory. Students who had better perception of the science laboratory tended to have higher academic achievement when compared to those with less favourable perception.

(2) There were significant correlations between science achievement and the subscales Student Cohesiveness ($r = .33$, $p < .001$);

Integration (r = .49, p < .001); Rule Clarity (r = 0.35, p < .001); and Material Environment (r = .19, p < .01). Students who had better perceptions of their science laboratory environment did better in the science test. They were of the opinion that the class was often cohesive. In addition, these students often found that the laboratory activities were related to the theory classes and were governed by clear rules. They also perceived that the materials and equipment of the laboratory were often adequate.

(3) However, science achievement was found to be not significantly correlated at p < .05 with the subscale Open-endedness.

5.1.4 Relationship between Attitude toward Science and Students' Perception of Science Laboratory Environment

(1) There was a significant relationship (r = .40, p < .001) between attitude toward science and the students' perception of the science laboratory environment. Students who had a more favourable perception of the science laboratory environment had a better attitude toward science.

(2) Attitude toward science was significantly correlated at p < .001 with the four SLEI subscales Student Cohesiveness (r = .35), Integration (r = .30), Rule Clarity (r = .29), and Material Environment (r = .26). Students who had better perception of the

science laboratory environment also had better attitude toward science. These students often viewed their class environment as cohesive. They perceived that the laboratory activities were often integrated with the theory classes. In addition, these students often found that there were clear rules to guide laboratory activities. They, also often found that the materials and equipment of the laboratory were sufficient.

(3) There was no significant relationship at $p < .05$ between attitude toward science and the subscale Open-endedness. This result suggests that open-ended, divergent approach to experimentation has no effect on the students' attitude toward science.

5.1.5 Gender Differences in Students' Perception of Science Laboratory Environment

(1) For all the subjects, the boys and girls did not differ in their overall perception of the science laboratory environment. Both the boys and the girls seemed to have relatively similar perceptions of their science laboratory environment.

(2) There were significant gender differences at $p < .05$ in the students' perception for the subscales Integration, Rule Clarity, and Material Environment. The girls viewed their science laboratory activities as significantly more integrated with the theory classes and guided by

formal rules than the boys. Also, the girls were of the opinion that the material environment and equipment were more adequate than the boys.

(3) However, both the boys and the girls did not have significant differences ($p < .05$) in their perceptions of the cohesiveness of the class and open-ended approach in experimentation. It was clear that they had similar perceptions regarding the cohesiveness of the class. All the students, irrespective of their gender, also had similar perceptions of the nondivergent approach in experimentation.

(4) For the Form 2 Jujur class which was the best Form Two class in the school, there was a significant gender difference at $p < .05$ in the perception of the science laboratory environment. The girls of this class viewed their science laboratory environment as more cohesive than the boys. They had better perception than the boys regarding how often the laboratory activities were integrated with the theory classes. The girls also viewed that the laboratory activities were more often guided by formal rules as compared to the perceptions of the boys

(5) There were no significant gender differences ($p < .05$) in the students' perception of the science laboratory environment for the other Form Two classes except for Form 2 Gigih. The girls of Form 2

Gigih viewed their science laboratory as more integrated with the theory classes than the boys.

5.2 Implications

The findings of this study show that the students often found that their science laboratory environment cohesive, laboratory activities integrated with nonlaboratory theory classes and were often guided by formal rules. The findings also revealed that the students were of the opinion that the materials and equipment in their laboratory were often adequate. However, the students seldom or only sometimes perceived that the laboratory activities emphasised on the divergent approach in experimentation. This result is consistent with the findings of Fraser et al. (1995). The results of Fraser et al. (1995) "reinforced an international pattern in which science laboratory classes in school and universities are dominated by closed-ended activities" (p. 407).

The correlational analysis indicated that there were significant relationships between the students' perception of the science laboratory environment and science achievement and attitude toward science. The data showed that the perceived science laboratory environment for all the subscales except Open-endedness were related to science achievement and attitude toward science. These results imply that students who perceived the science laboratory environment as more

favourable were most likely to obtain better science achievement and they also possessed better attitude toward science.

However, the findings of this study indicated that open-ended, divergent approach to experimentation was not significantly related to science achievement and attitude toward science. This finding suggests that providing open-ended investigations in the experimental work for students would not lead to improved science achievement and attitude toward science. This may be due to the fact that the Malaysian school system is still very much exam-orientated. Teachers may only just emphasise on the content of what is tested in the examinations. They may only deliver the facts but do not encourage the students to adopt the divergent approach in experimentation. Another reason may be that the examinations have yet to include many questions that require divergent thinking.

This study has provided evidence that science teachers should endeavour to create a science laboratory environment that is more cohesive, integrate their laboratory activities with nonlaboratory classes and ensure that these activities are carried out orderly. This can promote improved science achievement and better attitude toward science. In addition, they should be aware that adequate facilities in terms of materials and equipment may also lead to students with better attitude toward science and science achievement.

The findings revealed that there were no significant gender related differences in the students' perception of the overall science laboratory pyschosocial environment. These results suggested that the boys and girls had similar overall perceptions of their science laboratory environment. There were no gender differences in the Form Two students' perception of the science laboratory environment. This suggests that there is no traditional gender-biased opinion towards science. However, further analysis showed that there were significant gender related differences in the students' perception of the subscales Integration, Rule Clarity, and Material Environment. The girls had a better perception of the above mentioned subscales.

5.3 Suggestions for Further Study

Further investigations should be carried out by the science teachers of the school to determine why the boys in the school had lower perceptions for Integration, Rule Clarity, and Material Environment when compared to the girls. This could help the teachers to adjust and determine the optimum laboratory environment that can produce better academic performance and attitude toward science of the boys and the girls.

In addition, longitudinal studies can be carried across the students going from Form One to Form Three to investigate whether there is any

significant change in the students' perception of the science laboratory environment. The findings of this further research would be important to science educators because the results of this present study has shown that there are significant relationship between the students' perception of the science laboratory environment and science achievement and attitude toward science.