SOME CORRELATES OF LOWER SECONDARY SCHOOL MODERN MATHEMATICS OVER-AND-UNDER-ACHIEVEMENT

by

Lim Ewe Jin

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ABSTRAK

Pencapaian lampau dan singkat dalam matematik kerapkali dilihat dari segi penjimatan dan pembaziran sumber-sumber pendidikan. Dalam dunia sekarang di mana persaingan begitu hebat, pandangan seperti ini sangatlah penting, dan **lebih-lebih** lagi di negara-negara yang sedang membangun seperti Malaysia di mana sumber dan masa adalah terbatas. Kajian ini cuba menentukan unsur-unsur pertalian yang berkaitan rapat dengan pencapaian lampau dan singkat dalam matematik di sekolah, dan juga membandingkan unsur-unsur pertalian dalam perkara pencapaian lampau dengan unsur-unsur pertalian dalam perkara pencapaian singkat. Ia juga cuba mencari kefahaman tentang keertian setengah unsur-unsur pertalian itu dari segi kurikulum "Matematik Moden" yang sedang dilaksanakan di Malaysia.

Untuk tujuan kajian ini murid-murid Tingkatan II dari salah sebuah sekolah menengah perempuan di kawasan bandar telah dibahagikan kepada empat kumpulan - pencapai lampau, pencapai singkat, pencapai biasa tinggi dan pencapai biasa rendah. Walaupun kajian ini menumpukan perhatian kepada pencapai lampau dan pencapai singkat, kumpulan-kumpulan yang lainnya dan juga keseluruhan sampil merupakan asas perbandingan.

Penentuan pencapai lampau dan pencapai singkat dilakukan dengan cara pelencungan "linear" pencapaian matematik ke atas kecerdasan yang tidak melibatkan bahasa dengan menggunakan $\pm$ 1.00 ralat lazim anggaran sebagai had tinggi dan bawah pencapaian selisih.

Murid-murid yang lainnya dibahagikan kepada pencapai biasa tinggi dan pencapai biasa rendah berdasarkan kepada sama ada mereka berada di atas atau di bawah garisan pelencungan.

Analisa pelencungan berbagai unsur telah dijalankan ke atas tiap-tiap kumpulan murid dan juga keseluruhan sampil.

Kriteria yang digunakan ialah peperiksaan matematik akhir tahun Tingkatan I dan II, jumlah markah dari kedua-dua peperiksaan tersebut dan Ujian Pencapaian Matematik LEJ yang dibentuk khas berdasarkan kepada sukatan pelajaran Matematik Tingkatan I dan II yang sedang digunakan oleh murid-murid.

Penelah yang digunakan adalah dalam tiga kumpulan - yang berhubung dengan murid-murid, yang berpunca dari guru-guru dan yang berkaitan dengan ibu-bapa. Kumpulan pertama terdiri dari kebolehan bahasa murid dan tanggapan kendiri dan minat matematik mereka.

Kumpulan kedua meliputi tanggapan guru terhadap pencapaian dan minat matematik murid-murid. Kumpulan yang terakhir ialah tekanan dan pertolongan ibu-bapa.

Didapati bahawa unsur pertalian terpenting yang berkaitan dengan segala kategori pencapaian matematik (lampau, singkat, biasa) dan pencapaian matematik keseluruhan sampil ialah tanggapan guru terhadap pencapaian matematik murid-murid. Pengaruh ibu-bapa berbeza dari kumpulan ke kumpulan tetapi secara amnya adalah penting kepada pencapai lampau, pencapai singkat dan pencapai biasa

rendah. Kebolehan bahasa juga penting kepada kumpulan-kumpulan pencapai biasa dan keseluruhan sampil.

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ABSTRACT

Over-and under-achievement in mathematics have often been looked at in terms of savings and wastage of educational resources. In the present highly competitive world this view becomes crucial, and even more so in developing countries like Malaysia where resources and time are limited. This study sought to identify correlates closely associated with over-and under-achievement in school mathematics and to compare the patterns of the correlates in the two cases. It also attempted to seek an understanding of the significance of some of the correlates in terms of the "Modern Mathematics" curriculum being implemented in Malaysia.

Form II pupils of an urban secondary girls' school were divided into four groups for the study - over-achievers, under-achievers, higher normal-achievers and lower normal-achievers. Although the over-and under-achievers were the main concerns of the study the other two groups as well as the total sample afforded baseline comparisons.

Identification of over-and under-achievers was effected by a linear regression of mathematics achievement on non-verbal intelligence and using $\pm$ 1.00 standard error of estimate as the upper and lower limits of discrepant achievement. The rest of the sample was divided into higher normal-achievers and lower normal-achievers according to whether they fell above or below the regression line.

Multiple regression analysis was carried out for each achievement group of pupils as well as the total sample.

The criteria used were the school end-of-year Forms I and II mathematics tests, the total of these two tests and a specially constructed LEJ Mathematics Achievement Test based on the Forms I and II mathematics syllabuses being used by the pupils.

The predictors used were in three clusters - those pertaining to the pupil, those originating from the teachers and those concerned with the parents. The first cluster consisted of the pupils' language ability and their mathematics self-concept and interest. The second was made up of the teachers' perception of the pupils' mathematics achievement and interest. The last group of predictors were parental pressure and parental help.

The overriding correlate associated with all categories of mathematics achievement (over-, under-, normal-) as well as the mathematics achievement of the total sample turned out to be the teachers' perception of pupils' mathematics achievement. Parental influence was varied from group to group, but in general it was important to over-and under-achievers and lower normal-achievers. Language ability was also important for the normal-achieving groups and the total sample.

Teacher perception and language ability were found to be of special significance to the "Modern Mathematics" curriculum mentioned earlier.

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1.0 THE PROBLEM

1.1 General Background and Rationale

It is reasonable to expect that persons concerned with the education of the child will at all times have at least some interest in his scholastic achievement in general and mathematics achievement in particular. But since the late 1950's there has been widespread and intense interest in the mathematics achievement of the child. This phenomenon is highlighted by (a) the efforts of the International Project for the Evaluation of Educational Achievement (IEA), Hamburg, resulting in the report, International Study of Achievement in Mathematics (Husen (Ed.), 1967, 1967 a), (b) the long-term undertaking of the School Mathematics Study Group (SMSG) Stamford, generating among other things, a long series of reports on National Longitudinal Study of Mathematical Abilities (NLSMA) (E.g. Travers, 1971) and (c) the numerous current or recent mathematics curriculum development projects of various countries endeavouring to improve mathematics learning and consequently achievement. Examples of curriculum projects mentioned in (c) may be found in reports like that edited by Lockard (1970).

One can conjecture varied reasons for this sudden surge of interest in mathematics achievement - ranging from the launching of the sputnik to simply the urgent need for updating

mathematics education because of the rapidly changing world. But for developing countries the more pertinent reason must be their anxiousness to maximise mathematics educational output (such as in terms of mathematics achievement) with the limited educational resources and restricted time available to them.

Malaysia is such a developing country. She too has to maximise, or at least optimise, her educational output. However, the study of the country's school dropout problem conducted by the Ministry of Education, Malaysia (1973) does not seem to indicate that maximisation is being achieved. Futhermore, the study indicates that certain sections of the community are experiencing higher failure rates in Science and Arithmetic than others in the country (Ibid., p. 53). This problem is not confined to only the primary and lower secondary school levels. For the upper secondary level the matter is even discussed in parliament from time to time (e.g. The Straits Times 1973).

If failure and low achievement are considered wasteful, then under-achievement is even more so; for, the child is not performing as well as expected. It is alarming to realise that even high achievers may be under-achieving. Gowan (1955, p. 247) suggests that the situation of the gifted child under-achieving "often leads to undesirable social or personal behaviour as an outward indication of the power within, which is seeking some outlet". This is a state of affairs which Malaysia can ill afford.

Any significant study that contributes towards the effort to minimise low - and under-achievements should therefore be welcome.

High - and over-achievements on the other hand represent savings and, perhaps, efficient use of educational and other resources. Studies of them are also important if they are to be maximised. A by - product of these studies might perhaps be a partial solution to the low - and under-achievements problems.

Starting with 26 schools in 1970, Malaysia in yearly stages introduced her new mathematics ("Modern Mathematics") curriculum to more and more Malaysian schools. (Kementerian Pelajaran Malaysia, 1975, p. 50). The intention was to cover all secondary schools in the country. It is therefore now opportune to study mathematics achievement of Malaysian children - at the early stages in the life of the new curriculum. In contrast, towards the time when the curriculum is about to be replaced by another it would be almost futile to engage in such a study.

What then are the priorities in the study of mathematics achievement of Malaysian school children? The answer will depend on the purpose of the undertaking, its size or scope, the manpower and resources available and the support that it can command. In a small scale investigation like the present one in hand, very often it is also a question of what one <u>can</u> do rather than what one <u>should</u> do. Hence in this case it will be pointless to give an exhaustive and elaborate list of priorities. A more realistic

approach would be to identify the broad major priorities and then to make sure that the small scale investigation falls within them.

One major priority area of study is to identify the factors that relate to mathematics achievement and to find out the nature of this relationship. Obviously, it is not within the scope of the present investigation to exhaustively identify any particular factor, much less to identify all the factors.

It is however relevant to see how some of these factors may be roughly identified initially. Now achievement presupposes learning. But, learning results from the interaction of the learner with his environment (Travers 1971, p. 1). So achievement is the product of this learner - environment interaction. Therefore factors related to achievement are derived from the learner and his environment.

In the present study the factors derived from the learner are termed intrinsic variables and those from his environment, extrinsic variables. Because the teacher and the parents are the ones most closely associated with the achievement of the child, the above mentioned extrinsic variables pertaining to them are considered important. It goes without saying that the intrinsic variables pertaining to the child himself must also be studied. The intrinsic and extrinsic variables investigated in the present study are selected partly because they are fundamental variables complying with the above requirements and partly because

they are considered investigable within the constraints of available resources and that of the school where the investigations are carried out. The choice of school itself is subject to practical constraints.

1.2 Statement of the Problem

The present study is primarily concerned with ascertaining how and to what extent a set of variables correlate with, and hence help to predict, over- and under-achievement in mathematics.

In order to delimit the scope of the investigation, only pupils in an early grade of secondary school, namely Form Two, would be used. Furthermore, since the fine comparisons in terms of such variables as sex of pupils, location of schools, etc. are less important at this preliminary stage, the study is confined to all the Form Two pupils of a girls' school in an urban area, namely the Light Street Convent in Penang, in 1973.

However, in order to afford baseline comparisons, besides the over - and under-achieving groups, which are determined by linear regression of mathematics achievement on non-verbal intelligence and using $\pm$ 1.00 standard error of estimate as the upper and lower limits of discrepancy between the actual and predicted achievements, the rest of the sample are not discarded, as has been the typical practice in such studies. Instead, they are further divided into two groups, those pupils whose scores

lie above the regression line, but below + 1.00 standard error of estimate, being classified as the higher normal achieving group, while those whose scores lie below the regression line, but above - 1.00 standard error of estimate, would belong to the lower normal achieving group. Multiple regression analysis would then be carried out not only with the over-achieving and under-achieving groups, but also with the higher normal achieving and lower normal achieving groups, as well as with the total sample.

For convenience, the predictor variables are divided into two main types, namely intrinsic variables which reside in the pupils themselves and extrinsic variables which are outside the jurisdiction of the pupils. While it is conceivable to use a whole host of variables as plausible correlates, within the scope of the present study it is necessary to impose a high degree of selectivity in choosing the variables. Accordingly, only three intrinsic variables have been used: Form II end-of-year achievement in English Language, self-concept and interest in Mathematics. It is assumed that performance in Modern Mathematics very much depends on one's ability to comprehend the problems in the language in which they are expressed. Hence, language proficiency is considered as a likely predictor of mathematics achievement. Of the numerous possible affective variables, self-concept and interest have been selected on the strength that a prerequisite to sustained involvement in any task is that the person concerned is reasonably confident of success in handling it and sufficiently enthusiastic

to persist even in the face of difficulties encountered.

Two clusters of variables were likewise selected as the extrinsic variables for the study. In the first place, the teachers' perceptions of their pupils' levels of achievement and interest were considered to be important correlates of achievement. There is increasing evidence that teachers' expectations, or the self-fulfilling prophecy, can, and does, influence the interactions between teachers and pupils. It is also conjectured that since mathematics achievement is a cumulative process, the teachers' perceptions at an earlier grade, namely in Form I, may be relevant. Accordingly, Perceived Achievement and Interest in both Forms I and II were utilised in the multiple regression.

Parental influence is also envisaged as crucial. However, it is assumed that pupils' perceptions of such influences, rather than the actual influence, are probably even more crucial, for children tend to respond according to how they perceive their parents to be, whether strict or lenient, for example, even though their parents may exhibit the opposite characteristic. Two clusters of parental influence are used in the study, namely those pertaining to parental pressure and parental help. For each of these clusters, the influence of both male and female parents or guardians are taken into account and the statements were further divided into those that are positively reinforcing (+) or negatively reinforcing (-) ones.

Two sets of criterion variables are also used in this study, namely those associated with the end-of-year school achievement in mathematics and performance in a specially constructed mathematics test. Since regression does not imply causation, besides examining how the set of predictor variables are predictive of Form II achievement, it is useful also to consider how the same set of variables can predict retroactively the preceding Form I achievement. Besides employing the Forms I and II Achievements separately, the combined or Total School Achievement in Mathematics over the two years will also constitute one of the criterion variables.

Typically, end-of-year examinations in Malaysian schools do not reflect the whole year's work and are seldom, if at all, based on representative sampling of both the content and objectives of the syllabus. An additional set of Mathematics Achievement Test was therefore constructed by the investigator based on an appropriate table of specification. In the objectives dimension, the items may then be divided into three broad categories, namely those associated with Knowledge, Understanding and Application. Hence, an additional set of criterion variables used in the study consists of what may, for convenience, be termed LEJ Knowledge subtest, LEJ Understanding subtest, LEJ Application subtest, as well as LEJ Total test of mathematics achievement.

Table 1.1 then summarises the various groups of pupils as

Table 1.1 Groups of Pupils and Variables Involved in Study

Groups of Pupils

1. Over-achievers
2. Under-achievers
3. (Higher) Normal-achievers
4. (Lower) Normal-achievers
5. Total sample

Criterion Variables

1. School Mathematics Achievement Tests
   - (a) Form I
   - (b) Form II
   - (c) Total (i.e. Form I + Form II)

2. LEJ Mathematics Achievement Test + Subtest
   - (a) LEJ Knowledge Subtest
   - (b) LEJ Understanding Subtest
   - (c) LEJ Application Subtest
   - (d) LEJ Total Test

Predictor Variables

1. Intrinsic
   - (a) Pupils' Form II English Language Attainment
   - (b) Pupils' Mathematics Self-Concept
   - (c) Pupils' Mathematics Interest

2. Extrinsic
   - (d) Teacher's Perception of Pupils' Mathematics Achievement in
     - (i) Form I and
     - (ii) Form II
   - (e) Teacher's Perception of Pupils' Mathematics Interest in
     - (i) Form I and
     - (ii) Form II
   - (f) Pupils' Perception of Parental Pressure
     - (i) Positive (+) Pressure by Father
     - (ii) Positive (+) Pressure by Mother
     - (iii) Negative (-) Pressure by Father
     - (iv) Negative (-) Pressure by Mother
   - (g) Pupils' Perception of Parental Help
     - (i) Positive (+) Help by Father
     - (ii) Positive (+) Help by Mother
     - (iii) Negative (-) Help by Father
     - (iv) Negative (-) Help by Mother

well as the variables involved in the present investigation. The major, as well as minor, concerns of the study may perhaps be expressed in terms of a series of questions as follows, the first three being relatively the most important, while the last ten being the least important:-

1. Would a linear combination of intrinsic and extrinsic variables predict significantly the performance in various mathematics achievement tests and subtests of groups of over-achievers and under-achievers from an urban girls' school?

2. Which variables are most predictive both positively and negatively, of performance of these over - and under-achievers in various mathematics achievement tests and subtests, and to what relative extents?

3. How would the predictability of the set of variables, as well as the patterns of the most important predictors, based on their beta weights, for over-achievers compare with the case of under-achievers?

4. Is the set of variables also significantly predictive of mathematics achievement in the case of the higher and lower normal achieving groups, as well as the total sample?

5. Which of the variables are most predictive of mathematics achievement in the case of the higher and lower normal achieving groups, as well as the total sample?

6. How would the predictability of the set of variables, as well as the patterns of beta weights for the most predictive variables, for the over - and under-achievers compare with the cases of the higher and lower normal achieving groups, as well as the total sample?

7. How do the different groups compare with each other as well as with standardised British norms in their performances on the Raven's Progressive Matrices test and subtests?

8. How do the different groups compare in their performances on the school end-of-year mathematics

tests in Forms I and II, as well as the LEJ mathematics achievement tests and subtests?

9. To what extent are the performances of each group as well as the total sample in the Raven's Test and subtests, the Forms I and II Tests and total test, and the LEJ test and subtests correlated with each other?

10. How do the different groups compare in respect of the English Language end-of-year test in Form II, as well as the self concept and interest inventories?

11. To what extent are the three intrinsic variables, namely Form II Language, self concept and interest, correlated with each other?

12. How do the different groups compare in respect of their teachers' perceptions of their achievement and interest in both Forms I and II?

13. To what extent are the perceived achievement and interest in Forms I and II correlated with each other?

14. To what extent are the perceived achievement and interest in Forms I and II correlated with the manifest achievement, vis-a-vis school achievement tests and LEJ test and subtests, and expressed interest, respectively?

15. How do the pupils' perceptions of parental pressure and parental help, both positive and negative, as well as in respect of male and female parents/guardians, compare in terms of the different groups?

16. To what extent are the perceived parental pressure and parental help correlated with each other?

It should be apparent that although the last ten questions are relatively least important in terms of the primary objective of the study, they are nevertheless essential in helping to interpret the results of the multiple regression analyses which are associated with the major questions. Moreover, answers to these ten questions might also serve to corroborate or caution the findings from the multiple regression analyses.

CHAPTER 2

2.0 REVIEW OF PERTINENT LITERATURE

2.1 Mathematics Achievement

Interest in mathematics achievement has a considerable span both in space and time. Geographically numerous studies have been reported not only in developed but also in developing countries. For instance, a comparative study of the effects of expository - didactic versus guided discovery approaches in mathematics was carried out by Balraj (1970), while in Uganda Osolukoya studied the mathematics achievement of Makerere College School students (El-Abd, 1971). Various cross-national comparisons of mathematics achievement have also been, or are being, made. For example, the ongoing project called SEASAME (South East Asia Science and Mathematics Experiment) at RECSAM (Regional Centre for Education in Science and Mathematics) attempts to develop prototype curriculum units in science and mathematics which are then tried out in the various countries to ascertain the achievement, as well as interest, of pupils. (e.g. Sim, 1974). The International Project for the Evaluation of Educational Achievement (IEA) (see Husen (Ed.) 1967, 1967 a) investigated the mathematics achievement of children in twelve countries stretching from Europe through the United States of America to Japan. In terms of time too, as early as 1908 Stone reported his work on Arithmetic Abilities and the factors determining them, and as recently as 1977 Educational Testing Service,

Princeton, reported a study in California on the relationship between instructional styles of teachers and the learning (and therefore achievement) of reading and mathematics. The work of Piaget on children's cognitive development, such as in concepts like number, length, area, volume, speed, time, etc., has spanned almost half a century and needs no further documentation. In spite of this it is true that much work in this area of mathematics achievement still needs to be done - especially in developing countries.

But as world population increases, resources become more scarce and competition between individuals (or groups) become keener, efficiency becomes crucial. So too, in addition to achievement, it is imperative that whenever possible under-achievement is minimised while over-achievement should be maximised.

2.2 Over - and Under-achievement

The study of over - and under-achievement is of relatively recent vintage. Travers in 1971 (p. 6) was still of the opinion that over-achievement and under-achievement "are often poorly defined terms." Wellington and Wellington (undated) expressed the fear that "research on under-achievers often serves to confuse more than to clarify because selection (of under-achievers) is based on whatever system happened to appeal to the particular researcher." (p. 8). Asbury (1974) reported that Farquhar and

Payne (1964) undertaking an evaluation of various techniques then used to identify over - and under-achievers "pointed out the contradictory conclusions often resulting from inconsistency in operational definitions of over - and under-achievement."

Asbury (Ibid) further reported that the evaluators grouped the techniques of selection into the following categories:-

"1. Central tendency splits: Under - and over-achievement are determined by dichotomizing a distribution of combined aptitude and achievement measures.

2. Arbitrary partitions - middle group eliminated: Discrepancies are determined by contrasting extreme groups in achievement - aptitude distributions and by eliminating a middle group.

3. Relative discrepancy splits: Grade - point average and aptitude predictors are ranked independently. Under - and over-achievement are determined by the discrepancy between the sets of ranks.

4. Regression model selection: A regression equation is used to predict achievement from aptitude measures. Under - and over-achievement are then determined on the basis of the discrepancy between actual and predicted achievement."

Then, comparison of the various techniques led them to conclude that "there was an extreme range in the absolute number of individuals identified as under- and over-achievers, depending on the particular technique used."

Asbury also mentioned that this "and other problems led Farquhar and Payne (1964) to suggest the superiority of a linear regression prediction using $\pm$ 1.00 standard error of estimate as the lower and upper limits of discrepancy between the actual

achievement and the predicted achievement. In other words, one would be selected as a discrepant achiever if this discrepancy were $\pm$ 1.00 standard error of estimate or greater. The need for a standard method of procedure for identifying discrepant achievers was also emphasized. These findings and the points of view expressed were, for the most part, in complete agreement with the procedures and suggestions of Thorndike (1963), who also made a detailed study of various research designs and selection schemes for use in studying discrepant achievement."

Thorndike's (Ibid) definition of over - and under-achievers seemed to be lifting the cloud of confusion and gaining strength. For example, in a recent large and important study of mathematics over - and under-achievement Travers (1971, p. 6) seemed to support this definition. He also pointed out that "most importantly, this approach does recognise the existence of regression effects. Thorndike (1963, p. 44 - 45) ...."

In various studies however, measures of achievement and predictor used were varied, quite understandably, largely depending on needs and circumstances. Also, the upper and lower limits of discrepancy between the actual achievement and the predicted achievement were not always $\pm$ 1.00 standard error of estimate - as in the examples cited by Asbury (1974, p. 410).

2.3 Research on Possible Correlates

2.3.1 Language

Aiken (1972) made an expressed attempt to review studies pertaining to the effects of all language factors on mathematics learning. The fact that studies on the learning of mathematics through a second language are not reported in his excellent paper is rather unfortunate, for language is a very special problem for Malaysia where large sections of the student population learn mathematics through languages other than their own mother tongue. Furthermore, with the implementation of the country's "Modern Mathematics" programme which emphasises concepts that require more verbal explanation than traditional mathematics programmes, the influence of language on mathematics learning has become more crucial. Notwithstanding the existence of these pressing problems there is still a lack of local investigation in this field.

2.3.2 Pupils' Self-Concept

Purkey (1970) asserted that over - all, research evidence clearly showed a persistent and significant relationship between self-concept and academic achievement and that sex difference seemed to influence the relationship between the self and achievement, primarily in the area of under-achievement - male under-achievers tending to have more negative self-concepts than female under - achievers. On the other hand Christmas (1973) after a review of studies on this subject concluded that no clear trends were

indicated as to the correlations of self-concept with academic achievement and that most of the studies contained methodological weaknesses with consequent limitations in generalisability. This view was also largely supported by Shavelson et al. (1976).

However, for the purpose of the present study, the conclusion of Brookover (1964) and his associates, that there are specific self-concepts of ability which are related to specific academic areas and which differ from the self-concept of general ability, should at least be tentatively noted. On the tentative assumption that Brookover's conclusion is valid studies on the relation between mathematics self-concept and mathematics achievement should therefore be just as important as between general academic self-concept and general academic achievement.

In the area of mathematics self-concept and mathematics over - and under-achievement the investigation of the National Longitudinal Study of Mathematical Abilities (NLSMA) is noteworthy. Travers (1971) in reporting some of the results of this investigation suggested that to some extent mathematics self-concept tended to relate to over - and under-achievement.

Two mathematics self-concept scales, ideal self-concept scale and actual self-concept scale, developed by NLSMA (Wilson et al. 1968) are also noteworthy. Wilson (1971) was of the opinion that the NLSMA scales were probably the only published scales of self-concept toward mathematics although many general attitude tests

included similar items.

2.3.3 Pupils' Interest

Typically mathematics interest and attitude towards mathematics are seldom sufficiently differentiated from each other in the dimensions of liking mathematics and preference for mathematics. For instance, in Wilson (1971) although the item "I like doing mathematics (a lot more, a little more, etc.) than doing anything else" appeared in the attitude scale it could equally well serve in an interest scale. Other examples may be found in Lyda and Morse (1963) and Corcoran and Gibb (1961). The difficulty in differentiating between the two dimensions is mainly due to the fact that there is an almost imperceptible transition from the one to the other, as is evident in the Taxonomy of Educational Objectives (Affective Domain) (Krathwohl et al., 1970).

Besides dimensional affiliation, mathematics interest and attitude towards mathematics also have other relationships. For example, it is not inconceivable that a correlational relationship may exist between the two. Although the IEA study of mathematics achievement investigated the connection between students' mathematics interest and students' view of mathematics as an open system (Husen (Ed.), 1967, 1967 a - Hypothesis 15) it is unfortunate that its planners did not think it fit to regard a fuller study of the correlational relationship between mathematics interest and attitude towards mathematics as one of its major concerns. However its

finding of moderate to high correlations between mathematics achievement and interest measures within countries is of interest to the present study.

The connection between mathematics interest and mathematics over - and under-achievement may be of interest to some investigators (for example, Frankel, 1960) but its absence in a major report (Travers, 1971) and a recent major review (Asbury, 1974) is conspicuously noticed.

2.3.4 Teacher Perception

Braun (1976) asserted that one of the prime questions facing the instructional theorist was, exactly how the dynamics of teacher personality operated to effect differential performance in the pupils. He also suggested that in connection with this question, research efforts had lead to the formulation of hypotheses regarding pupil - teacher interaction. One such hypothesis suggests that the teacher for varied reasons perceives competencies and potentialities of children differently and that these expectancies are reflected in his interactions with children to produce differential performance among learners, thus fulfilling his prophecy. "Teacher expectation" and "self-fulfilling prophecy" have been coined to imply this tendency for the teacher to create a reality commensurate with his perceptions. Furthermore, the learner, while creating his own reality, shadows substantially the reality forming in the teacher's mind.

The history of teacher expectation is marked with raging controversy and a proliferation of studies conducted either to affirm or to refute it. It began with the experiment of Rosenthal and Jacobson (1968) to determine whether creating expectations in the minds of teachers regarding the potential achievement of children would affect achievement. The findings of the study, according to the authors, indicated that if teachers expected intellectual blooming in specific children, such gains would, in fact, result.

The study of Rosenthal and Jacobson stimulated immediate reactions which ranged from unquestioning acceptance of the phenomenon to scathing skepticism, one of the most damaging of which coming from Snow (1969).

The attack on the questionable generalisability of the self-fulfilling phenomenon can be attributed to questionable design and procedures of the original study (see Snow, 1969; Thorndike, 1968) and the failure of some replications to support its findings (e.g. Flemming and Anttonen, 1971; Fielder, Cohen and Finney, 1971; Wilkins and Glock, 1973).

Although methodological concerns and the generalisability of the original Rosenthal and Jacobson study have been the subject of wide debate (Elashoff, Dixon and Snow, 1971; Mendels and Flanders, 1973; Snow, 1969, Thorndike, 1968; Wilkins and Glock, 1973), it stands as a significant pioneering effort to uncover some of the teacher-pupil interactive dynamics. Also, the

expectation phenomenon has a logical basis both psychologically and philosophically in spite of its elusive nature experimentally (Braun, 1976). The psychological credibility of the expectancy phenomenon is probably one reason why research has continued despite the failure of Rosenthal and Jacobson to provide totally convincing evidence. Indeed, neither Thorndike (1968) nor Snow (1969) denied the possibility that teacher expectation may be a potent variable relevant to children's learning.

Further impetus for justified continued research has been provided by a number of studies that lend convincing, if not unequivocal, support to the expectancy hypothesis (e.g. Cornbleth, David and Button, 1974; Good, 1970, Jeter, 1972).

2.3.5 Parental Influence

Typically, studies of parental and home influence on the child's performance were concerned with interviews with parents, investigator observation of the home situation and teacher or parent filled questionnaire about the pupil's home and family (e.g. Department of Education and Science, 1969; Nisbet and Entwistle, 1969). However these methods are questionable, for, what really affects the child is his own perception of parents, home and family and not what they in fact are or what the investigator interprets the situation to be. Hence a more valid procedure might perhaps be the gathering of data directly from the pupils themselves, especially among older children such as in the case of the present study.

CHAPTER 3

3.0 DESIGN AND INSTRUMENTATION

3.1 Introduction

As stated in Chapter I, the primary concern of the present study is to determine by multiple regression analysis how and to what extent a set of variables correlate with and hence help to predict over - and under-achievement in mathematics. In order to afford baseline comparisons, besides over - and under-achieving groups, higher normal-achieving and lower normal-achieving groups as well as the total sample have also been included in this study.

3.2 Research Design

3.2.1 The Sample

In order to delimit the scope of the investigation, only pupils in an early grade of secondary school, namely Form Two (aged 13-14 years), were used. Furthermore since the fine comparisons in terms of such variables as sex of pupils, location of school, etc. are less important at this preliminary stage, the study was confined to all the Form Two pupils of a girls' school in an urban area, namely, the Light Street Convent in Penang, in 1973.

Another reason for the choice of this sample was that it was the pioneer group in the school studying the new mathematics (Modern Mathematics) curriculum being implemented by the Government, and, as

explained in Chapter I, the time was opportune to study such a sample. Also, it was considered that after a year's study in the previous Form (Form One) the pupils would have had sufficient opportunity to adjust themselves to the demands of the transition from primary school to secondary school and from the traditional to the new mathematics curriculum. Moreover, the availability of Form One data would afford retrospective comparisons between conditions in Form Two and in the previous Form.

Altogether 218 girls were involved in the study.

3.2.2 Identification of Over-Achievers, Under-Achievers, Higher Normal-Achievers and Lower Normal-Achievers.

In Chapter 2 it was explained how from among the various possible methods of identifying over - and under-achievers the regression model of selection emerged as the one that is widely supported. In the present study this same method is adopted for the identification of mathematics over-achievers, under-achievers, higher normal-achievers and lower normal-achievers as defined below.

Typically, the method involves a linear regression (assuming that this is the case) of mathematics achievement on intelligence. For the purpose of this study and for reasons given in Chapter I the LEJ Mathematics Achievement Test was used as the criterion test. Raven's (1966) Standard Progressive Matrices test was used as the predictor test, because it is a non-verbal test; and so its demands

on the testees were thought to be akin to those of the mathematics test. Also Raven's test was thought to be less culturally biased than (say) a verbal or a picture test.

Translated into operational terms the adopted method of determining the various groups of mathematics achievers may be explained by means of Figure 3.1. The figure shows a linear regression of LEJ Mathematics Achievement Test Scores on Raven's Matrices Test Scores, the sloping full line being the regression line. The upper dotted line is parallel to the regression line and 1.00 standard error of estimate above it. Similarly the lower dotted line is 1.00 standard error of estimate below it. These dotted lines are taken as the upper and lower boundaries of discrepancy between the actual and predicted achievements. Each pupil was classified as an over-achiever or under-achiever, and so on, according to the position of the point representing her Raven's Test Score together with her LEJ Test Score in the figure. That is, all pupils whose points fell above the upper dotted line in the figure were classified as over-achievers, all those whose points fell below the lower dotted line were classified as under-achievers, those between the upper dotted line and the regression line were regarded as higher normal-achievers and those between the regression line and the lower dotted line lower normal-achievers. It was decided beforehand that those whose points fell exactly on any boundary would be put in the next higher category. But as it turned out in the study, none fell exactly on any boundary.

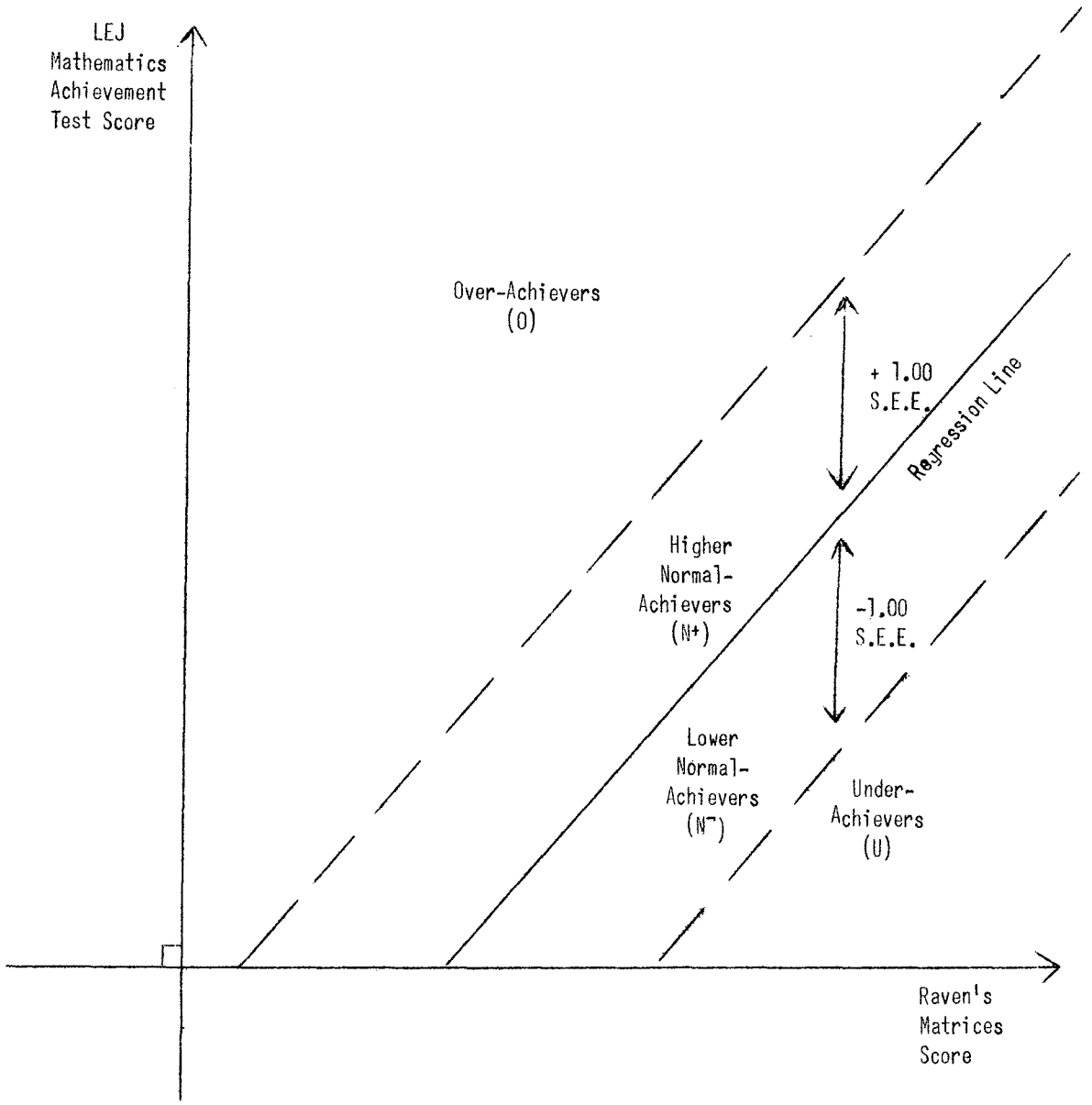

Figure 3.1 Regression Model for Determining Over-, Under-, Higher Normal - and Lower Normal-Achievers