# CHAPTER 5

# CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

## 5.1 Introduction

The present study is designed to explore the students' perceptions of their mathematics classroom environment and determine if any associations exist between students' achievement and their perceptions of their mathematics classroom environments.

Data were collected using both quantitative and qualitative instrument. The quantitative data were collected through a survey method using Personal Form of the WIHIC questionnaire, which was translated and validated in the study. The second quantitative instrument is a 40-items multiple-choice Mathematics Achievement Test that is also found to be reliable and valid. Qualitative data were also gathered through an open-ended response questionnaire. The subjects of the study comprised 250 students from two public coeducational secondary school situated in a sub-urban area in Selangor while the pilot school is the third school from the same district. All the students are about 13-14 years of age. They have gone through six years of primary school mathematics in Bahasa Melayu and approximately one and a half years of secondary school mathematics in English. This study has used descriptive statistics to interpret students' perceptions of their mathematics classrooms environment and correlation analysis on the data collected to measure possible associations of the mathematics classroom learning environment and achievement. The findings of this study are grouped in the following sections.

(i) Instrumentation

(ii) The students' perception of the mathematics classroom learning environment.

(iii) Relationship between the students' perception of the mathematics classroom learning environment and mathematics achievement.

## 5.2 Summary of findings

### 5.2.1 Instrumentation

(1) The validated Malay version of the WIHIC questionnaire consists of 49 items in eight scales. This instrument has item-total correlations that range from .32 to .69 which were significant at $p < .001$

(2) The WIHIC scales internal consistency was consistent and comparable to the previous studies in Australia and in Indonesia. The Cronbach's Alpha coefficients of the scales range from .65 to .84. The overall reliability of the instrument is found to be .86 are within acceptable limits and attest to the internal consistency of the scale. The Malay version of the Personal Form of WIHIC questionnaire is found valid and reliable for the assessment of students' perception of their mathematics classroom learning environment.

(3) The K-R 20 reliability coefficient of the MAT is .83 and hence the MAT was considered reliable and a good criterion measure for mathematics performance.

5.2.2 The students' perception of the mathematics classroom learning environment.

(1) The mean score for the students' perception of their mathematics-learning environment is 3.3. This suggests students have a positive perception of their mathematics classroom learning environment.

(2) The rank order of the scales based on the students' perception of the mathematics learning environment is as follows

Involvement < Investigation < Teacher Support <
(2.66) (3.03) (3.09)

Emphasis on understanding < Cooperation <
(3.39) (3.47)

Equity < Student Cohesiveness < Task Orientation.
(3.56) (3.68) (3.73)

Based on the rankings, the findings of this study show that the students seldom found themselves involved during mathematics class. The findings revealed that the students perceive they are often focused on their mathematics work in class and sometimes investigate mathematical problems. They perceived sometimes their teacher is supportive and emphasizes on their understanding of work. They perceived often, they are friendly, are treated equally in their work and in their class contribution, and are helpful with each other's work.

(3) Comparison made with the previous study find that there is a consistency in five out of eight scales, namely, Student Cohesiveness, Task Orientation, Cooperation, Equity and Emphasis on Understanding. The item mean for Student Cohesiveness scale for this study is similar to that of Margianti (2001). The item mean for Teacher support in this study is also found in the range of Rawnsley's (1997) study. Students in this study also perceived low personal involvement in their mathematics class like in Margianti's (2001). However, they perceived they investigated mathematical problems in a variety of ways more than the students in Rawnsley's (1997) study. Thus, the findings in this study do concur with some of the findings of study in Australia by Rawnsley (1997) and that in Indonesia by Margianti (2001).

(4) The study finds that students' low perceptions of involvement in class are attributed to their friends, lack of teacher support and their inadequacy in English that inhibited their class participations. The study find students' low perception of their teacher support because they perceived their teacher did not accommodate for their language inadequacy and consequently perceived their teacher lack emphasis on their understanding of mathematics in the class.

(5) The students perceived they are friendly and cooperative. The findings suggest that the 'cooperation' they had were always discussion centered on the homework but not group work or special mathematics projects. These comments highlight the uniformity of mathematics task in the classroom and

that all the students work through the same books and consequently showed the same low perceptions on the Investigation scale.

(6) The study find students' perception of their teacher support is associated to the way the teacher place emphasis on understanding in class. This finding is similar to the findings in Wong's (1996) study with mathematics students in Hong Kong.

(7) This study find students' perception low on three scales; Involvement, Teacher Support and Emphasis on Understanding associated with the recent change in the medium of instruction.

(8) This study also reinforce that the Emphasis on Understanding scale in the Personal Form of WIHIC questionnaire is an important and relevant scale to the environment of mathematics classroom.

5.2.3 Relationship between the students' perception of the mathematics classroom learning environment and mathematics achievement.

(1) Mathematics achievement is found to be significantly related ($r = .20, p < .001$) to the students' perception of their mathematics learning environment. This suggests that there is a weak but statistically positive relationship between students' perceptions of their mathematics classroom environment as measured by the WIHIC Questionnaire and their and their mathematics achievement as measured by the MAT. This result is consistent and replicates the results of previous studies by Rawnsley (1997) and Margianti (2001).

(2) There were significant correlations between mathematics achievement and six out of eight mathematics classroom environment scales. The scales that correlate positively in descending ranking are Investigation, Involvement, Task orientation, Emphasis on understanding, Cooperation and Student Cohesiveness.

(3) However, mathematics achievement was found not significantly correlated with Teacher support scale and Equity scale.

## 5.3 Implications

The correlational analysis indicated that there were significant relationships between the students' perceptions of the mathematics classroom learning environment and their mathematics achievement. The data showed that the perceived mathematics learning environment for all scales except Teacher support and Equity were related to mathematics achievement. This result suggests that students who perceived the mathematics classroom environments as more positive in these scales are more likely perform better. Hence, this implies that teachers should work to enhance the scales that are relevant to create a more favourable mathematics environment that will then encourage students to perform better. This suggestion is supported by Wong's (1996) study that found high achieving students are normally high-monitored individuals and that these individuals can perform better in an environment closer to their preference. Based on this study, teacher should endeavour teaching mathematics with task which involves investigation and creative thinking (Investigation scale) that involves the students actively (Involvement scale), focus on mathematic task (Task orientation), probe their understanding (Emphasis on

Understanding) and in group or team that will enhance team working. (Student Cohesiveness and Cooperation scale)

The findings of this study indicate Teacher Support and Equity was not significantly related to achievement. Data analysis pointed that this could be due to the effects from a high achieving class in the study with low perceptions of their teacher. However, there were evidence in the study that shows students perceived lack of teacher support and interest in their studies. Furthermore, students' perceptions of their own involvement in class were found to be low. The study also found students' perception of their own involvement in the class, their perceptions of teacher support and their perceptions of teacher's emphasis on their understanding associated with the recent change in the medium of instructions. This implies teachers and students have different perceptions of the same classrooms. Hence, mathematics learning environment assessments should be used in addition to student learning outcome measures to provide information about subtle but important aspects of mathematics classroom life. Student feedback about classrooms should be collected. Based on the feedback, teachers should strive to accommodate to students needs in order to create 'productive' mathematics classroom learning environments. Prior to this, in fact, the evaluation of reform efforts should include classroom environment assessments to provide process measures of effectiveness and also provide insight into possible 'side effect' consequences.

The findings of this study suggest that the students perceived that in their mathematics classroom they are task orientated but the task low in investigative mathematics nature. This study has thus provided evidence that mathematics teacher should try to create mathematics classroom that has more dynamics. The mathematics task

in the class should encompass a variety of task and learning approaches. Problem solving exercises should include some 'real life' problems rather than 'made up' problems to encourage and involve them in investigating ways to solve mathematical problems. Collaborative learning, Cooperative learning, Peer group assessment and group work are some of the approaches that mathematics teacher should be taking into the classroom to increase students involvement during mathematics lesson.

Another implication from this study is application of Malay Language version of the instrument WIHIC that has been shown to be reliable and can be used to profile the mathematics classroom. The profiles provide an insight of some of the dimensions interacting in the mathematics classroom. When intervention is needed, specific selection of the dimensions can be worked to create a more positive learning environment. This study has shown, specifically in one class, where the students are high achiever but perceived the environment of their mathematics class with mixed feelings because they perceived low teacher support. Strategies can be put in place to improve the classroom learning environment in this class not just for academic achievement but to increase the enjoyment of the learning experience and consequently, it is hope, making mathematical subject more interesting.

An obvious limitation to this study is that conclusions drawn from this sample relate only to this sample. This sample is bias in the sense any inferences made are in favour of Form Two mathematics students in a sub-urban coeducational schools. The second limitation of the study is that this study is co-relational, not causal. Therefore, caution should be exercised in drawing conclusion made with regards to mathematics classroom environments causing an effect on mathematics achievement

Furthermore, the data collected could be subjected to biasing influences such as 'demand characteristics' whereby subjects respond in accordance with their perceptions of the expectation of the researcher. Thus, the findings from the present study should be interpreted with prudence.

## 5.4 Suggestions for further research

There are several further researches that arise from this study. Classroom learning environment research is still in its infancy at present in Malaysia. Despite the contribution to the mathematics classroom learning environments in secondary school, further validation in other secondary school throughout Malaysia would be desirable. A larger and more diverse sample would provide further evidence to support the reliability and the validity of the Malay version Personal Form of WIHIC questionnaire used in this study.

The current WIHIC questionnaire (used across many subjects) has been refined from nine to seven scales, Autonomy and Emphasis on Understanding scales were removed. However, this study found Emphasis on Understanding an important scale in a mathematics classroom environment. Validation of the original WIHIC involved a cross-continental effort but it involves samples from science classes (Fraser, Fisher & McRobbie 1996). This study suggests further research to validate the role of Emphasis on Understanding scale (in WIHIC questionnaire) for the measures of mathematics classroom environment.

This study found weak associations between students' perceptions of their mathematics classroom environments with mathematics achievement. Consequently, the second area of further study would be looking into factors that are significant in the

mathematics classroom environments that relates strongly to students' performance. These areas could include gender and causal effects of the classroom relationship.

The profiles and associations found in this study are related to Form Two mathematics classes. Ferguson and Fraser's (1996) study indicated students perceived their high school environment less favourably than their primary school classroom environments. The fourth area of research of study would be to research the profiles and classroom environment in Form One and Standard Six so that changes in the way students perceive their mathematics classroom environment during their transition from primary to secondary school can be taken into account by teachers.

The present study was restricted to investigating students' perception of the learning environment. It would be desirable for future research to include the perceptions of teacher and administrators too. Despite the importance of quantitative nature of the present study, a collection of important qualitative data was used to complement of the quantitative study. The richness of these data could be further explored to investigate further dimensions that interact in a Malaysian mathematics classroom. Similar study resulting in development of culturally based instruments has been done by Wong (1996) for Hong Kong students and Jegede, Fraser and Okebukola (1994) for African students.

This study has identified associations between students' perceptions of their mathematics classroom environment and their achievement. The results indicate positive associations between student achievement and students' perceptions of the mathematics classroom learning environment. Consequently, this finding supports the importance of the quality of the learning environment in the mathematics classroom.

It has also shown that the Malay version of the Personal form of WIHIC questionnaire a valid and reliable instrument for study of classroom environments. The results from this study will have implications for mathematics teachers who are interested to improve the dynamics of their mathematics classroom environment. This study will help determine which aspects of the mathematics classroom environment that could positively contribute to the cognitive outcomes of the students in mathematics classes. The findings will inform teachers about how they may improve students' achievement by giving greater emphasis to learning environment aspects correlated positively to outcomes and less emphasis to those correlated negatively with the outcomes.

Based on research on learning environments and the findings from this study several other practical implications for mathematics teachers and school administrators can be drawn. First, mathematics learning environment assessments should be used in addition to student learning outcome measures to provide extra information about subtle but important aspects of mathematics classroom life. This is because teachers and students have systematically different perceptions of the same classrooms, student feedback about classrooms should be collected. Based on the feedback, teachers should strive to create 'productive' mathematics classroom learning environments. For example, working towards a classroom environment with better organisation, cohesiveness and goal direction for the low achieving students or an environment that is highly challenging and investigative to provoke deeper problem-solving skills among the high achievers.

Second, the evaluation of innovations, new curricula and reform efforts should include classroom environment assessments to provide process measures of effectiveness. This study also found students perceived less of their mathematics classroom

environment because of the change in the medium of instruction. Students perceived their performance in mathematics affected by the recent education reform. Therefore, learning environment assessments for mathematics and science should be used by school to take into account the possible effect of the transition from learning mathematics in Malay language at Standard Six and then switching to English in Form One. School counsellor then can advised mathematics teachers on how to change their styles of teaching with students and improve their classroom learning environments.

Although one would not disregard the worth of achievement, it cannot give a complete picture of the whole educational process. Given the ready availability of questionnaire, the importance of classroom environment on students' achievement, it would be important that teachers, administrators and researchers include mathematics classroom environment in evaluations of mathematics educational effectiveness.