AN EVALUATION OF SOME COGNITIVE, AFFECTIVE, AND SCHOOL VARIABLES AS PREDICTORS OF THE ACADEMIC ACHIEVEMENT OF STANDARD 10 PUPILS IN KWAZULU SCHOOLS

by

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DECLARATION

I hereby declare that AN EVALUATION OF SOME COGNITIVE, AFFECTIVE AND SCHOOL VARIABLES AS PREDICTORS OF ACADEMIC ACHIEVEMENT OF STANDARD 10 PUPILS IN KWAZULU SCHOOLS is my own work and that all sources consulted and quoted have been indicated and acknowledged by means of complete references. The opinions expressed in this study are those of the writer and are not those of the Potchefstroom University for Christian Higher Education, the Human Science Research Council, or the KwaZulu Department of Education and Culture.

D.M. GUMEDE

DEDICATION

THIS WORK IS DEDICATED TO MY LATE MOTHER MRS. ALLIMINA GUMEDE (umaGcwabaza), who was a source of inspiration when I started this work but passed away before its completion.

AFRIKAANSE OPSOMMING:

DIE EVALUERING VAN ENKELE KOGNITIEWE, AFFEKTIEWE EN SKOOL-VERANDERLIKES AS VOORSPELLERS VAN AKADEMIESE PRESTASIE VAN STANDERD 10 LEERLINGE IN KWAZULU SKOLE

1. DIE DOEL VAN DIE NAVORSING

Die doel van hierdie navorsing was om die beste voorspellers van akademiese prestasie (dit is persentasie slaag) onder die kognitiewe, affektiewe en skoolveranderlikes vas te stel. Die teikengroep het uit standerd 10 leerlinge in Kwazulu skole bestaan.

2. DIE BEVINDINGE UIT DIE LITERATUUR

Om die voorgemelde doel te bereik is die oorsig van literatuur met verwysing na die vermelde onafhanklike veranderlikes gedoen, en die volgende gevolgtrekkings is bereik.

2.1 DIE VOORSPELLINGSWAARDES VAN DIE KOGNITIEWE VERANDERLIKES

Betreffende die voorspellingswaarde van die kognitiewe veranderlikes, het die literatuur daarop gewys dat die kognitiewe veranderlikes ongeveer 25 persent van die variansie in die akademiese prestasie verklaar. Belangrik in hierdie verband is die bevindinge deur Lavin (1967), Bloom (1979) en talle ander wat die voorspellingswaarde van intelligensie en aanleg ondersoek het. Die ander belangrike bevinding, in verband met intelligensie as voorspeller van akademiese prestasie, is dat die voorspellingswaarde van intelligensie daal as die leerlinge die hoër klasse bereik. Met ander woorde, intelligensie is volgens die literatuur 'n goeie voorspeller van akademiese prestasie in die primêre klasse. Sowel Lavin (1967) as Jensen (1980) het hierdie bewering gemaak.

Die voorspellingswaarde van vorige prestasie is ook ondersoek deur die literatuur te bestudeer. Sonder uitsondering het die literatuur daarop gewys dat vorige prestasie die beste voorspeller van akademiese prestasie is.

Wat aanleg as voorspeller van akademiese prestasie betref, wys die literatuur daarop dat variansie wat groter as 25 persent in akademiese prestasie is, verklaar kan word op grond van aanleg. In hierdie verband kan die werke van Von Mollendorf (1978) en Van der Westhuizen (1987) genoem word.

2.2 DIE VOORSPELLINGSWAARDE VAN DIE AFFEKTIEWE VERANDERLIKES

Die affektiewe veranderlikes wat hier betrokke is, is persoonlikheid en beroepsbelangstelling.

Betreffende die voorspellingswaarde van persoonlikheid is teenstrydige bevindinge in die literatuur verkry. Enersyds het ondersoeke wat in Amerika gedoen is, getoon dat die byvoeging van die persoonlikheidsveranderlikes by die kognitiewe veranderlikes in die voorspelling van akademiese prestasie 'n toename in die verklaring van variansie meebring. Andersyds het die navorsing wat in Suid-Afrika gedoen is, nie 'n duidelike beeld gegee nie. In die algemeen het die Suid-Afrikaanse ondersoeke daarop gewys dat die persoonlikheidsveranderlikes van min waarde is in die voorspelling van akademiese prestasie.

Uit die studie van die literatuur, betreffende die voorspellingswaarde van beroepsbelangstelling, het dit geblyk dat beroepsbelangstelling van minder waarde is in die voorspelling van akademiese prestasie is as beroepsbelangstelling.

2.3 DIE VOORSPELLINGSWAARDE VAN DIE SKOOLVERANDERLIKES

Die skoolveranderlikes is in twee groepe verdeel: die fisiese wat skoolgrootte, klasgrootte, skoolligging en skool fasiliteite

behels, en die sosiale wat die prinsipaal en die onderwysers behels. Die oorsig van die literatuur het daarop gewys dat die fisiese fasiliteite belangrik is vir opvoeding, maar hulle uitwerking op die kwaliteit van onderrig afhanklik is van hulle benutting deur die onderwysers. Byvoorbeeld, kleiner klasse het nie beduidend bygedra tot beter prestasie as die groter klasse nie. Die gevolgtrekking wat deur Bloom (1976) onder andere, bereik is, is dat die hele skoolomgewing belangrik is vir onderrig en nie net die fisiese fasiliteite nie. Ongeveer 5 persent van die variansie in akademiese prestasie is volgens Bloom (1979) deur die skool verklaar. Dit was om hierdie rede dat die hele skool in hierdie ondersoek bestudeer is. Literatuur het ook deurgaans daarop gewys dat die verskille tussen die skole in akademiese prestasie verdwyn as intelligensie en die sosio-ekonomiese status gekontrolleer is.

2.4 DIE INVLOED VAN GESLAG OP AKADEMIESE VOORSPELLING

Die literatuur het daarop gewys dat die twee geslagte se akademiese prestasie verskil. Die dogters, byvoorbeeld, presteer beter as seuns in toetse wat verbale aanleg verg, terwyl die seuns beter as dogters in wiskunde presteer. Die twee geslagte het geen verskille in intelligensie getoon nie.

3. DIE EMPIRIESE ONDERSOEK

3.1 DIE FORMULERING VAN HIPOTESES

3.1.1 Hoof hipotese

HOOF HIPOTESE 1

Die aanleg veranderlikes is die beste voorspellers van standerd 10 akademiese prestasie in vergelyking met die affektiewe en die skoolveranderlikes.

HOOF HIPOTESE 2

Die affektiewe veranderlikes bring 'n toename mee in die variansie wat verklaarbaar is in akademiese prestasie as dit by die kognitiewe veranderlikes bygevoeg word.

HOOF HIPOTESE 3

Die skoolveranderlikes bring 'n toename mee in die variansie wat verklaarbaar is in akademiese prestasie as dit by die kognitiewe veranderlikes bygevoeg word.

3.1.2 Onderhipotese

ONDERHIPOTESE 1

Die gehalte van die skool het beduidende invloed op die voorspelling van akademiese prestasie in standerd 10.

ONDERHIPOTESE 3

Die ligging van die skool het 'n beduidende invloed op die voorspelling van akademiese prestasie in standers 10.

ONDERHIPOTESE 4

Skoolsoort het 'n beduidende invloed op die voorspelling van akademiese prestasie in standerd 10.

ONDERHIPOTESE 5

Geslag het 'n beduidende invloed op die voorspelling van akademiese prestasie in standerd 10.

ONDERHIPOTESE 6

Daar bestaan steeds 'n verskil tussen koshuis en dagskole in akademiese prestasie selfs as aanleg gekontroleer is.

ONDERHIPOTESE 7

Daar bestaan steeds 'n verskil tussen stedelike en plattelandse skole in akademiese prestasie selfs as aanleg gekontroleer is.

3.2 DIE EMPIRIESE ONDERSOEK

Die empiriese ondersoek is ingestel om die geformuleerde hipoteses te toets.

3.2.1 Die teikengroep en die steekproef

Die KwaZulu 1983 standerd 10 leerlinge is die teikengroep. Om die invloed van die skool op voorspelling vas te stel is 'n 10 persent ewekansige steekproef uit 170 sekondêre skole geneem (dit is 17 skole). As gevolg van die ewekansige steekproef is 'n monster van 1912 leerlinge gevorm. Die vermindering van die steekproef tot 1615 leerlinge in sommige analises, is 'n gevolg van onvolledige data van sekere leerlinge.

3.2.2 Die veranderlikes wat gebruik is

3.2.2.1 Die onafhanklike veranderlikes wat in hierdie ondersoek gebruik is, is die volgende:

a. Aanlegtoetsresultate (AAT)
b. Persoonlikheidsresultate (HSPQ)
c. Belangstellingsresultate (VIQ)
d. Skoolveranderlikheidstotaal (SVTOT)

3.2.2.2 Die afhanklike wat in hierdie ondersoek gebruik is, is die volgende:

e. Standerd 10 geslaag persentasie .

3.2.2.3 Die modererende veranderlikes wat in hierdie studie bestudeer is, is die volgende:

f. Die skoolgehalte;
g. Die vakgroepe wat die leerlinge leer;
h. Die ligging van die skool (stedelik of plattelands);
i. Skooltipe (koshuis of dag); en
j. Geslag.

In hierdie ondersoek is gebruik gemaak van gestandardiseerde meetinstrumente om kognitiewe, en affektiewe veranderlikes te meet. Om die "skool" te meet is verskeie skoolveranderlikes eers geoperasionaliseer en daarna punte volgens rangorde deur die inspekteurs toegeken.

Geslag is in hierdie ondersoek as modererende veranderlike gebruik om die invloed daarvan op voorspelling te bestudeer. Om die invloed van die skool as 'n modererende veranderlike te bestudeer is die steekproef verder verdeel volgens skoolgehalte, skoolligging en skooltipe. Die leerlinge was ook gegroepeer volgens die vakgroepe wat hulle geneem het (dit is algemeen, natuurwetenskap en handel).

4. STATISTIESE TEGNIEKE WAT IN HIERDIE NAVORSING GEBRUIK IS EN DIE RESULTATE VAN DIE ONDERSOEK

4.1 MEERVOUDIGE REGRESSIE-ANALISE

Deurgaans is die meervoudige regressie-analise (BMDP9R program) toegepas om die beste voorspellers van akademiese prestasie te

identifiseer. Die resultate van die analise het daarop gedui dat:

i die kognitiewe veranderlikes die beste voorspellers van akademiese prestasie is, in vergelyking met die affektiewe en die skoolveranderlikes;

ii die affektiewe veranderlikes van min voorspellingswaarde is; en

iii die skoolveranderlike 'n beduidende effek op voorspellings het.

As gevolg van meervoudige regressie-analise is die kognitiewe en skoolveranderlikes gebruik as kontrole veranderlikes in die moderatorveranderlikestudie. Die affektiewe veranderlikes is weggelaat weens hulle geringe bydrae tot R^2.

4.2 VARIANSIE ANALISE

Die meervoudige regressie-analise (BMDP1R) is ook gebruik by die moderatorondersoek. Die resultate van die ondersoek het daarop gedui dat:

i die skoolgehalte 'n beduidende inlvoed op die voorspelling van akademiese prestasie het;

ii die vakgroepe wat leerlinge leer 'n beduidende invloed op akademiese voorspelling het;

iii die skoolligging 'n beduidende inlvoed op akademiese voorspelling het;

iv die skooltipe 'n beduidende invloed op akademiese voorspelling het;

v geslag geen beduidende invloed op die voorspelling van algehele akademiese prestasie het nie;

vi die verskil in akademiese prestasie tussen die koshuisskole en dagskole bly steeds dieselfde selfs as aanleg gekontroleer is; en

vii die verskil in die akademiese prestasie van stedelike en plattelandse leerlinge steeds dieselfde bly selfs as aanleg gekontroleer is.

5. IMPLIKASIES VIR VERDERE ONDERSOEK

In hierdie studie is gevind dat aanleg 'n goeie voorspeller van akademiese prestasie in goeie skole is, maar nie in swak skole nie. 'n Geldigheidsstudie is nodig om swak voorspelbaarheid in swak skole vas te stel. Sulke geldigheidstudies moet die sistematiese veranderlikes ook bestudeer sodat hulle invloed op R^2 verklaar kan word.

In hierdie studie is ook gevind dat die plattelandse skole akademies beter as stedelike skole presteer.

Die bevinding is teenstrydig met die bevindinge van die vorige navorsers. 'n Verdere studie is dus ook nodig om die bevindinge van hierdie studie te bevestig of te verwerp. Die moontlikheid bestaan dat hierdie bevinding die invloed van die onrus wat gedurende daardie jare plaasgevind het, weerspieël.

Verdere navorsing is ook nodig om die invloed van die groepvakke op akademiese prestasie te bevestig en om die geldigheid van die resultate van hierdie navorsing te toets.

Verdere navorsing is nodig om die waarde van die insluiting van 'n toets in moedertaal in die AAT battery vir voorspellings van akademiese prestasie vas te stel. Die resultate van hierdie studie (kyk tabel 6.2) het getoon dat die AAT die swakste met Zulutaal korreleer. 'n Toets in moedertaal blyk dus nodig te wees.

6. OPVOEDKUNDIGE IMPLIKASIE

Die kruisvalidasie van die beste stelveranderlikes het daarop gewys dat dit goed by goeie skole kan voorspel en nie by swak skole nie. Om al die skole se akademiese prestasie te verbeter, word dit aanbeveel dat die toetse aan die begin van die jaar toegepas moet word en dat die nuwe snitpunte (kyk paragraaf 6.7) by die verwagtingstabel gebruik moet word. Die vroegtydige beskikbaarheid van die toetsresultate kan help om leerlinge en die onderwysers te motiveer om beter te presteer.

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CHAPTER 1

STATEMENT OF THE PROBLEM, AIM AND METHOD OF STUDY

1.1 BACKGROUND TO THE PROBLEM

The high failure rate in Standard 10 caused great concern in the Department of Education and Culture, in KwaZulu. This concern was caused by a sharp decline in the percentage of passes from above 70% before 1982 to below 40% after 1982. The following table illustrates this phenomenal drop in the achievement of Standard 10 pupils in a period of 9 years from 1977 to 1985.

TABLE 1.1
STANDARD 10 PERCENTAGE PASSES SINCE 1977

Reference	Year	Entries	Pass	% Pass
Annual Report	1977:14	1 517	1 279	84,0
Annual Report	1978:21	2 848	2 379	82,2
Annual Report	1979:30	4 408	3 451	78,0
Annual Report	1980:27	7 275	5 385	72,2
Annual Report	1981:27 & 34	9 691	6 963	71,8
Annual Report	1982:29	14 931	6 019	40,31
Annual Report	1983:24	19 636	6 540	32,86
Annual Report	1984:49	19 206	6 738	35,08
Annual Report	1985[1]	19 592	7 149	36,48

Some of the causes of a high failure rate are indicated in the annual reports mentioned in tabel 1.1. For instance, one of the causes of failures is attributed, in the annual reports, to <u>poor quality of instruction</u> in all schools except those with good results, as Annexure A shows. Another cause is indicated as the <u>high enrolment</u> which nullified most of the means done to improve the quality of work in the schools (Annual Reports 1982:10, 1983:7 and 1984:5).

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[1] Unpublished statistics.

Still another cause of poor results is indicated in the same annual reports, and this is the leakage of examination question papers. When the leakage of examination question papers was stopped in 1982 the results dropped from above 70% to below 35% as table 1.1 shows. The irregularities during examinations are reported in the Annual reports (1982:19, 1983:24, 1984:47). The leakage of examination question papers is indicated as one of the causes of poor results in that the pupils relied on the leakage of papers and did not prepare thoroughly for the examinations (Zimu, 1986b:8). What this indicates is that the examination results used in this study are a better reflection of the pupils achievement than the results of the previous years.

Another variable that contributed towards poor achievement in KwaZulu Schools was identified by Mattock. Mattock was sponsored by the Anglo-American Co-operation to evaluate KwaZulu education. He was from the University of Leeds. In his report he remarked that he was struck by the lack of motivation on the part of the teachers more than by the qualifications of teachers the principals complained about (Mattock, 1982:7).

Although there was a drop in the percentage passes as from 1982 some schools continued to produce more than 75% passes in standard 10. This indicated that the poor quality of instruction, the high enrolment, the leakage of examination question papers and the lack of motivation on the part of the teachers affected some schools and not others (see Annexure A). The between school variation in the examination results prompted the Secretary for KwaZulu education to request the Psychological Services of his department to test all Standard 10 pupils for the purpose of predicting the results at the end of the year, using pupils' characteristics like aptitude, personality and vocational interest. The psychological test results were to be used by the general inspectorate during the campaigns for improving the quality of instruction and the motivation of teachers to improve the standard 10 results.

The prediction of standard 10 achievement had never been done before in KwaZulu. What had been done elsewhere was the identification of achievement predictors without going further to predict achievement in subsequent years to evaluate the identified predictors as in this study. The following discussion of the reality of the problem will illustrate briefly, what has been done, in general; what has to be done; and the prediction models on which this study is based.

1.2 REALITY OF THE PROBLEM

1.2.1 Introduction

From the above paragraph the following have been identified as problems to be investigated in this study: (1) the predictive validity of the student characteristics like the cognitive and the affective variables, and (2) the influence of the school environment (including the physical facilities and the teacher characteristics) on academic achievement prediction.

Before an investigation is done on the influence of these variables on academic achievement prediction, it is necessary to indicate that these problems, generally speaking, have not been solved by previous researchers and that they still remain as problems to be solved especially for KwaZulu.

In the following paragraphs the studies conducted by Lavin (1967), Bloom (1976), and Venter (1983) will be used to indicate the reality of the problem, because the variables they investigated will also be investigated in this study. The review of these studies will indicate what knowledge exists in the field of academic prediction and what knowledge is still lacking.

1.2.2 Lavin's review of literature on prediction

Lavin (1967) reviewed literature on the predictive validity of intellective, affective, and sociological variables on scholastic and academic achievement. The review revealed that the cognitive variables are the best predictors of academic achievement (Lavin, 1967:57-59).

Concerning the predictive validity of affective variables, Lavin (1967:111) came to a conclusion that the relationship between the affective variables and academic achievement is weak and inconsistent, and he added that the personality variables are predictive in some school settings and not in others.

Concerning the influence of sociological factors as determinants of achievement, Lavin (1967:149-150) came to a conclusion that the socio-economic status (SES) has a positive relationship with academic achievement and the results are consistent. The consistency of the results is attributable to the fact that the SES is a summarizing variable, the influence of which disappears when certain variables are controlled.

To indicate that his review does not lead to a solution of the prediction problem Lavin himself proposed a prediction model which takes into account the interaction between the need for affiliation, the need to achieve, and the peer group value system (Lavin, 1967:163).

1.2.3 Bloom's review of literature on prediction

Another broad review of literature on prediction studies was done by Bloom (1976). Bloom reviewed literature on the predictive validity of cognitive variables, affective variables, and quality of instruction. Like Lavin (1967), Bloom (1976:169) came to a conclusion that:

(1) the cognitive variables are the best predictors of achievement;

(2) when the affective variables are added to cognitive variables in the prediction equation, Bloom reported that the prediction power increased. When the quality of instruction was combined with the cognitive entry behaviours (cognitive variables), a multiple correlation of about R=0,70 (70%) was obtained between these variables and academic achievement. The combination of these three variables is regarded by Bloom as intricate, but still he is convinced that a combined effect of the three variables can produce a multiple correlation of about R=0,90 (90%) (Bloom, 1976:195).

In summary Bloom states that the way these three variables (in combination) affect the teaching and the learning processes as well as the cognitive and the affective outcomes, is the problem to be studied in the future (Bloom, 1976:201).

The implication of Bloom's theory is that the school and the learning process have great influence on achievement, but the review he made does not confirm this beyond doubt (Bloom, 1976:213).

1.2.4 Venter's study of the influence of the school environment on academic achievement

In Venter's study the dependent variables were the 1980 standard 10 examination results in various school subjects. The most important independent variables appear on table 4.3. The control variable was intelligence. The results of the study revealed that the school environment has significant influence on certain school subjects. When the total school environment was the independent variable, and intelligence controlled, the total school environment appeared to have more influence than intelligence on academic achievement (see table 4.3).

The study conducted by Venter (1983) is significant for this study because it confirms that the school has influence on academic achievement and it is for this study to operationalise some of the school physical and social variables with the purpose of obtaining a score that can be used in the prediction equation.

Other variables that appeared, in previous studies, important to investigate further, in relation to the school, are school situation, academic streams, school type (which relate to physical facilities), and school quality, with the purpose of finding out whether they are true for KwaZulu. These studies are reported in detail in chapter 4.

One other variable that has appeared in various studies as a classification variable, is sex. In this study it will be determined to what extent sex influences the prediction of the standard 10 academic achievement.

1.3 STATEMENT OF THE PROBLEM AND THE AIM OF THE STUDY

From the contents of paragraph 1.2 it appears that the problem of achievement prediction is a real one. The broad reviews of literature by Lavin (1967), Bloom (1976), and Venter (1983) are comprehensive enough to indicate that the student characteristics (cognitive and affective) and the school environment (physical and social) are important in achievement prediction.

Concerning the cognitive variables, previous studies, besides the three mentioned above, and especially those conducted by Fourie (1967) Swanepoel (1975), Van Staden (1975), Von Mollendorf (1978), and Van der Westhuizen (1987) do point at the cognitive variables as the best predictors of academic achievement; but there is no agreement among the researchers concerning the best subset of cognitive predictors. This lack

of consensus is due to the methods used in the selection of the predictors. It is the aim of this study to determine the 'best' set of predictors by empirical procedures that can make the findings verifiable by other researchers.

Concerning the addition of the affective variables with the purpose of improving the prediction power, evidence is not conclusive as revealed by the cited studies. This lack of conclusive evidence warrants further research on the additiveness of the affective variables in the prediction of academic achievement.

Besides the study by Venter (1983), earlier studies by Heyneman (1976) Summers and Wolfe (1977), Coleman et al. (1979) Reynolds et al. (1976) and Burnstein (1977), Brookover et al. (1977) and Bouchard et al. (1987), to mention a few, confirm the presence of the influence of the school environment on academic achievement, especially in less industrialized countries (see paragraph 4.3.3.2). No study has attempted to determine the additiveness of the school variables in the prediction of academic achievement. Even the study by Venter does not go further to quantify the schools as very good, average, and weak in terms of variable scores. Venter did not include the process variables of the school in his study. In this study an attempt will be made to quantify the selected school variables with the purpose of using the school variable score in the prediction equation. The problems for this study are therefore the following:

Main Problems

- Which are the best predictors of academic achievement of the standard 10 pupils among the cognitive, affective and school variables?

- Does the addition of the affective variables to the cognitive variables increase the prediction power?

- Does the addition of the school variables to cognitive variables increase the prediction power?

Subproblems relating to school variables and sex

- To what extent does school quality influence the prediction of academic achievement?

- To what extent does the education stream influence the prediction of academic achievement?

- To what extent does the school situation influence the prediction of academic achievement?

- To what extent does the school type influence the prediction of academic achievement?

- To what extent does sex influence the prediction of academic achievement?

1.4 METHOD OF RESEARCH

1.4.1 Introduction

To reach the aim of this study, the investigation will consist of the study of literature, and the empirical investigation. The research design for this study is ex post facto and is suitable for the identification of the variables that influenced academic achievement in the past.

1.4.2 Study of literature

This part of the investigation is confined to the review of literature related to the influence of the cognitive, the affective, and the school variables on academic achievement. On the basis of the previous findings the hypotheses will be stated, and the variables for investigation will be selected and studied (in the method chapter) for their predictive efficiency.

1.4.3 Research procedure

1.4.3.1 Introduction

The empirical study consists of: sampling, the collecting and the processing of data, the interpretation and the summary of results, the conclusion, and the recommendations.

1.4.3.2 Sampling

The subjects for this study are the KwaZulu pupils who wrote standard 10 examinations in 1983. The sample consists of schools sampled in a random fashion. Schools rather than pupils were sampled in order to study their influence as modifier variables.

1.4.3.3 Collecting of data

The independent variables consist of cognitive and affective variables (as available from the pupil personal profiles that were produced by the HSRC computer), and the school variables. The cognitive variables were measured by the Academic Aptitude Test Battery (AAT) and the affective variables were measured by the High School Personality Questionnaire (HSPQ) and the Vocational Interest Questionnaire (VIQ). The data on these

variables were collected by the writer by applying the above mentioned tests and questionnaires to standard 10 pupils in sampled schools in 1983. The answer sheets were scored by the computer (HSRC).

The criterion scores consist of the examination results of standard 10 pupils. The data on all variables were entered by hand into computer data -capture forms and processed by the computer of the Potchefstroom University for Christian Higher Education.

1.4.3.4 Division of chapters

The aim of this study as stated in paragraph 1.3 is to find the best achievement predictors among the cognitive and the affective variables and to find the contribution of the school variables on academic achievement prediction. To reach this aim it is necessary to review previous studies on the relationship of these variables with academic achievement. The review of relevant literature, will lead to the statement of the tentative solutions to them in the form of hypotheses.

To arrive at the hypotheses, as tentative solutions to the problems stated in paragraph 1.3, it is necessary to devote chapter 2 to the review of literature on the predictive value of the cognitive variables. It is also necessary to devote chapter 3 to the review of literature on the affective variables as achievement correlates.

Since it was indicated in paragraph 1.1 that schools differ in their achievement and was confirmed by a few studies that were cited in paragraph 1.2.4, it is therefore necessary that chapter 4 be devoted to the review of previous studies on the relationship of the school variables with academic achievement. The last paragraph of this chapter will be devoted to the summary of the review of literature which will lead to the statement of the

hypotheses. Chapter 5 will be devoted to the method of investigation to test the hypotheses. The following steps will be followed in the empirical investigation: the selection of the sample, the description of the measuring instruments and the methods used in analysing data. Chapter 6 is devoted to the interpretation of the results and the testing of the hypotheses.

The last chapter (chapter 7) will be devoted to the summary of the findings, conclusion, and recommendations.

CHAPTER 2

THE COGNITIVE VARIABLES RELATED TO ACADEMIC ACHIEVEMENT

2.1 INTRODUCTION AND THE DEFINITION OF CONCEPTS

This chapter is devoted to the review of literature that contains information relating to the first problem. The problem is: which are the best cognitive predictors of academic achievement? To arrive at the tentative solution to this problem it is necessary to review literature on the predictive validity of the cognitive variables. Before relevant literature is reviewed, it is necessary to define the key concepts used in this investigation in order to clarify what is intended, and to delimit the scope of this chapter.

The first concept is EVALUATION. Evaluation refers to a judgement of merit which is sometimes solely based on measurements, like those provided by the test scores, but more frequently involving the synthesis of various measurements, critical incidents, subjective impressions, and other kinds of evidence weighed in the process of carefully appraising the effects of an educational experience (Good, 1973:200).

The second concept is ACHIEVEMENT. This concept refers, according to Good (1973:20), to a well-defined reaction tendency observed in the fields of behaviour which are concerned with knowing and understanding as contrasted with feeling and willing. Another concept is cognition. Cognition itself, according to Neisser (1967:4) refers to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. From a psychological perspective, according to Scott et al. (1979:7), cognition is the representation of reality that a person experiences as reality itself. These definitions refer to cognition as the knowing or the understanding of reality. This knowledge is internalised in the

form of schemas, and the various schemas compose the cognitive structure (Vrey, 1979:280). The cognitive structure is also referred to as the intellectual structure (Vrey, 1979:280).

The cognitive variables used in most prediction studies are grouped into three types: intelligence, aptitude, and previous achievement (Lavin, 1967:51). All these variables relate to the acquisition and the retension of knowledge (Scott, et al., 1979:11); and can therefore be used in the prediction of achievement (Scott, et al., 1979:10). A distinction between these variables will be made in paragraph 2.4.2.

Various researchers have used the three cognitive variables as predictors of academic achievement separately or in combination. In this chapter the studies reporting the individual contributions of each independent variable (intelligence or aptitude or previous achievement) will be reported in separate paragraphs. Multiple correlations with the combination of all three or any two will be reported in a different paragraph. This will be done with the purpose of evaluating the contribution of each variable to the explanation of variance in academic achievement without the influence of other variables.

To arrive at a partial or tentative solution of the first problem, this chapter will be devoted to the review of relevant studies on the relationship of cognitive variables with academic achievement. The main focus will, however, be on the review of aptitudes as cognitive predictors. The review of intelligence and precious achievement will be made with the purpose of putting aptitude in perspective. Intelligence will be reviewed in paragraph 2.2, previous achievement in paragraph 2.3, and aptitude in paragraph 2.4. Paragraph 2.5 will be devoted to the summary, conclusion, and implications for this study.

2.2 RELATIONSHIP OF INTELLIGENCE WITH ACADEMIC ACHIEVEMENT

2.2.1 Concept of Intelligence

There are many definitions of intelligence put forward since 1904 by C.E Spearman up to 1969 by P.E. Vernon. The scope of this paragraph does not allow for the discussion of a large number of these definitions. Only three definitions will be stated and discussed briefly for their relevance to this study. What makes them relevant to this study is that they are based on a mathematical method of factor analysis which makes the concept measurable. Of relevance, therefore, are the intelligence theories of Spearman (1904), Cattell (1940), and Vernon (1968).

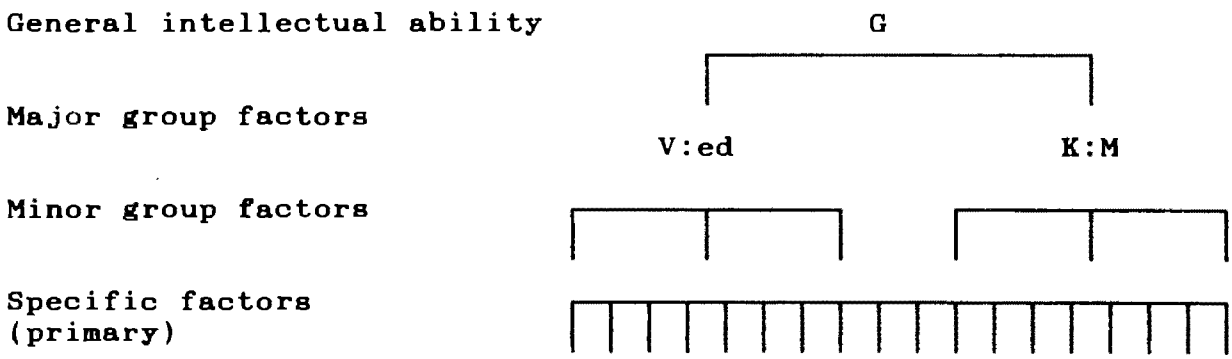
Spearman (1904), (in Anastasi, 1968), proposed a two-factor theory of intelligence. According to Spearman all intellectual activities share a single common factor, called the general factor 'g'. Later, Spearman acknowledged the presence of specific factors which are specific to certain activities (Anastasi, 1968:327; Skemp, 1979:195). On the contrary Cattell (1940) objected to a single general ability factor 'g' and proposed two types of intelligence: fluid intelligence and crystallised intelligence (Cattell and Butcher, 1968:18). Fluid intelligence (gf) relates to non-verbal or non-scholastic forms of abilities (Jensen, 1980:539). These non-verbal abilities refer to the ability to adapt to new situations (Butcher and Lomax, 1972:89). Crystallised intelligence (gc) on the other hand refers to cognitive performances which are mainly verbal, such as formal reasoning, number facility, experiential evaluation, and verbal comprehension (Jensen, 1980:538). Horn (1968) also remarks that these general factors, either the gf or the gc, have the same relationship with general reasoning (Butcher and Lomax, 1972:89).

A further investigation into the relationship of the general factor 'g' with either fluid or crystallised intelligence was conducted by Jensen (1980) who factor-analysed the Wechsler

Intelligence Sale (WISC) with the purpose of testing Spearman's 'g' on Cattell's 'gf' and 'gc'. Jensen found that Spearman's 'g' loads higher on tests on 'gf' than on those on 'gc' (Jensen, 1980:539). This indicates that the two second-order variables (gf and gc) are co-operative to have one underlying factor common to both, with the only difference that the 'g' loads higher on 'gf' than on 'gc' (Cattel and Butcher, 1968:177, Cattel, 1963:20).

The relationship of the two second - order variables can be illustrated by the hierarchical structure of human abilities that was proposed by Vernon (1968). Vernon, however, used different labels for these two second - order factors: viz, V:ed, for verbal educational and K:M, for spatial - mechanical skills, as follows:

FIGURE 2.1
STRUCTURE OF HUMAN INTELLIGENCE



The details of the meanings attached to 'gf' and 'gc' by Cattell, and to V:ed and K:M by Vernon are contained in Butcher (1972:92) and will not be reproduced here. The importance of Vernon's structure indicates that the general intellectual factor 'g' is a high level skill at the summit of the hierarchy of cognitive skills, and that it functions in the intergrative manner on different hierarchies (for V:ed and K:M) with different ceilings of complexity according to the individual's educational experience (Butcher, 1972:25). According to Cattell

(1963:20) this third - order factor is hypothesized to express the formative fluid intelligence. Intelligence as defined above can be regarded as a hypothetical construct which cannot be measured directly but only inferred from the performances of the individual at a variety of tasks (Jensen, 1980:224; Skemp, 1979:196). This hypothetical property is possessed by people to solve diverse problems of varying complexity and novelty (Van den Berg, 1986:2). This property of human beings has been operationalised by the cited theorists for the purpose of achievement prediction (Skemp, 1979:198-199). In the following paragraph the relationship of intelligence with academic achievement will be reviewed.

2.2.2 The relationship of general intellectual ability with academic achievement

A number of studies on the relationship between intelligence and achievement have reported low positive to significant correlation coefficients (Riaz, 1979:58-70; Pandey and Singh, 1978:6-8; Marshall et al., 1978:408-410; Troutman, 1978:401-404; Pentecoste et al., 1977:759-762; Ryan et al., 1976:553-559).

After a review of previous studies on the relationship of intelligence with achievement, both Lavin (1967) and Jensen (1980) arrived at a summary which indicates that the correlation between intelligence scores and achievement is relatively high in the elementary school and it decreases with the rise in school level. The lowest correlation coefficients were found at the graduate school. Table 2.1 illustrates this decrease.

TABLE 2.1

SIMPLE CORRELATIONS BETWEEN INTELLIGENCE AND ACHIEVEMENT

School level	Lavin 1968:50-57	Jensen 1980:319
Elementary school	.65	.60 - .70
High school	.50	.50 - .60
College	.50	.40 - .50
Graduate school	.20 - .35	.30 - .40

The information given on table 2.1 suffices to indicate that intelligence is a good predictor of achievement at lower school levels, but not an effective predictor of academic achievement at the graduate school, for instance. A recent study by Venter (1983) confirms this conclusion, since he found that the total school environment was a better predictor of academic achievement of standard 10 pupils than intelligence (see table 4.3). This lowering in the prediction power of intelligence can be attributed to the development of fluid intelligence (gf).

The 'gf' is reported to reach maximum development at ages between 12 and 15 years (Cattell and Butcher, 1968:19). According to Gerders et al. (1981:273) and Cattell (1963:3) fluid intelligence reaches maximum development a little later, during the later teens and starts to decline slowly in the 20's. These periods of maximum development of fluid intelligence seem to correlate with the effectiveness of intelligence as a predictor of academic achievement as indicated on table 2.1. Usually, pupils reach college when they are already adults and at that time the measures of intelligence, as they load highly of 'gf', according to Jensen (as reported above) are less effective in predicting crystallised abilities. From the late teens to old age crystallised intelligence develops and the implication is that measures of crystallised abilities would be more suitable, than measures of intelligence, for academic prediction. That intelligence does not correlate at a high degree with academic achievement is also supported by the

results of the study by Venter (1983), already cited above. The results of the reported studies imply the use of alternate measures in predicting standard 10 academic achievement.

The foregoing discussion of intelligence relates to the studies that were conducted in the Western cultures. Studies have also been conducted in the non-western cultures especially among Africans. In this regard Cryns (1962) made a critical survey of cross-cultural intelligence research in Africa, south of the Sahara. For this purpose he reviewed the studies that investigated the morphological and physiological studies of the African brain, reviewed the studies that compared African and White intelligence (psychological studies), reviewed the studies that made the quantitative analysis of the African intelligence, the studies that researched the nature - nature issue in African intelligence, and the studies that aimed at determining the quantitative significance of the differences between African and White intelligence. The main conclusion that Cryns came to is that the cultural differences between African and Whites cultures make cross-cultural research on intelligence a hazardous affair. These cultural differences make it difficult to differentiate between the African's actual level of intellectual achievement and what he is potentially capable of achieving (Cryns, 1962:283-293).

Another comprehensive review of cognitive development and measurement in Africa was done by Wöber (1975). The studies reviewed by Wöber range from Biesheuvel (1952) to Claeys (1972). The results of factor analysis indicate the presence of a general factor of ability 'g' that underlies the other special directions of cognitive development (Wöber, 1975:77). Wöber also observed that the intellectual factors of the educated Africans resemble those of Europeans.

Concerning the differences between the intelligence of the Africans and that of the Europeans evidence conflicts with respect to the etiology of differences. Cryns (1962:299) cites

Porteus and Fick who attribute low African intelligence scores to inborn intellectual inferiority. Similarly Wöber (1975:76) cites Fick and Van Rensburg who attributed low scores for Africans to inherited inferiority. Evidence on the contrary was produced by Biesheuvel and Winterbottom that the intelligence tests were not culture - fair (Wöber, 1975:76), and that low intelligence scores were attributable to unfavourable environmental conditions for Africans (Cryns, 1962:299). The interpretation of intelligence test results, with reference to White and non-white cultural groups, was also commented upon by Van den Berg (1985). Van den Berg, (1985:6) attributes the differences in test scores for the South African White, Indian and Coloured children to socio-economical factors and in this way supporting the reasons given by Biesheuvel and Winterbottom (op cit). Van den Berg (1986:23) stresses the influence of the socio-economic environment in the development of intelligence, and also stresses the consideration of the socio-economic status of the group when the intelligence scores are interpreted.

The above review of intelligence testing among Blacks gives a picture that the intelligence tests applied to White children are not suitable for the Blacks due to socio-cultural differences. At present there is no intelligence test that is being used in the schools for the Blacks in South Africa. Instead aptitude tests are applied. It is for this reason that the aptitude tests are used in this study as predictors of academic achievement in standard 10.

2.2.3 Conclusion

From the above discussion of intelligence as a concept, and its relationship with academic achievement, it can be concluded that:

* Intelligence as a general intellectual ability, measured by the Wechsler intelligence scale (WISCH) among other

intelligence tests, loads more on fluid intelligence (gf) than on crystallised intelligence. This implies that I.Q. tests are not very suitable for standard 10 and undergraduate or graduate achievement prediction as students have already passed the age during which fluid intelligence develops (see paragraph 2.2.2). The tests which measure crystallised abilities can be more useful at senior school levels than I.Q. tests (Vernon, 1968:42).

* The decrease in the correlation coefficients shown on table 2.1 also confirms that at senior school levels, intelligence alone is not effective enough in predicting academic achievement. Lavin (1967) regards intelligence as a threshold variable which explains achievement variation up to the high school levels, and which does not explain the rate of failures at the university levels where the intelligence levels are generally high (Lavin, 1967:58). At higher educational levels, other variables like study habits, attitudes and achievement motivation are important in explaining achievement variation (Butcher, 1972:274).

* Intelligence tests are used in the prediction of academic achievement if learning is intentional, and the content is hierachical, meaningful, permits transfer, insightful, of moderate difficulty and is age related; as in the content of English, Mathematics, and Science (Jensen, 1980:320-328). This indicates that intelligence tests are not good achievement predictors in subjects like History, Zulu, Accountancy, Biblical Studies, and Business Economics, because these subjects do not have their content hierarchically arranged and do not demand transfer. It is for this reason that aptitude tests are used in achievement prediction at higher educational levels since they cover a wider spectrum of crystallised abilities.

Before aptitude is reviewed as an achievement predictor, it is necessary to devote a paragraph on the review of previous achievement in order to put aptitude in perspective.

2.3 PREVIOUS ACHIEVEMENT AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

2.3.1 Introduction

Previous achievement is a cognitive variable like intelligence and aptitude, as was defined in paragraph 2.1. All the three variables relate to previous learning in one way or the other and to the specific forms of learning that took place in the past. A further distinction between these variables will be made in paragraphs 2.4.2.4 and 2.4.2.5. In this paragraph previous achievement will be reviewed as a predictor variable in order to put aptitude and intelligence in perspective.

2.3.2 The correlation between previous achievement and academic achievement

Previous achievement has consistently emerged as the best predictor of academic achievement in the studies where it was used in combination with other cognitive and non-cognitive variables (Lavin, 1967:52). For instance Roberts et al. (1978:12) found that the measures of previous academic performance were more highly correlated with the personalised system of instructional course (PS1) than with the SAT and IQ measures. Similar findings were obtained by Brown (1976:174) and Lunneborg (1977:212). Lavin (1967:51) as well as Guisti (1964:207) came to the same conclusion that previous achievement is the best predictor of academic achievement (GPA), after reviewing previous studies on achievement prediction.

In South Africa similar studies and reviews were made and the conclusions arrived at were in agreement with those of the researchers cited above. For instance, Schoeman (1976:7) stated that previous achievement is a good predictor of future success and to support his statement he cited the findings by Scanell (1960), Klausmeier and Goodwin (1966); Norlund (1972), Lätti

(1972) and Frankel (1960). In the studies conducted by Monteith (1983:56), De Wet (1983:52), and Van der Westhuizen (1984:45) standard 7 achievement was found to be the best predictor of standard 10 achievement in comparison with intelligence and personality variables. Elton (1965:166) (non-South African) in addition, found that a combination of the 9th to the 11th grade marks (equivalent to standards 7, 8 and 9 for South African Blacks) was a better predictor of first year success at college.

Concerning the use of previous achievement in the prediction of future achievement for Blacks, evidence points at the use of standardized cognitive and non-cognitive measures. For instance, Von Mollendorf (1978:304) found that either the standard 8 achievement or the Academic Aptitude Test (AAT) test results can be used in predicting the standard 10 achievement. Thomas (1979:10) again stated that, especially for Black males, the high school grades based on rank alone were not better predictors of college grades than standardized test scores. Similarly, Tatham and Tatham (1974:371) stated that the measures of academic achievement should not be used alone in the selection of Black students for admission to College, and suggested that the measures of motivation and socio-economic status should also be considered. Pfeifer and Sedlacek (1974:68) also stated that research on the prediction of Black achievement shows increase in emphasis on the use of non-intellectual variables as predictors. Madge (1972:7) too, stated that various researchers indicate that previous achievement is a better predictor of future achievement when viewed in conjunction with cognitive and personality measures. Swanepoel (1975:294) recommended a prediction model which involves intelligence, personality, and interest in combination with previous achievement as independent variables for predicting Black achievement.

The use of previous achievement in the prediction of grades at the university is not supported like at school level. A few studies that have investigated the relationship between previous

achievement and academic achievement indicate that previous achievement is not the best predictor of grades at the university. According to Penny (1982:23) the Academic Aptitude Tests were better predictors of university success than previous achievement. A similar conclusion was also arrived at by Shochet (1986:313), who found that matric results were not predictive of success at university as compared to the measures of intelligence (for White students) and to cognitive modifiability measures (Feuersteinian technique of prediction) for Black students.

Both Minnie (1974:1) and Penny (1982:23) state that the linguistic and the numerical factors of the Academic Aptitude Tests are powerful indexes of academic success at university in comparison with the matriculation results, and as a result they should be used in the selection of study directions at the university.

At the university the students have to work with little guidance from the tutors, have to cultivate study habits, and work independently (Cattell and Butcher, 1968:44). Another reason is that at the university students have developed special abilities and they take courses which are different from those they took at high school (Lavin, 1967:19) and achievement in such courses depends on the adaptability of the cognitive structure, especially for Blacks (Shochet, 1986:314) and on personality and motivation (Lavin 1967:125). Another reason is that intelligence is a threshold variable which does not explain the high incidence of failures among first year university students since at the university the intelligence levels are generally high (Lavin, 1967:58).

According to Lavin (1967:16) it is unquestionable that previous achievement is an index of school performance, but this depends on some personal or societal goals, and he concludes that reliance of previous grades as the only predictors of student performance is unwarranted. It is for these reasons again that

the academic aptitude tests (which are measures of crystallised abilities) were studied in this investigation for their relationship with standard 10 achievement (see paragraph 1.1).

2.2.3 Conclusion

It can be concluded from the above review that previous achievement is a better predictor of future achievement than intelligence and non-cognitive variables. Evidence from previous studies also indicates that other variables should be used with previous achievement in the prediction of academic achievement. This conclusion is in agreement with that arrived at by Swanepoel (1975:294) and by Van der Westhuizen (1987:144-145) among others after a review of literature on the relationship of previous achievement with future achievement.

In the following paragraph attention will be paid to the review of literature on the relationship of aptitude with academic achievement.

2.4 RELATIONSHIP BETWEEN APTITUDE AND ACHIEVEMENT

2.4.1 Introduction

In paragraph 2.2 it was indicated that intelligence is the best predictor of achievement especially in the lower grades. The predictive power of intelligence was reported to decrease with the rise in the academic levels. The implications of these findings for this study are that the intelligence tests are not very suitable for the prediction of the achievement of standard 10 pupils, even if they were available.

The absence of an intelligence test for Black students makes it imperative to have the aptitude tests reviewed in detail, for their predictive validity as they are the only available

standardised cognitive measuring instruments of crystallised abilities of standard 10 pupils. The specialised courses studied by the standard 10 pupils make aptitude tests worth evaluating for their predictive power since aptitude tests measure specific abilities.

The following review will include the definition of the concept aptitude; the discussion of the distinction between intelligence, aptitude, ability and achievement; and the sex differences in intellectual (I.Q.), verbal, quantitative, and spatial abilities, and also in achievement in different school subjects.

2.4.2 Concept of aptitude

2.4.2.1 Definition

Adams (1965:151) cites the definition of aptitude from Warren's dictionary (1934) as follows: "It is a condition or a set of characteristics regarded as symptomatic of an individual's ability to acquire, with learning, some (usually specified) knowledge, skill, or a set of responses like the ability to speak the language, to produce music, etc." This definition of aptitude includes all specific cognitive abilities and even creativity.

Similarly, Hahn and Maclean (1955) cited by Cottle and Downie (1970:207) regard aptitudes as latent, potential, undeveloped capacities to acquire abilities and skills and to demonstrate achievement. Van der Westhuizen (1979:86) sees aptitude as a potential ability that enables a person to attain a specific level of proficiency. From these definitions it can be deduced that an aptitude is:

i a latent or potential ability to acquire with learning a skill or knowledge;

ii future oriented;

iii a specific ability; and is

iv an ability that can be developed.

These characteristics of aptitudes are also applicable to intelligence, to a smaller or larger extent. The overlap between these concepts leads to a problem of content validity. Content validity can be defined as a sample of performances which are representative of the set of performances from which the sample was drawn (Tuckman, 1978:165, Kerlinger, 1973(b):458 & Brown, 1976:65). In simpler terms, content validity refers to the relationship between the type of content chosen for the test items and the behaviour that is measured (Anastasi, 1968:121). This ensures that the test measures what it is intended to measure (Anastasi, 1968:99).

2.4.2.2 Distinction between aptitude and intelligence

Aptitude as well as intelligence tests measure the individual difference in cognitive behaviour and a distinction between the two can be summarised from the above paragraphs in a tabular form as follows:

TABLE 2.2
THE DISTINCTION BETWEEN APTITUDE AND INTELLIGENCE

Intelligence	Aptitude
1. is a general ability	is a specific ability
2. is characterised by convergent thinking	is both convergent and divergent in thinking
3. is characterised by abstract reasoning	involves both abstract and concrete reasoning
4. can be measured in young children as well as in adults	can be measured in older children and in adults (Anastasi, 1968:336)
5. has verbal skills as the best indicators	has both verbal and non-verbal skills and indicators

The contents of table 2.2 suffice to indicate the differences between intelligence and aptitude . These differences are, however, not clear-cut and some authors prefer to avoid making a distinction between the two, e.g. Jensen (1980:239). (See paragraph 5.3.2.5 for the details of the aptitude tests with specific reference to validity).

In the following paragraph attention will be paid to the distinction between aptitude and ability for the purpose of clarifying the problem of content validity of aptitude and ability tests.

2.4.2.3 Distinction between aptitude and ability

The term ability applies to intelligence, as intelligence is called a general intellectual ability. The term ability is also applicable to aptitude as aptitude is defined as a potential ability. Ability as a concept on its own refers to the current status of the individual's performance on a particular course of instruction (Brown, 1976:228). Ability tests constructed to

measure this variable, seek to measure maximum performance (Cronbach, 1984:28). Aptitude tests on the other hand measure individual differences in specific forms of learning with the purpose of predicting future performance (see paragraph 2.4.2). According to Cronbach (1984:228) the main difference between aptitudes and abilities is that aptitudes refer to broad learning experiences and has a future focus, while ability refers to the broad learning experiences but has a present reference. Therefore, time reference is another distinguishing characteristic between the two variables (see figure 2.2). The distinction between aptitude and achievement will be discussed in the following paragraph since it is the correlation between the two variables that is investigated in this study.

2.4.2.4 Distinction between aptitude and achievement

According to Brown (1976:228) achievement refers to performance in a well-defined learning task and has a past and present reference, while aptitude refers to ability to acquire a skill or the ability to perform on a learning task and has a future reference. Achievement in a course of instruction is measured by achievement tests. This indicates that such tests are applied after a course of instruction has been completed by the testees. According to Wick (1973:152) achievement tests measure what the student has learned up to the moment of testing. Aptitude tests according to Brown (1976:228) measure the results of general and incidental learning experiences and has a future reference. Put the other way, Wick (1973:152) says aptitude tests measure the student's ability to learn in the future.

To clarify the distinction between aptitude and achievement testing, a conference was held in America (U.S.A.) in 1974 and the discussions were reported by Green (1974). The conference centred around the distinction between aptitude and standardised achievement tests. The illustrative examples of the two types

of these tests appearing in figure 2.2 below show how these tests differ in their complication.

FIGURE 2.2
EXAMPLES OF ACHIEVEMENT AND APTITUDE TESTS

IOWA Tests of basic skills (ITBS)	Differential Aptitude Test (DAT)
Test V Vocabulary	
Test R Reading comprehension	VR Verbal reasoning
Test L Language skills	AR Abstract reasoning
L-1 Spelling	NA Number ability
L-2 Capitalization	CSA Clerical speed accuracy
L-3 Punctuation	MR Mechanical reasoning
L-4 Usage	SR Space relations
Test W Work - study habits	LU Language usage
W-1 Map reading	SP Spelling
W-2 Reading graphs and table	(Brown, 1976:327)
W-3 Knowledge and use of reference materials	
Test M Mathematics skills	
M-1 Mathematics concepts	
M-2 Mathematics problem solving	
(Wick, 1973:158)	

The contents of these two batteries differ in what they exactly measure but do not differ in the purposes for measuring those attributes. The controversy reported by Green (1974) centres around the use of the aptitude and standardised achievement tests. The hypotheses proposed by Burcket (in Green, 1974:9) state that:

* academic aptitude test scores function as a measure of <u>learning rate</u>, and

* achievement tests scores function as a <u>measure of amount learned</u>.

The data used to test these hypotheses were collected by means of the Short Form Test of Academic Aptitude (SFTAA) and the California Achievement Tests (CAT), 1970 edition.

The results of his study made him (Burket) conclude that aptitude is a source which is transformed by learning to achievement. Although he could not make a clear distinction between aptitude and achievement he, however, felt that such a distinction is necessary (Green, 1974:53).

Carrol (1963) originally formulated the definition of aptitude as the time that is required by the learner to learn the task to a specified criterion (Green, 1974:54). This means that any individual can learn any skill provided he is given enough time (Block, 1971:50). This definition applies in experimental situations on mastery learning and even there, other variables are considered, in addition, to account for achievement, and these are: quality of instruction, ability to understand instructions, perseverance, and time allowed for each learner (Block, 1971:50-54). This definition of aptitude is not applicable to non-experimental conditions where pupils learn in groups and at a rate that is uniform.

A conception of a distinction between aptitude and achievement was proposed by Ebel (1976) in his discussion of the relation of <u>aptitude for learning</u> and <u>achievement in learning</u> (Green, 1974:312). This statement agrees with Burket's statement that aptitude is a source (or potential) for learning and this source (or potential) for learning is converted to achievement by learning. Put differently, future learning success depends on aptitude, and achievement is a product of learning. Ebel's (in

Green, 1974:325) concluding remarks illustrate the relationship between aptitude and achievement clearly, and the first four concluding remarks are cited below for their educational implications:

1. Aptitude for learning consists mainly of the possession of relevant knowledge (see also Ausubel et al., 1978:209).

2. Achievement in learning consists mainly of the development of useful knowledge.

3. All new achievements build upon prior achievements (see also Bloom, 1876:33 & Ausubel, et al., 1978:125).

4. Any person's knowledge is a unique private possession - a structure of relationship among concepts, built out of information by thinking (see also Skemp, 1979).

In conclusion, Green (1974:354) affirms that Ebel was close to the point when identifying the efforts to produce either the aptitude or the achievement tests.

Going back to our example of the Iowa of Basic Skills (ITBS) (the standardised aptitude test battery) and the DAT, it can be said that the ITBS tests test the cognitive entry behaviours (to use Bloom's terminology) since the tests measure the presence of the basic skills which are the prerequisites for learning success in specified courses of instruction, as Bloom (1976:44) asserts. Such batteries confound the distinction between the aptitude and achievement tests, in the sense that the scores on the standardised achievement tests can also be used to predict achievement as is also the case with the scores on the DAT which are mainly used to predict achievement. The ITBS assesses the amount of previous knowledge learned and the various ITBS scores can be used to predict the future learning rate (in accordance with Burket's hypothesis stated above). In this study this controversy does not exist, as aptitude refers to

aptitude for learning and achievement refers to achievement in learning which means that achievement is a result of the transformation of aptitude to achievement by learning as Ebel (op cit) put it. Ebel's view is in agreement with the views expressed in the definition of aptitude (see paragraph 2.4.2). That the controversy does not exist in this study between aptitude and achievement tests is because the criterion for this study is the end-of-the-year results of standard 10 pupils.

The aggregate percentage obtained by the pupil in the examination is what is predicted by the standardised academic aptitude tests used in this study. The final examinations are conducted at the end of the course of instruction to determine the amount of knowledge the pupils have acquired during the year. In short, achievement in learning is the criterion, and prediction is based on the assumption that a high aptitude score indicates the possession of a large amount of relevant knowledge in the cognitive structure that facilitates the assimilation or accommodation of new material; and a low aptitude score indicates a small amount of relevant knowledge in the cognitive structure.

Aptitude tests are applied at the beginning of the year to determine the aptitude for learning. We are however not out of trouble when both aptitude (AAT) and achievement (GPA) scores are used to predict achievement at the university in spite of the fact that our examination tests are not standardised. This issue is further addressed in paragraph 5.6.4.

In the following paragraph attention will be paid to the controversy on the predictive validity of the scholastic aptitude tests.

2.4.2.5 Controversy on the predictive validity of the Scholastic Aptitude Test (SAT)

There is some controversy that surrounds the predictive validity of the Scholastic Aptitude Tests (SAT). First, the scholastic aptitude tests are also regarded as achievement tests as they also measure previous learning as has been discussed above. Second, the SAT has been reported to decline in its predictive validity as a result of grade (GPA) inflation. To investigate the latter, Bejar and Blew (1981) conducted a longitudinal study using the technique of meta-analysis over a period of 15 years. The study confirmed the decrease in the predictive validity of the SAT as a result of grade inflation, but this was found to happen from 1964 up to 1973 only. After 1974 there was stability in the predictive validity of the SAT. Grade inflation was attributed to the change in the conditions for admissions to college (Bejar and Blew, 1981:149). From 1974 grade inflation appeared to diminish and this resulted in the improvement in the predictive validity of the SAT even above that of the High School Record (Bejar and Blew, 1981:155).

Another controversy on the predictive validity of the SAT is a result of Slack and Porter's (1980) critique that the SAT is susceptible to coaching. This means that if an individual has been coached he can attain higher scores on the SAT. This implies that the SAT is also sensitive to a course of instruction like the achievement tests, thus contradicting Green (1974:351) who stated that aptitude tests are not very sensitive to instruction. In response to Slack and Porter's "Critical Appraisal", Jackson (1980), produced evidence from other reports that coaching has very little effect on the SAT scores, especially in short term training (Jackson, 1980:387). That the aptitude test scores are affected by coaching would be implying that the SAT measures previous learning as does the achievement tests.

2.4.2.6 Summary

The foregoing discussion of the distinction between aptitude and achievement does not give a clear distinction between the two. These two variables overlap as far as predictive validity is concerned but differ to a certain extent in content validity. But as far as predictive validity is concerned aptitudes are mainly used for prediction, while achievement tests are sometimes used to predict achievement. Table 2.3 below indicates the main differences between achievement and aptitude tests as given by Tuckman (1975:230).

TABLE 2.3
TYPES OF VALIDITY FOR DIFFERENTIATING KINDS OF TESTS ADAPTED FROM TUCKMAN (1975:230)

Time Reference of Test Outcome	Validity Questions	Type of Validity	Kind of Tests
Past	1 Does the test reflect what was intended to be taught?	Appropriateness (content)	Achievement Tests
	2 Do persons who have been taught do better on the test than persons not taught?	Criterion	Achievement Tests
Future	1 Do scores on the test predict success in a subsequent, related area?	Predictive	Aptitude Tests

This table shows what is most prominent for each test without reference to secondary functions which cause an overlap in the description of the various tests. For instance, achievement tests have past and present reference, and can be used to

predict future performance. Aptitude tests measure past learning and they also indicate the present status of the individual in certain subtests which are related to school subjects in content. Nevertheless, the main distinguishing characteristics of each type of test are indicated in figure 2.3.

In the following paragraph attention will be paid to the operationalisation of aptitude variables.

2.4.3 Description and operationalisation of aptitude variables

Aptitude is usually operationalised in terms of verbal and non-verbal skills which are a results of learning which took place under relatively uncontrolled and unknown conditions (Anastasi, 1968:391). The initial work at operationalisation of aptitudes was done by Thurston (1947). Using a factor analytic method Thurstone arrived at 12 group factors designated as 'primary mental abilities" (Anastasi, 1968:329). Of these primary mental abilities, the following seven are included by most test compilers in their tests of mental abilities:

V. Verbal comprehension - measured by vocabulary tests.
W. Word fluency - knowledge of words in different categories.
N. Number - speed and accuracy in computation.
S. Space - two- and three-dimensional spatial perception.
M. Associative memory - rote memory for paired associates.
P. Perceptual speed - quick and accurate gripping of visual details, similarities, and differences.
I (or R)
Induction (or general reasoning) - requires syllogic reasoning for arriving at a rule (Anastasi, 1968:329, Butcher, 1972:55).

Various aptitude test batteries include the above subtests (see for instance, the Differential Aptitude Test (DAT) in figure

2.2). The South African batteries follow the same pattern in the operationalisation of aptitude variables, e.g. the Academic Technical Aptitude Test (ATA) by Owen (1977) and the Scholastic Aptitude test battery for Indian South Africans (SATISA) by De Villiers (1983). The Academic Aptitude Test battery (AAT) for Blacks, differs from the other aptitude test batteries in that it has more language and number subtests than others, as shown on table 2.4 below, to make it more academic oriented than others.

TABLE 2.4
COMPOSITION OF APTITUDE TEST BATTERIES

Test	Description of the test	DAT	ATA	SATISA	ATA
1.	Non-verbal reasoning	X	X	X	X
2.	Verbal reasoning	X	X	X	X
3.	English Vocabulary	X	X	X	X
4.	English reading comprehension	X	X	X	X
5.	Number comprehension/ ability	X	X		X
6.	Afrikaanse woordeskat				X
7.	Afrikaanse leesbegrip				X
8.	Spatial perception (2-D)		X	X	X
9.	Spatial perception (3-D)	X	X	X	X
10.	Mathematics proficiency				X
11.	Clerical speed	X	X		
12.	Classification			X	
13.	Co-ordination		X		
14.	Memory			X	
15.	Filing			X	
16.	Comparison		X	X	
17.	Mechanical	X	X	X	

From figure 2.4 it appears clearly that the different aptitude batteries have been compiled differently in terms of aptitudes measured, but all include verbal and non-verbal reasoning tests, two- and three-dimensional spatial perception tests, and tests on number ability, as indicated above. For the purpose of this study the Academic Aptitude Test battery (AAT) is investigated for its ability to predict academic achievement, hence its

composition is designed for this purpose. The details of this battery appear in paragraph 5.5.2.

In the following paragraph attention will be paid to the relationship of the four common variables with academic achievement, and these are: general reasoning ability, language ability, number ability, and spatial perception ability.

2.4.4 Simple correlation between various aptitudes and achievement

2.4.4.1 Introduction

The aptitudes which are reviewed for their correlation with academic achievement are the general reasoning ability, language ability, number ability, and spatial perception ability, as are measured by the Academic Aptitude Test battery (AAT). The tests measuring these variables appear on table 5.7; but the review covers other aptitude batteries with the different tests measuring the same variables.

These variables can be defined briefly as follows: General reasoning ability is the ability to reason (VR + NVR) and it gives an indication of the pupils' general reasoning ability for further training (Minnie, 1974:30, Cottle and Downie, 1970:247). Language ability can be briefly defined as the ability to understand ideas expressed in words (Klausmeier and Goodwin, 1971:62), and the ability to reason inductively and deductively using verbal concepts (Minnie and Paul, 1982:12). Number ability can be defined as the ability to perform arithmetical operations rapidly and accurately (Cottle and Downie, 1970:228) depending on the mastery of the underlying logical operations and the mastery of certain specific number skills like counting, matching and analysing (Carpenter, 1979:29). Spatial perception refers to the ability to visualise and manipulate the objects in space (Anastasi, 1968:361).

The discussion of the various aptitudes was not made in paragraph 2.4.2 and is necessary here in order to distinguish among them. In the following paragraph the relationship of the general reasoning ability with academic achievement (GPA) will be reviewed.

2.4.4.2 Correlation between general reasoning ability and achievement

TABLE 2.5
RELATIONSHIP BETWEEN DIFFERENTIAL APTITUDE TESTS (DAT) AND ACHIEVEMENT (GPA)

Researcher	Criterion	Independent variable	Boys	Girls
Boney 1966	GPA	VR + NA	R =,72	R =,71
	GPA	VR (Verbal reasoning)	r =,65	r =,65
	GPA	NA (Number ability)	r =,67	r =,62
Omizo 1980:197-200	Science	NA (Number ability)	r =,39	
	GPA	NA (Number ability)	r =,31	
	Mathematics	NA (Number ability)	r =,25	
	Engineering	AR (Abstract reasoning	r =,45	
	Mathematics	AR (Abstract reasoning	r =,47	
	Science	AR (Abstract reasoning	r =,49	
	GPA	AR (Abstract reasoning	r =,48	
	Engineering	SR (Spatial relations	r =,38	
	Mathematics	SR (Spatial relations	r =,37	
	Science	SR (Spatial relations	r =,49	
	GPA	SR (Spatial relations	r =,44	

Table 2.5 also shows the results of the simple correlations between the number ability (NA), abstract reasoning (AR), and spatial relations (SR) with the GPA, obtained by Omizo (1980:197-200). From this table the magnitudes of the multiple correlation coefficients of the multiple correlation between the GPA and the verbal reasoning and number ability test are the highest This indicates that there is a large general factor underlying performance in all academic achievement (Anastasi, 1968:340).

Lower multiple correlations between the GPA and verbal reasoning have, however, been reported by Jensen (1980) from a study that was conducted by Green and Furquhar (1965) in respect of White males and females. The coefficients are 0,61 for males and 0,21 for females, with respect to the DAT (Jensen, 1980:474).

The South African equivalent for the DAT is the Academic Aptitude Test battery (AAT) for Blacks. Simple linear correlations of the variables measured by the battery (AAT) were calculated by Minnie (1974), by Von Mollendorf (1978), and by Van der Westhuizen (1987). The findings of these researchers appear on table 2.6 below.

In the AAT, the non-verbal and the verbal reasoning sub-tests scores serve as an index for scholastic ability (Minnie, 1974:2 & Penny, 1982:42). Von Mollendorf (1978) did not calculate multiple correlations using these two variables only but used them in combination with other variables in multiple regression analysis (Von Mollendorf, 1978:215). Only simple correlation appear on table 2.6, therefore, the South African studies do not produce evidence in support or rejection of the evidence reported above. Von Mollendorf (1987) did, however, discover that this factor consisted of the non-verbal reasoning, verbal reasoning and number comprehension (NVR + VR + NC) but he did not determine its predictive value (see paragraph 5.5.2.2). Van der Westhuizen (1987:226) did not find this factor in his factor analysis of the AAT.

In the study that was conducted by Penny (1982) on the ability of the AAT to predict achievement at the university, the general intellectual ability (consisting of the NVR + VR scores) was ranked as the best predictor of achievement in the faculty of arts, education, science, and agriculture in comparison with other variables of the AAT. In the faculty of science it was ranked second to English verbal ability (Penny, 1982:39-40).

The general intellectual ability that is measured by the verbal and the non-verbal reasoning tests of the Academic Aptitude Test Battery (AAT) is the estimation of the pupil's ability to benefit from instruction in an academic situation. It is, however, not a true measure of intelligence, but a measure of a general reasoning ability.

The evidence from the studies by Boney (1966), Omizo (1980), Minnie (1974), Penny (1982), Von Mollendorf (1978) and Van der Westhuizen (1987) reported above, gives an indication that the general reasoning ability is an important predictor of academic achievement. The correlations found by Boney and Omizo between the general ability as measured by the DAT variables and the GPA seem very large when compared with the correlations found by the South African researchers (see tables 2.5 and 2.6).

The non-verbal test measures the non-scholastic forms of learning and is therefore a measure of fluid intelligence (see paragraph 2.2.1). The verbal reasoning test also measures fluid intelligence to a smaller extent as compared with the non-verbal reasoning test. To a larger extent the verbal reasoning test items sample the cognitive behaviours learned under unknown and uncontrolled conditions. The mastery of English is very important for the Black student in answering the items in the aptitude test battery (AAT).

From the fact that this variable, general reasoning ability, is mainly fluid intelligence, it is expected that the tests for this variable, will be almost symmetric about the mean, and

therefore not highly correlated with academic achievement which is mainly influenced by previous learning (see table 6.2).

Achievement in other aptitude tests (which measure crystallised abilities) may be more related to academic achievement than general reasoning ability, with the exception of the two spatial perception tests, as remarked in paragraph 2.2.3. In the following paragraph attention will be paid to language ability.

2.4.4.3 Simple correlations between language ability and academic achievement

Verbal ability is characterised by high interrelations with various language tests included in the aptitude test battery (see table 2.6). In the Academic Aptitude Test battery (AAT) there are four language tests, viz: English vocabulary and English reading comprehension, Afrikaanse woordeskat and Afrikaanse leesbegrip, which measure this ability.

The factor analysis of the AAT has added verbal reasoning to this list to have the factor, with these variables under it, labelled the verbal factor (Von Mollendorf, (1978:95; Van der Westhuizen, 1983:33). There is no study which can be cited to have used all the four language tests in multiple regression. In the studies consulted they were used in combination with other variables. Such studies were conducted by Minnie (1974:27), Von Mollendorf (1978:144), and Van der Westhuizen (1987:355) who correlated (simple) the AAT variable scores with achievement in school subjects: Black language, Afrikaans B, English B, Biology, History, Geography, Mathematics, Physical Science and Commerce; and the results appear on table 2.6 below.

TABLE 2.6

INTERCORRELATION OF THE AAT VARIABLES WITH SCHOOL SUBJECTS

AAT Variables	Minnie, 1974:27	Von Mollendorf, 1978:143-144					Van der Westhuizen 1987:355	
		r	Boys	r	Girls	r		r
NVR (Non-verbal reasoning)	Black language	19					Black languages	111
	Afrikaans	18	Afrikaans B	153			Afrikaans	202
	English	19	English B	201			English	279
	Biology	16	Biology	215			Biology	082
	Science	29	Science	219	Science	239	History	110
	Mathematics	21	Mathematics	312	Mathematics	386		
	History	15	History	188				
VR (Verval reasoning)	Black Language	26					Black language	175
	Afrikaans B	36	Afrikaans	305	Afrikaans B	391	Afrikaans	370
	English	37	English B	466	English B	409	English	435
	Biology	24	Biology	312	Biology	307	Biology	180
	Science	42	Science	300				
	Mathematics	48	Mathematics	269	Mathematics	462		
	Geography	18	Geography	182	Geography	540		
	History	25	History	125			History	209
			Commerce	351				
EV (English vocabulary)	Afrikaans	41	Afrikaans	327	Afrikaans	251	Black language	185
	English	29	English	618	English	357	Afrikaans	409
	Science	25	Biology	256	Biology	560	English	531
	History	30	History	345	History	452	Biology	248
	Bookkeeping	43	Geography	263	Mathematics	276	History	252
			Science	303	Commerce	687		
			Mathematics	194				
			Commerce	422				
ERC (English reading compre-hension)	Black language	12	Afrikaans	285	Afrikaans	467	Black language	180
	Afrikaans	36	English B	488	English	493	Afrikaans	397
	English	37	Biology	295	Biology	228	English	516
	Science	09	History	210	Geography	357	Biology	221
	History	36	Geography	327	Mathematics	287	History	146
	Bookkeeping	19	Mathematics	162	Commerce	514		
			Science	282				
NC (Number compre-hension)	Black language	20	Afrikaans B	252	Afrikaans	238	Black language	206
	Afrikaans	28	English B	274	Biology	335	Afrikaans	302
	English	25	Biology	317	Biology	335	English	355
	Biology	23	History	277	Mathematics	558		
	Science	35	Geography	278	Science	364		
	Mathematics	59	Mathematics	582				
	Geography	16	Science	411				
	History	20	Commerce	247				
	Commerce							

TABLE 2.6 (continued)

INTERCORRELATION OF THE AAT VARIABLES WITH SCHOOL SUBJECTS

AAT Variables	Minnie, 1974:27	r	Von Mollendorf, 1978:143-144 Boys	r	Girls	r	Van der Westhuizen 1987:355	r
AW (Afrikaanse woordeskat)	Black language	23	Afrikaans B	540	Afrikaans B	652	Black language	120
	Afrikaans	54	English B	458	English B	605	Afrikaans	478
	English	40	Biology	365	Biology	336		
	Biology	16	History	267	Mathematics	462	English	460
	Science	41	Geography	227				
	Mathematics	32	Mathematics	156				
			Science	291				
			Commerce	412				
ALB (Afrikaanse leesbegrip)	Black language	18	Afrikaans B	500	Afrikaans B	638	Black language	226
	Afrikaans	55	English B	556	English B	552	Afrikaans	463
	English	50	Biology	360	Biology	269	English	498
	Biology	18	History	266	Geography	381	Biology	117
	Science	27	Geography	194	Mathematics	343		
	Mathematics	20	Mathematics	189				
	Geography	16	Science	291				
	History	33						
	Bookkeeping	26	Commerce	452				
	Commerce							
Squares SQ.	Black language	11	Afrikaans B	173			Afrikaans	203
			English B	116			English	198
			Biology	224			Biology	099
			History	-				
			Geography	352				
			Mathematics	208	Mathematics	215		
			Science	123				
2-D			Commerce	-				
Spatial perception			Afrikaans	-			Black language	079
			English	-			Afrikaans	I44
			Biology	172	History	387	English	190
SQ.			History	-				
			Geography	321				
			Mathematics	236	Mathematics	202		
SP.			Science	-				
3-D			Commerce	-				
Mathematics Proficiency	Afrikaans	25	Afrikaans	225	Afrikaans B	484		
	English	34	English	277	English	416		
	Biology	32	Biology	312	Biology	352		
	Physical Science	42	History	239	Mathematics	706		
	Mathematics	76	Geography	324	Science	385		
	History	36	Mathematics	731	Commerce	623		
			Science	519				
			Commerce	549				

* NB: Only the correlations which are significant at 1% and 5% level of significance appear on this table. In all cases the decimals have been omitted.

The simple correlations between the AAT variables scores and achievement in these school subjects were found by Minnie (1974), Von Mollendorf (1978), and Van der Westhuizen (1987) to be significant at 1% level (see table 2.6). It should, however, be noted that in the case of boys it is only commerce which correlated negatively with English reading comprehension. In the case of girls a larger number of correlations were not significant as the case was with boys. Although there are differences between boys and girls as indicated by these correlations, high correlations between the languages and school subjects indicate that the language factor is important in academic achievement prediction. This is supported by the pilot study that was conducted by Van der Westhuizen (1983:46). The study indicated that only the verbal aptitude has a significant contribution to R^2, when compared with other variables included in the AAT. This verbal aptitude was represented by English vocabulary (EV) as a variable that correlated the highest with the rest of the variables under factor 1 when the AAT was factor analysed by Van der Westhuizen (1983:33). In his completed study Van der Westhuizen (1987:226) found this factor but did not use all the variables found in the verbal factor in multiple regression.

Whether this factor explains maximum variance when all the AAT variables are included in the prediction equation remains to be investigated.

In a study by Penny (1982) English language ability was ranked the second in the prediction of achievement in all faculties (at university) except in the faculty of law where it was ranked the first (Penny, 1982:39-40). This finding by Penny (1982) supports the other findings that a language factor is important in academic achievement prediction.

From the studies cited above it can be concluded that verbal ability correlates with achievement in most school subjects. This is expected since English is the medium of instruction in some school subjects and the Afrikaans language as a medium of instruction in other school subjects. At university level Afrikaans language ability was not ranked as an important predictor. The language factor, consisting of English vocabulary, English Reading comprehension, Afrikaanse woordeskat, and Afrikaanse leesbegrip has been reported above to have the higher correlation with academic achievement than the non-verbal factor. The task for this study is to determine the maximum variance (R^2) that can be explained by all the AAT variables in achievement (GPA) rather than the variance explained by each factor or a representative factor variable (see also paragraph 6.4.2). In the following paragraph attention will be paid to the predictive validity of number ability.

2.4.4.4 The simple correlations between number ability and academic achievement

In paragraph 2.4.4.2 it was indicated that number ability increases the multiple correlation coefficient when added to the verbal ability of the DAT, in the equation for the GPA (see table 2.5). In the AAT, mathematical ability is indicated by the scores in number comprehension (AAT-5) and in mathematical proficiency (AAT-10) (Penny, 1982:30). A study to determine the relationship between mathematical ability and achievement in school subjects was conducted by Minnie (1974:27), by Von Mollendorf (1978:143), and by Van der Westhuizen (1987:355) (see table 2.6).

The results of these studies indicate that number comprehension has a significant relationship with achievement in most school subjects. Number comprehension (AAT-5) was found to correlate above 0,5 with mathematics, while mathematical proficiency test (AAT-10) was reported to have correlations which exceed 0,7 with

achievement in mathematics in standard 10. (Minnie, 1974:27 and Von Mollendorf, 1978:144. See also table 2.6.)

In a study by Boney (1966) the correlation between number ability and the GPA was reported to be about 0,67 and 0,62 for boys and girls respectively (see table 2.5). Omizo (1980) found lower correlation coefficients when he correlated achievement in science, the GPA, and mathematics with number ability, (see table 2.5).

In a study by Von Mollendorf (1978) number ability correlated with a fewer subjects in the case of girls than in the case of boys. The same tendency was also noticed in the case of Afrikaans (see table 2.6).

In his study, Van der Westhuizen (1987) included this variable (NC) in the set of predictors and its contribution was significant but smaller than that of previous achievement and English vocabulary.

In a study by Penny (1982:39-40) mathematical ability (AAT 5 and AAT 10) was ranked the third in three out of four faculties at the university.

The studies reported above indicate that number ability is related to academic achievement. The extent of its contribution to R^2 will be investigated in this study (see table 6.5).

In the following paragraph attention will be paid to spatial ability as an achievement correlate.

2.4.4.5 Simple correlations between spatial perception and academic achievement

In contrast to language and number ability, spatial perception does not require a high command of the language in the performance of the related tasks.

This aptitude is expected to correlate with achievement in the forms of learning that require this skill, like arts and dentistry. High correlations are reported by Anastasi (1968:361) to have been found between spatial perception and achievement in these two courses.

The Academic Aptitude Test Battery has two tests for spatial perception ability: the two - dimensional and the three - dimensional spatial perception tests. Researchers have studied the correlation between the two spatial perception tests and academic achievement.

The correlations between spatial perception and academic achievement are reported to be low, generally (Minnie, 1974:27; Von Mollendorf, 1978:143-144, and De Villiers, 1983:116) and Van der Westhuizen (1987:355). These two variables, squares (2-D) and spatial perception (3-D) have higher correlations with achievement in courses, taken at the university and technikon level, like geometry (Cronbach, 1984:301 & Minnie, 1974:27).

From the above discussion it can be inferred that spatial perception is not a significant academic achievement correlate as revealed on table 2.6. In the study by Von Mollendorf (1978) (see table 2.6) the simple correlation between spatial perception and academic achievement was lower for the girls than for the boys. It is therefore necessary to include these variables in the multiple regression in order to determine their significance in achievement prediction, and their inclusion or exclusion among the cognitive variables that compose the subset of the best predictors will be determined with the use of Mallows Cp-criterion or the stepwise method.

2.4.4.6 Summary on simple correlations between aptitudes and academic achievement

In the above paragraphs the relationship between, general reasoning ability, verbal, numerical, and spatial aptitudes with academic achievement, has been reviewed and it appears that the verbal aptitudes are the most important variables in the prediction of academic achievement. A possible reason for this is that teaching and learning in the academic situation is mostly verbal (paragraph 2.4.4.3).

Second in importance is number ability as has been shown in the various studies that, when number ability is added to verbal ability, the variance explained by this combination of variables is larger than when verbal ability alone was used. The combination of verbal and number ability is regarded by various researchers as the intellectual general ability (paragraph 2.4.4.4).

Spatial ability has been reported to be of least importance in the prediction of academic achievement in standard 10. It was, however, reported that spatial ability is significant for the prediction of grades in certain courses at the university (paragraph 2.4.4.5)

The discussion of these variables in groups follows the pattern found in Von Mollendorf (1978) and Penny (1982:40) which shows four pairs of tests with each pair measuring one aptitude. That all these 10 tests have been included in the AAT battery is an indication that the individual tests are independent of each other. It is for this study to determine the maximum variance that is explained by all the AAT variables and to determine which ones from the AAT tests do not contribute significantly to R^2.

2.4.5 Sex differences in intellectual, verbal, quantitative, and spatial abilities

2.4.5.1 Introduction

The aim, for the inclusion of this paragraph on sex differences in potential abilities, is to determine, from literature review, whether it is necessary to have separate prediction equations for the different sexes or not. A brief review of sex as modifier variable is also necessary. Other variables like age, attitude, socio-economic status, culture, race, and parenting are outside the scope of this paragraph. These variables will only be mentioned in passing in the discussion of the causes of differences between the sexes in academic achievement.

2.4.5.2 Sex differences in intelligence

There is no study that has indicated the superiority of males to females in intelligence tests (Jensen, 1980:623; Gerdes et al., 1981:129; Mouley, 1982:180). The differences are, however, revealed in different subtests of the various I.Q. tests. The tendency is for the females to score higher on verbal subtests while the males tend to score higher than females on tests involving spatial perception and mathematics. To verify such a generalisation Jensen factor analysed the scores on the Wechsler Adult Intelligence Scales (WIS) and found that the average loading of a verbal factor for females was 0,48 and that of males was 0,38. In the performance tests the males had an average of 0,26 and the females had an average loading of 0,16. When the distinction between verbal and performance I.Q. was removed by calculating a global score, no difference was found between males and females in intelligence (Jensen, 1980:624).

2.4.5.3 Sex differences in verbal ability

Verbal ability involves vocabulary and reading comprehension, the use and understanding of language, and verbal fluency (Gerdes et al., 1981:129). It has been reported that females are superior to males in verbal ability from infancy to adulthood (Anastasi, 1968:472). Recent studies indicate that there are differences between boys and girls in verbal ability up to the age of 11 years with girls outperforming boys (Gerdes, et al., 1981:129; Jensen, 1980:625). The superiority of females to males in verbal ability is attributed to:

* early maturity of girls (Anastasi, 1964:473) and

* contact with the mother (Anastasi, 1968:473; Fein, 1978:184).

At this age girls enter adolescence and from this stage through adulthood the superiority of girls to boys in verbal ability is consistent as has been evidenced by longitudinal studies conducted by Moccoby and Jacklin (1973 and 1974), cited by Dwyer (1979:514), Jensen (1980:625) and by Gerdes et al. (1981:129), Clarizio et al. (1981:80).

One possible reason for the superiority of girls to boys after the age of 11 years is attributable to physiological maturity (Gordon, 1975:284). That girls mature earlier than boys indicates that the ability of girls to acquire verbal skills better than boys, after the age of 11 years, is due to the fact that the left cerebral hemisphere, which specialises in verbal memory, right-hand skills, hearing speech, superior comprehension of language and right visual field, matures earlier. The right cerebral hemisphere which specialises in the memory of shapes, left hand manipulation and feeling shapes, hearing environmental sounds, superior recognition of typological forms, and faces, body image and left visual field, matures later (Wittrock, 1980:84). However this distinction in cerebral

functioning indicates one of the possible many reasons why girls perform better than boys in verbal ability after the age of 11 years (Jensen, 1980:626).

Another reason given for the superiority of girls to boys in verbal ability is attributed to verbal communication between the mother and the girl as the mother is the main source of language (Anastasi, 1958:473; Fein, 1978:185). The reason for this was found by Cherry and Lewis (1976) as cited by Fein (1978:184) that mothers of girls talked more to girls than to boys. The greater communication between the mother and the girl is due to the fact that girls mature earlier than boys as indicated above. The early physiological maturity of girls makes them pick up the language earlier than boys and as a result girls start talking to mothers earlier, thus eliciting communication with the mother and the mother in return talks to the child. In this way the girl learns higher language forms earlier than the boy (Blau, 1981:147), Maccoby and Jacklin (1978), Clarizio et al., 1981:80).

The above mentioned two reasons why girls are superior to boys in verbal ability after the age of 11 years are regarded as important to indicate causes, among many, which are found in different cultures, attributed to sex roles and the socio-economic status (Blau, 1981:148-154).

Evidence from studies cited suffices to indicate that girls do better than boys in languages, in general, since the scope of this paragraph does not allow for a detailed discussion of this issue. Attention will now be briefly paid to sex differences in number ability.

2.4.5.4 Sex differences in number ability

Concerning number ability Anastasi (1965) cited a number of studies which indicate that at the elementary school and in

higher classes girls perform better than boys in computational tests which measure speed and accuracy, while boys are superior to girls in tests that require numerical reasoning. At college level Anastasi (1968) also quotes a study by Sweeney (1958) which indicated that boys were significantly superior to girls in operations that require the restructuring of facts. In this study (by Sweeney) the sex differences remained significant even when controlled for intelligence, verbal ability, mathematical ability and previous knowledge. Anastasi (1968) cites another study which was conducted by Kostik (1954) with high school pupils. Kostik found that boys excelled in their ability to transfer knowledge to new situations when the variables mentioned above were controlled (Anastasi, 1968:477).

The studies conducted by Moccoby and Jacklin (1978), confirm the previous findings that boys perform better than girls in number ability (Gerdes et al., 1981:129). In an earlier study by Hilton and Berglund (1974:232) sex differences in mathematics performance was found to increase with age. A longitudinal study by Benbow and Stanley (1980:598-622) confirmed earlier studies that boys perform better than girls in mathematics. The differences they found in primary schools persisted in the secondary and high schools. In a study by Ngobeni (1984:100) the multiple correlation results indicated that mathematics profiency had the highest contribution to R^2 for boys than for girls (16% and 15% respectively). Von Mollendorf 1978 found a larger R for boys than for girls (see table 2.7).

A more recent British study of the sex differences in mathematics was conducted by the Committee of Inquiry into the teaching of mathematics in London in 1982. The Committee reported conclusive evidence that boys were superior to girls in mathematics achievement at various examination levels. This was even confirmed by the number of male mathematics teachers which exceeded that of female mathematics teachers, with males mathematics teachers being 5 264 and female mathematics teachers

being 2 484. The reverse was the case with English performance and the number of English teachers (Cockcroft, 1982:276).

The most recent study of sex differences in mathematics participation and achievement in the South African context was conducted by Visser (1985). Her findings can be briefly stated as follows:

* More boys than girls studied mathematics after standard 7.

* No differences were observed with regard to computation in all age groups. At higher standards boys performed better than girls because the mathematics courses in higher standards contain less computation.

* Boys regard mathematics as more useful for their future careers.

* Sex differences in mathematics in favour of boys start after standard 7.

* There is a stereotyped belief that mathematics is a male subject, and even parents regard mathematics as important for boys.

In the study by Visser (1985), adolescence was confirmed as the critical period during which patterns in mathematics are established (Visser, 1985:1-4).

From the studies cited above it can be concluded that there are no sex differences in the performance of both sexes at the primary school phase but at the secondary school level boys outperform girls in mathematics. The following questions remain to be answered by further research: do the differences in the performance of both sexes hold for urban and rural pupils?

2.4.5.5 Sex differences in spatial perception

Sex differences with regard to spatial perception have not attracted researchers and it was not possible to cite many studies in this regard. The only study that is to some extent related to spatial perception was conducted (by Maccoby and Jacklin, 1978) on sex differences in field dependence. The test on field-dependence is related to spatial perception. In the field-dependence test the testee sits on a tilting chair when manipulating the rod-and- frame. The results of the test indicated, however, that girls are more field independent than boys (Gerdes et al., 1981:130). According to Jensen (1980:626) sex differences in spatial ability are found in tests that require the breaking up of the geštalt mentally into smaller parts, rotation or turning over, or mirror imagining of a complex geometric figure to determine whether it matches a given target. Jensen does not however state whether boys do better than girls in test of spatial perception.

According to Ngobeni (1984:51) there is a relationship between spatial perception and achievement in mathematics. Pattison and Grieve (1984:688), however, warn that sex differences in mathematics should not be explained in terms of spatial ability.

2.4.5.6 Conclusion

From the above discussion it appears that there are no reported differences between the sexes in general intelligence (see paragraph 2.4.5.2). In specific tests differences have however been reported, for instance in verbal ability tests girls have been reported to perform better than boys (see paragraph 2.4.5.3). In number ability tests boys have been reported to do better than girls in mathematics from adolescence to adulthood, while in computations girls have been reported to perform better than or equal to boys (see paragraph 2.4.5.4).

No convincing evidence has been produced on sex differences in spatial perception. From these studies it cannot be concluded that boys do better than girls in all the four variables; but there is conflict between the American and African studies with respect to the achievement of both sexes.

Studies conducted in Western countries reveal that girls perform better than boys (Bingham, 1937:43; Green, 1965:243; Cross et al., 1974:39; Lavin, 1967:129 and Jensen, 1973:238).

The studies conducted in Africa reveal that boys do better than girls in academic work (Fourie, 1967:237; Irvine, 1969:22; Swanepoel, 1975:119; Wöber, 1975:60 and Von Mollendorf, 1978:69). The differences between the Western and African cultures are probably responsible for the contradictory findings. In Africa, generally, emphasis is laid on the education of boys as future breadwinners (Butcher, 1968:249) whereas this is not the case with the Western cultures.

In the following paragraph attention will be paid to the multiple correlation of the aptitude variables with academic achievement.

2.4.6 Multiple correlation of aptitude scores with academic achievement

2.4.6.1 Introduction

In this paragraph a few studies which have been conducted to determine the correlation of the aptitude tests scores with academic achievement will be reported. In some studies the GPA was regressed on the aptitude variables alone and in other studies aptitudes were used in combination with the non-cognitive variables. In some studies an attempt was made to determine the group of variables from the AAT variables that correlated

the highest with the performance in each school subject, and such studies will be reported under **general prediction.**

2.4.6.2 The use of the aptitude scores in the differential prediction of academic achievement

Differential prediction refers to the use of various independent variables to predict achievement in different criteria (Lavin, 1967:53). The aptitude tests were originally constructed for this purpose (Anastasi, 1968:336; Cottle & Downie, 1970:248 and Brown, 1976:327).

A review of previous studies by Anastasi (1968) by Cottle and Downie (1970), and by Brown (1976) on differential prediction indicates that the multiple aptitude test batteries can predict achievement in different school subjects, at high school. Cottle and Downie (1970:251) cite previous studies which indicate that achievement in English, social studies, science, mathematics is best predicted by the following tests of the DAT: verbal reasoning, numerical reasoning, abstract reasoning, spelling and sentence tests. According to Brown (1976:330) achievement in English, mathematics, science, social studies, history, and languages are best predicted by the combination of verbal reasoning and number ability tests of the DAT (VR + NA) with the median validity coefficients of 0,50. Anastasi (1968:340) reports higher correlation coefficients of 0,70 and 0,80 between (VR + NA) aptitude scores and the composite criteria of academic achievement. In a review of various studies on the predictive validity of the multiple aptitude test batteries, Lavin (1967:55-56) reports the correlation coefficients which range from 0,34 to 0,80 between aptitudes and different criteria of academic achievement.

TABLE 2.7

SUBSETS OF COGNITIVE PREDICTORS OF ACHIEVEMENT IN SCHOOL SUBJECTS SELECTED BY MULTIPLE CORRELATION (Von Mollendorf, 1978:213-224)

School subject	Best subset of predictors	Boys R	Girls R	N
Afrikaans B	AW + ALB + NC	,588*	,713*	308
English B	EV + ERC + ALB + VR	,700*		97
	AW + EV + VR		,690*	308
Biology	AW + Maths + EV	,502*		97
	NVR + 3-D + NC		,605*	307
History	EV + NC + 3D	,406*		94
	EV + AW + Maths + 3D		,749*	208
Geography	2D + EV + Maths + 3D + ERC	,509*		32
	VR + 3D + Maths + AW		,523*	284
Mathematics	Maths + NC	,750*		31
	Maths + 2D + NC		,712*	308
Science	Maths + EV + AW	,570*		97
	Maths + 3D + NC		,455*	308
Commerce	Maths + EV + ERC + NVR	,729*		97
	EV + Maths + AW		,974*	96

* R-coefficients significant at 1% level

Meaning of abbreviations

1. NVR = Non-verbal reasoning
2. VR = Verbal reasoning
3. EV = English reading
4. ERC = English reading comprehension
5. NC = Number comprehension
6. AW = Afrikaanse woordeskat
7. ALB = Afrikaanse leesbegrip
8. SQ = Squares
9. SP = Spatial perception
10. MATHS = Mathematics proficiency

In South Africa there is only one study which investigated the differential prediction of the multivariable battery (AAT).

The study was conducted among Blacks by Von Mollendorf (1978) and table 2.7 indicates the best subsets of predictors of achievement in each school subject, as rearranged from Von Mollendorf (1978:213-224).

Table 2.7 indicates the multiple correlation coefficients which range from 0,5 to 0,9. These coefficients are slightly higher than those reported by Lavin (1967), as cited above. This indicates that the multivariate batteries have a potential of predicting achievement at high school level thus, supporting the conclusion in paragraph 2.2.3. Attention will in the following paragraph be paid to general prediction by means of the multivariate aptitude battery.

2.4.6.3 General prediction of achievement by means of an aptitude test battery

While differential prediction is based on the assumption that some pupils may be good in some subjects and not in others, general prediction is based on the assumption that there is a general factor underlying performance in various learning activities (Lavin, 1967:53).

In general or global prediction a number of dimensions of ability are used to predict a global measure of academic performance (GPA) (Lavin, 1967:49). Lavin (1967:52) goes on to report that in the studies in which a battery of predictors was used to predict an overall index of college performance (GPA), multiple predictors showed higher magnitudes of correlations than the unitary batteries (I.Q.).

In the South African context very few studies have been conducted on general prediction among Blacks. In this regard only the studies conducted by Van der Westhuizen (1987) can be cited. In this study Van der Westhuizen (1987:242) calculated a multiple correlation between standard 10 total (GPA) and sex,

residential area, vernacular, English vocabulary (EV) number comprehension (NC), standard 8 aggregate, interest and personality variables. These variables together explained 0,3974 of variance in standard 10 aggregate marks.

Another short study on the prediction of standard 10 achievement (GPA) was conducted by Gumede (1986:5-7). In his study he regressed the GPA on all Academic Aptitude Tests battery (AAT) variables, (except mathematics proficiency i.e. test 10), vocational interest questionnaire variables, High school personality factors, self-directed search variables, and the variables of the Survey of Study Habits and Attitudes, with N = 1983. Using the stepwise regression technique the maximum variance explained by the 'best' subset of predictors from the aptitude tests and personality questionnaires is 0,18 (R^2 = 0,18).

2.4.6.4 Conclusion

The lack of sufficient research on the predictive validity of the Academic Aptitude test battery in South Africa makes it difficult to draw any generalisable conclusion from the reported studies; moreover because the cognitive variables (AAT) were used in conjunction with non-cognitive variables in the prediction equation. There is no study in which the GPA was regressed on all the AAT variables (together) to determine the maximum variance that can be explained by the cognitive variables alone.

Differential prediction has however indicated high correlations between achievement in individual school subjects and a particular subset of cognitive variables. It is the task of this study to determine the maximum variance that is explained by the cognitive variables of the AAT in the GPA, and to determine the 'best' subset of cognitive predictors from this battery (see paragraph 6.4).

2.4.7 Summary of the review of aptitude

The data on table 2.7 indicate the best subsets of predictors of achievement in each school subject that was used as a dependent variable.

The multiple correlations are higher than the simple linear correlations as shown on table 2.7 ranging from 0,406 to 0,974, while simple correlations range from 0,11 to 0,70 (see table 2.6).

Concerning the predictability of boys and girls evidence produced on table 2.7 is mixed. It cannot be concluded that boys are more predictable than girls and visa versa. The main causes of this mixed evidence is that there are different predictors of achievement for different sexes in different school subjects, with the exception of Afrikaans B where the best predictors are the same for both sexes, irrespective of grouping into mathematics and non-mathematics groups by Von Mollendorf (1978).

The multiple correlation coefficients, obtained by Von Mollendorf, are higher than simple linear correlation coefficients (tables 2.4, 2.5, 2.6, and 2.7). The coefficients obtained by correlating (simple and multiple) the DAT variables with the GPA, (see table 2.6) compare favourably with the coefficients obtained by Von Mollendorf in multiple correlation where the individual school subject was the criterion (see table 2.7). Von Mollendorf did not calculate the multiple regression (correlation) between the GPA and the various aptitudes, as was also reported earlier. His findings are, however, significant in the sense that higher multiple correlations coefficients indicate that the AAT variables can predict the composite score of all school subjects. In this study focus is on the predictability of the GPA by means of aptitude tests.

2.5 EVALUATION AND IMPLICATIONS FOR THIS STUDY

In this chapter the relationship between the cognitive variables and academic achievement was reviewed. The review was done with the purpose of determining 'how good' the cognitive variables can predict academic achievement. The review was mainly focussed on the predictive validity of the aptitude tests. Intelligence and previous achievement were reviewed as academic achievement predictors for the purpose of putting aptitude tests in perspective, as they are also cognitive variables.

In paragraph 2.2 the predictive validity of intelligence tests was reviewed since academic achievement is to a larger or smaller extent dependent on the intellectual functioning of the individual. A review of literature indicated that intelligence correlates with academic in the region of 0,5. An I.Q. score is a linear composite of the individual's performance in a number of tests and such a global score indicates the general performance level of the individual. In a definition of intelligence by Butcher (1972:25) it is stated that intelligence functions in the intergrative manner on different hierarchies with different ceilings of complexity according to the educational experience of the individual. This definition implies that intelligence depends on previous learning or that what is measured by intelligence tests is previous learning. It was therefore logical to review previous achievement <u>per se</u> as a predictor of academic achievement and for this purpose paragraph 2.3 was devoted to previous achievement as an achievement correlate.

In paragraph 2.3 the review of previous achievement as a predictor of achievement was done and previous studies were consistent in indicating that previous achievement is the best predictor of achievement in comparison with other cognitive variables reviewed in this chapter.

A detailed review of the relationship of the aptitude test scores with academic achievement was done in paragraph 2.4. The review indicated that the verbal and the number ability tests are the best predictors among the aptitude tests (see paragraphs 2.4.4.3 and 2.4.4.4).

The spatial perception tests do not correlate significantly with academic achievement (see paragraph 2.4.4.5).

Multiple regression showed coefficients which range from 0,406 to 0,974 depending on the subset of predictors and the school subject which was used as a dependent variable (see table 2.7).

The prediction of the GPA by means of the multiple aptitude test battery was reported in paragraph 2.4.4.2, and the simple and multiple correlation co-efficients were reported to range from 0,62 to 0,72 (see table 2.5). These correlations were calculated between the GPA and the reasoning ability tests of the DAT.

From the review of the predictive validity of cognitive variables it can be said that intelligence is the best predictor of achievement in the elementary school when compared with previous achievement and aptitude; but in the senior classes previous achievement has been reported to be the best predictor of academic achievement.

Concerning the prediction of achievement at university level a few studies cited indicated that aptitude tests are slightly better predictors than previous achievement especially for the Black students (see paragraph 2.3.2).

The studies reviewed in this chapter indicate that better predictions are obtained by multiple correlations (regression) than by simple linear correlations - hence achievement is also a function of a multiple of variables.

The review also indicates that language, number, and reasoning ability are better predictors of academic achievement than spatial perception. Evidence is mixed concerning the performance of boys and girls. While girls do better in languages, boys do better in Mathematics and the sexes do not differ in general intelligence.

From the studies cited in this chapter it can be generalised that the cognitive variables explain only about 25% of variance in achievement. The remaining variance is expected to be explained by the affective and other variables. That the cognitive variables alone are not sufficient in predicting academic achievement is evidenced by the studies cited in this study.

What was not investigated by the previous researchers and what is to be investigated in this study is the amount of variance that is explained by the 'best' set of predictors from the Academic Aptitude Test battery, when regressed on the aggregate pass percentage (APP) of the standard 10 pupils.

In the following chapter attention will be paid to affective variables as predictors of academic achievement.

CHAPTER 3

AFFECTIVE VARIABLES AS PREDICTORS OF ACADEMIC ACHIEVEMENT

3.1 INTRODUCTION

In the previous chapter the cognitive variables were reviewed for their predictive validity. The review indicated that the cognitive variables alone correlated with academic or scholastic achievement in the region of 0,5. That is, the cognitive variables explain only about 25% of variance in achievement (see paragraph 2.5). The additional variance, according to Bloom's model, is accounted for by the affective variables and the quality of instruction. According to Lavin 1968, in addition to intellective and affective variables, sociological variables are important in explaining additional variance. Venter (1983) found that the total school environment explains more variance than intelligence (see paragraph 1.2).

In view of the low correlation between the cognitive variables and academic achievement, low in the sense that not all variance is accounted for, it is necessary to review the contribution affective variable to R^2. To reach this aim the contribution of the affective variables to R^2 will be reviewed in separate paragraphs. Paragraph 3.2 will be devoted to personality as an achievement correlate and paragraph 3.3 will be devoted to interest as an achievement correlate.

3.2 PERSONALITY AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

3.2.1 Introduction

In this chapter the aim is to review personality as a predictor of academic achievement. This aim will be reached by, (i) defining personality (paragraph 3.2.2), by (ii) reviewing the

methods by which personality was operationalised for the purpose of measurement (paragraph 3.2.2), by (iii) reviewing the predictive validity of personality (paragraph 3.2.4), and by (iv) drawing conclusions from the previous research findings (paragraph 3.2.5).

3.2.2 Definition of personality

The prediction model for this study involves the pupil characteristics in interaction with the school environment (see paragraph 1.2). This model presupposes the importance of personality theories that stress the individual characteristics in interaction with the environment. Such theories are those of Allport (1950) Murray (1951) and Cattell (1950).

Allport (1937) defines personality as a dynamic organisation within the individual of those psychophysical systems that determine his unique adjustments to his environment (Allport, 1937:47 in Corsini and Marsella, 1983:356). In this definition personality is seen as an organised system which is relatively stable but subject to change and evolution as a result of growth and maturation and in response to the environmental demands for adjustment. These systems according to Allport are within the individual and they are the determinants of his **uniqueness**. The basic tenants of Allport's theory are the **traits**. The traits are organised hierarchically from cardinal through central to secondary traits to form a system that is unique to the individual. This illustrates Allport's belief that human beings are organised and unified wholes and must be studied as such (Corsini and Marsella, 1983:363).

In his generalisation about mankind Murray stated that:

Every man is in certain aspects
a. like all other men
b. like some other men
c. like no other men (Kluckhohn and Murray, 1964:53).

This indicates Murray's broad conception of personality. The most important tenant of Murray's personality theory was the need. He categorised the human needs, and the most prominent human need was the need for achievement. This he defined as a need to overcome obstacles, to attain a high standard, and to excel, rival or surpass others (Pervin, 1975:106). In a nutshell, Murray's theory expresses that a person functions as a unified cohesive organism within any given situation (Corsini and Marsella, 1983:367).

Personality according to Cattell (1950) is that which permits a prediction of what a person will do in a given situation (Hall and Lindzey, 1970:386; Corsini and Marsella, 1983:390). This definition like that of Murray and Allport stresses the person as a whole and his response to the environment. In his conception of personality Cattell stresses the importance of source traits in determining overt behaviour. According to Cattell a trait is a relatively stable disposition to respond in a give manner across a wide variety of situations, thus making the prediction of behaviour possible (Corsini and Marsella, 1983:391).

There is similarity among Allport, Murray and Cattell in their conception of personality. They all conceive of the 'trait' as the most important characteristic of personality although they define it differently. To Allport the trait is a neuropsychic structure (Hall and Lindzey, 1970:264). Murray makes use of the term needs instead of traits. To Murray a need is a hypothetical construct employed to understand the relationship between conditions which provoke an action, a force which is in the brain that organises perception, apperception, intellection, cognition, and action in such a way that a particular behaviour pattern is determined (Corsini and Marsella, 1983:365). Cattell regards the trait as a mental structure, which is a fundamental dimension of personality (Fransella, 1981:88).

In this paragraph it is aimed to indicate the relationship of Cattell's personality theory with at least two other theories which are concerned with 'normal' human behaviour; with particular reference to its description and measurement. Comparing and evaluating the theories is not the main concern in this paragraph but to say whether each leads to measurement, generates research, and can be used in predicting human behaviour, will suffice.

Allport's theory does not lead to measurement since the individual traits could not be stated in a general form and could not be operationalised. It therefore, failed to generate research and could not be used in predicting unobserved events (Hall and Lindzey, 1970:292). Murray's theory on the other hand stressed the human needs and motivation to achieve. Murry identified twenty needs (Hall and Lindzey, 1970:176). The operationalisation of the needs led to the compilation of the instruments for measuring personality; one of these being the Thematic Apperception Test (TAT). This instrument has led to research on personality and predictions could be based on the results of measurement. The results of measurement cannot however be tested because the assumptions are not based on clearly stated psychological assumptions. Murray also paid more attention to motivational processes than to the learning processes (Hall and Lindzey, 1970:205). That is why his theory is used mainly in clinical settings and in vocational placements and not in the learning situations (Retief, 1987:49).

Cattell's theory is eclectic and the traits have been operationalised to measure the various dimensions of personality with the purpose of predicting behaviour (see details in paragraph 3.2.3). A large amount of research on the reliability and the predictive validity of the measuring instruments (based on Cattell's theory): the Sixteen Personality Factor (16 PF) and the High School Personality Questionnaire (HSPQ), has been done and is still going on. No final evaluation of Cattell's theory

can therefore be made at this point in time (Hall and Lindzey, 1970:409).

3.2.3 Operationalisation of personality by Cattell

3.2.3.1 Introduction

Cattell (1950) sought to identify the basic structural components of personality that would make it possible to predict the individual's behaviour by means of the specification equation that combines the person, the environment, and the situation variables (Corsini and Marsella, 1983:390). Cattell therefore set himself a task of specifying the personality variables that could be used in the prediction of behaviour. The following paragraph will be devoted to the method used by Cattell in operationalising personality. The method will be discussed in two stages: sources of information (paragraph 3.2.3.2) and the source traits of personality (paragraph 3.2.3.3).

3.2.3.2 Sources of information

Cattell (1950) drew his information from three sources: life-data records (L-data); questionnaire data (Q-data); test data (T-data) (Cattell and Butcher, 1968:55). The L-data formed the first source of information, and this included information from the person's school records, legal records, and so on. The second source of information is questionnaire data (Q-data). This data is generated by self-report questionnaires and provides the person's own view of feelings, moods, and behaviour. The last source of information is obtained through the use of objective tests (T-data). The T-data information is obtained from paper-and-pencil, psychomotor or other objective instruments (Corsini and Marsella, 1983:390; Hail and Lindzey, 1970:380). The data from all these three sources provided information on the personality sphere of the individual.

Cattell then undertook the task of finding source traits from the L-data, that could be used in developing the questionnaire and tests for measuring personality (Pervin, 1975:330). In the following paragraph the method that was employed by Cattell to arrive at source traits will be discussed.

3.2.3.3 Source traits of personality

Cattell began his L-data research with the assumption that verbal symbols in language reflect the total domain of personality (Pervin, 1975:330). Using trait names in Allport and Odbert (1936) dictionary, Cattell arrived at a list of 171 variable names by combining the obvious synonyms. A sample of 100 people from all the walks of life was selected and people were rated by the judges who knew them very well on the 171 variable names. The correlation and factor analysis of the ratings resulted in 67 clusters. These 67 cluster variables were further reduced to 35 clusters by factor analysis. Again 208 men were rated according to the 35 trait names and this resulted in 15 primary source traits of personality (Anastasi, 1965:348; Hall and Lindzey, 1970:380; Maddi, 1976:412; Pervin, 1975:331).

The source traits exist in a number of modes. Some are motivational (dynamic traits), others are goal effective (ability traits), and still others are affective and constitutional in style (temperamental traits). According to Murray (see paragraph 3.2.2) these traits are shared by all men - hence his statement that everyman is in certain aspects like all other men. This idea of common traits is shared by Cattell and Allport (Hall and Lindzey, 1970:387).

Besides the common traits, there are relatively unique traits which are a unique combination of different of source traits that characterise some individuals in a particular social setting. Further, there are unique traits that characterise an individual in such a way that he is like no other person.

In this instance Cattell agrees with Murray who says, every man is in certain respects like no other man (see paragraph 3.2.2) (Corsini and Marsella, 1983:391, Hall and Lindzey, 1970:387).

Cattell, with the assistance of his associates, constructed a test that could be used in assessing personality source traits. This effort resulted in the construction of the Sixteen Personality Factor Questionnaire (16PF) by Cattell and Stice (1957) (Maddi, 1976:414). The primary source traits of personality consist of 15 pairs of opposites, 12 of which are found in L-data and in self-rating questionnaire (Q-data), and the other four were identified later from test data (T-data) (Anastasi, 1965:349; Pervin, 1975:335).

For the purpose of measuring the personalities of High School pupils the 16PF was reduced to fourteen factors in the compilation of the High School Personality Questionnaire (HSPQ). The details of this questionnaire appear in paragraph 5.3.3.2. The fourteen personality factors are the following:

TABLE 3.1
MAJOR PERSONALITY FACTORS

Letter symbol	Technical label	Popular label
A	Affectothymia-Sizothymia	Out-going - Reserved
B	Intelligence	More intelligent - less intelligent
C	Ego-strength	Stable-emotional
D	Phegmatic-Excitability	Submissive-dominant
E	Dominance-subissiveness	Assertive-humble
F	Surgency-desurgency	Happy-go-lucky-sober
G	Super-ego-strength	Conscientious-exedient
H	Permia-Threctia	Venturesome-shy
I	Premsia-Harria	Tender-minded-taugh minded
J	Coasthemia-Zeppia	Individualistic-Zestful
Q_1	Conservatism-Redicolism	Apprehensive-self-assured
Q_2	Self-sufficiency-lack of resolution	Resourceful - group dependent
Q_3	Strong-weak self-sentiment	Controlled-uncontrolled
Q_4	High Ergic-low Ergic tension	Tense-relaxed

(Madge, 1972:9-19; Cattell and Butcher, 1968:56; Fransella, 1981:89.) The first ten factors are among the 15 factors underlying the description of personality according to the dictionary compiled by Allport and Odbet as has been already cited above. The factors have been arranged according to their importance in human personality, from A through J. In the HSPQ, factors K, L, M, N and O have been excluded, but, with the exception of factor K, they are included in the 16PF for their significance in adult personality description (Karson and O'Dell, 1976:29).

The four Q-data variables are included in both the HSPQ and the 16PF and research has indicated that they are more valuable than they were originally thought (Karson and O'Dell, 1976:29).

The factors in the HSPQ include those which are typically temperamental and hereditary determined, like: A, H, and O; and factors which are environmentally determined like F, J, and Q_3. In the list, ability traits like factors B, G, Q_2 and E- are included in Cattell's specification or linear regression equation (see Hall and Lindzey, 1970:390).

Academic prediction by means of this equation is based on the assumption that behaviour is a function of situation and personality variables (Corsini and Marsella, 1983:390). With the use of this formular Cattell attempted to predict scholastic achievement among other dependent variables (for details see Cattell et al., 1970:390-395).

In the following paragraph attention will be paid to the prediction of achievement by means of personality variables alone (first), and in combination with ability variables (second). This will be done by reviewing simple correlations between personality factors and achievement, and by reviewing the multiple correlations (or regressions) between achievement and personality variables.

3.2.4 Simple correlations between personality source traits and academic achievement

Cattell's personality theory has been used widely in prediction studies at High school or at University level, or in the prediction of success in the various careers.

Intercultural studies have also been conducted in America, England, Europe, Asia and Africa to determine the stability of the personality factors. Although wide variations were found among the cultures, the factors were found to be relatively stable in all cultures (Cattell et al., 1970:XXI). This indicates that the personality measuring instruments based on Cattell's personality theory can be used in all cultures in the prediction of scholastic achievement, after the establishment of the new norms for a particular language or cultural group.

In the prediction studies that have been conducted in America and South Africa both instruments, the 16PF and the HSPQ have been used, either to predict high school achievement or success at university. The summary of the simple correlation studies is given in table 3.2.

TABLE 3.2

PERSONALITY FACTORS CORRELATING SIGNIFICANTLY WITH ACHIEVEMENT

HSPQ FACTORS	SIGNIFICANT PREDICTORS IN VARIOUS STUDIES													
	1	2	3	4	5	6	7	8	9	10	11	12	13	F
A Sociability	X_5		X						X		X			4
B Intelligence	X_1	X	X	X	X	X	X		X	X	X	X		11*
C Ego-strenght			X	X		X	X				X	X		6
D Excitability	X_7													1
E Dominance	X_4					X			X	X		X		5
F Enthusiasm				X				X			X			3
G Super-ego-strength	X_2	X	X		X		X	X	X	X				8*
H Venturesome				X		X	X					X	X	5
I Tendermindedness			X		X						X		X	4
J Individualistic								X						1
Q1 Apprehensiveness														
Q2 Self-sufficiency	X_3				X	X				X	X	X		6*
Q3 Controlled	X_6	X					X		X				X	5
Q4 Tenseness			X	X				X						3

Remark: The researchers whose findings appear on table 3.2 are the following:

1. Cattell et al., 1968:188.
2. Barton et al., 1971:331-6.
3. Smith, 1971:111-112.
4. Van Niekerk, 1972:439.
5. Mandryk et al., 1974:450-452.
6. Engelbrecht, 1973:74.
7. Von Mollendorf, 1978:305.
8. Van der Westhuizen, 1987:237.
9. Schoeman, 1981:23 (Summary).
10. Butcher et al., 1963 in Cattell and Butcher, 1968:198.
11. Botha, 1971 in Van der Westhuizen, 1987.
12. Engelbrecht, 1971 in Van der Westhuizen, 1987.
13. Scott, 1984:85.

From Table 3.2 it appears that factors B, G and Q_2 have significant correlations with achievement as revealed by their high frequency (F). This confirms the findings obtained by Cattell and Butcher, (1968:188) who ranked the factors according to their significance with the first three being Factors B, G, and Q_2. Factor C is fourth in frequency. The rest have been ordered by Cattell et al. (1968) as shown on the table under column 1. In addition, the three factors, factor C and E have shown a strong relationship with achievement by a high frequency.

The study conducted by Von Mollendorf (1978) and by Van der Westhuizen (1987) among Blacks, did not indicate Factor B and Q_2 as significant predictors of standard 10 academic achievement. Cattell et al. (1970:105) says factor B is a constant and a very significant predictor of scholastic achievement. This has been confirmed by 12 out of 13 studies cited on table 3.2. In the study by Scott (1984:85) factor B was not regress together with other personality factors.

Concerning the simple correlations between the personality factors and academic achievement, Schoeman (1976:9) noted in the studies he reviewed, most of which have been reported on table 3.2, that besides factor B the correlation coefficients do not exceed 0,4. As has also been remarked by Schoeman (op cit), there is no clear pattern of the relationship been academic achievement and personality, as has been revealed by the studies conducted among Blacks and Whites. That there is no clear pattern is also supported by the studies conducted by Monteith (1983) as cited by Van der Westhuizen (1987:169), in which factors A, H, and I appear as achievement correlates. These three factors have a low frequency on table 3.2. In summary, Schoeman stated that personality factors explain less than 20% of variance in achievement. In the following paragraph attention will be paid to the multiple correlation of personality variables with achievement and their additiveness in the prediction equation.

3.2.5 Multiple correlation of personality variables with academic achievement

In the above subparagraph it was indicated that simple correlations between personality source traits and achievement do not exceed R = 0,4 with the exception of factor B (intelligence). In this paragraph the review is focussed on the multiple correlation and the additiveness of the source traits in the prediction equation when the cognitive variable is X_1. It is the additiveness of the source traits that is reviewed in this paragraph and not the measuring instruments. Therefore the findings with the 16PF and the HSPQ will be the source of evidence.

The results to be reported in this paragraph were obtained by Cattell when Factor B was excluded from the HSPQ, and when it was included (Cattell and Butcher, 1968:186).

Using a sample of 153 High School pupils from Springfield (urban), Cattell correlated, first, the six personality factors (A, D, E, G, Q_2, and Q_3); second, the 13 factors (excluding Factor B) and then the entire HSPQ with the GPA. The average multiple correlation between achievement and the six personality factors was R^2 = 0,130. The average multiple correlation obtained with the use of the 13 personality factors increased to R^2 = 0,221. When the entire HSPQ was added to cognitive variables in the equation the R^2 increased to 0,624. These results indicate that the multiple correlations increase with the increase in the number of personality factors added in the equation, and that when the personality variables were added to cognitive variables the R^2 increased (Cattell and Butcher, 1968:193).

Cattell and Butcher (1968:199) went further to compare the urban and rural samples. When the multiple correlations were averaged the picture is simplified as follows (see table 3.3).

TABLE 3.3

COMPARISON OF URBAN AND RURAL SAMPLES WITH RESPECT TO THE ADDITIVENESS OF PERSONALITY FACTORS TO ABILITIES IN THE SPECIFICATION EQUATION. TOTAL ACHIEVEMENT WAS THE CRITERION

School situation	Abilities alone	Abilities + personality	N
Urban (Springfield)	R^2= ,518	R = ,624	153
Rural (Paxton	R^2= ,449	R = ,548	124

The results on table 3.3 indicate that when the personality factors are added to cognitive variables there is an increase of about 0,10 on R^2 (Cattell and Butcher, 1968:192 & 197). Another observation is that the correlations of the urban sample are higher than those of the rural sample. Cattell and Butcher (1968:199) attributes the lower correlations of the rural sample to adverse testing conditions.

After the publication of the above findings, several validation studies were conducted in various cultures and the findings were found consistent with those obtained by Cattell and Butcher (1968). In this regard Cattell and Butcher (1968:199) cite the studies by Butcher, Ainsworth and Nisbitt (1963) and Cattell, Seally, and Sweney (1966). Other American studies conducted by Barton et al. (1971:33), and Mandryk and Chuerger (1974:450) using the I.Q. as a cognitive variable, confirm the findings obtained by Cattell and Butcher (1968:197) reported above, that the addition of personality variables to cognitive variables in the prediction equation for the GPA brings about an increase in R or R^2.

In Barton et al. study this increase in the multiple correlation coefficient occurred in spite of the fact that Barton et al. (1971) used the sixth and the seventh grades in their samples. Their results made them conclude that the I.Q. alone accounts for about 20% of variance in achievement while the addition of the HSPQ variables increased the percentage variance explained

to 35%, in the sixth grade. In the seventh grade there was an increase of 21% above 30% (for English, Social Studies and Mathematics) and an increase of 10% above 17% (for spelling and mathematics) (Barton et al., 1971:333). These findings are supported by those found by Mandryk (1974) who found an increase in R from 0,48 to 0,57 when the cognitive variables (verbal and quantitive) were added to the 14 HSPQ variables in the specification equation. In his sample the personality factors accounted for 23% of variance in achievement, thus agreeing with the findings by Cattell et al. (1966) who found that personality variables account for 25% of variance in achievement. With the addition of cognitive variables to personality variables the variance explained increased to 32% (Mandryk et al., 1974:452).

From the above reported studies the highest variance explained as a result of the addition of cognitive variables to personality variables is 35% as indicated by the study conducted by Barton et al. (1971). The American studies produce convincing evidence that there is an increase in R^2 when the cognitive variables are combined with the HSPQ variables in the prediction of the GPA.

The American results obtained with the use of the HSPQ are confirmed by the studies in which other personality measures were used together with cognitive variables in the prediction of scholastic or academic achievement. For instance Ames (1943:233) found an increase from R = 0,54 to R = 0,71 when an Otis I.Q. test scores were used with ratings from persistence and attitude towards school. That personality factors increase the R^2 when combined with cognitive variables in the prediction equation can, from what has been reported above, be generalised in America. Attention will now be paid to South African studies with the purpose of finding out whether the American findings can also be generalised to South Africans.

In South Africa only two studies have been conducted among Blacks to determine the combined effect of cognitive and affective variables on the prediction of achievement. One such a study was conducted by Von Mollendorf (1978) and another study was conducted by Van der Westhuizen (1987).

Among other personality measures used by Von Mollendorf the HSPQ was one, the other measures were the Survey of Study Habits and Attitudes (SSHA) and the Mehrabian Achievement Motivation scale. With specific reference to the HSPQ, Von Mollendorf (1978) did not calculate the separate contribution of the personality variables as did Cattell and Butcher (1968) and Barton et al. (1971), cited above. He used a method of principal component analysis in which the cognitive and affective variables were included. Using a sample of standard 10 Black students from the industrial area of the Rand, Von Mollendorf came to a conclusion that the HSPQ variables except Factor B were of no value in achievement prediction (Von Mollendorf, 1987:305). Von Mollendorf's findings are supported by the findings obtained by Van der Westhuizen (1987). Van der Westhuizen (1987) used a random sample of all Black students in South Africa in his prediction study, using the cognitive (AAT) and the affective variables (personality and interest) as predictors. From the results of multiple regression he came to a conclusion that the personality variables do not contribute significantly to the explanation of variance in the achievement of standard 10 pupils (Van der Westhuizen, 1987:259).

Among the South African Whites, two studies were conducted on the predictive validity of personality variables. Such studies were conducted by Monteith (1983) and Scott (1984) as cited by Van der Westhuizen (1987:168-170). Both Monteith (1983) and Scott (1984) found significant correlations between personality variables and achievement. The studies also found an increase in R^2 when cognitive variables were combined with personality variables (Monteith, 1983:29, Scott, 1984:84).

The South African studies conducted among White students agree with the studies conducted in America as has been shown above; but the studies conducted among Black South African students indicate that the personality variables are less useful in the prediction of standard 10 achievement. Moreover the researchers that applied the HSPQ among the Black students found different personality factors that correlated significantly with academic achievement. But this is not strange if one looks at table 3.2. The different populations and the techniques used in the analysis of data can be regarded as the main cause of different findings. It is for this reason that multiple regression analysis will be used in the selection of the 'best' subset personality variables instead of factor analysis. See paragraph 5.9.2.4 concerning the selection procedure.

3.2.6 Summary

In this chapter personality was defined with reference to the theories by Allport, Murray and Cattell. Cattell's personality theory was discussed and compared with that of Allport and Murray.

Like the personality theories of Allport and Murray, Cattell's personality theory is labelled a trait theory. Such a theory stresses the importance of source traits as the determinants of overt behaviour. With the help of factor analysis Cattell and his associates managed to operationalise personality in terms of traits that were significant in predicting behaviour.

The operationalisation of traits resulted in the compilation of the High School Personality Questionnaire (HSPQ), besides the 16 PF which is meant for adults. Research on the predictive validity of the HSPQ indicated that there is no clear pattern as to the source traits that correlate significantly with academic achievement; but factors B, G and Q_2 have the highest

frequency on table 3.2. The studies conducted among the Blacks do not indicate factor B and Q_2 as achievement correlates.

Simple correlation studies indicated that the correlations between personality factors and achievement do not exceed 0,4, thus explaining less than 20% of variance in achievement. Only factor B has a correlation with achievement that exceeds 0,4.

Concerning the additiveness of the personality variables to cognitive variables in the prediction equation, the studies conducted in America are unanimous in finding a significant increase in R^2. The South African studies conducted among Whites also indicated significant increase in R^2 when the personality variables were added to cognitive variables in the prediction equation. Conflicting results were obtained in the studies conducted among Blacks. Among Blacks no significant increase in R^2 was found with the addition of the personality variables in the prediction of academic achievement.

The conclusion that the additiveness of the personality variables to cognitive variables is not consistent between White and Black children was also arrived at by Van der Westhuizen (1987:176) after a review of literature and confirmed this in his study (Van der Westhuizen, 1987:309).

The two studies conducted among Blacks by Von Mollendorf (1978, and by Van der Westhuizen (1987) are not enough to generate a conclusion that the personality variables do not contribute statistically significant to R^2; when studies among Whites report correlations of ten to twenty percent when added to cognitive variables. There is therefore a need for a further study of the additiveness of the personality variables to cognitive variables in the equatation for the GPA.

In the following paragraph attention will be paid to the significance of interest variables as predictors of academic achievement, and their additiveness in the prediction equation.

3.3 INTEREST AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

3.3.1 Introduction

The aim in this paragraph is to review interest as an achievement correlate. To reach this aim interest will be defined in order to expose it as a construct (paragraph 3.3.2). After defining interest, the relation between interest and personality will be reviewed (paragraph 3.3.3), and this will be followed by the review on the operationalisation to interest (paragraph 3.3.4), and then by the review of the predictive validity of interest variables (paragraph 3.3.5).

3.3.2 Definition of interest

Interest is seen by Strong (1943) as an expression of ones reaction to his environment. The reaction of liking or disliking is a result of satisfactorily or unsatisfactorily dealing with the object. He continues to say that different people react differently to the same object, and he illustrates this by saying that people who have the kind of brain that handles Mathematics easily will like Mathematics and vice versa. According to him interests are related to abilities (Strong, 1943:692). While stating that achievement is a function of aptitude and interest, Anastasi (1968:466) warns that a high level in aptitude does not necessarily mean a high level in interest. She goes on to indicate that an individual may have sufficiently high aptitude for success in educational, vocational, or recreational activity without the corresponding interest; or he may have interest in the activity for which he has no pre-requisite aptitude. According to Anastasi the measurement of both variables (aptitudes and interest) permits a more effective prediction of performance than the use of either (Anastasi, 1968:467).

Other definitions of interest refer to interest as an intentional and spontaneous reaction towards an object or activity. For instance, Block (1971:17) defines interest as a voluntary engagement of the pupil in additional learning task if free to make a choice, and it is (subjectively) the individual's liking, enthusiasm, positive view, preference, and desire. Vrey (1979) has a similar view and he defines interest as a deliberate direction of attention and as a completely voluntary attitude. Similarly Coetzee (1975:1) defines interest as a spontaneous attraction towards or preference for certain activities, as well as a spontaneous dislike of other activities.

Block's (1971) definition of interest indicates why an individual engages in an activity and his definition relates to a learning activity that is purposefully learned.

The same view is held by Vrey (1979) in his definition of interest. On the contrary interest according to Coetzee (1975) is a spontaneous reaction to a stimulus, which response is more of a reflex than deliberate reaction to a stimulus. Why Coetzee defines interest like this will be followed up under the operationalisation of interest for the purpose of measurement.

Another definition of interest is given by Smit (1984:284) who sees interest as a dynamic inclination of an individual to look for a specific object or action, or to do something with which need satisfaction can be brought about. To Smit interest is dynamic and not static. It is something that changes. It is true that interests (or attitudes) are labile in young children (Vrey, 1979:73) but there is evidence that from adolescence to adulthood interests are relatively stable as a result of vocational information that has become available to pupils at this age (Strong, 1943:380; Msimeki, 1973:18).

The characteristics of interest are summarised by Jackson and Messick, 1978:684 as follows:

i they are acquired reaction or tendency to like or dislike a certain activity or object for the purpose of satisfying a certain need,

ii they are persistent especially after adolescence (see also Msimeki, 1973:114),

iii they are characterised by intensity in the sense that differential preference for various activities depends on the extent the activity satisfies a particular need, and

iv they are characterised by bipolar variables of acceptance and rejection, and by a state of indecision, in case both poles have equal valency for the individual. This characteristic is important in item writing for an interest inventory (see paragraph 5.3.4.2).

3.3.3 Relationship between interest and personality

3.3.3.1 Introduction

Interest is related to other personality variables like attitude and motivation, and this relationship in discussed below.

3.3.3.2 Relationship between interest and attitude

Attitude is defined as a tendency to react favourably or unfavourably towards a designated class of stimuli, such as racial groups or school (Anastasi, 1968:459). Anastasi (op cit) also states that interests are a special type of attitude while attitudes are more comprehensive and include, besides interests, values, mores and appreciation. An attitude may be illustrated by the fact that males generally do better than females in Mathematics (Ngobeni, 1984:101). According to Visser (1985:4) as cited in paragraph 2.4.5.4, there is a stereotyped belief

that Mathematics is a male subject, and even the parents regard it as important for boys. That Mathematics is a male subject lowers motivation and perseverence in females thus leading to the loss of interest when difficulty is experienced in the learning of Mathematics; while on the other hand social attitude reinforces interest among boys in the learning of Mathematics.

The study by Antonen (1969:468-470) illustrates the influence of attitude on achievement in Mathematics at grades 7 and 12 for both sexes. Table 3.4 below shows the results of the study of the intercorrelations of Elementary and Secondary Mathematics scores, lower Arithmetic Total, Quantitative Thinking, and Mathematics GPA for different grades and sexes (Antonen, 1969:468-470).

TABLE 3.4

CORRELATION BETWEEN GPA AND ATTITUDE AND QUANTITATIVE THINKING SCORES FOR BOTH SEXES

Dependent variable	Elementary Attitude score	Secondary Attitude score	Quantitative Thinking
Maths GPA (all students)	,311 (N = 607)	,432 (N = 607)	,804 (N = 607)
Maths GPA (Grade 7 males)	,323 (N = 156)	,485 (N = 156)	,706 (N = 149)
Maths GPA (Grade 2 males)	,403 (N = 150)	,165 (N = 150)	,771 (N = 147)
Maths GPA (Grade 7 females)	,295 (N = 143)	,473 (N = 143)	,804 (N = 148)
Maths GPA (Grade 12 females)	,297 (N = 155)	,362 (N = 155)	,739 (N = 155)

Table 3.4 is a contraction of tables from Antonen (1969). According to Antonen (1969:471) higher correlations at High School level indicate a closer temporal relationship of the attitude and achievement measures.

From the table it is also important to note that boys have higher simple correlations between attitudes and Mathematics achievement, at Primary and High School levels, than girls.

The scope of this paragraph does not allow for a more detailed review of attitudes and their relationship with achievement. The above example suffices to illustrate the importance of attitude to learning and achievement. It can, therefore, be concluded that a positive attitude re-inforces interest or lack of interest in the learning activity to some extent. The experience of success in an activity can arouse interest in spite of social stereotypes towards certain forms of learning.

3.3.3.3 Relationship between interest and motivation

Another affective variable that is related to interest is motivation. Motivation refers to goal seeking or need-satisfying behaviour (Klausmeier and Goodwin, 1971:16). Achievement motivation is a widely generalized level of aspiration (Mouley, 1982:83). The need to achieve success has a corollary: the need to avoid failure. An example could be one student with a high aptitude and another with a low aptitude for Mathematics.

An item on the motivational scale asking, how many hours do you spend studying Mathematics a week, can elicit a response which indicates that both students are highly motivated. While one is self-actualising the other is avoiding failure and struggling to maintain a public image (Klausmeier and Goodwin, 1971:222; Mouley, 1982:83). These two students, in this example, may have interest in Mathematics, but the one with motivation for success may have average anxiety for failure, while the other who is motivated to avoid failure may have high anxiety for failure (Atkinson, 1974:34-35). High anxiety has been found by various researchers to have an inhibitory effect on achievement (Lavin,

1967:88; Cattell and Butcher, 1968:182; Smit, 1971:22; Atkinson, 1974:245).

Interest is a concomitant variable in both attitude and motivation. While attitude on the one hand indicates the general tendency towards or against an activity or object as a result of social influence; motivation on the other hand indicates the amount of energy expended on the learning activity for the purpose of achieving a goal.

In both cases interest is an overt behaviour variable that is observable, and has attitude and motivation as its source traits. This indicates the elusive nature of interests in prediction studies. Such a variable, from what has been stated above, does not seem to have a potential to predict academic success. In the following paragraph attention will be paid to the operationalisation and the measurement of interest.

3.3.4 Operationalisation and measurement of interest

The pioneer work in the operationalisation of interest is Freyer's Measurement of Interest in Relation to Human Adjustment which appeared in 1931 as cited by Cottle and Downie (1970:264).

Fryer had a subjective and an objective approach to the appraisal of interest. Objective interests were evaluated by the use of inventories, questionnaires and rating scales; while subjective interests were measured by verbal information, free association, and learning tests, which are one's observable reaction to a stimulus. Fryer's work was followed by the appearance of the Michigan Vocabulary Profile Analysis which measured interests on the basis of vocabulary one had on the different occupational fields. Another contribution made by Fryer was the idea of separating interest from motivation (Cottle and Downie, 1970:264).

The attempts made by Fryer at operationalisation of interests were followed by the work of Strong (1943); the Strong's Vocational Interests of men and women, and the Strong Vocational Interest Blank (SVIB). Another work at operationalisation of interest was done by Kuder (1930) in his Kuder Preference Record: Vocational. Many other interest assessment techniques appeared thereafter, and in this paragraph only the Strong Vocational Interest Blank (SVIB) and the Kuder Preference Record: Vocational (KPR:V) will be discussed, because of their relationship with the Vocational Interest Questionnaire (VIQ) which was used in this study.

To compile the Strong Vocational Interest Blank, Strong compiled about 400 items which cover the following 8 fields of interest (see Cottle and Downie, 1970:278).

TABLE 3.5
STRONG'S VOCATIONAL INTEREST VARIABLES

Group	Field of Interest
I	Occupations
II	School subjects
III	Amusements
IV	Practical activities
V	Perculiarities of people
VI	Order of preference of activities
VII	Comparison between two interests
VIII	Rating of present abilities and characteristics

Strong compiled the questionnaire for males and females. To each item the individual responded by indicating by a mark whether he liked (l), disliked (D) or was indifferent (I).

The responses of the individuals are scored either by hand or computer to produce a profile. The results are recorded in letters A through C. A stands for great interest, B for medium interest and C for the lack of interest. Strong proceeded to

make separate keys for different occupations (Cottle and Downie, 1970:280).

Kuder (1966) differed from Strong in the operationalisation of interest. While Strong used criterion groups of successful individuals in different occupations, Kuder built items and constructed a key on the basis of item - analysis. The results of the procedure was the construction of 10 scales for the 10 broad occupational fields indicated on table 3.6.

TABLE 3.6
FIELDS OF INTEREST MEASURED BY THE KUDER PREFERENCE RECORD : VOCATIONAL

Field	Interest measured
1	Outdoor
2	Mechanical
3	Computational
4	Scientific
5	Persuasive
6	Artistic
7	Literary
8	Musical
9	Social Service
10	Clerical

Cottle and Downie, 1970:298).

The Kuder Preference Record: Vocational, is very similar to the Vocational Interest Questionnaire (VIQ) which is to be discussed below. Further details are therefore not necessary on the KPR:V as the same information applies to the VIQ.

The Vocational Interest Questionnaire (VIQ) is a South African interest questionnaire that was compiled and standardised by the Human Sciences Research Council (HSRC) for the assessment of vocational interests of Black students from standard 6 to 10. This questionnaire resembles the Kuder Preference Record: Vocational in the number of fields of interests measured and in responses to items. The details of this questionnaire appear on table 5.13.

The Vocational Interest Questionnaire (VIQ) consists of 154 items, each provided with the triad as follows:

i a 'like' response (L)
ii An uncertain response (I)
iii a dislike response (D)

The respondent, like in the KPR:V has to indicate his preference by making a circle round L, or I or D as explained (Coetzee, 1982:13). In the VIQ the testee is supposed to indicate his preference for as well as his dislike of the activities included in the defined fields of interest (Coetzee, 1982:1).

In the foregoing paragraph the operationalisation of interest has been given. In the following paragraph attention will be paid to the relationship of the vocational interest with academic achievement.

3.3.5 Relationship between vocational interest and academic achievement

A number of studies conducted on the predictive validity of the vocational Interest Questionnaire is very limited. It is limited to the study that was conducted by Von Mollendorf (1978) and Van der Westhuizen (1983 and 1987).

Von Mollendorf (1978) conducted simple and multiple correlation studies on the predictive validity of the VIQ. Afrikaans B correlated negatively with all VIQ variables and the coefficients ranged from -0,0004 to -0,207. Almost the same results were obtained for English B and the rest of the school subjects with the highest negative coefficient of -0,348 between the natural sciences, and commerce (Von Mollendorf, 1978:182).

The above results were obtained with the sample of boys. With the sample of girls the picture is slightly different. There are 10 coefficients which are significant at 1% level, ranging from -0,373 to -0,637 to 0,591. The rest of the correlation coefficients are low (Von Mollendorf, 1978:184).

Van der Westhuizen (1983) calculated simple correlations between the VIQ variables; science (VIQ 3), commerce (VIQ 9) and technical work (VIQ 1), and Vernacular, and standard 10 achievement. The correlation coefficients obtained were very small and ranged from -0,014 to 0,045 (Van der Westhuizen, 1983:39).

In his (1987) study Van der Westhuizen obtained the following simple correlation coefficients between Language Group I and Language Group II and the VIQ fields of interest.

TABLE 3.7
SIMPLE CORRELATIONS BETWEEN LANGUAGES AND THE VIQ FIELDS OF INTEREST (Van der Westhuizen, 1987:362)

VIQ Field	Group I Language	Group II Language
VIQ 1	0,076*	-0,115**
VIQ 2	0,052	-0,013
VIQ 3	-0,117**	0,097**
VIQ 4	-0,082	0,035
VIQ 5	0,051	-0,052
VIQ 6	0,085	-0,075*
VIQ 7	-0,156**	0,066
VIQ 8	-0,088**	-0,035
VIQ 9	0,032	-0,025
VIQ 10	-0,117**	0,021

Remarks:
Language Group I refers to Northern Sotho/non-Northern Sotho.
Language Group II refers to Zulu/non-Zulu.

Table 3.7 indicates the coefficients that are very low and negative as the case was with the findings obtained by Von

Mollendorf (1978). The correlation coefficients for other school subjects are equally low (Van der Westhuizen, 1987:355-362).

Concerning the multiple correlations of the VIQ variables with achievement, Von Mollendorf, using principle components analysis in which the VIQ variables were included, the results indicated that the VIQ variables were not of significant value in achievement prediction hence the coefficients did not exceed 0.596 for boys and 0.571 for girls (Von Mollendorf, 1978:244). Von Mollendorf, came to a conclusion that the VIQ variables are not very useful in the prediction of achievement (Von Mollendorf, 1978:304).

In a multiple correlation study that was conducted by Van der Westhuizen in 1983 the personality variables including the VIQ were found to be of no significant value in the prediction of standard 10 achievement. The contribution of these HSPQ variables was however greater than that of the VIQ variables (Van der Westhuizen, 1983:57). In his main study Van der Westhuizen (1987) found that the personality variables which include the interest variables, have a significant contribution towards the explanation of variance in achievement. In the main study the contribution of the VIQ variables was again lower than that of the HSPQ variables as the case was with the findings in the pilot study. Van der Westhuizen, however, adds that in all cases the contribution of the personality variables to R^2 was of little educational value (Van der Westhuizen, 1987:265).

3.3.6 Summary

Interest was defined in paragraph 3.3.2 as an approach or avoidance reaction tendency for the individual to respond to an external stimulus for the purpose of satisfying a certain need or to preserve the self-concept.

In paragraph 3.3.3 interest was discussed in relation to attitude and motivation. Both variables influence interest in that interests are a subvariable of attitudes to a certain extent and motivation is the drive or energy that the individual expends in the activity. Interest therefore can be regarded as an overt behaviour variable.

In paragraph 3.3.5 a review of literature was done on the predictive validity of the VIQ variables and the conclusion was arrived at that the VIQ variables contribute very little to the explanation of variance in achievement. Its contribution is even smaller than that of the HSPQ. The review made by Bloom (1976:85) indicated that interests accounted for less than 20% of variance in achievement while attitude accounted for more than 20% of variance in achievement (Bloom, 1976:92).

The intercorrelations between the HSPQ and the VIQ variables are very low thus indicating that the two instruments are independent, and they measure different traits. This makes it possible to use both measures in achievement prediction.

3.4 SUMMARY AND IMPLICATIONS FOR THIS STUDY

The affective variables reviewed in this study are personality and interest. Personality was defined within Cattell's trait theory and compared with Allport's and Murray's conception of personality. Interest was also defined with the main bias on Strong's conception of interest (see paragraph 3.2.2 and 3.3.2).

The definition of both concepts was followed by the review of the methods followed in their operationalisation. The operationalisation of personality variables (of Cattell's personality traits) was done by means of factor analysis. With the aid of this technique a large number of factors were reduced ultimately to 16 personality bi-polar factors (16PF) which were then reduced to 14 factors for the measurement of High School

pupils' personalities and for the prediction of their academic achievement.

The review, on the operationalisation of the vocational interest variables, was also done with specific reference to the work of Strong (1943) and Kuder (1966). To operationalise the interest variables Strong used the criterion group of people who were successful in their occupations. On the other hand, Kuder's key for scoring was based on item analysis (see paragraph 3.2.3 and 3.3.4).

The review of the predictive validity of both personality and interest was done and the findings revealed that personality and interest are independent as predictors. The simple correlations of both personality and interest with academic achievement are low. When personality was added to cognitive variables in the prediction equation for the GPA, American studies showed significant increases in R^2. The South African studies did not show such large increases.

Concerning the VIQ no American Study was available for comparison with the South African studies. The available, very few South African studies, on the contribution of the VIQ variables to R^2 revealed very small increases which were not of practical value for educational purposes (see paragraph 3.2.4 and 3.3.5).

The findings reported in this chapter reveal that there is a need for further research on the predictive validity of affective variables, among Blacks especially. This is necessary since the findings compared on tabel 3.1 revealed a different pattern of personality predictor variables for Blacks which differs from that of the Whites in America and in South Africa. An example is the absence of HSPQ factor B among the predictors for Blacks in South Africa.

Comprehensive reviews on the contribution of the affective variables to R^2 reveal that the contribution of affective variables when added to cognitive variables is not higher than that contributed by cognitive variables alone (Bloom, 1976:193). When the cognitive variables were combined with the quality of instruction there was a significant increase in R^2 (Bloom, 1976:194). The additiveness of the quality of instruction in the prediction equation signifies the importance of the school variable in achievement prediction.

In the following chapter attention will be paid to the school variable as the predictor of academic achievement, as the review of personality by Lavin (1967:161) indicated that personality was a good predictor as some schools and not in others.

The possible reason advanced for that, is that variability in the predictive value of personality variables may partly be attributed to the different social contexts in which they are used (Lavin, 1967:111).

CHAPTER 4

THE SCHOOL AS A PREDICTOR OF ACADEMIC ACHIEVEMENT

4.1 INTRODUCTION

Academic achievement as a dependent variable is a function of pupil, teacher and school environmental characteristics. In the form of the equation this can be presented as follows:

$A = f\ (P + T + E)$ (for a related model see Parkerson et al., 1984:638)

where: A = academic achievement (dependent variable).

P = pupil characteristics, which include cognitive and non-cognitive variables, with the prominent ones being intelligence, aptitude, previous achievement, selfconcept, achievement motivation, socio-economic status, and sex.

T = teacher characteristics, like teacher efficacy and the capability of the principal to organise and manage the school.

E = environment for learning, which includes urban and rural environments, physical facilities like hostels, libraries, and laboratories.

In the previous chapter the relationship of pupil characteristics, like cognitive and affective variables, with academic achievement was reviewed.

The review, in chapter 2, of the relationship of cognitive variables, in particular, the aptitudes, with academic achievement indicated that only about 25% of variance in achievement is explained by the cognitive variables.

The additiveness of the affective variables in the prediction equation was reviewed in chapter 3. The review of the additiveness of the affective variables was found conflicting, thus leaving scope for further research.

Various studies reported in the foregoing chapters did not take into account the pedagogic situatedness of the pupil, thus ignoring the impact of the different school environments on learning. In this study achievement is regarded as a function of the pupil characteristics and the environment in which learning takes place. In this chapter attention will be paid to the influence of the school environment on academic achievement in an attempt to arrive at a tentative solution to the third main problem (see paragraph 1.3). To achieve this aim attention will be paid to the school physical characteristics (in paragraph 4.2) and to teacher characteristics (in paragraph 4.3) as achievement correlates. Paragraph 4.4 will be devoted to the relationship between school quality and academic achievement, paragraph 4.5 to the operationalisation of the school variables and paragraph 4.6 to the summary and the statement of the hypotheses.

4.2 RELATIONSHIP BETWEEN SCHOOL PHYSICAL CHARACTERISTICS AND ACADEMIC ACHIEVEMENT

4.2.1 Introduction

In the context of this study the school physical characteristics include the school situation (urban/rural), the school size, the class size, and the physical facilities. In the following paragraph attention will be paid to the influence of the school situation on academic achievement.

4.2.2 Relationship between school situation and academic achievement

4.2.2.1 Introduction

By school situation is meant, in this study, the rural or urban environment in which the school is situated. This distinction has been made in most research studies (to be cited below) on the influence of school situation on academic achievement.

There is a close relationship between school situation and school size as indicated in some studies cited in paragraph 4.2.3. The rural schools are generally smaller than urban schools in pupil enrolment (Engelbrecht, 1972:280). The problem to be solved in this paragraph is whether there is a difference between the achievement of pupils attending rural and urban schools when intelligence and socio-economic status are controlled. The answer to this problem is very important for this study because in KwaZulu there are schools which are in remote poor and traditional rural areas, and there are schools in densely populated metropolitan areas. The socio-economic status of the people in or around the densely populated metropolitan areas is in general higher than that of the rural areas.

The studies to be reported in this paragraph have been conducted to determine the influence of the school situation, thus implying the contribution of the socio-economic status in the explanation of variance between the achievement of rural and urban schools.

Attention in the following paragraph will be paid to the comparison of rural and urban schools in achievement.

4.2.2.2 Comparison of rural and urban schools in achievement

As early as 1946 Dent (1946:23) had found that pupils in urban schools perform better than pupils in rural schools. Dent attributed the higher mean scores of urban pupils in I.Q. to heredity. He attributed this superiority of urban pupils over the rural pupils in achievement to the migration of the intellectually gifted parents to the cities, leaving less intellectually gifted people behind (Dent, 1946:24). The same opinion is shared by Jensen with respect to the migration of people to the cities in other countries of the world (Silver, 1973:359, Blau, 1981:10). This opinion (not a fact) is not generally accepted (Lewontin, 1976:89) since it is highly possible that Dent (1946) did not control for intelligence and socio-economic status. Nevertheless, the differences between the achievement of pupils in different environments were also found to exist, by other researchers like Biesheuvel (1943:29).

In the studies conducted by Sher (1977:63-66) and by Randhawa and Fu (1973:300) no differences were found between the achievement of pupils in rural and urban schools when intelligence and socio-economic status were controlled. The results obtained by Sher (1977) and Randhawa and Fu (1973) indicate that the differences between rural and urban schools in achievement are caused by the differences in socio-economic status and the level of general intelligence of the pupils in these different areas.

In a careful study that was conducted in Sweden by Marklund (1969) the results he obtained made him come to a conclusion that, with small classes, student's intelligence, the curricula and time tables of schools and, to a certain extent the teacher factor being equal, rural schools provide as good an environment for the student's requirements of knowledge as urban schools (Marklund, 1969:311).

A South African study by Engelbrecht (1972:280) indicated that a higher percentage of successful than unsuccessful pupils is found in the schools which are in cities or urban areas.

4.2.2.3 Conclusion

As a result of limited research on the differences in the achievement of pupils in rural and urban schools no conclusion can be made in this regard, but the tendency is for urban schools to do better than rural schools (see also Venter, 1983:45). This points at a need for further research on the differences between rural and urban schools in achievement, especially in developing countries, and among Blacks in particular, as was indicated in paragraph 1.2. In the following paragraph attention will be paid to the influence of school size on academic achievement.

4.2.3 The influence of school size on academic achievement

4.2.3.1 Introduction

By school size is meant in this study the number of pupils who attend a particular school during a particular year. School size differs from country to country.

In South Africa as well as in England small schools have an enrolment of less than 600 pupils (PAS. dispensation, 1984, Halsall, 1973:119). In America, during the years 1971 to 1972 the school of average size had about 527 pupils according to Sher (1977:6). According to Conant (1967:8) moderately large schools in the United States of America had in 1965 pupil enrolment ranging between 750 to 1999. In this range, about 64% of the high schools had less than 750 pupils while about 6% had more than 2 000 pupils; and 30% of the schools fell within this range. In the Kleinert study (1965:3735), small schools had less than 600 pupils.

Because school size differs from country to country and because of a large number of studies conducted on this issue the summary will be better understandable if it is done for each country as follows: The American studies will be reviewed in paragraph

4.2.2.2. The British studies will be reviewed in paragraph 4.2.2.3 and the studies conducted in other countries including South Africa will be reviewed in paragraph 4.2.2.4. Similar grouping of studies was done by Venter (1983) in his study of literature in this respect.

The grouping of the studies in this manner will also make the comparison, of the studies conducted in different countries with different education systems and cultures, possible. The comparison of the findings within and among the countries will lead to a generalisable conclusion on the effect of school size on academic achievement.

4.2.3.2 Review of American studies on the influence of school size on academic achievement

Of the American studies that have been conducted on the influence of the school size on academic achievement, the studies by Kreitlow (1961), Greer and Harbeck (1962), Coleman et al., (1966 and 1979), Summers and Wolfe (1977), Sher (1977), will be reviewed this order.

Concerning the influence of school size on academic achievement, Kreitlow (1961) cites the studies conducted by Hieronymus and Feldt in this regard. In his sample, Hieronymus involved 1 005 schools with 71 000 pupils in the State of Iowa. The pupils were within their 6th and 8th year of schooling. The comparison of the achievement of pupils in small and big schools led Hieronymus to a conclusion that in small schools, where one teacher had to teach other classes the achievement was lower than in the large schools where one teacher had a class to himself (Kreitlow, 1961:385-386). Kreitlow also cites the study, (based on the same data that was used by Hieronymus), by Veldt who found that the children who had their primary education in the rural schools and attended small high schools with the enrolment which is less than 100 had a double

disadvantage in comparison with the pupils who had their primary education in big centres and their secondary education in big high schools.

From the review of the studies cited by Kreitlow it can be concluded that, in the state of Iowa, pupils in big schools did better than pupils in small schools. The studies cited above did not control for the influence of intelligence and the socio-economic status of the family, on academic achievement. These variables are well documented to have a significant relationship with achievement (see paragraph 2.2.2 with respect to intelligence; and Coleman, 1940:63, Coleman et al., 1966 and 1979:21, Blau, 1981:4, with respect to the socio-economic status).

Another study of the influence of school size on achievement was conducted by Greer and Harbeck (1962). Their study indicated that low intelligence pupils in big schools did not do better than low intelligence pupils in small schools; but as far as the high intelligence pupils are concerned, the pupils in big schools had more credits than those in small schools as calculated by the Carnegie - units. The schools with more credits had more than 500 pupils and schools with less credits had less than 200 pupils. This study controlled for the influence of intelligence but not for the influence of the socio-economic status. The results of the study, however, indicate that the tendency is for larger schools to perform better than smaller ones (Greer and Harbeck, 1962:122). A more comprehensive study on the influence of school size on achievement was conducted by Coleman et al., (1966) as part of the main survey on the Equality of Educational Opportunity. The study involved about 645 000 pupils in about 3 100 schools.

From the results of the study by Coleman et al. (1966:313-314) it was found that pupils in large schools performed better than pupils in small schools in academic achievement. This difference in achievement was attributed to the better

facilities like well equipped libraries and laboratories found in large schools, all of which were in large cities.

Another finding by Coleman et al. (1966:313-314), was that Negro children from low socio-economic groups were at a disadvantage in very big schools (see also Summers and Wolfe, 1977:650). The findings by Coleman et al. (1966), confirm the findings by Greer and Harbeck (1962) and were again confirmed by Smith (1974:225-229) after a re-analysis of Coleman et al., data.

Another study of the influence of school size on academic achievement was conducted by Summers and Wolfe (1977). This study was based on a sample of 103 elementary schools with 627 sixth grade pupils, and 553 eighth grade students in 42 junior and middle high schools, and 716 pupils in 5 senior high schools. The average size of the school in the sample was 912.90 between the years 1968 and 1971. The standard deviation(s) of 343.79 indicates that there were large schools with about 1 257 pupils and small schools with 569 pupils and the mean (912) represents 70% of the schools which were within this range (see Summers and Wolfe, 1977:650). The study controlled for the influence of intelligence, socio-economic, teacher and pupil characteristics, among others independent variables. Using multiple regression analysis Summers and Wolfe obtained the results which indicated that small schools were beneficial for all students, but were more beneficial for black pupils (Summers and Wolfe, 1977:645).

From the study conducted by Summers and Wolfe (1977) it appears that when the socio-economic status is controlled the differences between small and large schools disappear. Even Coleman et al., (1979) confirm this when they relate about the achievement of their pupils when the socio-economic background of the pupils is controlled (Coleman et al., 1979:21).

The re-assessment of the studies conducted on the influence of school size on academic was done by Sher (1977:64) who concluded that where intelligence and socio-economic status were controlled no difference was found between small and large schools.

The summary of the American studies indicates that the differences between small and big schools disappear when intelligence and the socio-economic status are controlled.

4.2.3.3 Review of British studies of the relationship between school size and academic achievement

England is a very small country compared to American to have a variety of small and large schools. Therefore small schools are usually grammar schools which admit selected pupils (Lynn, 1959:129).

Large schools are mainly comprehensive schools which cater for all pupils with different abilities for learning. In England the size of the school is influenced by its type - grammar or comprehensive.

The earliest studies on the influence of school size on academic achievement were conducted by Pedly (1956) and Oldfield (1958) as cited by Lynn (1959). The study by Pedley (1956) indicated that small schools were inefficient, and one of the reasons for inefficiency is that small schools could not offer a variety of optional subjects. Pedley compared the schools according to the number of awards for Oxford and Cambridge scholarship. According to the number of awards, large schools performed better than small schools (Lynn, 1959:129-135). (Compare with the American study by Greer and Harbeck, 1962:122 cited in paragraph 4.3.2.2.)

Lynn (1959:129) also cited a study by Oldfield (1958) which aimed at verifying Pedley's findings. The statistical findings

by Oldfield indicated that small schools did better than large schools, thus contradicting Pedley's findings.

Lynn (1959:130) had certain objections to the analysis that was made by Oldfield, such as the admission on age to the two types of schools, and the criterion of awards. A minimum of seven awards was considered as a criterion for comparing schools and this eliminated small schools. Lynn set out to solve this controversy between the findings by Pedley and Oldfield by conducting his own study.

In his own study which involved; open awards and school size; advanced level results and school size; and ordinary level results and school size, Lynn, (1959:135) came to the following conclusion: (1) Pedley was right in saying that small schools are not efficient; (1) large schools produce better achievement than small schools.

Lynn went further to provide possible explanations for the superiority of big schools to small schools and came to the following conclusion:

i the large schools attract better teachers;
ii the large schools attract more intelligent children;
iii in small schools teaching cannot be efficiently organised;
iv the large schools provide a more stimulating and competitive atmosphere (Lynn, 1959:134-135).

The first two variables i.e. teacher qualification and intelligence could have been controlled to make the conclusion to a certain extent acceptable, as was remarked above (see Habsall, 1973:118).

Another study of the influence of school size on academic achievement was conducted by Rutter et al. (1979). The study included 12 schools which were under the control of the Inner London Education Authority. The study controlled for the

influence of the socio-economic status and intelligence on achievement. Besides school attendance and conduct, academic achievement was the dependent variable. The results of the study did not indicate significant differences between the schools (large or small) Rutter et al.,(1979:100). The findings by Rutter et al. agree with the American findings by Sher (1977), Summers and Wolfe (1977) and Coleman et al. (1979), (reported above) that when intelligence and socio-economic status is controlled the differences in the achievement of small and big schools diminish.

Like the American studies the British studies do not lead to a generalisable conclusion that in large schools pupils perform better than in small schools when intelligence and socio-economic status are controlled. The evidence that larger schools perform better than small schools is conflicting. According to Marklund (1969) the contradictory results of the studies conducted in these countries are caused by the local control which could not bring about uniformity in all schools, whether small or large, rural or urban (Marklund, 1969:295).

Other reasons given by Marklund for the failure of the studies to give uniform findings are: different curricula and time tables for big and small schools; shorter courses and fewer subjects for small schools in comparison with large schools; and cheaper quality of text books for small schools. As a result of conflicting evidence Venter (1983:42) also did not come to the conclusion after reviewing the same literature. In the following paragraph attention will be paid to the studies conducted in other countries than America and England.

4.2.3.4 Review of Swedish and South African studies of the relationship between school size and academic achievement

Besides the studies conducted in America and England on the relationship between school size and achievement other related

studies were conducted in Sweden by Marklund (1969) and in South Africa by Venter (1983).

In Sweden, as Marklund (1969:306) states, there is uniformity in the schools with respect to physical facilities and staffing, whether the school is in rural or urban areas or whether it is small or large. Marklund sampled sixth graders from 158 classes with 2 608 pupils from 6 counties and controlled for the influence of intelligence and teacher qualifications. The results he obtained (Marklund, 1969:309-310) indicated that the students in large schools performed better than the students in small schools in subjects, like reading, writing, mathematics, history, geography and nature studies. The superior performance of the large schools was attributed to the number of pupils with higher intelligence as compared with pupils in small schools. When intelligence was controlled the differences increased with the increase in school size.

Although the study by Marklund concludes that there are no differences when intelligence is controlled, smaller schools have never appeared to perform better than large schools. The results are in favour of big schools (Marklund, 1969:312). Marklund (1969:311) does however add with a reference to other countries, that the smaller schools have a better potential for achievement provided their conditions for learning are improved.

In South Africa a study on the relationship between school size and academic achievement was conducted by Venter (1983). The sample consisted of all Afrikaans speaking students who wrote standard 10 examinations in 1980, in the province of the Orange Free State. The sample consisted of 1 200 pupils who had all independent variable data from a population of 3 237 standard 10 pupils. The average I.Q. of the pupils in the sample was about 100 (Venter, 1983:246). The results obtained by Venter indicated an inclination of students in larger schools to perform better than pupils in smaller schools (Venter, 1983:246). These

results agreed with some studies, conducted in America, England and Sweden. Venter (1983) attributed the difference to the limited choice of subjects and study directions offered in small schools.

4.2.3.5 Summary

The studies reported above were conducted in industrialised countries like America, England and Sweden. The study conducted in South Africa used white students only.

According to the review of literature the large schools tended to have pupils who perform better than those in small schools, but when intelligence and socio-economic status was controlled the differences disappeared. The disappearance of the differences in the performance of pupils in large and small schools when intelligence and the socio-economic status were controlled, indicated that these two variables account for a certain amount of variance between the schools.

The small schools are usually found in rural areas, but in some studies, particularly those conducted in England, small schools were also found in urban areas. It is therefore preferred in this study to classify the schools according to situation (urban and rural) in order to determine the differences between the performance of rural and urban schools, irrespective of size. Table 4.1 below, gives the summary of the research findings cited above.

TABLE 4.1

SUMMARY OF STUDIES OF THE RELATIONSHIP BETWEEN SCHOOL SIZE AND ACHIEVEMENT

Researcher Data and Page	Better performance in			
	Small schools	Large schools	No Difference	Country
Krietlow, 1961:386-386		X		
Greer et al., 1962:122		X		America
Coleman et al., 1966:313-314		X		
Summers et al., 1977:645			X	
Sher, 1977:64			X	
Coleman et al., 1979			X	
Pedley (in Lynn, 1959)		X		
Oldfield (in Lynn, 1959)	X			British
Lynn (1959:134-135		X		
Halsall, 1973:118-119)	X			
Rutter, 1979:100			X	
Marklund, 1969:309-310		X		Other countries
Venter, 1983:246		X		

In the above table (4.1) the research findings indicate that pupils in large schools tend to perform better than pupils in small schools.

In the following paragraph attention will be paid to the relationship between class size and academic achievement.

4.2.4 The relationship between class size and academic achievement

4.2.4.1 Introduction

According to Glass et al. (1979:42) class is defined as the number of pupils taught by a single teacher. Flemming (1959:37) defines class size as the number of pupils who regularly meet in

one instructional building usually under the direct guidance of a single teacher. According to these definitions there may be as many as 100 pupils or as little as 2 pupils per teacher. In the following paragraph literature is reviewed on the influence of class size on academic achievement.

4.2.4.2 The influence of class size on academic achievement

The studies that attempt to determine the influence of class size on achievement have to control for the influence of the method used, capabilities of teachers, abilities and background of pupils, and the subject matter taught; and then manipulate class size (see Glass et al., 1979:43). For instance, if a teacher is capable of applying a group method to teach a certain content a larger class is better (Hamachek, 1969:343). The research findings on the influence of class size is conflicting and this conflict is obvious from table 4.2.

In order to have a summary picture of the research findings on the influence of class size on academic achievement table 4.2 has been compiled to provide information on: class size, the researcher, the summary of the research results in favour of either large or small classes, and on some studies which did not find the differences between the achievement of small and large classes. The table also indicates the dependent variable that was used in some studies.

TABLE 4.2

SUMMARY OF STUDIES ON CLASS SIZE

Number in classes		Author and Date	Differences in favour of			Subjects
Small	Large		Small	Large	None	
		Rice 1902 in Flemming, 1959:39			X	
		Blake, 1954:44			X	
		Flemming, 1959:38			X	
		De Cecco, 1964:561			X	
		Coleman, 1966:312			X	
16-20	26-36	Marklund, 1967:309		X		Reading
31-34	34-40	Little, 1971:769		X		
		Eastcott, 1973:242		X		
		Averch, 1974:54		X		
		David, 1976 in Summers, 1977:647		X		
		Simons, 1980:90		X		
		Class et al., 1979:42	X			
		Cohen et al., 1979:492	X			
		Glass et al., 1978:44	X			
0-9	20-29	Engelbrecht, 1972:268	X			
-50	50+	Pedley, 1959		X		Mathematics
		Oldfield, 1958	X			
		Lynn, 1959:134		X		English/ French
		Venter, 1983:288		X		

From table 4.2 it appears that in older studies no significant relationship was found between class size and achievement. This conclusion was arrived at by Rice (1902), Blake (1934) and Flemming (1959), De Cecco (1964) and Coleman et al. (1966). Later studies, produced evidence that was somewhat in favour of larger classes like those conducted by Marklund (1969), Little et al. (1971), Eastcott (1973), Averch (1974), David (1976), Summers and Wolfe (1977), Simons (1980) and Venter (1983).

The third group of studies which reviewed all available studies on the relationship of class size and achievement found that pupils in smaller classes perform better than pupils in larger

classes. The important study to mention in this regard is that which was conducted by Cohen et al. (1979) in which a technique of meta-analysis, developed by Glass (1978), was used. Using this method of meta-analysis the percentile rank of the individual pupil in a class was seen to increase with the increase in class size (see Cohen et al., 1979:413). The review of previous studies with this method indicated that small classes are better than large classes in academic achievement.

The general picture of the findings as revealed on table 4.2 shows that no conclusion can be arrived at as to the effect of class size on achievement; but a number or recent studies indicate that small classes are essential in lower primary schools where remedial and individual attention is most needed, to give the child firm background knowledge. This was indicated by Cohen and Filby (1979:494); Glass et al., 1979:44; and David (1972:127). Other studies indicate that small classes are suitable for low achieving students and students from socially deprived environments (Summers and Wolfe, 1977:649; and Blake cited by Summers and Wolfe, 1977:645). Other studies indicate that in certain school subjects large classes are better places for learning. In this respect the studies by Littel et al. (1971) Lynn (1959) and Venter (1983) will be cited in this order.

In his investigation of the influence of class size on achievement in English language, French, and Mathematics, Lynn (1959) using a chi-squire statistical technique, found that boys in large classes tended to do better in French and Mathematics while girls did better in English and French, than pupils in small classes. The higher achievement of schools with large classes was attributed to the number of education streams offered in that class. The more streams offered the better the achievement (Lynn, 1959:133).

Concerning English reading, Little et al. (1971:769) cited the studies by Joyce Morris, Stephen Wiseman, the studies of the

National Child Development Survey., and the study by Marklund (1969) which reported better achievement in English reading in large classes than in small classes. In their own study Little et al. (1971:769) found an increase in reading attainment with the increase in class size.

In South Africa the study of the influence of class size on achievement, conducted by Venter (1983:288), indicated that in a few school subjects pupils in large classes performed better than pupils in small classes. For instance, Venter (1983:288) found that pupils in large classes do better in History (Higher Grade) than pupils in small classes. Pupils in small classes did better in Mathematics (Higher and Standard Grades). In the rest of the school subjects there were no differences reported by Venter (1983).

4.2.4.3 Conclusion

From the studies cited above no conclusion can be drawn as to what class size is related to academic achievement in general. What can be said, as indicated by a few studies, is that small classes on the one hand are effective in the teaching of school subjects like Mathematics and science. Even in the teaching of these school subjects the numbers should not be too small (i.e. less than 10) for group work. On the other hand larger classes are effective in the teaching of the school subjects like History (Higher Grade) and the languages. Too large classes are not easy to control and the quality of work is affected. It is mainly Venter (1983) who came to a similar conclusion.

Small classes have been reported to be essential for remedial teaching and in the teaching of slow learners. In such classes the teacher has to pay attention to individual pupils with learning problems.

In the following paragraph attention will be paid to the influence of school physical facilities on academic achievement.

4.2.5 Relationship between school physical facilities and academic achievement

4.2.5.1 Introduction

As was stated in paragraph 4.2.4.1, the provision of the physical facilities like libraries, laboratories, and hostel accommodation for students is aimed at improving the quality of teaching and learning. In this paragraph previous studies on the relationship of these facilities with academic achievement will be reviewed for the purpose of determining the magnitude of the relationship.

4.2.5.2 Influence of physical facilities on academic achievement

In an extensive investigation into the Equality of Educational Opportunity, Coleman et al. (1966:313) found that the effect of school size disappears when various facilities (like laboratories and libraries) and curricula differences are controlled. This indicates that the higher achievement of larger schools, reported above from some studies, is mainly accounted for by additional facilities they had, in comparison with small schools which lack these facilities (Coleman et al., 1966:313-314 and Coleman et al., 1979:313). The correlation coefficient indicating the correlation between physical facilities and achievement is usually not more than 5% (Bloom, 1976:111). While small schools suffer from the lack of physical facilities, very large and overcrowded schools do not have the physical facilities that are enough for all pupils, and in such schools the effect of physical facilities cannot be demonstrated (Lavin, 1967:133).

Bowles and Levin 1968 undertook an appraisal of the Coleman Report with respect to the effect physical facilities on achievement. These writers were critical of the analysis, used in the Coleman Report, that only the science laboratory and the library were considered in determining the effect of the entire physical facilities including the other instructional aids. Their criticism was based on the fact that the use of these facilities was not made explicit as the only determinants of the effect of physical facilities on academic achievement (Bowles and Levin, 1968:11).

Besides the laboratories and the libraries, the other facility that is provided to maximise teaching and learning is hostel accommodation. A study that was conducted in Sweden by Marklund (1969) was aimed at determining the effect of travelling long distances to and from school on achievement. In his review of previous studies he cited Gunnar Boalt (1942) who found that pupils travelling long distances, to and from school had lower marks than pupils travelling short distances. The findings by Boalt were confirmed by the findings of the study conducted by Tore Osterberg (1958). Osterberg found that the pupils who travelled to and from school obtained poor results as compared with the students who stayed in the hostels or very close to the school (Marklund, 1969:312).

The third study (cited by Marklund, 1969) conducted in Sweden on the effect of travelling long distances to and from school was conducted by Peterson (1960). His study controlled for the influence of intelligence, and the dependent variables were Swedish and Mathematics. Using the method of covariance analysis, Peterson found slight differences in 50 comparisons and only one difference in 50 comparisons was significant, thus indicating that travelling to and from school has some effect on achievement (Marklund, 1969:312-313).

In his own study, Marklund (1969) investigated the effect of distance from school on achievement. The independent variable

was the distance to school and the dependent variable was the combined score on reading, writing, mathematics, English, history, geography, and nature studies. With intelligence controlled, the results of the analysis indicated F- quotients which were not significant. This study concentrated on rural schools and the travelling distances to them. The results of the study, though not significant, indicated that long distances to school had a negative effect on the achievement of pupils. Marklund (1969:316) attributed this negative effect to fatigue that was caused by travelling long distances.

4.2.5.3 Summary

The few studies reported above on the effect of physical facilities like, laboratories, libraries and hostels on achievement indicate that these facilities explain about 5% of variance in achievement. This indicates that, as Bloom (1976:111) puts it, it is the teaching and not the physical facilities that are important for school learning. What Bloom says indicates that these facilities are important only as far as they can facilitate teaching and learning. The presence of these physical facilities means nothing if they are not used effectively by the teachers (see paragraph 5.5.2 for further comment on the physical facilities of the school). No conclusion can be drawn regarding the influence of travelling time to school, from the studies that have been cited. The effect that is reported by Marklund is indirect rather than direct. This summary points at the importance of teacher characteristics in achievement. The following paragraph will be devoted to the influence of teacher characteristics on academic achievement.

4.3 THE RELATIONSHIP BETWEEN TEACHER CHARACTERISTICS AND ACADEMIC ACHIEVEMENT

4.3.1 Introduction

As has been stated in paragraph 4.2.4.5 that the physical facilities alone explain about 5% of variation in academic achievement, the following variables will be reviewed in this paragraph for their relationship with academic achievement: teacher characteristics and academic achievement (paragraph 4.3.2); the relationship between school management, organisation and discipline and acedemic achievement (paratraph 4.3.3).

4.3.2 Teacher characteristics and academic achievement

4.3.2.1 Introduction

In his paragraph teacher characteristics refer to (i) teacher quality (which will be reviewed in paragraph 4.3.2.2); to (ii) the relationship between teacher's expectations and pupil achievement (to be reviewed in paragraph 4.3.2.3); and to (iii) the teacher-pupil relationship and its relationship with academic achievement, (to be reviewed in paragraph 4.3.2.3).

4.3.2.2 The relationship between teacher quality and academic achievement

Teacher quality can be defined in terms of traits such as verbal facility, educational level, and experience (Bowles and Levin 1968:10). In a survey that was conducted by Coleman et al. (1966), teacher quality was one of the variables that were studied for their relationship with academic achievement. The results of the Coleman study indicated that the teacher characteristics (quality) accounted for more variance in achievement than all other school characteristics excluding

pupil characteristics (Coleman et al., 1966:318, and Coleman et al., 1979:22). The appraisal done by Bowles and Levin (1968) of the Coleman Report on the same issue, using the same table of findings, also revealed that the teacher traits accounted for significant variation in achievement (Bowles and Levin, 1968:10). To illustrate the point further Bowles and Levin indicated that teacher characteristics account for about three quarters of the variance in teacher salaries, thus implying that higher expenditure on teacher salaries have influence on academic achievement. What this means is that teachers with higher qualifications get higher salaries (Bowles and Levin, 1968:10.)

The same conclusion was arrived at by Welch (1966) who found that superior quality teachers do apparently enhance the productivity of schools (Welch, 1966:391). Welch came to this conclusion after identifying the more important variables that contribute to the quality of schooling; these being (i) teacher quality as reflected in salaries and (ii) the size of the secondary school (Welch, 1966:380).

That the best qualified teachers have influence on student achievement supports the findings that large schools perform better than small schools in academic achievement. What happens is that highly qualified teachers are attracted to large schools (see paragraph 4.2.3.3) which are well equipped with most facilities for teaching and learning and such schools are usually attended by pupils from higher socio-economic status. It is well documented that pupils from the higher socio-economic status perform better than pupils from the lower socio-economic status (Coleman, 1940:63, Gouph, 1946:637; Abrahamsen, 1952:14; Brookover et al., 1977:235); Coster, 1959:62; Curry, 1962:49; Lavin, 1967:49; Coleman et al., 1979:324; Fortheringham and Creal, 1980:315; Marjoribanks, 1982:655; Niles, 1981:423; Heyneman, 1979:210; Swift, 1967:20) in various countries. This indicates that the combination of the high social status of the pupils with best qualified teachers in large schools which are

well equipped (physically) makes such schools ranked as high quality schools. The ranking of schools as high quality tallies with the high performance of pupils in them (see table 6.5).

The study of the effect of teachers on academic achievement conducted by Veldman and Brophy (1974) revealed that different teachers exert different influences on different pupils. For this reason Veldman and Brophy assert that the schools are not the appropriate units for analysis since the schools are affected by teachers of varying ability and merging data on all teachers masks rather than reveal the effects of the quality of schooling (Veldman and Brophy, 1974:313). The analysis of the ability of teachers can indicate that some teachers are better than others. The success of the teachers is also seen in their ability to create good relations with their students. In the following paragraph attention will be paid to teacher-pupil relationship and its relation with academic achievement.

4.3.2.3 Teacher-pupil relationship as an achievement correlate

The pedagogic situation is characterised by the relationship of inequality between the educator and the educand. The educator being more cognitively mature than the educand in terms of knowledge of the subject matter and experience in teaching it, and of his ability to instill in the educand a positive feeling towards the subject by his example of liking it.

Interest in teaching the subject indicates congruence between the personality (interest) of the teacher and the mastery of the subject content. Interest also elicits motivation in teaching the subject (Ames and Ames, 1984:553). The affect the teacher exhibits to his students, with respect to the subject of his interest, is transmitted to the students who receive the instruction. In this manner the subject-related affect is developed in pupils and is said to account for about 17% of variation in achievement (Bloom, 1979:85).

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One of the characteristics of the relationship between the teacher and the student is the comment (praise or criticism) the teacher makes on pupil performance.

A study conducted by Brophy and Good (1970) on the teacher's communication of differential expectations for children's classroom performance indicated that achievement levels of pupils in different classes were related to the teacher's demands and expectations (Brophy and Good, 1970:373). Another aspect noted by Brophy and Good (1970) in their study is that teachers favoured the pupils who raised up their hands (Brophy and Good, 1970:272). This indicated that the students initiated or elicited a positive affect in teachers by raising up their hands, but according to Rosenthal and Jacobson (1968:41) the teacher's expectations influenced pupil performance.

In another study which aimed at determining the causal relationship between teacher's expectation and achievement was conducted by Crano and Mellon (1978). Crano and Mellon (1978) found that teacher's expectations enhanced (caused) pupils performance to an extent appreciably exceeding that to which performance influenced teacher expectation (Crano and Mellon, 1978:41), thus supporting the results obtained by Rosenthal and Jacobson, cited above.

The studies by Rosenthal and Jacobson (1968), by Brophy and Good (1970), and by Crano and Mellon (1978), cited above, indicate that there is a relationship between teacher behaviour and pupil achievement. According to Lavin (1967:139) the relationship is

to indicate that teacher affect, is not related to student learning. Similar findings were obtained by James (1976:6156A).

Brophy (op cit) found however that the low SES students appeared to benefit from a positive affect of the teacher; but the high SES students benefitted from the teachers who demanded high levels of performance and who showed little tolerance for student failure (Brophy et al., op cit), Peng et al., 1978:79). According to Brophy (1979:738) high levels of performance are observed in classrooms where the students receive a large amount of instruction from a teacher and a great deal of interaction with the teacher. This school social climate was also found to explain more of variance in academic achievement than the SES by Bouchard et al. (1987:13).

4.3.2.4 Conclusion

The studies cited in this paragraph indicate that a positive teacher-pupil relationship influences achievement (Brophy and Good, 1974:42). In comparison with the SES the school inputs have been found to have more influence on academic achievement. In the following paragraph attention will be paid to organisational inputs.

4.3.3 Relationship between school management, organisation and discipline and academic achievement

4.3.3.1 Introduction

School depicts a pedagogic situation which is characterised by the educator and the educand engaged in an educative relationship (Killian and Viljoen, 1974:97). Both the educator and the educand are subject to the authority of the norms governing behaviour in the pedagogic situation (Van Vuuren et al., 1978:26). The educator being an adult exercises the authority

of the norms over the educand in a way that is condusive to the acceptance of authority. The acceptance of authority is possible if the relationship of trust, love, and understanding exists between the parties involved in the learning activity (Smit, 1979:64-77). Authority according to Smit (1979:79) creates a safe and a trusted space for learning.

The success of any school depends on the ability of the principal to exercise authority. The exercise of authority indicates the principal's ability to manage and organise the school, and this again indicates the principal's leadership quality. Discipline problems arise as a result of the conflict between the needs of the group or the individual with the authority (principal) (Curvin and Mendler, 1980:10). A school with conflicts between the teachers and the principal, between the staff and the students can find it very difficult to make progress in teaching and learning. The results of such a school are usually poor (see Gumede, 1986:5). Attention will now be paid to the effect of a well run school on achievement.

4.3.3.2 The effect of the principal on academic achievement

There are a few studies that have been conducted on the relationship of the principal's leadership role with student achievement. One such a study was conducted by Cuban (1984). Cuban cited undated studies which were conducted by Steven Bossert et al. and also by Hallinger on the management behaviour of principals. According to these studies there is a high correlation between the quality of the principal's leadership skills and student achievement (Cuban, 1984:144).

The quality of the principal's leadership is revealed in his ability to develop a school climate that supports academic achievement. Such a climate grips the teachers with the spirit of commitment to their educative task; it develops high achievement motivation in pupils; and it makes it possible for the

principal, himself, to supervise the work of the staff while at the same time it controls order in the school (Cuban, 1984:145). According to Cuban (1984:145) there is as yet no empirically derived principal behaviours that have been laid out as variables or traits that can be used to operationalise the principal's leadership qualities.

A number of studies on the **effectiveness of the school** have stressed the central role of the principal (Cuban, 1984:145). The importance of the principal's leadership role is easily assessed by the delinquency rate in the school.

It may also be stated that the delinquency rate can be caused by the social environment from which the school draws its pupils. In this regard Reynolds et al. (1976) conducted a study on the differences between the schools with respect to delinquency and its effect on achievement, in London, among the working class community. They concentrated on the group of a secondary modern schools which take at grade II, the bottom two thirds in the ability range. Their findings indicated that the 9 schools were consistent in their relative performance over the years. The schools with high delinquency rate had low academic achievement and also low attendance as compared with schools with low delinquency rates. Besides the differences in the behaviour of pupils in schools, variation in administrative methods of the principals either prevented delinquency in some schools or provided a suitable environment for the development of delinquency in other schools (Power, 1967 as cited by Reynolds et al., 1976:223).

Previous studies on the **effectiveness of schools** consistently indicated that schools contribute very little in achievement variation that is independent of the socio-economic status of the family and the social context from which the student comes (Coleman et al., 1966:325).

The study conducted by the International Association for the evaluation of Education Research (IEA) on the relative effects of home background and schooling on achievement test scores brought to light some other issues. In agreement with other studies, the IEA found that home background was more important than schooling in accounting for variation in pupil achievement. In addition to this, the results of the IEA survey also indicated that schooling seems more important than social class and home background in the achievement of pupils in school subjects like science, literature and second language teaching. This indicates that school subjects learned by pupils bring about differences in their achievement over and above the social and home background (Featherston, 1974:448).

Concerning the differential effectiveness of schools, there seems to be some variation in achievement between schools as reported in paragraph 1.1 and also by Reynolds et al. (1976:223) and Brunstein et al. (1977:67). The study by IEA reported above indicates that there is also variation in achievement within schools in the sense that the school has effect in the learning of some subjects and not others. This within school variation in achievement also depends on other variables like sex and home background of pupils, and organisation.

A study of the amount of variation between and within schools was conducted by Kellaghan et al. (1979) in Ireland using a number of high schools.

Using standardized measures and the results of public examinations in school subjects, Kellaghan et al. (1979) were able to calculate the between and the within school variance by means of the analysis of variance method for an unbalanced test design. The results of the study indicated that of the 18 schools the within school variance, with one exception, was always more than 50% of total variance, and a sizeable amount of this variance was found between classes. The between school variance was found to be in excess of 40%. The results also

indicated that the within school variance was lower than the between class variance in standardized measures, but in curriculum sensitive public examinations the between school variance is higher than the between class variance (Kellaghan et al., 1979:100).

In the Coleman et al. study cited by Kellaghan et al. it was found that the within school variance was greater than between school variance, with the between school variance being in the region of 8.69% for verbal achievement scores (Kellaghan et al., 1979:101). In the Kellaghan et al. study there was not much differences in the variance between schools and within classes (Kellaghan et al., 1979:104).

4.3.3.3 Summary and conclusion

The review of the studies by Cuban (1984) on the leadership of principals indicates that differences in the quality of principals brings about differences between the schools.

The study by Reynolds et al. (1976) indicated that discipline is one of the contributory variables that account for variance between the schools and this reflects on the managerial and the organisational skill of the principal. To investigate whether the social and the home background had more influence than school on achievement, as asserted by the Coleman Report, Featherstone (1974) found that schools are more effective in achievement in certain school subjects than the environmental factors. This effect of environment has a bearing on the causes of variance between the schools and their relative effectiveness. The relative effectiveness of the school again reflects on the capability of the principal. The study by Kellaghan pursued the point further to investigate the within and the between school variance, and the findings indicated that even within the schools there was variation between the classes. The within school variance explains the composition of the students

according to their abilities. According to Silver (1973:356) the family background of pupils were accountable for the larger variance within schools than between schools.

The studies reviewed in this paragraph indicate two variables that are important in the operationalisation of school social variables in addition to staff morale, indicated in paragraph 4.3.2.5. These variables are **discipline** and **school management**. In the following paragraph school quality will be discussed as a summarising variable.

4.4 RELATIONSHIP BETWEEN SCHOOL QUALITY AND ACADEMIC ACHIEVEMENT

4.4.1 Introduction

In the above paragraphs attention was paid to the relationship of the various aspects of the school with academic achievement. In the review of school situation as an achievement correlate, previous studies dichotomised school situation into urban and rural. Literature was inclined to indicate urban environment as a contributory factor in having urban schools perform slightly better than rural schools. Further review indicated that larger schools are in urban areas and literature tended to indicate large schools as better performers than small schools (see paragraph 4.2.3.3). Further review again associated large classes with urban environment and small classes with rural environment. The review of class size as an achievement correlate revealed conflicting evidence, but it could be concluded that small classes have influence on the performance of pupils in certain school subjects while large classes enhanced performance in other school subjects.

The review of literature on the effect of physical facilities on academic achievement indicated a positive relationship (see paragraph 4.2.5.2).

The reviews cited above were aimed at identifying the school variables that have significant contribution to academic achievement, individually or in combination.

In this paragraph attention will be paid to those studies that researched the effect of the total school environment on academic achievement. In the following paragraph the school environment will be conceptualised as school quality in order to review the between school and the within school variance with respect to the combined effect of the variables identified by different researchers in their multivariate approaches to the effect of school quality on academic achievement.

4.4.2 Effect of school quality on academic achievement

4.4.2.1 Some criteria for determining school quality

Various criteria have been used in various studies to classify the schools according to quality. Therefore, quality does not mean exactly the same thing in different studies. According to Jencks and Brown (1975:281) school quality is any set of school characteristics that affects the average student's rate of growth between the 9th and the 12th grade. According to these authors school quality is the function of the resources like adequate salaries of teachers, small classes, experienced teachers, well equipped science laboratories, and the like.

In a study of the Ten Good Schools in England, by the members of Her Majesty's Inspectorate (1977:6), attention was paid to the following seven criteria in the selection of these ten schools.

1. fundamental objectives, and their realisation in relationships, discipline, curricular policies and the personal and social development of the pupils;

2. pastoral care and oversight of academic progress, including administration, organisation, communications and the definition of roles and responsibility for staff and pupils;

3. curriculum design and organisation (especially appropriateness to the developing needs and capabilities of the pupils), content, choice and balance, and planning and co-ordination and critical interest in new ideas on the part of the staff;

4. staffing and quality of work, including clarity of intention and presentation, levels of expectation and standards of response;

5. use of premises and resources, particularly the degree to which the quality of life of the school and the distinctive characteristics of its work are reflected in the environment it creates;

6. links with the local community, including contacts with parents, interaction with the community outside school, and co-operation with local services; and

7. leadership and climate. In this regard it is the effective leadership of the principal and the climate he creates that is conductive to growth (HMI, 1977:7).

According to Niven (1987:5) good schools seem to (i) have pupils of homogeneous ability, (ii) have staff that is competent, involved, and dedicated in their professional and academic tasks (iii) and have concern for the pastoral care of its pupils.

4.4.2.2 The relationship between school quality and academic achievement

A number of studies have been conducted with the purpose of determining the influence of school quality on academic achievement. One of the studies on the effects of high schools on their students was conducted by Jencks and Brown (1975). The study was, firstly, aimed at determining the amount of variance in individual outcomes that could be explained by disparities in high school quality; secondly, at investigating the extent to which certain aspects of the high schools influence certain areas of learning and not others; and thirdly, at determining the overall effect of the high schools. In the classification of schools as 'best' 'average' and 'worst' the following six traits were used: ninth-grade Grades, ninth-grade Curriculum, ninth-grade Plans, SES, and sex. The results of the study indicated that if pupils on the 50th percentile on Arithmetic Reasoning attend the 18 worst schools, they can gain less points than they would if they attended the 18 best schools (Jencks, and Brown, 1975:292).

The findings by Jencks and Brown (1975:292) were confirmed by the British study of the TEN GOOD schools reported above, that they achieved the results which were well above the average, in general (HMI, 1977:30).

The studies on the relationship of the school and teacher variables with students achievement have been criticised in that the findings were based on the data collected at one point in time; instead of the analysis of longitudinal data (Leucke and McGinn, 1975:326). In response to such criticism Leucke and McGinn (1975) conducted a study on the relationship of school and teacher variables with student achievement in three types of schools classified according to quality. The variables that entered in the regression equation were family background, school quality, teacher quality, and student achievement level (Leucke and McGinn, 1975:352). In the Coleman Report (1966) the

findings reported indicated that the schools contribute little to the achievement of pupils, and when family background was controlled the influence of the school disappeared (Leucke and McGinn, 1975:326). The findings of the study by Leucke and McGinn also indicated that family background had a more consistent relationship with achievement than the school hence it entered the equation first and the school or teacher variables entered next. The study also indicated that the teacher had as much as twice contribution as school to achievement variation (Leucke and McGinn, 1975:345).

The findings that the family background is the best predictor of achievement as reported above implies that the school has little or no effect on achievement especially in young children, but it does have an effect on the attainment of older children (Featherstone, 1974:450).

The public judges the quality of the school on the basis of pass rates as shown on annexure A. A good school generally confirms to the seven criteria given in paragraph 4.4.2.1. The success of pupils in these schools is not always attributed to the fact that their intake consisted of academically gifted children (Reynolds et al., 1976:225). Success is attributable to the impact of the school itself on student learning - in terms of combined school and teacher effects within the individual school (Centra and Potter, 1980:278).

One variable that has been indicated to be generally held responsible for the effectiveness of the school is the principal (Cuban, 1984:148; Niven, 1987:3). There are however exceptions to the rule where a school (staff in particular) can maintain high standards of achievement without a highly capable principal (Cuban, 1984:146).

The South African study of the influence of the school environment was conducted by Venter (1983) and the results of appear on table 4.3. The study did not classify the schools

according to quality but according to macro - environment (outside of classroom), micro - environment (inside classroom), and according to total environment (macro and micro). The main finding of the study by Venter (1983), which is relevant for this study, is that the total school environment (macro and micro-environments) have more influence on academic achievement than intelligence (Venter, 1983:286-289). Table 4.3 provides the summary of the study by Venter.

TABLE 4.3

THE SCHOOL SUBJECTS THAT CORRELATED WITH CERTAIN SCHOOL VARIABLES SIGNIFICANTLY - SUMMARY FROM THE STUDY BY VENTER (1983:286-289)

INDEPENDENT VARIABLES FOUND TO BE SIGNIFICANT PREDICTORS		SCHOOL SUBJECTS THAT CORRELATED SIGNIFICANTLY WITH THE PREDICTORS
INFLUENCE OF MACRO SCHOOL ENVIRONMENT ON ACHIEVEMENT		
MANIPULATED	CONTROLLED	Mathematics H.G. and S.G.
School size	intelligence	Physical Science H.G.
School affect	intelligence	Accountancy H.G.
Trust in academic aspiration	intelligence	Physical Science H.G.
Combined micro-school environment	intelligence	Accountancy H.G. History
INFLUENCE OF MICRO SCHOOL ENVIRONMENT ON ACHIEVEMENT		
Class size	intelligence	Mathematics H.G. and S.G.
Self-concept	intelligence	Mathematics H.G. Accountancy H.G.
Combined micro-school environment	intelligence	Mathematics H.G. Physical science H.G.
COMBINED MACRO AND MICRO SCHOOL ENVIRONMENT INFLUENCE		
Total school environment	intelligence	Total school environment has more influence on achievement than intelligence

4.4.3 Summary and conclusion

From the above discussion of the school quality it can be deduced that what accounts for high quality, average quality and

low quality school (using Leucke and McGinn, 1975:332 labels) is a multiple of physical, organisational, and process variables as summarised in paragraph 4.4.2. The school situation may seem on the surface not a contributory variable towards making a school high, average and low quality; but school situation becomes a prominent variable on closer investigation as to where most of these high quality and low quality schools are situated. In KwaZulu for instance the rural communities build their own schools on R for Rand basis of subsidy. The poor rural communities are not able to put up quality structures (see Departmental circular number 3 of 1986). The structures referred to are classrooms, libraries and laboratories.

In this paragraph (4.4) literature was reviewed on the criteria for classifying schools as good, average, and weak; or high, average, and, low quality, and the review has confirmed such a distinction using a multiple of variables; high achievement of pupils being one of them. Good schools are characterised by high achievement and poor schools by low achievement, the same applies to average schools (see also table 5.3). In the following paragraph attention will be paid to the operationalisation of the school variables.

4.5 OPERATIONALISATION OF SCHOOL VARIABLES

4.5.1 Introduction

The variables operationalised for the purpose of this study are hostel accommodation, the school library, the laboratory, the school management by the principal, discipline, and the dedication of the teaching staff. The significance of these variables in academic achievement has been discussed in the above paragraphs. These variables have been selected because they relate closer to the quality of instruction than other variables like school size, class size or school situation. These five variables are the main ones that contribute towards

school quality. In order to be able to operationalise these variables it is necessary to devote a paragraph, on each, that will serve as background for the compilation of the questionnaire.

4.5.2 Hostel accommodation

A school with hostels provides the pupils with periods for organised study. As a result, pupils get enough time to do homework and further reading. In the course of learning the students can develop good study habits. Pupils staying in hostels do not travel long distances to and from school daily and this has been found to have some negative fatiguing effect on pupils (see paragraph 4.6.2). Meals at boarding schools are regular and the attention span of pupils in boarding schools is not reduced by hunger as the case is with some of the day scholars. Schools with hostels have stable staff. Pupils attending boarding schools enjoy these facilities while students attending day schools do not have most of these facilities. The performance of pupils in boarding and day schools is expected to vary, and it is for these reasons that this variable is included as one of the school variables that influence achievement (see table 5.3, and Cohen and Manion, 1981:394).

4.5.3 The school library

The school library is a collection of materials listed and classified according to a general standard (Carrol, 1981:226). This definition does not however include science apparatus but only the reading material. It can also be added that the school library stocks the reading material that is relevant to the needs of the pupils (Dyer et al., 1970:56).

For the academically talented student the school library is the most important single factor in his education (Carrol,

1981:128). Carrol generalized from the Foley Report (1978) that the objectives of the school library are:

* to support, complement and extend the schools education programme;

* to ensure that appropriate resources are available to all staff and students;

* to provide opportunities for the guidance of staff and students in the use of resources, ensuring not only that they are able to locate information, but also that they are able to use it with understanding;

* to provide a place where students are welcome, where they are assisted by skilled staff to explore the world of imagination and information, and where they can develop the desire and the skills to learn independently; and

* to cater for students' recreational, cultural and social needs beyond the school's instructional programme (Carrol, 1981:187).

A well equipped school library can have these objectives actualised. The actualisation of these objectives can obviously have influence on the achievement of pupils. To have these objectives actualised the school must have a full-time librarian, without which the library is of very little value to students (Coleman et al., 1979:72).

In KwaZulu there are schools with libraries and others without. Such schools have been included in the sample. For instance all rural day schools do not have libraries while all boarding schools have libraries. Schools without libraries are disadvantaged since they cannot have the objectives cited from the Foley Report realised.

The above objectives (Carrol, 1981:187) served as guidelines for assigning a score for the effectiveness of the library in a school where it exists.

4.5.4 The laboratory

The presence of a well equipped science laboratory facilitates the teaching of science subjects, since the teacher can demonstrate, and the pupils can experiment with the apparatus. Where there are no laboratories, or where there are, but not sufficiently equipped with essential apparatus, science teaching and learning cannot be very effective. Since not all pupils in a school have an aptitude for science, a school with a science option provides pupils with a choice between science and the general subjects. Pupils with such an option are expected to perform better than those without because they learn what they have aptitude for and what they are interested in (see paragraph 4.2.3.4).

Previous studies on the influence of physical facilities on achievement indicated that such facilities play a very small role in achievement (see paragraph 4.3.2). It is the total learning environment that accounts for greater variation in achievement between the schools than the physical facilities (Bloom, 1976:111). The learning environment includes the teachers (social aspect) and the physical facilities as described above. The principal and his staff form a very important part of the learning environment. The influence of the principal and the staff on achievement will be discussed below.

4.5.5 School management by the principal

School management refers to the control of the school by the principal. To manage the school properly, the principal should

have the following characteristics: integrity, reliability, firmness of purpose, idealism, enthusiasm, dedication, perseverance, tolerance, loyalty, administrative expertise, the ability to motivate and to be inspiring and be inspired, punctual, tactful, and have sustained diligence (Kritzinger, 1978:1). The principal with these characteristics can create an atmosphere that is condusive to hard work on the part of both pupils and staff. An effective principal is capable of maintaining good relations with the parents, school committees, and the officials of the Department of Education (Averch et al., 1974:109).

The principal, in his professional capacity is expected to (a) interpret and implement departmental policies, and (b) to carry out curriculum programs (Ngcobo, 1985:3). The principal who does not have the attributes given above cannot perform these duties efficiently and his school will be characterised by a low tone, conflict among staff, discipline problems, and even riots. Such a conflict situation hampers effective teaching and learning in the school (Ngcobo, 1985:4). The end result in a school with conflicts is poor achievement of the pupils at the end of the year in that particular school.

The school management variable is based on these assumptions, and this background was used in ranking the schools as far as this variables is concerned.

4.5.6 Discipline

Discipline according to Raffini (1980:23) is a process of maintaining order by helping students to discover the value, the utility and the necessity of controlling their behaviour. This humanistic definition of discipline lays more emphasis on self-discipline than on external discipline, as may be exercised by the principal. Actually the principal with the qualities stated in paragraph 4.5.5 will always aim at developing self-discipline in pupils.

When a discipline problem arises in a school it is often caused by a conflict between the needs of the individual(s) and the needs of a group of students and/or authority. Such needs are detailed by Curwin and Mendler (1980:15-19). The definition of discipline emphasises the good relationship between the teachers and students, and the students among themselves as was discussed in paragraph 4.3.2.3. It is an onerous task of the principal to bring about this harmony in his school. The differences in the capabilities of the principals to maintain good discipline accounts for the differences in the discipline of the schools and these differences account for differences in achievement to a larger or lesser extent. Where there is poor discipline, teaching cannot be effective and the results are prone to be poor (Gumede, 1986:5). For these reasons this variable is very important to include among the subvariables of the school.

4.5.7 Dedication of the staff

In a school with good discipline the exercise of authority is possible.

The possibility of exercising authority by the staff depends on the ability of the principal to manage the school. The principal can manage the school very well if he has the characteristics of a good principal, as indicated in paragraph 4.5.5. The staff under a good principal can feel inspired to work hard, and the pupils too can be motivated ot work hard for the good name of the school (Averch et al., 1974:108). If the school has all or some of the learning and teaching facilities discussed in paragraphs 4.5.2 - 4.5.6 the teacher can teach very effectively. At the schools where the above attributes are not present teaching cannot be effective and the teachers are found not dedicated to their task of educating the children (Mattock, 1982:25).

On the basis of the above discussion, of the importance of physical and social variables in pupil achievement, the schools can be ranked.

4.5.8 Assigning of ranks to schools

As was stated in paragraph 1.3 the aim was to find means of arriving at a school variable score that could be used in the prediction equation. Six school variables have been selected and discussed above in paragraphs 4.5.1 to 4.5.7. The measurement of these variables by structured techniques is not within the scope of this study. The above discussion provided a frame of reference for the subjective assigning of ranks to schools. In addition to the above, the inspection reports of the schools were studied thoroughly for the same purpose. The pass percentages of the schools influenced the giving of ranks (see annexure A).

Departmental circular number 3 of 1986 was consulted on the quality of the classrooms, libraries, and laboratories. The writer visited the sampled schools four times at regular intervals to observe whether there were any changes in school discipline, in the teacher-pupil relations, and in staff changes in 1983, which could influence academic achievement. For instance two schools were affected by riots in the same year.

It is worth remarking that this method of ranking the schools using the six variables is exploratory. No previous study has been found to have used this procedure. The method employed by Coleman et al. (1979) in collecting data on school variables, as appearing on their tables 2.21.1 to 2.23.1 is more elaborate than this, and beyond the scope of this study in detail.

Table 5.14 indicates the results of ranking the schools by the Circuit Inspectors together with the School Psychologists. Seven Circuit Inspectors and eight School Psychologists were involved.

The ordinal scale was used in the assigning of ranks to schools. This scale was used because the inspectors were to give their own impressions about the schools, based on their observation of the schools during the year. To indicate their observations the inspectors were to assign numbers, referred to as ranks (Edwards, 1975:13).

While the interval and the ratio scales tell us **how much**, the ordinal scale gives us the information of greater than or smaller than (Edwards, 1965:13). A three-point-scale was used for the sake of simplicity in assigning ranks. The numbers indicating the ranks are:

1 = absence or very weak

5 = average effectiveness in the use of the variable or just average

9 = very good, highly effective (see tabel 5.14).

These ranks were used by the inspectors in indicating their observations, of the schools sampled, with respect to these six variables.

The Circuit Inspector of the school was approached for the purpose of ranking the schools according to his observation. Other Inspectors and School Psychologists took part in the assigning of ranks. Before the ranks could be assigned the above background with respect to hostels, library, laboratory, discipline, staff dedication, and school management was given to the Inspectors. Examples of schools which are very good, medium and weak were given to the circuit inspectors to guide their judgement. For instance a good school must have a good hostel, a well stocked library with a full-time librarian; a well equipped laboratory with a well qualified teacher for science; good discipline with a highly motivated staff under the guidance

of a good principal. Such a school is assigned a rank of 9 for each of the six variables to reach a total of 54.

4.6 SUMMARY AND IMPLICATIONS FOR THIS STUDY

4.6.1 Introduction

After a review literature on the relationship of cognitive, affective and school variables with academic achievement, it is necessary to indicate the areas in knowledge where more information is needed or where further research is needed in order to confirm or reject the findings of the previous researchers. This paragraph is therefore devoted to the summary and the formulation of the problems for which the tentative solutions will be stated, thereafter.

4.6.2 Aptitude as predictor of academic achievement

In chapter 2 literature was reviewed on the relationship between the cognitive variables and academic achievement. The review also went further to find out the extent to which the cognitive variables correlated with academic achievement in terms of correlation coefficients. The review revealed R of about 0,5.

Besides the review of literature on the predictive validity of intelligence and previous achievement, the review indicated that multiple correlations of aptitude variables with academic achievement are between 0,62 and 0,72 (see table 2.2). Even higher multiple correlations were reported by Von Mollendorf (1978) to be between 0,406 and 0,974 with individual school subjects (see table 2.6). The problem with the correlation between aptitudes and achievement is that (i) the variance explained is not the maximum, but only about 25% (see paragraph 2.5), (ii) there are different subsets of cognitive predictors of achievement in different subjects (see table 2.7) and (iii) that

only one study has investigated the relationship between the AAT and the standard 10 aggregate pass percentage (APP) among Blacks in South Africa.

The problem still remains unsolved with respect to the 'best' subset of predictor variables for the APP from the AAT, and whether the findings reported are true for KwaZulu standard 10 population. Of the studies reviewed none determined the 'best' subset of cognitive (aptitude) variables objectively using the computer programmes such as the BMDP9R for multiple regression or BMDP2R for stepwise regression. These objective procedures for selecting the 'best' subset of predictors make the replication of the findings possible. For this purpose the objective selection of the 'best' predictors from the AAT is the task of this study (see paragraph 5.9.2.4).

The studies reported on the predictive validity of the aptitude variables, calculated separate statistics for the different sexes. In this study a thorough review of the sex differences in achievement in intelligence, verbal, number, and spatial ability tests was done (see paragraph 2.4.5). The review did not justify a separate study of the sexes since no differences were reported between the sexes in intelligence and in spatial perception. While boys were reported to do better than girls in mathematics, girls did better than boys in languages. This review indicates that boys outperform girls in certain school subjects and not in others. The same applies to girls. (See for example tables 2.5, 2.6 and 2.7). Sex, therefore, deferentially influences achievement in certain school subjects and the subproblem to be solves in this study is whether sex does have influence on achievement prediction (R^2).

4.6.3 Affective variables as predictors of academic achievement

Concerning the additiveness of the affective variables in the prediction equation no conclusion was arrived at as a result of

conflicting evidence from literature. Failure to conclude is not contrary to common knowledge. It is common knowledge that the total person is involved in learning. The cognitive variables are the determinants of the capacity for learning and also the determinants of the learning rate; while the affective variables are there to sustain the learning rate or the performance level. The affective variables being the basis of the motive behind the learning activity cannot be expected to explain the variance that is more than that which is explained by the cognitive variables alone. In statistical terms, the affective variables co-vary largely with cognitive variables, with the result that the affective variables bring about little or no increase in R^2 when added to the cognitive variables in academic prediction (Bloom, 1976:193, Cohen and Manion, 1981:69).

High or low scores in aptitude measures also indicate the influence of personality factors and the direction in the development of aptitude as governed by interests. The lack of conclusive evidence from literature review on the additiveness of the affective variables leaves an open question to be answered in this study in support or rejection of the above argument that has been in support of this lack of conclusive evidence.

4.6.4 School variables as predictors of academic achievement

Brown (1976:235) cites Hernstein (1971) who stated that when individual variations in aptitudes are not very wide, the differences in the performance of pupils are determined by the environmental characteristics. Table 5.3 clearly confirms this. The school provides an opportunity for learning - hence achievement can be regarded as the product of pupil characteristics and opportunity for learning (Brown, 1976:236). To determine the influence of the school on learning, literature was reviewed in chapter 4 under physical and social variables.

Besides the additiveness of the school variables previous studies reviewed also left the following question unanswered, with particular reference to the school: whether the quality of the school has influence on achievement prediction (R^2). No study that was reviewed reported the influence of quality of the school on R^2 (see paragraph 4.4.2).

From the review of previous studies it does not appear in any, where the different education streams were investigated for their influence on academic achievement (R^2). As reported in chapter 2, Von Mollendorf (1978:78-79) calculated the varimax rotated factor matrix for science - and non-science groups of boys and girls separately (Von Mollendorf, 1978:237), without reference to general, science, and commercial streams. The study by Venter (1983) indicates the relationship of certain school subjects with certain school variables, (and the summary of the results appear to table 4.3) without reference to streams.

In this study cross validation will also be done with the three groups: general, science and commercial in order to determine the influence of **education stream** on R^2. This information does not exist especially with reference to KwaZulu standard 10 pupils.

Also related to the school is the influence of **school situation** (urban and rural) (see paragraph 4.2.2) and **school type** (day or boarding) (see paragraph 4.2.5) on R^2, that needs further investigation as a result of the lack of conclusive evidence from the review of literature (see paragraph 4.4.3).

The review indicated that the school variables do not explain more than 5% of variation in achievement (see paragraph 4.2.5.3). Of the studies reviewed none attempted to quantify the school variables with the purpose of determining the additiveness of the school variable in the prediction equation as an independent variable. It is the problem of this study to

determine the additiveness of the school variables in the prediction of academic achievement.

4.6.5 Sex as a modifier variable

Previous studies on the predictability of achievement of boys and girls produce conflicting results. All American studies indicate that the academic achievement of girls is more predictable than that of boys (see paragraph 2 or Lavin, 1967:130, Jensen, 1980:484). Some American findings even indicate that (White) girls are more intelligent than boys: but no differences were found between Black boys and girls (Blau, 1981:71) in academic achievement (in America).

A detailed analysis of the achievement of boys and girls in different aptitude tests revealed that girls achieve better than boys in languages, while boys outperform girls in Mathematics and spatial perception. There were no differences reported in intelligence (see paragraph 2.4.5.2).

As far as Africans are concerned it is the other way round. Boys have been found to outperform girls. Von Mollendorf (1978) for example found that boys are more predictable than girls (see table 2.7) thus agreeing with the studies conducted in other African countries. A further study is therefore necessary to determine whether the sex differences influence R^2 when the dependent variable is the APP.

4.6.6 Statement of the problems

4.6.6.1 The main problems

First main problem

Are the cognitive variables better predictors of academic achievement than affective and school variables?

Second main problem
To what extent are the affective variables additive to the cognitive variables in the prediction of academic achievement?

Third main problem
To what extent are the school variables additive to the cognitive variables in the prediction of academic achievement?

4.6.6.2 Subproblems relating to school and sex

First subproblem
To what extent does the quality of the school influence the prediction of academic achievement (APP).

Second subproblem
To what extent does the education stream influence the prediction of the academic achievement (APP).

Third subproblem
To what extent does the school situation influence the prediction of academic achievement (APP).

Fourth subproblem
To what extent does the school type influence the prediction of academic achievement (APP).

Fifth subproblem
To what extent does sex differences influence the prediction of academic achievement (APP).

Sixth subproblem
When aptitude is controlled, is there a difference in the academic achievement of pupils attending urban and rural schools?

Seventh subproblem

When aptitude is controlled, is there a difference in the academic achievement of pupils attending boarding and day schools?

The above paragraphs contain the summary of relevant literature that was reviewed with respect to the problem stated in paragraph 1.3. As a result of the review of relevant literature the predictor and the modifier variables were identified, and the problems were restated for investigation in this study. The empirical investigation that follows aims at solving the problems that were stated in paragraph 1.3 with specific reference to the prediction of academic achievement of standard 10 pupils in KwaZulu schools.

CHAPTER 5

METHOD OF RESEARCH

5.1 INTRODUCTION

In the preceding chapters literature was reviewed with the purpose of finding out:

(i) What knowledge is available on the predictive validity of the variables that were studied in this investigation;

(ii) How these variables were operationalised; and

(iii) What remains to be investigated in this study.

For this purpose the relationship between the cognitive variables and academic achievement was reviewed in chapter 2. The relationship between the affective variables and academic achievement was reviewed in chapter 3, and the relationship between the school variables and academic achievement was reviewed in chapter 4. The summary of literature study was made at the end of chapter 4, and the problems were restated in paragraph 4.6.6.

This chapter is devoted to the method that wil be followed in researching for the solution to the problems stated in paragraph 4.6.6. On the basis of literature review the method of research to be followed in this study will be described in this chapter. The aim of the empirical research and the statement of the hypothesis will be described in paragraph 5.2; the research procedure will be outlined in paragraph 5.3; the target population and the sample will be described in paragraph 5.4; the description of the measuring instruments is given in paragraph 5.5. The details of the criterion are in paragraph 5.6 and the school variables operationalised for this study are described in

paragraph 5.7, and the summary of the variables is given in paragraph 5.8.

Paragraph 5.9 will be devoted to the experimental design and the statistical techniques used in this study. The summary of this chapter will be made in paragraph 5.10. In outline the steps given above appear on figure 5.2.

These steps are necessary to follow since the correlation between the dependent and the independent variables is according to Minimum (1970:163) influenced, among other things, by;

* the kind of subjects used for investigation,

* the specific measures that were taken for each of the variables, and

* by the particular circumstances under which the variables were operative.

According to Horst (1947:101) the accuracy of prediction is affected by sampling errors, changes in the individuals, measurement errors, omission of significant variables, remoteness of prediction, the effect of coaching, and the kind of quantification. Lavin (1967:34) sees the problems of prediction in three areas: (i) in the independence of measuring instruments, (ii) in the interpretation of the relationship between the predictors and the criterion, (iii) and in the general characteristics of the study design. Attention will be paid to the control of these extraneous variables in the relevant sections of this chapter.

In the following paragraph attention will be paid to the aim of the study and the statement of the hypotheses.

5.2 THE AIM AND THE STATEMENT OF THE HYPOTHESIS

5.2.1 The aim of the empirical investigation

The aim of this investigation is to solve the problems which were stated in paragraph 1.3. These problems relate (i) to the finding out of the best academic achievement predictors among the cognitive, effective and school variables; (ii) to the separate additiveness of affective and school variables to cognitive variables in the prediction equation; and (iii) to the influence of the modifier variables like school quality, education stream, school situation, school type, and sex differences on R^2.

To guide research with respect to sample size, sampling method, variable control, research design and statistical techniques to be used, it is necessary to, first, state the hypotheses which will also serve as tentative solutions to the problems stated in paragraph 4.6.6.

5.2.2 Statement of the hypotheses

The hypotheses are in two groups; The main and the subhypotheses.

5.2.2.1 The main hypotheses

The main hypotheses relate to the selection the set of the best predictors from cognitive, effective, and school variables.

Main Hypothesis 1

The aptitude variables are the best predictors of standard 10 academic achievement in comparison with the affective and the school variables.

Main Hypothesis 2
The affective variables are additive to aptitude variables in the prediction of standard 10 academic achievement.

Main Hypothesis 3
The school variable total is additive to aptitude variables in the prediction of standard 10 academic achievement.

5.2.2.2 The Subhypotheses

The subhypotheses relate to the influence of the modifier variables in the prediction of standard 10 academic achievement.

Subhypothesis 1
The quality of the school has significant influence on the prediction of standard 10 academic achievement.

Subhypothesis 2
The education stream has significant influence on the prediction of standard 10 academic achievement.

Subhypothesis 3
The school situation has significant influence on the prediction of standard 10 academic achievement.

Subhypothesis 4
The school type has significant influence on the prediction of standard 10 academic achievement.

Subhypothesis 5
Sex has significant influence on the prediction of standard 10 academic achievement.

Subhypothesis 6
When aptitude is controlled there is still a difference between boarding and day schools in academic achievement.

Subhypothesis 7

When aptitude is controlled there is still a difference between urban and rural schools in academic achievement.

5.3 OUTLINE OF DATA COLLECTION AND PROCESSING

For the purpose of this present study, use was made of the standard 10 Guidance Test Programme data of the KwaZulu Psychological and Guidance Services, that was collected in 1983. The data consisted of the cognitive variables, measured by the Academic Aptitude Test Battery (AAT); of the affective variables, measured by the High School Personality Questionnaire (HSPQ); and of the interest variables, measured by the Vocational Interest Questionnaire (VIQ).

At the sampled schools, the writer was responsible for the application of these measures to assure uniformity in the testing procedure and the testing conditions. The tests were applied in April and May 1983. The answer sheets were scored by the optic reader and processed by the computer of the Human Science Research Council (HSRC), Pretoria.

At the and of 1985 the computer printouts which contained, in addition, data on the Survey of Study Habits and Attitudes and on the Self-direction Search were available. This necessitated the extraction of the required data only. A special form was then designed to collect data from the examination results of KwaZulu standard 10 pupils, included in the sample, together with the data on the Academic Aptitude tests, High School Personality Questionnaire, and the Vocational Interest Questionnaire. The collected data were entered into the computer and the necessary tables were produced.

5.4 THE TARGET POPULATION AND THE SAMPLE

5.4.1 The target population

The target population for this study consisted of 170 KwaZulu Senior Secondary and High schools in which the standard 10 pupils underwent the Guidance Testing Programme during the first semester of 1983. At the same schools the standard 10 pupils wrote the Senior Certificate examination at the end of 1983. Both the Guidance Testing Programme and the National Senior Certificate examinations are the same for all Black standard 10 pupils in South Africa.

5.4.2 The sample and the sampling procedure

In this study the schools rather than the pupils were sampled. This was done in order to provide enough data for testing the hypotheses that relate to the influence of the school on the prediction of academic achievement (see paragraph 5.2.2). From a population of 170 Senior Secondary and High Schools, ten percent (10%) of the schools was selected at random, in the following manner. All the schools had a computer code, starting from 401 through 570. These codes were used during testing and during the processing of the answer sheets by the computer.

Sampling was done as follows: In a box, 170 cards bearing the school codes were put and mixed. The clerk, with his eyes closed, was requested to pick one card and put it back into the box after the code had been written down. The cards were again mixed to ensure random positions in the box. The process was repeated 17 times to have 10% of all the 170 schools. The results of this simple random sampling appear on tabel 5.1.

TABLE 5.1

THE SCHOOLS INVOLVED IN THE TESTING PROGRAMME IN 1983, THE SCHOOLS SAMPLED, AND THE NUMBER OF PUPILS INVOLVED IN THE INVESTIGATION

Circuit	Number of schools	Schools forming 10% sample	Number of pupils tested	Number of pupils examined	Final number in the sample
Bergville	12				
Edendale	10				
Enseleni	4	Khombindlela	282	287	282
Hlabisa	3				
Inkanyezi	6	Thukela	108	77	77
KwaMashu	6				
Madadeni	13	Siyamkela	192	188	188
Mahlabathini	9	Impumelelo	19	18	18
		Masibumbane	62	75	62
Maphumulo	5	Montebello	25	25	25
		Vukile	86	81	81
Mehlwesizwe	7	Dlangezwa	241	223	223
Mnambithi	6	Endakane	135	139	135
Mpumalanga	11				
Msinga	12				
Ndwedwe	7	Ohlange	151	157	151
Nkandla	4				
Nongoma	4	Dwaleni	79	82	79
Nquthu	6	Ekucabangeni	68	50	50
Pholela	5	Mpophomeni	147	102	102
Port Shepstone	6	Mbusi	118	117	117
Ubombo	4	Star of the sea	30	30	30
Umbumbulu	8	Amanzimtoti	42	43	42
Umlazi North	5				
Umlazi South	6	Igagasi	258	250	250
Umzinto	4				
Umzumbe	7				
Total	170	17	2 043	1 944	1 912

Table 5.1 indicates 170 Senior Secondary and High Schools (Zimu, 1983:38) and the 17 schools which were selected at random. the table also indicated 19 632 pupils who had standard 10 results at the end of 1983 (Zimu, 1983:24). The details of the sample also show the discrepancy between the number of the pupils tested during the first semester of 1983 and the number of pupils who wrote the standard 10 examinations at the end of

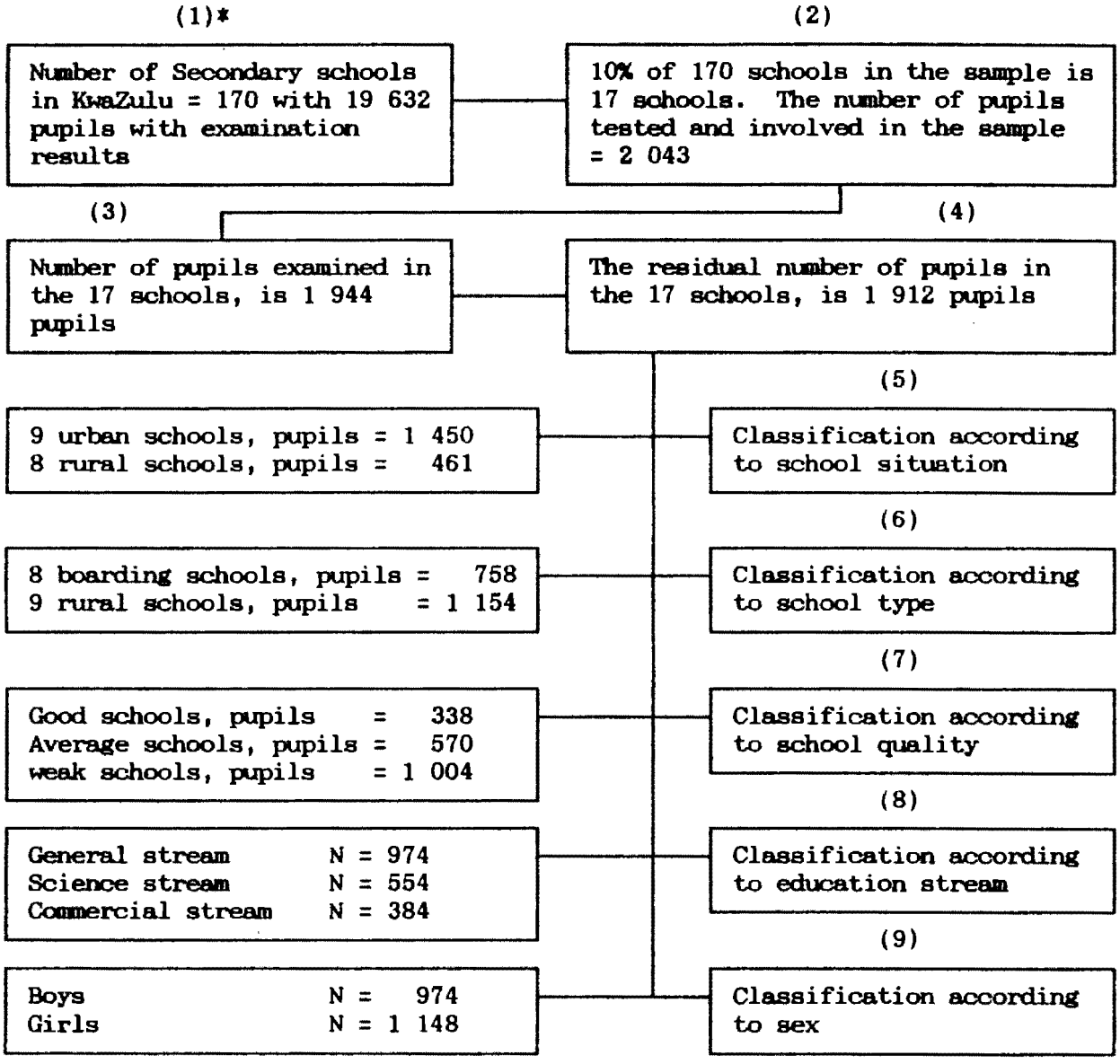
1983. This discrepancy resulted in the reduction in the number of pupils in the final sample, from 2 043 to 1 9433, and ultimately to 1 912. The reduction in the number of pupils was because, some pupils who were tested during the first semester did not write the final examinations; while some who wrote the final examinations at the end of the second semester were not present during the Guidance Testing conducted during the first semester. The final sample of 17 Senior Secondary (SS) and High School (HS) consisting of 1 912 pupils was not drastically reduced by the absentees, as it is still about 10% (9.68%) of the total number (19 632) of all the pupils with standard 10 examination results. This number excludes the number of pupils whose examination results were cancelled (Zimu, 1983:24). The 17 schools with 1 912 pupils represent 170 schools with 19 632 pupils.

5.4.3 Post hoc sampling

To conduct a modifier variable study, it was necessary to divide the sample in such a way that sufficiently large subsamples could be obtained for testing the related hypotheses (hypotheses 4 to 10; see paragraph 5.2.2). The sample was therefore divided according to school quality (see table 5.2), education stream (table 5.3), school situation and school type (table 5.4), and according to sex (table 5.5). It was necessary to divide the sample according to sex in order to have data for testing the hypothesis that relates to sex influence on academic achievement prediction (see table 5.5).

FIGURE 5.1

DIAGRAMMATIC REPRESENTATION OF THE STEPS FOLLOWED IN SAMPLING AND IN THE FORMATION OF SUBSAMPLES



* Numbers in brackets indicate steps in sampling (1-4) and post hoc subsampling (5-9).

Figure 5.1 shows the steps that were followed in the selection of 10% of the schools to form a sample with 1 912 pupils which is also 10% of the pupils who had examination results. Below

are further details of the sample and the subsamples. It is worth noting that the total number of pupils in the subsamples is reduced as a result of missing data during statistical analysis.

TABLE 5.2
GROUPING OF SCHOOLS ACCORDING TO SCHOOL QUALITY: WEAK: SVTOT = 18-26, MEDIUM: SVTOT = 27-53, VERY GOOD: SVTOT = 54

Code	Group	School Code	Rank	N	Number of pupils per group
1	Weak	539	18	81	
		427	26	117	
		452	22	282	
		526	18	77	
		461	26	62	
		472	26	135	
		437	26	250	1 004
2	Medium	499	42	151	
		516	42	188	
		478	34	102	
		417	30	79	
		419	30	50	570
3	Very Good	404	54	42	
		414	54	223	
		440	54	18	
		479	54	25	
		521	54	30	338
Total	3			1 912	1 912

Table 5.2 indicates the grouping of schools according to school variable total. In order to provide all available information on each school including school performance in subsequent years table 5.3 has been compiled.

TABLE 5.3

GROUPING OF SCHOOLS INTO GOOD, AVERAGE, AND WEAK USING STANDARD 10 EXAMINATION RESULTS FOR 1983, AND ADDITIONAL INFORMATION ON EACH SCHOOL

School Code	School roll	School		No of std 10 pupils	AAT mean scores	SV Total	1983 % passes	Teacher quality as in 1983					1983-1986 verage % passes (4 years)	Grading
		Situation	Type					Unqualified	Qualified					
								Std 10/BA	Std 10	BA/B Sc	BA(hon)	MA		
GOOD SCHOOLS														
404	576	Urban	Boarding	43	4,5	54	95,55	-	19	8	4	5	97,6 (1:16)*	HS
414	755*	Urban	Boarding	225	3,1	54	74,44	2	12	13	2		80,6 (1:26)	HS
479	279	Rural	Boarding	25	3,9	54	100,00	3	6	-	1		99,4 (1:28)	HS
440	182	Rural	Boarding	25	4,1	54	94,44	3	4	2	-		86,5 (1:20)	HS
521	395	Rural	Boarding	29	3,0	54	93,33	2	5	3	1	1	91,3 (1:33)	HS
AVERAGE SCHOOLS														
499	421	Urban	Boarding	157	3,4	42	27,35	1	15	6	4	2	41,9 (1:18)	HS
516	978*	Urban	Boarding	142	3,7	42	43,62	1	16	7	2	-	59,8 (1:46)	HS
478	787*	Rural	Day	93	2,1	34	73,53	-	28	-	1	-	30,2 (1:28)	HS
417	539	Rural	Day	79	2,8	30	64,63	1	11	3	-	-	58,2 (1:36)	HS
419	684*	Rural	Day	50	2,5	30	58,00	5	11	4	1	-	51,7 (1:34)	HS
WEAK SCHOOLS														
526	542	Urban	Day	107	2,5	18	32,45	5	14	2	2	1	48,9 (1:25)	HS
452	1045*	Urban	Day	227	2,3	22	30,31	-	18	6	6	2	36,7 (1:40)	HS
539	200	Rural	Boarding	72	2,7	18	19,75	2	5	1	1	2	39,2 (1:20)	HS
427	737*	Urban	Day	139	2,9	26	43,63	1	19	3	3	1	44,8 (1:29)	HS
472	455	Rural	Boarding	117	2,3	26	33,82	1	12	4	4	-	66,9 (1:27)	HS
461	433	Urban	Day	59	2,2	26	46,00	1	9	3	3	-	55,4 (1:19)	HS
437	831*	Urban	Day	258	2,4	26	22,00	-	18	5	5	1	57,8 (1:35)	HS

The three groups of schools differ with respect to the characteristics that are briefly described below.

*** Characteristics of good schools**

The five good schools included in the sample (see tabel 5.3) have the following characteristics:

(i) All are boarding schools situated either in rural or urban areas, with the maximum school variable total (54) indicating maximum effect of school variables on academic achievement.

(ii) The percentage passes in 1983 ranged from 74,44% to 100% while the average percentage passes over a period of 4 years (1983-1986) ranged between 80% and 99,4%.

(iii) The teacher-pupil ratio ranges from 1:16 to 1:33.

(iv) Class size is generally small, about 25 pupils on the average.

(v) There are unqualified as well as qualified teachers.

(vi) The academic aptitude levels of the students in these five schools as measured by the AAT = 3,72, and it is slightly higher than that of medium and weak schools.

(viii) These schools are generally small with one exception (school 414), and most of these schools admit students to standard 6 only.

* **Characteristics of average schools**

The next category of schools is that of schools of medium quality (school variable total = 27 - 53).

(i) In comparison with the good schools these schools are either day or boarding school, with the majority of them being day schools.

(ii) The majority of these schools do not have the physical facilities, found in good schools, like laboratories, libraries, and hostels.

(iii) The average percentage passes in the average schools range from 27,35% to 73,53% and these percentages have improved during the subsequent 4 years to range from 41,9% to 59,8%, thus indicating that they are on the average in performance.

(iv) The teacher-pupil ratio in medium schools is slightly higher than that of good schools, with the lowest being 1:18 and the highest, 1:46.

(v) Both school and class size is larger in average schools than in good schools.

(vi) Teacher quality as defined in terms of academic qualifications does not differ in the various schools included in the sample.

(vii) The aptitude levels of pupils in average schools are slightly lower than those of pupils in good schools - hence an average stamine of 2.7. This indicates that the medium group is 1 stanine below the good group. This difference is not statistically significant. To be significant the difference should be 1,97 (=2) (see paragraph 5.3.2.7). This, however, indicates that the tendency is for the average schools to have pupils with lower aptitudes than pupils in good schools. The contributory factor is that the day rural schools do not select students, and they also admit students to any class, even repeaters from other schools, while this is not the case with most boarding schools.

(viii) The ranks of the medium schools range from 26 to 42. This range is medium.

* **Characteristics of weak schools**

From the data on table 5.3 it seems that the weak schools are in urban and rural areas and some are either boarding or day schools. There is no school in this group that has an average stanine that is equal to or above 3, as the case is with medium and good schools. These schools have the school variable totals that range from 18 to 26. The low school variable total indicates that these schools rank low in the variables measured. The implication is that the conditions for learning in these schools are far from ideal, as compared with good schools. From this data it can also be expected that the predictability of academic achievement in good and weak schools will differ significantly.

Besides dividing the schools according to quality, the sample was also divided according to stream, type, situation, and sex (see tables 5.4 to 5.6 below).

TABLE 5.4
DISTRIBUTION OF PUPILS ACCORDING TO EDUCATION STREAM

Stream	Code	N
General	100	974
Science	020	552
Commercial	300	284
Total		1 810

TABLE 5.5

CLASSIFICATION OF SCHOOLS ACCORDING TO TYPE AND SITUATION

Urban/Boarding (1)	N	Rural/Boarding (3)	N	
Amanzimtoti (404)*	42	Impumelelo (440)	18	
Ohlange (499)	151	Montebello (479)	25	
Siyamkela (516)	188	Vukile (539)	81	
Dlangezwa (414)	223	Star of the sea (521)	30	
Total boarding schools	604		154	758
Urban/Day (2)	N	Rural/Day (4)	N	
Endakane (427)	135	Dwaleni (417)	79	
Khombindlela (452)	282	Ekucabangeni (419)	50	
Mpophomeni (478)	102	Masibumbane (461)	62	
Thukela (526)	77	Mbusi (472)	117	
Igagasi (437)	250			
Total for day schools	846		308	1 154
Urban total	1 450	Rural total	462	1 912

* School code.

TABLE 5.6

DISTRIBUTION OF PUPILS ACCORDING TO SEX IN URBAN DAY AND BOARDING AND IN RURAL DAY AND BOARDING SCHOOLS

Urban/Boarding (1)	Boys	Girls	Rural/Boarding (3)	Boys	Girls
Amanzimtoti	28	14	Impumelelo	9	9
Ohlange	66	85	Montebello	-	25
Siyamkela	86	102	Vukile	31	50
Dlangezwa	101	122	Star of the sea	14	16
Total	281	323	Total	54	100
Urban Day (2)	Boys	Girls	Rural Day (4)	Boys	Girls
Endakane	54	81	Dwaleni	47	32
Khombindlela	136	146	Ekucabangeni	25	25
Mpophomeni	36	66	Masibumbane	23	39
Thukela	40	37	Mbusi	47	70
Igagasi	90	160			
Total	356	490	Total	142	166
Grand total =	637	813		196	266

Total for boys = 833 Total for girls - 1 079.

Table 5.3 indicates the number of pupils who take each of the education streams. The computer was programmed to select the pupils who followed these streams using the code indicated on the table. Code 100, indicates those students who took the languages and any other subject except physical science and the commercial subjects. Code 020, indicates those students who took Physical Science, Mathematics, and Biology in addition to the languages. Code 300 indicates the commercial stream.

Table 5.4 indicates the classification of schools according to type (boarding or day) and according to situation (urban and rural). The table also indicates the number of pupils in each subsample. For the purpose of selecting these schools from the computer data, the school code was provided (see table 5.4).

Table 5.6 indicates the grouping of pupils according to sex, per school.

5.5 THE MEASURING INSTRUMENTS

5.5.1 Introduction

The measuring instruments used in this study are: the Academic Aptitude Test battery (AAT), the High School Personality Questionnaire (HSPQ), and the Vocational Interest Questionnaire (VIQ). All these measuring instruments were standardized by the Human Sciences Research Council (HSRC) for use in Black schools.

In the description of these instruments particular attention will be paid to the independence of the measuring instruments by attending to (i) the composition, (ii) to the standardisation, (iii) to the reliability, and (iv) the validity of each measuring instruments. Attention will also be paid to (v) the standard scores used with these measuring instruments. All these details are important to discuss since the accuracy of prediction is influenced by the specific measures that were taken for each variable and by the extent to which the measuring instruments are independent of each other, in addition to reliability and validity of the measuring instruments, as was indicated in paragraph 5.1.

5.5.2 Academic aptitude test battery (AAT)

5.5.2.1 Introduction

The aim of the Academic Aptitude Test Battery (AAT) is to serve as an objective, reliable, and valid aid in guiding the standard 10 pupils with regard to their choice of subjects for further study and occupation (Minnie, 1974:1). Further, this battery provides information on the general intellectual ability, the verbal ability, the number ability, and on the spatial ability (Minnie, 1974:2).

5.5.2.2 Composition of the Academic Aptitude Test Battery (AAT)

TABLE 5.7
TESTS COMPOSING THE AAT BATTERY

Aptitude	Test	Items
General intellectual ability	1. Non-verbal reasoning 2. Verbal reasoning	32 30
Language aptitude	3. English Vocabulary 4. English Reading Comprehension 6. Afrikaanse Woordeskat 7. Afrikaanse Leesbegrip	30 30 30 30
Number ability	5. Number comprehension 10. Mathematics proficiency	30 30
Spatial perception	8. Squares 9. Spatial perception	30 30

(a) General intellectual ability (intelligence).

This battery does not measure general intelligence directly. The general intellectual ability is a common factor which is the intersection of the two factors of the AAT (Verbal and non-verbal) and is, therefore, hypothetical (see Jensen, 1980:198). Von Mollendorf (1978:95) found this third factor to consist of:

AAT 1 - Non-verbal reasoning (NVR)
AAT 2 - Verbal reasoning (VR)
AAT 5 - Number comprehension (NC)

These variables are included in factors I and II but are prominent in factor III, which Von Mollendorf names the general reasoning ability factor (see Von Mollendorf, 1978:95). According to Minnie (1974:2) the scores on verbal reasoning (VR) and non-verbal reasoning (NVR) tests should give a good indication of the individual's general intellectual ability.

The importance of the general ability in achievement prediction was indicated in paragraph 2.4.1.

(b) **Verbal ability.**

The tests which measure this ability are the following:

AAT 2 - Verbal reasoning (VR)
AAT 3 - English vocabulary (EV)
AAT 4 - English reading comprehension (ERC)
AAT 6 - Afrikaanse woordeskat (AW)
AAT 7 - Afrikaanse leesbegrip (ALB)

These tests are grouped under one factor, verbal factor (see Von Mollendorf, 1978:98; and Van der Westhuizen, 1987:226). The verbal reasoning test assesses the pupil's grasp of the verbal concepts and the relationship among them through the use of inductive and deductive reasoning. The four language tests consist of vocabulary and reading comprehension items. The scores on these tests give an indication of the pupil's language ability that is required for further studies (Minnie, 1974:3).

The importance of this ability for achievement prediction was indicated in paragraph 2.4.2.

(c) **Number ability**

This ability is assessed by number comprehension (AAT 5) and mathematics proficiency (AAT 10) tests. The number comprehension test assesses the pupil's ability to manipulate and apply the fundamental mathematical principles and operations. The test on number comprehension and the test on mathematics predicts the success of the students in mathematics at the university (Minnie, 1974:3). The mathematics test is not applied to standard 10 pupils before they complete the mathematics syllabus. The importance of this ability in achievement prediction was stated in paragraph 2.4.3.

(d) **Spatial perception**

This ability is assessed by means of a two-dimensional (2-D) and a three-dimensional (3-D) spatial perception tests - tests 8 and 9. These tests assess the pupil's ability to represent figures in his imagination and to find the relationship by perceiving the similarities between two objects in space (2-D) and by the rotation of a 3-dimensional object (Minnie, 1974:3). The importance of this ability in achievement prediction is indicated in paragraph 2.4.4.

5.5.2.3 Standardisation of the Academic Aptitude Test Battery (AAT)

The AAT was standardised in 1974 for application to standard 10 pupils in Black schools in South Africa by the Human Sciences Research Council (HSRC).

The items in the battery are of a multiple choice type. The instructions for test administration, scoring, and for the interpretation of scores are contained in the test manual (Minnie, 1974:22).

5.5.2.4 Reliability (r_{tt}) of the Academic Aptitude Test Battery (AAT)

The Kuder-Richardson formula 20 was used in calculating the reliability of the AAT tests (Minnie, 1974:24). The formula is:

$$r_{tt} = \frac{n}{n-1}\left[\frac{6^2 - pq}{6^2}\right]$$ (Roscoe, 1975:135)

where, n = the number of items in a test.

6^2 = the variance of the test scores.

p = the proportion of the subjects answering a given question right.

q = 1 - p

This formula (KR-20) yields coefficients of internal consistency (Downie, and Heath, 1970:20). Using this formula (KR-20) the following reliability coefficients were obtained by Minnie (1974) and by Von Mollendorf (1978).

TABLE 5.8
RELIABILITY OF THE ACADEMIC APTITUDE TEST BATTERY (AAT)

Test	r_{tt} Minnie, 1974:34	r_{tt} Von Mollendorf, 1978:84-93	
		Boys	Girls
Non-verbal reasoning (NVR)	0,88	0,85	0,83
Verbal reasoning (VR)	0,79	0,71	0,68
English vocabulary (EV)	0,80	0,74	0,71
English Reading comprehension (ERC)	0,69	0,61	0,75
Number comprehension (NC)	0,90	0,87	0,82
Afrikaanse woordeskat (AW)	0,86	0,79	0,73
Afrikaanse leesbegrip (ALB)	0,82	0,76	0,68
Squares (2-D) (SQ)	0,80	0,78	0,73
Spatial perception (3-D) (SP)	0,89	0,89	0,83
Mathematics proficiency (M)	0,75	0,79	0,68

The reliability of the AAT, calculated by Minnie (1974) and by Von Mollendorf (1978) indicates the lowest coefficient of 0,61 and the highest coefficient of 0,90. These high reliability coefficients are an indication of how well the Academic Aptitude Test Battery measures academic aptitude.

5.5.2.5 Validity of the Academic Aptitude Test Battery (AAT)

Validity refers to the extent to which the test measures what it is supposed to measure (Minnie, 1974:24). The criterion validity of the AAT test scores was established by correlating them with the examination marks in 1973. The results indicated that all the test scores, except the scores on two spatial perception tests, correlate significantly with the marks in school subjects (Minnie, 1974:24).

5.5.2.6 Intercorrelations of the AAT tests

Although there are reasonable correlations between the non-verbal and the verbal reasoning tests, between the language tests, and between the number comprehension and the Mathematical proficiency tests, the inter-correlations are low enough to justify the inclusion of all the tests in the battery (Minnie, 1974:29).

5.5.2.7 Standard scores of the AAT

The AAT raw scores are converted to standard scores using the nine-point scale. The manual provides the conversion table used for converting the raw scores to stanines. The scores on the stanine scale range from 1 to 9 with a mean of 5 and a standard deviation of 1.96 or approximately 2 (Minium, 1970:125, Minnie, 1974:19, Anastasi, 1968:56). For a difference, between the scores (stanines), to be statistically significant the difference should be 1,96 or approximately 2.

5.5.3 High school personality questionnaire (HSPQ)

5.5.3.1 Introduction

The HSPQ is based on Cattell's personality theory that was discussed in paragraph 3.2.3. This questionnaire was aimed to be a reliable and a valid instrument for assessing the personality traits of high school pupils and was adapted for the Black students in standard 10. It was standardised during the first term of 1976. The HSPQ was constructed to meet the following requirements:

(a) All the main dimensions of personality which may be indicated by means of factor analysis should be covered.

(b) It should be easy to apply either to the individual or to the group, in the clinic or classroom, respectively.

(c) It must measure psychologically significant traits which can be used in achievement prediction. The traits measured should be capable of being indicated as functional units (Minnaar, 1981:5).

5.5.3.2 Composition of the HSPQ

The HSPQ measures fourteen primary bipolar factors. These primary factors are factorially and relatively independent personality dimensions.

Each primary factor is presented on a bipolar continuum with the lower scores on the left hand pole, ranging from 1, 2, and 3; and with the higher scores on the right hand pole, ranging from 7, 8, and 9. These factors are indicated by an alphabetic letter (as shown on table 5.9) as suggested by Madge (1972:70-71). The middle scores 4, 5, and 6 are not shown on the HSPQ profile since these scores indicate that the individual

is average as far as the trait is concerned. In this study a stanine of 5 has been used to indicate that the individual is average on the trait rather than using zero or a blank.

TABLE 5.9
THE PRIMARY FACTORS OF THE HIGH SCHOOL PERSONALITY QUESTIONNAIRE

Low score (Stanine 1,2,3)	Factor	High Score (Staninte 7,8,9)
1 Reserved	A	Warmhearted
2 Less intelligent	B	More intelligent
3 Affected by feelings	C	Emotionally stable
4 Phlegmatic	D	Excitable
5 Submissive	E	Dominant
6 Sober	F	Enthusiastic
7 Expedient	G	Conscientious
8 Shy	H	Adventurous
9 Though-minded	I	Tender-minded
10 Zestful	J	Circumspectly individualistic
11 Self-assured	O	Apprehensive
12 Socially-group dependent	Q_2	Self-sufficient
13 Uncontrolled	Q_3	Controlled
14 Relaxed	Q_4	Tense

The high scores on the right hand pole do not indicate an advantage or a low score on the left hand pole a disadvantage. It is the score on the individual factor that is more important than the pole.

5.5.3.3 Standardization of the HSPQ

Form A and form B of the HSPQ was applied to a sample of 2 237 form V pupils with the purpose of item analysis and the establishment of the norms during September 1974. It was standardised finally in 1976, in two forms for use in Black schools.

The instructions for the application, the scoring and the interpretation of the scores are contained in the manual (Minnaar, 1981:9-77).

5.5.3.4 Reliability of the HSPQ

The test-retest reliability was determined in 1976 by applying the HSPQ on two occasions with an interval of 10 days. This application refers only to Form A that is currently used. A sample of 233 urban pupils was used in establishing test-retest reliability. The results appear in Minnaar (1981:59) and have been reproduced on table 5.8 below. The reliability coefficients range from 0,23 to 0,64. These **coefficients of stability** are reasonably high to indicate that the HSPQ can produce consistent scores.

TABLE 5.10
TEST RE-TEST RELIABILITY OF THE HSPQ

HSPQ PERSONALITY FACTORS														
N	A	B	C	D	E	F	G	H	I	J	O	Q_2	Q_3	Q_4
2237	*64	53	58	56	53	60	44	67	52	23	43	47	32	57

The equivalent forms reliability was also calculated between Forms A and B, by correlating the two forms, factor by factor. The tests were corrected for the full length (Forms A and B) as

it is normally recommended. The homogeneity coefficients obtained by Minnaar (1976:61) appear on table 5.11 below.

TABLE 5.11
HOMOGENEITY COEFFICIENTS OF EQUIVALENCE FOR THE HSPQ

HSPQ PERSONALITY FACTORS														
N	A	B	C	D	E	F	G	H	I	J	O	Q_2	Q_3	Q_4
2237	*66	25	63	52	28	49	44	62	51	36	55	39	38	46

According to Roscoe (1975:133) the homogeneity coefficients of equivalent tests are generally lower than those of the test re-test reliability. In this case the homogeneity coefficients are slightly higher than the coefficients of stability with the means $\overline{X}$ = 50,6 and $\overline{X}$ = 46,7, respectively. The homogeneity coefficients are reasonably high to indicate that the two forms of the HSPQ are equivalent.

5.5.3.5 Validity of the HSPQ

According to Tuckman (1979:230) a personality test has a present reference and must have **construct validity**. Factor analysis is the most powerful method of determining construct validity (Kerlinger, 1973:468), and this technique was used in determining the construct validity of the HSPQ. The construct validity of the HSPQ was measured by correlating the scale with the pure factor, it is supposed to measure (Cattell et al., 1970:34). People in different circumstances were used in construct validation of the 16 PF (Cattell et al., 1970:161-246). The 16 PF is however an adult version of the HSPQ. The universality of the personality factors in both the 16 PF and the HSPQ has been established by the accumulation of data from different nations and cultures (see paragraph 3.2.3.1). In this country the construct validity of the HSPQ

was calculated by Minnaar (1976) who obtained the following results:

TABLE 5.12
VALIDITY COEFFICIENTS DERIVED FROM EQUIVALENCE COEFFICIENTS

HSPQ PERSONALITY FACTORS														
N	A	B	C	D	E	F	G	H	I	J	O	Q_2	Q_3	Q_4
2237	*81	50	79	72	53	70	66	79	71	60	74	62	62	68

These validity coefficients are derived (equivalent coefficients) by using the formula:

$$Val = \frac{Vco}{Vt}$$ (Kerlinger, 1973:460).

Where: Vco = common factor variance
Vt = total variance of the measure

The high validity coefficients shown on table 5.12 indicate that the HSPQ is a valid measure of personality traits of Black Standard 10 pupils.

5.5.4 Vocational interest questionnaire (VIQ)

5.5.4.1 Introduction

The aim of the VIQ is to measure the spontaneous preference for or dislike of a number of activities which are found in various vocational fields of interest. The information collected with this questionnaire serves as an aid in vocational guidance and in the choice of further study directions (Coetzee, 1975:1).

5.5.4.2 Composition of the VIQ

This questionnaire measures the interests of pupils in 10 fields of interest, as shown on table 5.13 below.

TABLE 5.13
INTEREST FIELDS OF THE VIQ

Field on Interest	Related Occupations	Items*
1 Technical	Mathematical, electrical, metalurgical	5 - 145
2 Outdoor	Forestry, agriculture, surveying	6 - 146
3 Social services	Teaching, nursing, social work, police, lawyer	7 - 147
4 Natural science	Medicine, biologist, dentistry, chemist, geologist	8 - 148
5 Office work (non-numerical)	Clerk, filing clerk, typist	9 - 149
6 Office work (numerical)	Actuary, auditor, cost accountant	10 - 150
7 Music	Disc jockey, singer, dancer	11 - 151
8 Art	Painting, sculpture,cartoonist, fashion designer	12 - 152
9 Commerce	Salesman, retailer,wholesaler	13 - 153
10 Languages	Journalist, teacher,translater, playwright	14 - 154

* Items 1 - 4 are practice examples.

For each field of interest there are 19 items. These items are arranged in a sequential order corresponding to the field of interest. In all, there are 150 items. With respect to each item the pupil has to indicate whether he likes (L), is undecided (I), or does not like (D) the activity by shading the

relevant letter L, I or D. The highest score (being 15) indicates the field of occupation he likes most.

The pupils can be asked to indicate their occupational fields of interest without the use of the questionnaire, but this method has a limitation in that pupils are not afforded an opportunity of evaluating their interest in a large number of activities within each field of occupation. The questionnaire has an advantage of indicating the extent to which the pupil likes the field of occupation by evaluating the alternatives.

5.5.4.3 Standardisation of the VIQ

The VIQ was standardized by the HRSC for use in Black schools, in classes ranging from standard 6 to 10. The application for item analysis was made in 1972 and the application for the establishment of norms was made in 1973. Norms were established for each standard (6 - 10) and for each sex. The details on test application, scoring and interpretation are contained in the manual (Coetzee, 1975:31).

5.5.4.4 Reliability of the VIQ

As stated before, reliability refers to the extent to which the psychological measuring instrument produces consistent scores on reapplication. The manual does not, however, state the type of reliability that was established. Nonetheless, it is obvious that it was test re-test reliability that was established since there is only one form of the VIQ. The reliability of the VIQ with respect to all classes (6 - 10) is contained in the manual.

Concerning standard 10, the reliability coefficients range from 0,77 to 0,93 (Coetzee, 1982:30). These high reliability coefficients indicate that the VIQ is a reliable measure of vocational interest of secondary and high school pupils.

5.5.4.5 Validity of the VIQ

The VIQ has content validity. To have content validity the Items Committee ensured that the items were classified according to fields for which they were intended and that there was no overlap. To ensure the independence of the occupational fields, factor analysis was applied. The correspondence of the factors with the broad occupational fields indicated that the VIQ has contruct validity too (Coetzee, 1982:32). The VIQ is therefore a valid measure of vocational interest.

5.6 THE CRITERION

5.6.1 Introduction

In this study the intention was to use the aggregate pass percentage (APP) of standard 10 pupils as the criterion. The criterion scores were obtained after the standard 10 pupils had written their final examinations, set by the examinations board. The question papers for the different subjects are regarded in this study as unstandardized achievement tests. The aggregate percentage is the mark obtained by the pupil in the subjects (group) taken for Senior Certificate.

The students take a particular group of subjects as stipulated by the Joint Matriculation Board for the purpose of Matriculation Exemption. For a science and a commercial group of subjects there are definite combinations as shown on table 5.14. To the general group, any subject can be added, after satisfying the basic requirements for this group (see JMB manual 1985).

TABLE 5.14
GROUPS OF SCHOOL SUBJECTS TAKEN FOR STD 10 EXAMINATIONS

Group	School subjects
General	Zulu, Afrikaans, English, Biology, Geography, History, etc.
Science	Zulu, Afrikaans, English, Biology, Mathematics, Physical Science
Commercial	Zulu, Afrikaans, English, Biology, Mathematics, Accountancy, Business Economics

The predictability of academic achievement in individual school subjects is not to be studied in this present research, instead the aggregate pass percentage will be studied.

5.6.2 Reliability of the criterion measures

Although it was stated in paragraph 5.4.1 that the examination question papers are not standardized to establish test-retest or split-half reliability, the question of reliability is applicable. In this regard, it can be said that the format of the question papers makes them reliable measures as they do not differ from the previous ones. It is also presumed that there is some reliability that is in-built in the question papers due to the standard format (Verhoef, 1966:11-2). See also annexure G.

On the contrary it is assumed that if a test is not reliable in terms of statistical criteria it cannot produce reliable scores. For instance, the marking of examination question papers is to some extent subjective. The allocation of marks to essays is a good example of subjective scoring and allocation of marks. The moderation of marks is aimed at normalizing the marks obtained by pupils, and also to ensure the reliability of examinations (Malherbe, 1977:437-473, Gumede, 1986:5). With respect to standard 8, Swanepoel (1975:85) justifies the use of examination

marks as the criterion with the following reasons (also applicable to standard 10):

a. The examinations are public (see Van Rensburg, 1975:36),
b. The question papers are marked using the memoranda which are prepared beforehand, and
c. After the examination scripts have been marked, the marks are moderated by the examinations committee.

For these reasons the examination marks are regarded in this study as reliable criterion scores.

5.6.3 Validity of the criterion measures

The examination question papers are based on the syllabus and therefore contain content validity. The examination marks do also have predictive validity - hence previous achievement, like grade point average (GPA) or high school record (HSR) has been found, consistently, to be the best predictor of achievement (Giusti, 1964:207; Lavin, 1967:51; Hinton et al., 1971:516; Von Mollendorf, 1978:304; De Wet, 1983:51; Monteith, 1983:57; Van der Westhuizen, 1984:45; and Ngobeni, 1984:108).

The above stated characteristics of the criterion and the information given in paragraph 1.2 are expected to make the prediction of the APP possible as the cirterion scores are regarded as reliable to some extent and the examination question papers as valid measures of the criterion also to some extent. This also indicates the reliability of examinations (Malherbe, 1977:474). The examination results, are however, regarded as the indicators of the academic achievement of pupils, as are based on predetermined norms. They can, therefore, to a large extent be used as reliable and valid criteria.

5.6.4 The criterion scores

The results of standard 10 pupils are available in the form of symbols and not as raw scores. The aggregate pass or fail symbol is the very criterion to be predicted by the independant variables. To be used in the prediction equation the symbols have to be converted to percentages. The table which is used by the Department in converting the symbols to percentages was also used for this purpose, as it appears below.

TABLE 5.15
STANDARD 10 ACHIEVEMENT SYMBOLS CONVERTED TO PERCENTAGES

Symbol	Percentage Interval	Percentage used for APP
A	80 - 100	80
B	70 - 79	74
C	60 - 69	64
D	50 - 59	54
E	45 - 49	47
EE	40 - 44	42
F	33 - 39	36
G	25)	
H	20) Fail	16
HS	10)	

As was stated previously, the raw scores are not used in this study since the aim is to use the scores as are used in practice for both dependent and independent variables. That the dependent variable is in percentages, the AAT and HSPQ scores in stanines, the VIQ scores ranging from 1 to 15, and the school variable total (SVTOT) in ranks (raw scores), will not affect the correlations since the computer is programmed to take care of the differences in scales. It can also be added that the results were available in this form, and not in raw scores.

5.7 THE SCHOOL VARIABLES

The school variable scores were obtained by ranking the schools according to the following criteria:

* A score of 1 is given if any of the variables is absent or is not effective or not contributing significantly towards the achievement of pupils in the respective schools.

* A score of five is given if any of the five variables is present or has moderate effect on the achievement of the pupils in the respective schools.

* A score of 9 is given if any of the five variables is present and has great effect on the achievement of pupils in the respective schools.

The ranking scale is based on the three-point scale in which the lowest extreme (stanine 1) indicates very weak or the absence of the attribute; the medium score (stanine, 5) indicates a medium effect; and the top extreme (stanine, 9), indicates very good or great effect on academic achievement. These three points of the 9-point scale were preferred by the Inspectors because they make them evaluate their decisions for giving a rank of 1 or 5 or 9 taking cognisance of the interval that is between these points. The results of ranking the schools appear on table 5.16.

To arrive at a school variable total the ranks given to the schools were added and the total was obtained. The school variable total was used in multiple regression analysis and in the classification or schools according to quality (see table 5.2).

TABLE 5.16

RANKS GIVEN TO SCHOOLS BY INSPECTORS

		School variables						
		1	2	3	4	5	6	
Schools	School Code	Hostels	Library	Laboratory	School Management	Discipline	Staff dedication	School Variable Total (SVTOT)
1	15 404	9	9	9	9	9	9	54
2	14 499	9	9	9	5	5	5	42
3	15 516	9	5	9	9	5	5	42
4	15 414	9	9	9	9	9	9	54
5	15 440	9	9	9	9	9	9	54
6	15 479	9	9	9	9	9	9	54
7	15 534	5	1	1	1	5	5	18
8	15 521	9	9	9	9	9	9	54
9	15 427	1	5	5	5	5	5	26
10	15 452	1	1	5	5	5	5	22
11	15 478	1	5	5	9	9	5	34
12	15 526	1	1	5	1	5	5	18
13	15 417	1	1	1	9	9	9	30
14	15 461	1	1	1	9	9	5	26
15	15 419	1	1	1	9	9	9	30
16	15 472	1	1	1	9	9	5	26
17	15 437	1	1	1	9	9	5	26

The data on this table (table 5.16) shows the ranks that were allocated by the inspectors to each school. The data was entered into the computer and the tables relating to or involving the school variables were extracted from this table.

5.8 VARIABLES USED IN THIS STUDY

The dependent and the independent variables used in this study are the following:

DEPENDENT VARIABLES:	1.	Aggregate pass percentage in Std 10
INDEPENDENT VARIABLES		
Aptitude:	2.	Non-verbal reasoning
	3.	Verbal reasoning
	4.	English Vocabulary
	5.	English reading comprehension
	6.	Number comprehension
	7.	Afrikaanse woordeskat
	8.	Afrikaanse leesbegrip
	9.	Squares (2-D)
	10.	Spatial perception (3-D)
Personality:	11.	Factor A sociability
	12.	Factor B intelligence
	13.	Factor C emotional maturity
	14.	Factor D excitability
	15.	Factor E dominance
	16.	Factor F enthusiasm
	17.	Factor G conscientiousness
	18.	Factor H adventitiousness
	19.	Factor I tender mindedness
	20.	Factor J introversion
	21.	Factor O apprehensiveness
	22.	Factor Q_2 self-sufficiency
	23.	Factor Q_3 emotional control
	24.	Factor Q_4 anxiety
Interest:	25.	Technical
	26.	Outdoor
	27.	Social
	28.	Natural science
	29.	Office work (non-numerical)
	30.	Office work (numerical)
	31.	Music
	32.	Art
	33.	Commerce
	34.	Language

School:	35. Hostels
	36. Library
	37. Laboratory
	38. School management
	39. Discipline
	40. Staff dedication
Modifier variables:	41. School quality
	42. Education stream
	43. School situation
	44. School type
	45. Sex

The above cognitive, affective, and school variables were used in this study. The methods used in the selection of the 'best' subsets of predictors and the determination of the control set are discussed in the following paragraph.

5.9 THE RESEARCH DESIGN AND THE PROCEDURE FOLLOWED IN THIS INVESTIGATION

5.9.1 The research design

As was stated in paragraph 1.4 the research design for this study is ex post facto. The term, ex post facto, refers to the study in which the researcher examines the effects of the independent variables on the dependent variable after they have followed their natural course (Kerlinger, 1973:379, Roscoe, (1975:189, Tuckman, 1978:147, Ary et al., 1979:271). This design is therefore suitable for this study because it was conducted after the variations in the independent variables, that were selected, had already been determined in the naturalistic course of events.

What also makes this design suitable for this study is the fact that the investigation is aimed at determining the presence or

the absence of the relationship between the independent and the dependent variables without specific reference to causality.

There are two types of the ex post facto research: (i) the co-relational design, used to show that the relationship existed, after the fact, between the independent (x) and the dependent (y^1) variables, thus suggesting the possible bases for causality; (ii) the criterion-group approach in which the researcher starts by identifying the two criterion groups, say for instance, the good and the weak schools and then study the effectiveness of the teachers in these two groups of schools with the purpose of determining their consequent effectiveness on pupil performance. Such a criterion-group study is used as the bases for an experimental research (Tuckman, 1978:148).

The basic model used with the co-relational research is the following:

$y^1 = a + b_1 x_1 + b_2 x_2 \ldots b_k x_k$ (Kerlinger, 1973:612).

where: y^1 = dependent variable (criterion)
a = intercept constant to correct for differences in predictor and criterion means.
$x_1, x_2 \ldots x_k$ = scores on independent variables
$b_1, b_2 \ldots b_k$ = regression weights which are proportional to the predictor's contribution to predictive accuracy.

The use of this multiple regression statistical technique is based on the assumption that (i) the expected relationship between the dependent and the independent variables is linear, (ii) and that the subjects to whom this equation is applied is representative of the population (Daniel and Wood, 1971:7).

This multiple regression formula has the advantage that (i) any number of variables can be used as predictors, (ii) that the statistical significance of the contribution of any independent variable to R^2 can be determined, (iii) and that the variables which do not contribute significantly to R^2 can be eliminated leaving only those that have high correlationswith the criterion and with low correlations with other predictors (Brown, 1976:153, Kerlinger, 1973:622). (iv) This prediction equation makes it possible to apply a statistical control by having other sets of variables added to the control set in order to study their contribution to R^2. (v) The contribution to R^2 can be calculated by having the difference between the full model (R^2fm), which consists of the control set plus other predictors, and the reduced model (R^2rm) which consists of the control set only. (vi) This multiple linear regression equation can be used to identify the significant predictors of academic achievement, and to order them step by step according to the magnitude of their contribution to R^2. This last method is named the stepwise regression and the details of the procedure are contained in Mulder (1982:100). The stepwise method will be used after the contribution of the best subsets of the affective and school variables to R^2 have been determined, as outlined in (vi) above. The other methods used with this formula are described in paragraph 5.9.2.4.

5.9.2 Statistical techniques used in this study

5.9.2.1 Introduction

With the availability of the computer and suitable statistical programmes it was possible to have descriptive and inductive statistics. In the following paragraphs these statistics will be described.

5.9.2.2 Descriptive statistics

In order to obtain a global picture of the data, it is necessary to compute the descriptive statistics. The descriptive statistics of significance in a co-relational study are the means that give information on the central values of the test scores and the standard deviations which are measures of variability.

The mean is an interval or a ratio statistic that takes into account the value of each and every score, and it is characterised by relative stability as a measure of central tendency in comparison with the mode and the median. It is the best indicator of the performance of the entire group in a sample (Ary et al., 1979:103). The mean as a basic statistic leads to the calculation or the standard deviation which is an index of how widely the scores are dispersed about the mean (Brown, 1976:39). The means and the standard deviations are the inputs for simple and multiple correlation or multiple regression.

5.9.2.3 Simple correlation

After the information on each sample has been obtained with respect to the mean and the standard deviation (as inputs), the next step is to calculate the simple correlations between or among the independent variables. The results of a simple correlation matrix provide data for further inferential statistics such as factor analysis and multiple regression. In the selection of the 'best' predictor variables from the correlation matrix the multiple regression is used. Factor analysis is used in the reduction of a large number of variables to a small number that represents the rest in the compilation of test batteries, or for use in multiple regression (see Van der Westhuizen, 1987:211 for details). In this study only multiple regression will be used in the selection of the best predictors because factor analysis was used in the reduction of a large

number of variables to a few that measured the different dimensions of aptitude, interest, and personality. The use of factor analysis in the compilation of these measures was discussed in chapter 3 and in paragraph 5.5. It will not be used in this study since it is the full measure of the construct that is studied for its predictive validity.

5.9.2.4 Multiple regression

There are two ways in which multiple regression is used in the selection of the best predictors. One method uses Mallows Cp-criterion. This method will be discussed below because it will be used in this study to determine the best subset of predictors of academic achievement from each measure. The use of the stepwise method has been stated in paragraph 5.9.1.

SELECTION OF THE BEST SUBSET OF PREDICTORS

MALLOWS Cp - STATISTIC. This statistic is presented in the following formula:

$Cp = RSS - (N-2_p1)$ (Dixon and Brown, 1981:422; Gorman and Toman, 1966:33; Hocking and Leslie, 1967:537).

where: RSS = residual sum of squares for the best subset.
p^1 = the number of variables in the subset.
S^2 = average sum of residual squares based on the regression in which all the independent variables are used.
N = sample size.

In the selection of the best subset of predictor variables using this method all possible combinations of variables are used and for each combination the Cp-value is calculated. The Cp-value indicates the total quadratic error variance of each combination

of variables. The smallest Cp.-value is therefore an indication of the smallest quadratic error variance which cannot be reduced further by the addition of variables (Hocking and Leslie, 1967:537). The subset with the smallest Cp-value is therefore the 'best' subset or predictors. The variables which are not included in the best subset are left out from the statistics for the 'best' subset.

It is also necessary to determine whether the 'best' subset of predictors contribute significantly towards the reduction of error variance in the dependent variable. This is determined by calculating the significance of the multiple correlation between the predictors and the criterion using the F-statistic. The formula for F is:

$$F = \frac{R^2 / K}{(1 - R^2)/(N - K - 1)}$$ (Kerlinger, 1973:260)

where: R^2 = squared multiple correlation.

K = the number of independent variables

$1 - R^2$ = proportion of variance of the dependent variable which is not accounted for by the predictor variables.

N = sample size.

Using the degreesof freedom, the significance of the F-value (P) can be found by consulting the F tables. In this study the computer program 9R will be used and all these values are calculated and shown on the printout.

TEST OF SIGNIFICANCE OF THE DIFFERENCES BETWEEN R^2 s

In the testing of the main hypotheses which have to do with the additiveness of the affective and school variables to cognitive variables in the prediction of standard 10 academic achievement, it is necessary to apply a test for the significance of the difference between the R^2 for the full model and the R^2 for the reduced model. The formule for testing for the significance of the difference between the R^2s is:

$$F = \frac{(N - U - 1)\ (R^2\ fm - R^2\ rm)}{(U - V)\ (1 - R^2\ fm)}$$ (Roscoe, 1975:376)

where: N = sample size

U = number of predictors in the full model

V = number of predictors in the restricted model

R^2 fm = Coefficient of determination for the full model

R^2 rm = Coefficient of determination for the restricted model

1 - R^2 fm = Coefficient of non-determination for the full model (i.e. proportion of variance of the dependent variable which is not accounted for by the independent variables).

The F-values calculated by means of this formula indicate whether or not the addition of the variables does contribute towards an increase in R^2. On the bases of the results the hypothesis can be rejected or accepted.

TEST FOR THE EFFECT SIZE OF THE DIFFERENCE BETWEEN THE R^2S

For educational purposes it is necessary to determine whether the contribution of the variable(s) to R^2 has great effect or not. Cohen's f^2-statistic for the effect size is used for this purpose and is presented by the following formula (Cohen, 1977:410):

$$f^2 = \frac{R^2K_2}{1-R^2K_1}$$

where: R^2K_2 = Contribution of each independent variable of a subset of independent variables to R^2.

R^2K_1 = contribution of the control set of independent variables to R^2.

1 - R^2K_1 = variance that cannot be accounted for by the control set in the dependent variable (coefficient of non-determination).

Using this formula, Cohen stipulated definite cut-off points for determining the effect size of the f^2-values. According to Cohen the f^2-value of 0,02 indicates a small effect, of the addition of the variable(s), on R^2. The f^2-value of 0,15 indicates a medium effect, and an f^2-value of 0,35 a great effect on R^2, for educational purposes. These criteria will be used in this study to determine the effect size of the contribution of the independent variables towards the prediction of academic achievement.

STATISTICS FOR COMPARING THE R^2S FOR THE DIFFERENT SUBSAMPLES DURING THE MODIFIER VARIABLE STUDY

In the modifier variable study the control set of predictors will be used with different subsamples to determine the influence of the modifier variables on the prediction of academic achievement. The R^2s for the various subsamples will be calculated by means of the following formula in the testing of the respective hypotheses (Dixon and Brown, 1981:245):

$$F = \frac{\text{Residual SS over groups}/(p_i + g - p - 1)}{\text{Residual SS within groups}/(N - g - p_i)}$$

where: P = number of independent variables in the regression equation for all groups taken together.

p_i = number of independent variables in the regression equation for the i-th group

g = number of groups

N = number of cases in all the groups combined.

The F-statistic for the comparison of the R^2s for the different subsamples is calculated using the computer program BMDP1R. The sample is divided according to the classification variables and the program for this formula is run. The results indicate whether the samples differ significantly or not in R^2, using the p-values.

Table 5.17 indicates the use of each regression equation in the testing of the respective hypothesis.

TABLE 5.17

THE DIFFERENT MULTIPLE REGRESSIONS USED WITH THE PURPOSE OF TESTING THE SPECIFIC HYPOTHESES

STEP	HYPOTHESIS	BASIC SET OF VARIABLES	INDEPENDENT VARIABLES	USE OF THE MULTIPLE REGRESSIONS
1	MAIN HYPOTHESIS 1 relating to the best predictors	None	Cognitive, Personality, Interest School	Comparison of the maximum R^2 explained by each group using Cp as the criterion
2	MAIN HYPOTHESIS 2 relating to the additiveness of the affective variables	Cognitive set of variables	Personality variables	Comparison between the R^2 for the full model and the reduced model
3	MAIN HYPOTHESIS 3 relating to the additiveness of the affective variables	Cognitive set of variables	Interest variables	Comparison between the R^2 for the full model and the reduced model
4	MAIN HYPOTHESIS 4 relating to the additiveness of the school variable total	Cognitive set of variables	School variable total	Comparison between the R^2 for the full model and the reduced model
	MODIFIER VARIABLE STUDY			
	SUB-HYPOTHESIS	CONTROL VARIABLES	MODIFIER VARIABLES	USE OF THE MULTIPLE REGRESSIONS
		Best predictors from aptitude interest Personality school variable		Identification of the best predictors by stepwise regression (2R)
5	SUBHYPOTHESIS 1 relating to the influence of school quality on R^2	Control set	School quality	Comparison of the R^2 for 3 groups using 1R program
6	SUBHYPOTHESIS 2 relating to the influence of education stream on R^2	Control set	Education stream	Comparison of the R^2 for 3 groups using 1R program

TABLE 5.17 (continued)
THE DIFFERENT MULTIPLE REGRESSIONS USED WITH THE PURPOSE OF TESTING THE SPECIFIC HYPOTHESES

7	SUBHYPOTHESIS 3 relating to the influence of school situation on R^2	Control set	School situation: urban/rural	Comparison of the R^2 for the 2 groups using the 1R program
8	SUBHYPOTHESIS 4 relating to the influence of school type on R^2	Control set	School type: boarding/day	Comparison of the R^2 for the 2 groups using the 1R program
9	SUBHYPOTHESIS 5 relating to the influence of sex on R^2	control set	Sex: boys/girls	Comparison of the R^2 for the 2 groups using the 1R program

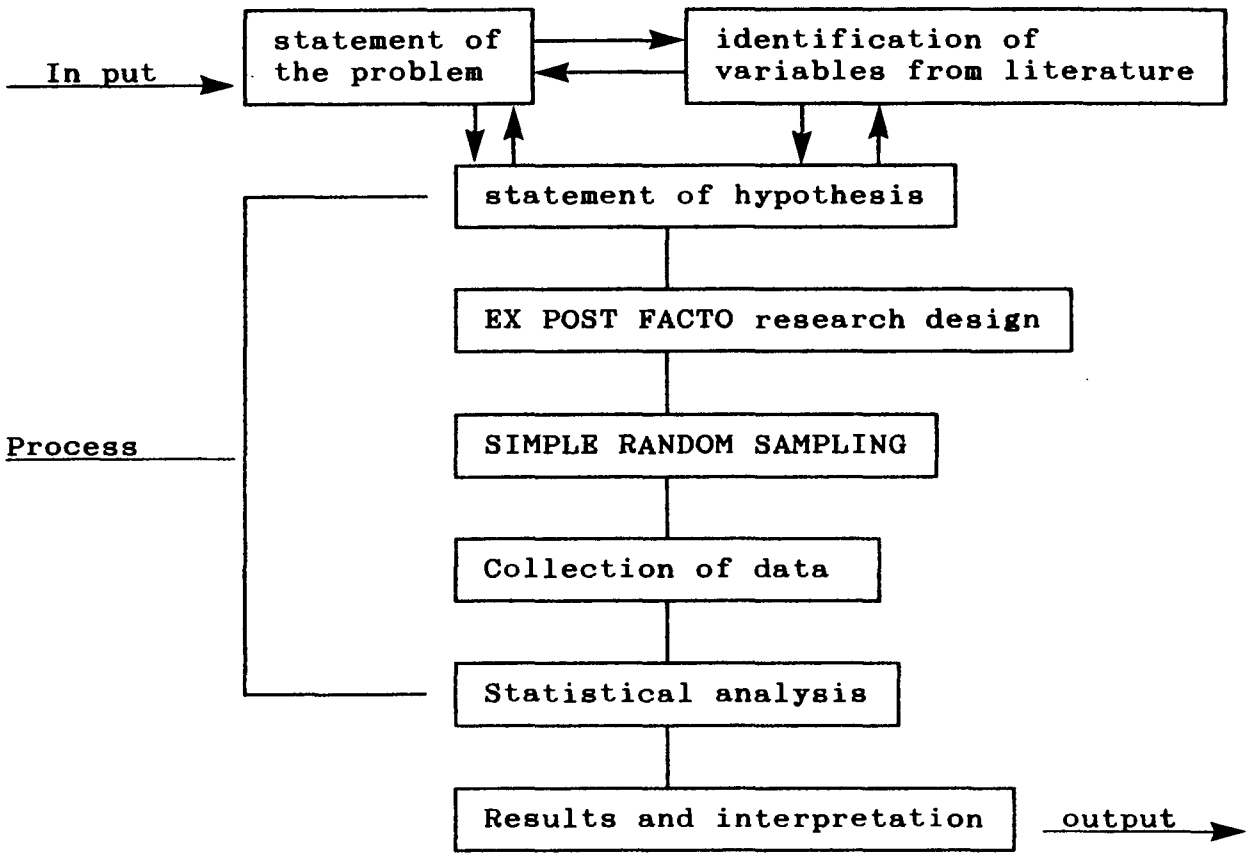
Table 5.17 indicates the various regression equations that are used at the respective stages in testing the hypotheses. In testing the sixth and the seventh subhypotheses the percentage passes will be used. The reason for the use of the percentages is that there will be no variations for the selected average stanine to explain the variation in the aggregate pass percentage (APP), thus making regressions impossible.

5.10 SUMMARY OF THE VARIOUS STEPS FOLLOWED IN THIS RESEARCH

5.10.1 Introduction

The summary of the steps followed in this study will be made with reference to the general model for research that is applicable to ex post facto research as well (see figure 5.2).

FIGURE 5.2
MODEL FOR RESEARCH



(Adapted from Roscoe, 1975:191.)

5.10.2 Research procedure

5.10.2.1 Introduction

The inputs for this research consist of the statement of the problems that are related to the prediction of standard 10 academic achievement. The problems were stated after the observation of the decrease in the pass rate of standard 10 pupils, and after conducting a brief review of relevant literature to determine the reality of the problem. The statement of the problem led to extensive review of relevant literature on academic prediction. As a result of literature

review the predictor variables were identified and the hypotheses were formulated in paragraph 5.2.2.

5.10.2.2 Method followed in this research

The design for this study is ex post facto, as was stated in paragraph 1.4.1 and the details for this design were given in paragraph 5.9.1. This research design is suitable for this study, (as was stated above) because the sample was selected in a simple random manner after the independent variables had followed their natural course of influencing the dependent variable.

After simple random sampling was done (see paragraph 5.4) the data was collected by means of cognitive and affective measures described in paragraph 5.5. The data on the dependent variable (described in paragraph 5.6) were collected from computer printouts. The data on school variables were collected by giving ranks to school variables by the inspectors (see paragraph 5.7). All this data was combined (by hand) in one form and was captured by the computer. The statistical analysis of the data was done by means of the computer in the following stages.

DETAILED DATA DESCRIPTION

The BMDP1D program was run to produce data for each pupil. After the program for detailed data, another program, BMDP2D for detailed data description was run. The second program was run mainly for checking the errors. Corrections were made and the program (BMDP2D) was run again to check whether the errors have been eliminated.

SELECTION OF THE BEST SUBSETS OF PREDICTORS

At this stage the multiple linear regression computer program BMDP9R, which employs the formula stated in paragraph 5.9.1, was used in testing the main hypotheses.

The main hypotheses relate to the selection of the best predictors from the cognitive, affective, and school variables. This was done by first selecting the basic set of predictors from the Academic Aptitude Test battery (AAT) and the calculating the R^2 between the AAT best set and the dependent variable. This was followed by the calculation of R^2 between the selected personality variables and the dependent variable. The same was done with the interest and the school variables. The hypothesis was tested by comparing the R^2s between the dependent variable and each group of predictors from cognitive, affective, and school variables.

The computer program proceeded to calculate the significance of the coefficient of determination (R^2). This test of significance was applicable to the R^2s for this study because the schools were drawn at random from the population thus (1) making the errors independent, (2) ensuring the normal distribution of errors for all the combination of predictor variables, and (3) also ensuring equal variability of errors for all the combinations of predictor variables. The ratio of the number of pupils to the number of predictor variables is quite high to have the R^2s which are less than 1, and reliable for testing the hypothesis (Roscoe, 1975:378).

The F-test for the significance of the R^2 between the criterion and each of the cognitive, personality, interest, and school variable was applied. The results are reported in paragraph 6.6.2. On the basis of the size of the R^2s for the separate regressions, the first hypothesis was tested.

In testing the hypothesis on the additiveness of personality, interest, and school variables, to cognitive variables in the prediction of academic achievement, the significance of the difference between the full model (R^2 fm) and the restricted model (R^2 rm) was tested by using the F-formula given in paragraph 5.9.2.4; and the results are reported in paragraph 6.7.2.

The EFFECT SIZE of the differences between the R^2s for different equations was further tested by using Cohen's criteria, stated in paragraph 5.9.2.4. This statistic (f^2) was used to determine whether the size of the contribution of the effective and school variables is effective enough for practical educational purposes.

MODIFIER VARIABLE STUDY

The modifier variable study investigated the influence of school quality, education stream, school type, school situation, and sex on academic prediction. These variables were used in the division of the sample into subsamples. To test for the significance of the R^2 of the different subsamples the F-formula (see paragraph 5.9.2.4), in the computer program BMDP1R, was used.

CROSS VALIDATION OF THE FINDINGS OBTAINED IN THE TESTING OF THE HYPOTHESES BY CONTROLLING FOR APTITUDE

Studies on the influence of school situation on academic achievement indicated that when intelligence and socio-economic status are controlled the differences in the academic achievement of pupils attending urban and rural schools disappear. The same is expected to happen if aptitude is controlled in the testing of the significance of the differences between the achievement of boarding and day schools. This cross validation will be done by calculating the percentage of passes for each average stanine of

the Academic Aptitude Test scores when the sample is divided into urban and rural, and day and boarding schools. The comparisons will be made at face value and the subhypothesis will be tested by applying a t-test for dependent samples. This statistic is possible to apply since the groups are equal.

EXTERNAL VALIDATION OF THE 'BEST' SUBSET OF THE APTITUDE VARIABLE

As was stated in paragraph 1.1 this study originated as a result of a practical educational need to predict standard 10 academic achievement in KwaZulu schools. The recommendations for practical purposes can only be made on the bases of external validity. A technique of discriminant analysis is used for this purpose. The results of discriminant analysis usually indicate very large R^2s possibly as a result of small subsamples. In this study it was preferred to determine the external validity of the 'best' subset from the AAT by:

(i) using the same schools that were sampled in 1983, in calculating the R^2 of the 1985 pupils, and

(ii) by calculating the R^2 for the 1986 population.

The correlations by expectancy tables and the histograms will give additional information on the correlations between the predictors and the criterion since 1983.

CHAPTER 6

RESULTS OF THE EMPIRICAL INVESTIGATION

6.1 INTRODUCTION

The aim of this study, as stated in paragraph 1.3, is to identify the best academic achievement predictors among the cognitive, affective and school variables; and to evaluate the contribution of the best predictors to R^2. The criterion for this study is the aggregate pass percentage (APP). The review of literature on the predictive validity of the named variables led to the formulation of the hypotheses stated in paragraph 5.2.2. The description of the measuring instruments used in this study was given in paragraph 5.5 and the methods used in the statistical analysis of data were described in paragraph 5.9. In this chapter the results of data analysis will be interpreted, and the hypothesis will be tested.

In the testing of the research hypotheses in paragraph 5.2.2 the probability exists that minor differences between the R^2s may be due to chance factors (or sampling error) and not to real differences (Tuckman, 1978:33, Ary et al., 1979:140, de Wet et al., 1981:81). In order to determine whether the variations explained by the independent variables in the dependent variable are not due chance factors, the statistical (null) hypotheses have to be stated and tested. The null hypotheses are the basic tools in inferential statistics and are generally rejected or accepted at 1% or 5% levels of significance. The research hypotheses are therefore reformulated as null hypotheses as follows:

NULL HYPOTHESES

1. The cognitive variables are not the best predictors of standard 10 academic achievement.

2. The addition of affective variables to aptitude variables in the prediction of standard 10 academic achievement does not significantly increase the R^2.

3. The addition of school variables to aptitude variables in the prediction of standard 10 academic achievement does not significantly increase the R^2.

4. School quality has no significant influence on R^2.

5. Education stream has no significant influence on R^2.

6. School situation has no significant influence on R^2.

7. School type has no significant influence on R^2.

8. Sex has no significant influence on R^2.

9. When aptitude is controlled there are no significant differences between boarding and day schools in academic achievement.

10. When aptitude is controlled there are no significant differences between urban and rural schools in academic achievement.

6.2 DESCRIPTIVE STATISTICS

6.2.1 Introduction

As an initial step the data on the aggregate pass percentage (APP), school variable total (SVTOT), personality (HSPQ), and interest (VIQ) were analysed for the purpose of determining the means ($\overline{X}$), the standard deviations (SD), the smallest value, the largest value, and the skewness of sample data for each variable.

6.2.2 Descriptive statistics for the dependent and independent variables

TABLE 6.1
DESCRIPTIVE STATISTICS FOR THE DEPENDENT AND THE INDEPENDENT VARIABLES (N=1861)

Variable	Mean	Standard Deviation	Smallest Value	Largest Value	Skewness
Aggregate % Pass (APP)	27,59	14,2	16	100	0,84
School variable total (SVTOT)	27,72	8,31	6	54	
AAT 1 Non-verbal reading	3,82	1,74	1	9	0,29
AAT 2 Verbal reasoning	2,73	1,60	1	9	0,64
AAT 3 English vocabulary	1,91	1,27	1	9	1,36
AAT 4 English read. comp.	2,50	1,51	1	9	0,84
AAT 5 Number comprehension	2,27	1,49	1	9	0,44
AAT 6 Afrikaanse woordeskat	1,58	0,74	1	9	2,43
AAT 7 Afrikaanse leesbegrip	1,74	1,11	1	9	1,64
AAT 8 Squares	3,67	1,85	1	9	0,45
AAT 9 Spatial perception	3,42	1,78	1	9	0,52
HSPQ A sociability	5,35	1,65	1	9	-0,11
HSPQ B intelligence	4,02	1,95	1	9	-0,03
HSPQ C emotionality	4,99	1,75	1	9	-0,03
HSPQ D excitability	5,78	1,68	1	9	-0,14
HSPQ E dominance	4,90	1,87	1	9	-0,31
HSPQ F enthusiasm	5,10	1,78	1	9	-0,09
HSPQ G conscientious	4,60	1,71	1	9	-0,21
HSPQ H adventurous	4,81	1,69	1	9	-0,12
HSPQ I tenderminded	5,37	1,93	1	9	-0,11
HSPQ J introversion	4,83	1,75	1	9	-0,13
HSPQ O apprehensive	5,15	1,51	1	9	-0,12
HSPQ Q_2 self-sufficiency	5,18	1,72	1	9	-0,13
HSPQ Q_3 emotional control	5,11	1,76	1	9	-0,24
HSPQ Q_4 anxiety	5,15	1,70	1	9	-0,06
VIQ 1 Technical	4,04	3,46	1	9	1,07
VIQ 2 Outdoor	3,51	3,03	1	9	1,21
VIQ 3 Social service	8,34	3,86	1	9	-0,50
VIQ 4 Natural Science	7,14	4,18	1	9	-0,03
VIQ 5 Office Work (Non-numerical)	6,26	4,38	1	9	-0,34
VIQ 6 Office Work (Numerical)	5,59	4,16	1	9	0,06
VIQ 7 Music	7,11	5,08	1	9	0,12
VIQ 8 Art	4,23	5,54	1	9	2,45
VIQ 9 Commerce	4,98	4,63	1	9	3,22
VIQ 10 Language	7,20	4,99	1	9	2,39

The data on table 6.1 shows that the mean (27,59) of the APP is below the minimum required for a pass, which is 33,3%. This indicates that there was a larger number of failures than passes, as is also indicated by the positive skewness of the scores. The low mean of the APP is likely to influence the R^2. This influence will be investigated in the testing of the first subhypothesis, that relates to school quality (see also paragraph 6.2.5).

6.2.3 Descriptive statistics for the aggregate pass percentage (APP)

The standard deviation of the APP is not very large. For the standard deviation to be large it should be larger than $^1/_6$th of the largest value (in this case, $^1/_6$ of 100 = 16,7). The SD = 14,2 indicates that the APP scores of the pupils are smaller than 16,7. A possible cause for a smaller standard deviation is that there is one score that indicates fail, which is 16. The variation that is indicated by the standard deviation is for the various pass percentages obtained by pupils. The absence of variation for fail is likely to influence the correlation between the AAT and the APP because no cut-off point for fail in the AAT scores is indicated.

The APP is a dependent variable which is influenced by the cognitive, the affective, and by the school variables among the many other independent variables. That these variables influence academic achievement presupposes the causal relationship between the APP and these variables. It is, therefore, necessary to have the descriptive statistics for the independent variables in order to see whether they do resemble that of the dependent variable, with respect to the central and the dispersion values. The independent variable data referred to, is that of the SVTOT, AAT, HSPQ and VIQ, appearing on table 6.1.

6.2.4 Descriptive statistics for the school variable total (SVTOT)

The mean for the school variable total (SVTOT), that is 27,72 is almost the same as the median. This indicates that the data on SVTOT is almost symmetrical as is also shown by the small positive skewness.

The standard deviation is slightly smaller than $^{1}/_{6}$th of the range. One sixth of the range is 9, whereas the calculated SD is 8.31. This indicates that a large number of schools are within one standard deviation above or below the mean.

6.2.5 Descriptive statistics for the Academic Aptitude Tests (AAT)

The raw scores of the AAT are converted to a stanine scale which has a mean of 5 and a standard deviation of 1,96 (Minium, 1970:125). The mean scores of all the AAT variables on table 6.1 are well below the mean of 5, with the lowest means for English Vocabulary (EV) and for both Afrikaans Tests (Afrikaanse Woordeskat and Afrikaanse leesbegrip). This, generally, indicates that the academic aptitudes of pupils in standard 10, as represented by the sample, have been underdeveloped. The low means, and the positive skewness of aptitude variable scores, indicate a casual relationship with poor performance indicated by the low mean and the positive skewness of the APP.

The standard deviation of scores on all the AAT variables is lower than 1,96. This indicates that the scores do not vary more than one standard deviation from the mean. The smallest SD (0,74) is for Afrikaanse Woordeskat (AW) and this indicates that the sample is almost homogeneous as far as this variable is concerned. From the low mean (1,58) and the small standard deviation (0,74) it can be concluded that almost all the pupils are very weak in this aptitude (AW).

6.2.6 Descriptive statistics for the High School Personality Questionnaire (HSPQ)

The means of the pupils in the HSPQ are about the average (±0,5) and the standard deviation is slightly smaller than 1,96 in most cases. This indicates that the pupils in the sample are 'normal' as they almost resemble the norm group. It should however be noted that the stanines 4,5, and 6 which indicate average scores, have been substituted by 5 (see table 5.7). The stanine scale has a mean of 5, and it was for this reason that 5 was used as the average since the personality profile does not indicate any of the three middle scores.

6.2.7 Descriptive statistics for the Vocational Interest Questionnaire (VIQ)

The highest value in the VIQ scale is 15 and the mean is 7,5. With the exception of VIQ 3 (Social service) all the means are below 7,5. The lowest means are, however, for VIQ 1 (Technical), VIQ 2 (Outdoor, and VIQ 6 (Office Work numerical); which are 4,04, 5,51, and 5,59 respectively. This was expected since the pupils learn the academic subjects which are related to languages and social service, and not to outdoor and technical work which may involve the use of numbers.

For the VIQ with a range of 1 to 15, $^{1}/_{6}$ is 2,50 (which is equal to 1 SD). The standard deviations are larger than 2,50 in all the cases thus indicating that the vocational interest of pupils vary widely about the mean.

6.2.8 The differences between boys and girls in the dependent and the independent variables(APP, AAT, HSPQ, VIQ)

Since the differences between boys and girls in academic achievement are investigated in this study, it is necessary to

have the description of the mean and the difference between and within the groups. The analysis of variance gives the necessary information on the significance of the differences between the means with respect to each variable. Table 6.2 below indicates these details.

From table 6.2 it appears that boys have a larger mean for the aggregate pass percentage (APP) than girls. The difference between the means is significant beyond 1% level.

Concerning the means for boys and girls in the AAT tests, table 6.2 indicates that boys perform significantly better than girls in most tests. The exceptions are verbal reasoning tests (AAT 2), where girls performed better than boys, and Afrikaans woordeskat (AAT 7) where the performance between the sexes is not significant at 1% level and the mean squares between the groups are 0,00. Boys, however, performed insignificantly better than girls in Afrikaanse leesbegrip (AAT 7) as shown by a difference of 0,01 and a P-value of 0,9772. In all other tests boys did better than girls as revealed by the means and by the F-values which are significant at 1% level.

That boys tend to perform better than girls in the AAT indicates a high possibility of a causal relationship between academic aptitude and academic achievement as boys tend to perform better than girls in the APP as remarked above. These results confirm the previous South African findings reported in paragraph 2.4.6.

At this stage it cannot be definitely said that boys do better than girls in academic performance from the data on descriptive statistics. For this reason it is necessary to calculate the R^2 for both sexes in order to determine the significance of the difference between the R^2s and test the 5th subhypothesis.

Concerning the sex differences in the affective variables, it is only in eleven cases where the sex differences are significant at 1% level as indicated by asterisk. Table 6.2 indicates a

TABLE 6.2
THE DIFFERENCES BETWEEN BOYS AND GIRLS IN DEPENDENT AND INDEPENDENT VARIABLES (APP, AAT, HSPQ, VIQ)

Variable	Boys(1)	Girls(2)		Analysis of variance			
Sample size Statistics	875 X	970 X	df	Mean Squares		F	P
				Between	Within		
Aggregate percentage pass							
APP	20,5	17,0	1/1855	5750,58	458,22	12,55	,0004
Academic aptitude							
AAT 1 (NVR)	4,30	3,77	1/1855	131,10	3,27	40,15	,0000
AAT 2 (VR)	2,29	2,80	1/1855	83,10	2,94	28,26	,0000
AAT 3 (EV)	2,29	1,87	1/1855	83,10	1,83	45,47	,0000
AAT 4 (ERC)	2,98	2,61	1/1855	64,78	2,80	23,15	,0000
AAT 5 (NC)	3,33	2,91	1/1855	79,74	2,70	29,49	,0000
AAT 6 (AW)	1,56	1,40	1/1855	10,67	0,73	14,66	,0000
AAT 7 (ALB)	1,84	1,83	1/1855	0,00	1,40	0,001	,977
AAT 8 (SQ)	4,26	3,51	1/1855	256,22	3,46	44,10	,0000
AAT 9 (SP)	3,87	3,27	1/1855	170,50	3,15	59,19	,0000
Factor	High school personality questionnaire						
HSPQ A	5,29	5,41	1/1828	6,26	2,74	2,29	0,13
HSPQ B	4,11	3,93	1/1829	16,07	3,81	4,21	0,04
HSPQ C	5,14	4,86	1/1829	36,60	3,03	12,08	0,00*
HSPQ D	5,71	5,85	1/1828	8,72	2,82	3,09	0,00
HSPQ E	5,06	4,76	1/1829	40,14	3,50	11,47	0,00*
HSPQ F	5,13	5,08	1/1829	1,05	3,17	0,33	0,57
HSPQ G	4,67	4,54	1/1829	8,34	2,93	2,85	0,09
HSPQ H	4,95	4,71	1/1829	27,59	2,85	9,69	0,00*
HSPQ I	4,97	5,74	1/1829	275,55	3,58	76,86	0,00*
HSPQ J	4,98	4,71	1/1829	34,43	0,03	11,38	0,00*
HSPQ O	5,05	5,26	1/1829	20,47	2,45	8,35	0,00*
HSPQ Q_2	5,22	5,14	1/1829	3,10	2,97	1,04	0,31
HSPQ Q_3	5,05	5,18	1/1829	7,24	3,13	2,31	0,13
HSPQ Q_4	5,04	5,25	1/1829	19,83	2,88	6,89	0,00*
Field	Vocational interest questionnaire						
VIQ 1	5,04	3,09	1/1852	1744,45	11,05	157,29	0,00*
VIQ 2	3,63	3,37	1/1852	30,27	9,26	3,27	0,07
VIQ 3	7,33	9,18	1/1852	1585,27	14,28	111,04	0,00*
VIQ 4	7,09	7,11	1/1852	0,18	15,50	0,01	0,92
VIQ 5	6,05	6,40	1/1852	55,93	19,11	2,93	0,09
VIQ 6	5,77	5,36	1/1852	77,25	17,21	4,49	0,34
VIQ 7	6,61	7,51	1/1852	377,20	25,71	14,67	0,00
VIQ 8	4,52	3,95	1/1852	155,50	12,45	12,49	0,00*
VIQ 9	5,12	4,78	1/1852	53,86	21,21	2,54	0,11
VIQ 10	7,09	7,24	1/1852	10,46	24,89	0,42	0,52

* Significant at 1% level.

mixed pattern of differences in personality and interest variables. For instance, the boys tend to be more emotionally stable (C), bold (H), dominant (E) and individualistic (J), while the girls tend to be more apprehensive (O), tenderminded (I) and tense (Q4). Boys tend to be more interested in technical work (VIQ 1) office work (Numerical) (VIQ 6) and in Art (VIQ 8) than in other occupations. Girls on the other hand tend to be more interested in the Social services (VIQ 3), music (VIQ 7) and in the languages (VIQ 10). As a result, the separate R^2s for the different sexes were calculated to obtain more accurate results.

6.3 RESULTS OF SIMPLE CORRELATION

The simple correlation matrix of all the independent variables was compiled for the purpose of determining whether the measures are independent. Annexure B indicates the correlation coefficients which are low enough to justify the use of the different measures in this study. Since each measure has content validity which is independent of the content validity of the other measures, there is no problem of multicollinearity among the measures of aptitude, personality, and interest to necessitate factor analysis. Moreover factor analysis was used in the compilation of these measures (see paragraph 5.5).

The value of using each measuring instrument in the prediction of academic achievement will be investigated independently. All the variables in each measure will be used in multiple regression analysis in order to determine the maximum variance explained in the APP. Previous research gives sufficient information on the individual aptitudes, personality factors, and vocational interests to makeit unnecessary to apply factor analysis. Multiple regression is most suitable for the selection of the 'best' subsets of predictor variables as is aimed at in this study.

In the following paragraph attention will be paid to the results of multiple regression analysis.

6.4 RESULTS OF MULTIPLE REGRESSION ANALYSIS

6.4.1 Introduction

In this paragraph (paragraph 6.4) the results of the statistical analysis will be interpreted and the hypotheses will be tested. The discussion of the results will be done separately in paragraph 6.5 in order to make it coherent.

Attention is consequently paid to the testing of all the hypotheses.

6.4.2 Contribution of aptitude, interest, personality variables, and school variable total to R^2

Main hypothesis 1. The aptitude variables are the best predictors of standard 10 academic achievement in comparison with the affective and school variables.

To test this hypothesis separate regressions of aptitude, interest, personality, and school variables were calculated using the Cp-method. By means of this method, the variables that contribute significantly to R^2, were selected and those which do not contribute significantly to R^2, were left out of the equation. The results on Table 6.3 indicate the contribution of the 'best' subsets of aptitude, interest and personality variables, and also of the school variable total, to R^2.

TABLE 6.3

SEPARATE CONTRIBUTIONS OF APTITUDE, INTEREST, PERSONALITY, AND SCHOOL VARIABLES TO R^2

Independent variables		Regr.	Contr.	Statistics for 'best' subset				
AAT	Aptitude (1)	Coef.	to R^2	Cp	R^2	F	P	N
1	Non-verbal reasoning	0,31	,0017					
2	Verbal reasoning	0,64	,0033					
3	English vocabulary	2,32	,0377					
4	English reading comprehension	1,07	,0108					
5	Number comprehension	1,21	,0106					
6	Afrikaanse woordeskat	1,06	,0032					
7	Afrikaanse leesbegrip	0,64	,0023	7,79	0,26	93,47	,000	1843
VIQ	Interest (2)							
1	Technical	-,19	,0017					
3	Social Service	-,48	,0125					
4	Natural Science	,18	,0018					
6	Office work (Numerical)	,39	,0098					
8	Art	,15	,0012					
9	Commerce	-,14	,0015	6,82	0,02	6,79	,000	1841
HSPQ	Personality (3)							
B	Intelligence	1,56	,0481					
D	Excitability	-,91	,0116					
F	Enthusiasm	,70	,0079					
G	Conscientiousness	,40	,0024					
Q_2	Self-sufficiency	-,57	,0051					
Q_3	Emotional control	-,28	,0012					
Q_4	Anxiety	,60	,0050	4,27	0,09	25,98	,000	1816
SVTOT	School variable total	,44	,1556		0,16	334,49	,000	1815

Regr. Coef. = Regressions coefficients proportional to the predictor's contribution to predictive accuracy.

Contr. to R^2 = Contribution to R^2 which is the amount of variance by which the R^2 will be reduced if removed from the equation. Decimals are correct to the fourth place.

Aptitude (1) = 'best' subset of aptitude variables

Interest (2) = 'best' subset of interest variables

Personality (3) = 'best' subset of personality variables.

Table 6.3 shows the 'best' subsets of variables that correlate significantly with academic achievement. Mallows Cp-statistic was used as a method for selecting the 'best' subsets of predictors (see paragraph 5.9.2.4). The Cp-criterion was not used with the school variable total because there was only one variable used in multiple regression.

The results on table 6.3 indicate that the best subset of aptitude variables explain the largest amount of variance (R^2 = 0,26) in academic achievement, in comparison with interest (R^2 = 0,02), personality (R^2 = 0,09) and school variable total (R^2 = 0,16). The research hypothesis which states that the aptitude variables explain the largest amount of variation in academic achievement is accepted and the null hypothesis is rejected at 1% level of significance.

6.4.3 Additiveness of affective variables to aptitude variables in the prediction of academic achievement

Main hypothesis 2: The affective variables are additive to aptitude variables in the prediction of standard 10 academic achievement.

To test this hypothesis the aggregate pass percentage (APP) was regressed on the aptitude variables and R^2 was determined. Another regression was calculated with the aptitude plus interest variables as predictors of the APP, and the second R^2 was calculated. The same was done with personality and school variable total (see table 6.4).

To calculate the increase in R^2, the R^2 for the reduced model (AAT only) was subtracted from the R^2 for the full model (AAT plus the respective subset). The F-values were then calculated. The results of this analysis appear in table 6.4.

TABLE 6.4

CONTRIBUTION OF THE INTEREST AND PERSONALITY VARIABLES AND SCHOOL VARIABLE TOTAL TO R^2 WHEN ADDED TO APTITUDE VARIABLES WITH APP AS CRITERION

Models	Variables	R^2	Increase in R^2	F	f^2	N
Reduced model	Best subset of AAT variables as basic set	0,26				
Reduced + full model	Basic set + 'best' subset of interest variables	0,27	0,01	2,75	,0135	1826
Reduced + full model	Basic set + 'best' subset of personality variables	0,28	0,02	7,11	,0272	1804
Reduced + full model	Basic set + school variable total	0,31	0,05	18,66	,068	1812

The results on table 6.4 indicate an increase of 0,01 when interest variables are added to aptitude variables in the prediction of academic achievement. The increase of 0,01 is equal to an F-value of 2,75 which is larger than p=2,04 at 1% level of significance when df = 16/1826.

When personality variables are added to aptitude variables there was an increase of 0,02 in R^2. This increase is equal to an F-value of 7,11 which is larger than p=2,04 at 1% level of significance, when df = 14/1804.

When the affective (interest and personality) variables are added to aptitude variables in the prediction of academic achievement there is a statistically significant increase in R^2. On the basis of these results the research hypothesis is accepted and the null hypothesis is rejected at 1% level of significance.

6.4.4 The additiveness of school variable total to aptitude variables in the prediction of academic achievement

Main hypothesis 3. The school variable total is additive to aptitude variables in the prediction of standard 10 academic achievement.

The results on table 6.4 indicate an increases of 0,05 when the school variable total is added to aptitude variables in the prediction of academic achievement. Using the F-formula for the significance of the difference between the R^2s, the F-value of 18,66 was obtained. This value is significant at 1% level. On the basis of these results the research hypothesis is accepted and the null hypothesis is rejected at 1% level of significance.

6.4.5 The effect size of the contribution of affective variables and school variable total to R^2 when added separately to aptitude variables

Using the data on table 6.4 the f^2 - values were obtained for each of the interest and the personality variables, and also for the school variable total. The f^2 - values for both interest and personality variables are 0,0135 and 0,0272 respectively. The value 0,0135 is smaller than 0,02 which indicates an increase of very small educational effect on R^2. The f^2 - value of 0,0272 indicates an increase of small effect on R^2.

Concerning the contribution of the school variable total to R^2 the results on table 6.4 indicate the f^2 value of 0,068 which is larger than 0,02 but smaller than 0,15 for medium effect. This f^2 - value indicates that the addition of the school variable total to aptitude variables in the prediction of academic achievement is of medium practical significance in education.

The results obtained with the use of the F-formula and those obtain with the use of the f^2 seem contradictory and therefore further explanation is necessary. Firstly the F-statistic is used to determine the significance of the difference between the R^2 for the full and for the reduced model, without reference to the practical significance of the increase in size for educational purposes. To determine the practical significance of the increase in R^2, the f^2 - formula is applied provided the R^2 s are significant. The R^2s computed in table 6.4 were all significant.

To simplify the picture, and to make it understandable at face value, the stepwise regression analysis was done. In this technique the variable that correlates the highest with the criterion is entered first in the equation and then the next highest, until there is no reduction in the mean squares or until there is no further increase in R^2. The stepwise regression analysis was used to indicate the variables that have brought this small increase in R^2 by regressing all the variables in the best subsets of the aptitude, personality, interest, and school variables on the aggregate pass percentage. The results of the stepwise method appear on table 6.5.

TABLE 6.5

SUMMARY OF THE VARIABLES SELECTED BY MEANS OF THE STEPWISE REGRESSION FROM THE AAT, VIQ, HSPQ, AND SCHOOL VARIABLES WITH AGGREGATE PERCENTAGE PASS AS THE DEPENDENT VARIABLE

Step	Variable Entered	Multiple		Change* in R^2
		R	R^2	
1	AAT 3 (EV)	0,4128	0,1696	0,1696
2	SVTOT	0,5055	0,2555	0,0860
3	AAT 2 (VR)	0,5333	0,2844	0,0289
4	HSPQ B (Intelligence)	0,5445	0,2965	0,0121
5	AAT 5 (NC)	0,5542	0,3071	0,0106
6	AAT 4 (ERC)	0,5604	0,3140	0,0069
7	AAT 7 (ALB)	0,5642	0,3184	0,0044
8	AAT 6 (AW)	0,5672	0,3217	0,0034
9	VIQ 4 (Natural Science)	0,5688	0,3236	0,0018

* Change in R^2 means the amount of variance the R^2 would be reduced when the variable is removed from the equation.

To obtain the results appearing on table 6.5 all the best subsets of variables from the AAT, VIQ, and HSPQ measures, together with the school variable total, were regressed on the aggregate pass percentage (APP). From the HSPQ only Factor B (intelligence) entered the equation bringing about an increase of 0,013 in R^2 (c.f. the f^2 = 0,0135). From the VIQ only VIQ 4 (Natural Science) entered the equation thus bringing about an increase of 0,001 in R^2 (which is much smaller than the f^2 - value (0,0135) shown on table 6.4).

The school variable total has the second largest contribution to R^2 after English Vocabulary (AAT 3, EV), and there is no doubt about the practical significance of school variable total in academic prediction, as was also indicated by the f^2 - value of 0,068 on table 6.4.

The question that has to be answered concerns the effect size of the contribution of the affective variables to R^2. Put in practical terms, the question is; Is the HSPQ and the VIQ of practical significance in the prediction of academic achievement in the light of the results stated above. Having one variable entering the equation from the HSPQ and this variable being the cognitive variable (intelligence) and not even a personality factor, the answer is simply, no. From the VIQ, too only one variable entered the equation (VIQ 4 interest in natural sciences). This variable is not relevant to the pupils who do not take science subjects or those who are not interested in the natural sciences. The answer again is that the VIQ is of very small practical significance in academic prediction, especially to the students who do not learn science subjects.

On the basis of the above findings only the aptitude variables and the school variable total will be used in the modifier variable study as the control set.

6.5 THE MODIFIER VARIABLE STUDY

6.5.1 Introduction

The modifier variable study was conducted with the purposes of determining the influence, of the school quality, education stream, school situation, school type, and sex on R^2.

6.5.2 The influence of school quality on R^2

Subhypothesis 1: The quality of the school has significant influence on the prediction of standard 10 academic achievement.

To test this hypothesis, the sample was divided according to school quality using the following criteria: Very good is

SVTOT = 50 to 54. Medium is SVTOT = 27 to 49 and Weak is SVTOT = 18-26. The dependent variable was the aggregate pass percentage (APP) and the independent variables which formed the control set. The results of the analysis appear on table 6.6.

TABLE 6.6

ANALYSIS OF VARIANCE AMONG THE REGRESSION COEFFICIENTS OF GROUPS DIVIDED ACCORDING TO SCHOOL QUALITY WITH THE AGGREGATE PASS PERCENTAGE AS THE DEPENDENT VARIABLE, AND THE AAT PLUS THE SVTOT AS CONTROL SET

Source of variance	Degrees of freedom	Mean sum of squares	F-Ratio	P
Regressions over groups	16	1991,293	16.120	0.000
Regressions within groups	1787	123,530		
Summary statistics	All data as one group	Good schools	Medium schools	Weak Schools
N R R^2	1811 0,5093 0,2594	302 0,5884 0,3462	505 0,3757 0,1411	1004 0,3620 0,1311

The results on table 6.6 indicate that there are significant differences in R^2s for the very good, the medium, and the weak schools as shown by the F-ratio which is significant beyond 1% level. The highest R^2 (R^2 = 0,3462) for the very good schools and the R^2 s 0,1411 and 0,1311 for the medium and weak schools respectively, indicate that academic achievement is more predictable in good than in average or weak schools.

On the basis of the findings on table 6.6 the research hypothesis was accepted and the null hypothesis was rejected at 1% level of significance.

6.5.3 The influence of education stream on R^2

Subhypothesis 2: The education stream has significant influence on the prediction of standard 10 academic achievement.

In order to test this hypothesis the sample was divided according to education streams: general, science, and commercial. The dependent variable was the aggregate pass percentage and the control set of predictors consisted of the 'best' subset of the AAT variables plus the school variable total. The results of the analysis appear on table 6.7.

TABLE 6.7

ANALYSIS OF VARIANCE AMONG THE REGRESSION COEFFICIENTS OF GROUPS DIVIDED ACCORDING TO EDUCATION STREAMS WITH THE AGGREGATE PASS PERCENTAGE AS THE DEPENDENT VARIABLE AND THE AAT PLUS SVTOT FORMING THE CONTROL SET

Source of variance	Degrees of freedom	Mean sum of squares	F-Ratio	P
Regressions over groups	18	566,194	4,439	0,00001
Regressions within groups	1648	127,561		
Summary statistics	All data as one group	Commercial group	Science group	General group
N	1675	264	530	881
R	0,5606	0,6478	0,6552	0,4585
R^2	0,3143	0,4196	0,4293	0,2103

The results on table 6.7 indicate the F-value of 4,439 which is significant beyond 1% level. This indicates that the education stream has significant influence on the prediction of academic achievement of standard 10 pupils. On the basis of these findings the research hypothesis is accepted and the null hypothesis is rejected at 1% level of significance.

6.5.4 The influence of school situation on R^2

Subhypothesis 3: The school situation has significant influence on the prediction of standard 10 academic achievement.

To test this hypothesis the sample was divided into urban and rural schools. The dependent variable was the aggregate pass percentage, and the predictors consisted of the best subset of AAT variables plus the school variable total as the control set.

TABLE 6.8
ANALYSIS OF VARIANCE AMONG THE REGRESSION COEFFICIENTS OF GROUPS DIVIDED ACCORDING TO SCHOOL SITUATION WITH THE AGGREGATE PASS PERCENTAGE AS THE DEPENDENT VARIABLE AND THE AAT PLUS SVTOT AS CONTROL SET

Source of variance	Degrees of freedom	Mean sum of squares	F-Ratio	P
Regressions over groups	9	1474,319	11,794	0,0000
Regressions within groups	1657	125,011		
Summary statistics	All data as one group	Urban schools (1)	Rural schools (2)	
N R R^2	1675 0,5606 0,3143	1222 0,5547 0,3077	453 0,6732 0,4532	

The results on table 6.8 indicate an F-value of 11,794 which is significant beyond 1% level. This indicates that there are differences in the predictability of the academic achievement of urban and rural schools, thus indicating a significant influence of the school situation R^2. On the basis of these findings the research hypothesis is accepted and the null hypothesis is rejected at 1% level of significance.

6.5.5 The influence of school type on R^2

Subhypothesis 4: The school type has significant influence on the prediction of standard 10 academic achievement.

To test this hypothesis the sample was divided into boarding and day schools. The dependent and the independent variables forming the control set remained the same as in the testing of other subhypotheses. The results of the analysis appear on table 6.9.

TABLE 6.9
ANALYSIS OF VARIANCE AMONG THE REGRESSION COEFFICIENTS OF GROUPS DIVIDED ACCORDING TO SCHOOL TYPE WITH THE AGGREGATE PASS PERCENTAGE AS THE DEPENDENT VARIABLE AND THE AAT PLUS SVTOT FORMING THE CONTROL SET

Source of variance	Degrees of freedom	Mean sum of squares	F-Ratio	P
Regressions over groups	9	1652,708	13,325	0,0000
Regressions within groups	1659	124,035		
Summary statistics	All data as one group	Boarding schools (3)	Day schools (4)	
N R R^2	1677 0,5616 0,1353	676 0,6767 0,4580	1001 0,4206 0,1769	

The results on table 6.9 indicate that there are significant differences in the academic achievement of pupils attending boarding and day schools as revealed by the F-value of 13,325 which is significant beyond 1% level of significance. On the basis of these results the research hypothesis is rejected at 1% level.

6.5.6 The influence of sex on R^2

Subhypothesis 5: Sex has significant influence on the prediction of standard 10 academic achievement.

To test this hypothesis the sample was divided into males and females. The dependent variable and the control set of predictors remained the same for this statistical analysis too. The results of the analysis appear on table 6.10.

TABLE 6.10
ANALYSIS OF VARIANCE AMONG THE REGRESSION COEFFICIENTS OF GROUPS DIVIDED INTO BOYS AND GIRLS WITH THE AGGREGATE PASS PERCENTAGE AS THE DEPENDENT VARIABLE AND THE AAT PLUS SVTOT AS THE CONTROL SET

Source of variance	Degrees of freedom	Mean sum of squares	F-Ratio	P
Regressions over groups	9	290,771	1,607	0,10777
Regressions within groups	1794	130,546		
Summary statistics	All data as one group	Boys (1)	Girls (2)	
N R R^2	1812 0,5550 0,3081	859 0,5653 0,3196	953 0,5482 0,3005	

The results on table 6.10 indicate a very small F-value of 1,607 which is not significant even at 0,05 level. The level for the rejection of the null hypothesis is either 1% of 5%. On the basis of these set limits the null hypothesis is accepted and the research hypothesis is rejected. Therefore sex has no influence on the prediction of standard 10, aggregate pass percentage.

6.6 CROSS VALIDATION OF THE FINDINGS ON THE TESTING OF HYPOTHESIS THAT RELATE TO THE INFLUENCE OF SCHOOL SITUATION AND SCHOOL TYPE ACADEMIC ACHIEVEMENT

6.6.1 Introduction

In the study of literature it was stated that the differences between urban and rural schools disappear when the socio-economic status and intelligence are controlled. This led to the re-evaluation of the hypothesis relating to school situation and school type by controlling for the influence of aptitude on academic achievement. Attention will in the following paragraphs be paid to the testing of the hypothesis relating to school situation and school type on academic achievement when aptitude is controlled.

6.6.2 The differences between boarding and day schools in academic achievement when aptitude is controlled

Subhypothesis 6: When aptitude is controlled there is still a significant difference between boarding and day schools in academic achievement.

To test this hypothesis the sample was divided into boarding and day schools. The pupils in boarding and day schools were again paired according to the average stanine. Pupils obtaining average stanine 1 at one boarding school were compared with the pupils who obtained the same average stanine 1 at a day school. The same was done with average stanines of 2, 3, 4, 5, 6, 7, 8, and 9.

The statistics for testing this hypothesis were obtained by calculating the differences between the percentage passes in each pair of schools for all stanine groups (see table 6.11 to 6.16). A t-Test for correlated groups was applied to test for the significance of the differences between boarding and day schools and the results appear on table 6.17.

TABLE 6.11

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 1 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	1			1					1
Dlangezwa	(B)	15	8	4	1	2				7
Impumelelo	(B)	-	-	-	-	-				
Montebello	(B)	1					1			1
Ohlange	(B)	9	8	1						1
Siyamkela	(B)	6	6							0
Star of the Sea	(B)	3	1	2						2
Vukile	(B)	14	14							0
Total		49	37							12
Percentage			75,51							24,49
Dwaleni	(D)*	10	6	1	3					4
Ekucabangeni	(D)	4	4							0
Endakane	(D)	18	12	5	1					6
Igagasi	(D)	24	21	3						3
Khombindlela	(D)	47	42	5						5
Masibumbane	(D)	11	6	4	1					5
Mbusi	(D)	30	21	7	1	1				9
Mpophomeni	(D)	44	13	8	14	7	2			31
Thukela	(D)	6	5	1						1
Total		194	130							64
Percentage			67,01							32,99
Difference (B) - (D)			8,50							8,50

* (B) = Boarding school
(D) = Day school

TABLE 6.12

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 2 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	1			1					1
Dlangezwa	(B)	68	28	15	14	8	3			40
Impumelelo	(B)	3	1	1		1				2
Montebello	(B)	3					3			3
Ohlange	(B)	44	35	6	2	1				9
Siyamkela	(B)	61	47	12	2					14
Star of the Sea	(B)	14		5	6	3				14
Vukile	(B)	36	32	3		1				4
Total		230	143							87
Percentage			62,17							37,83
Dwaleni	(D)*	36	13	13	8	2				23
Ekucabangeni	(D)	21	10	8	2	1				11
Endakane	(D)	71	48	20	3					23
Igagasi	(D)	116	97	15	3	1				19
Khombindlela	(D)	104	70	23	9	2				34
Masibumbane	(D)	37	23	10	3	1				14
Mbusi	(D)	59	35	16	6	1	1			24
Mpophomeni	(D)	40	11	6	15	4	4			29
Thukela	(D)	42	33	5	4					9
Total		526	340							186
Percentage			64,63							35,36
Difference (B) - (D)			2,47							2,47

* (B) = Boarding school

(D) = Day school

TABLE 6.13

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 3 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	10		2	3	3	2			10
Dlangezwa	(B)	63	14	13	19	10	7			49
Impumelelo	(B)	7			4	2	1			7
Montebello	(B)	8				1	6	1		8
Ohlange	(B)	29	24	3	2					5
Siyamkela	(B)	67	38	15	9	3	2			29
Star of the Sea	(B)	8		1	4	1	2			8
Vukile	(B)	23	16	5	2					7
Total		215	92	39	43	20	20	1		123
Percentage			42,79							57,21
Dwaleni	(D)*	19	5	2	5	5	2			14
Ekucabangeni	(D)	19	6	7	5	1	1			13
Endakane	(D)	49	21	18	10					28
Igagasi	(D)	181	46	26	5	4				35
Khombindlela	(D)	138	26	7	3	2				12
Masibumbane	(D)	12	5	5	2					7
Mbusi	(D)	19	5	7	4	1	1			13
Mpophomeni	(D)	9	1			1	5	1	1	8
Thukela	(D)	41	35	4	2					6
Total		287	151	76	35	14	9	1	1	136
Percentage			52,61							47,39
Difference (B) - (D)			9,82							9,82

* (B) = Boarding school

(D) = Day school

TABLE 6.14

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 4 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	12		1	1	3	6	1		12
Dlangezwa	(B)	30	2		11	7	10			28
Impumelelo	(B)	6			3	1	2			6
Montebello	(B)	8				2	6			8
Ohlange	(B)	38	24	5	4	1	4			14
Siyamkela	(B)	35	9	12	8	4	2			26
Star of the Sea	(B)	2				1	1			2
Vukile	(B)	5	1	3	1					4
Total		136	36	21	28	19	31	1		100
Percentage			26,47							73,53
Dwaleni	(D)*	9	3	1	1	2	1	1		6
Ekucabangeni	(D)	5	1	2	1	2				4
Endakane	(D)	20	11	2	5	1	1			9
Igagasi	(D)	20	12	3	2	2	1			8
Khombindlela	(D)	9	3	1	4	1				6
Masibumbane	(D)	7	3	1	1	1	1			4
Mbusi	(D)	5	3	2						2
Mpophomeni	(D)	1					1			1
Thukela	(D)	9	6	2		1				3
Total		85	42	13	14	10	5	1		43
Percentage			49,41							50,59
Difference (B) - (D)			22,94							22,94

* (B) = Boarding school

(D) = Day school

TABLE 6.15

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 5 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	12	1			4	5	1	1	11
Dlangezwa	(B)	11	1		3	3	2	2		10
Impumelelo	(B)	1							1	1
Montebello	(B)	5					4	1		5
Ohlange	(B)	6				1				1
Siyamkela	(B)	10	5	1	4	1	4			10
Star of the Sea	(B)	1				1				1
Vukile	(B)	-	-	-	-	-	-	-	-	-
Total		46	7	1	7	10	15	4	2	29
Percentage			15,22							84,78
Dwaleni	(D)*	2			1			1		2
Ekucabangeni	(D)	1			1					1
Endakane	(D)	3	1			2				2
Igagasi	(D)	-	-	-	-	-	-	-	-	-
Khombindlela	(D)	1	-	-	1	-	-	-	-	1
Masibumbane	(D)	-	-	-	-	-	-	-	-	-
Mbusi	(D)	-	-	-	-	-	-	-	-	-
Mpophomeni	(D)	-	-	-	-	-	-	-	-	-
Thukela	(D)	3	1	2						2
Total		10	2	2	3	2		1		8
Percentage			20,00							80,00
Difference (B) - (D)			4,78							4,78

* (B) = Boarding school

(D) = Day school

TABLE 6.16

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 6 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Amanzimtoti	(B)*	6				1	3	1	1	6
Dlangezwa	(B)	5				2	3			5
Impumelelo	(B)	1						1		1
Montebello	(B)	-	-	-	-	-	-	-	-	-
Ohlange	(B)	6	3	2	1	1				3
Siyamkela	(B)	1		1						1
Star of the Sea	(B)	-	-	-	-	-	-	-	-	-
Vukile	(B)	1			1					1
Total		20	3	3	2	4	6	2	1	17
Percentage			15							85
Dwaleni	(D)*	1					1			1
Ekucabangeni	(D)	-	-	-	-	-	-	-	-	-
Endakane	(D)	-	-	-	-	-	-	-	-	-
Igagasi	(D)	-	-	-	-	-	-	-	-	-
Khombindlela	(D)	-	-	-	-	-	-	-	-	-
Masibumbane	(D)	-	-	-	-	-	-	-	-	-
Mbusi	(D)	-	-	-	-	-	-	-	-	-
Mpophomeni	(D)	-	-	-	-	-	-	-	-	-
Thukela	(D)	1				1				1
Total		2	0			1	1			2
Percentage			0							100
Difference (B) - (D)			15							15

* (B) = Boarding school
(D) = Day school

TABLE 6.17

A t-TEST FOR THE DIFFERENCES BETWEEN BOARDING (B) AND DAY (D) SCHOOLS IN PERCENTAGE PASSES FOR EACH STANINE GROUP

AAT Average Stanine	Pass percentage		Differences	
	Boarding	Day	D	D^2
1	24,49	32,99	8,50	72,25
2	31,83	35,36	2,27	5,1529
3	57,21	47,39	9,82	96,4324
4	73,53	50,59	22,94	526,2436
5	84,78	80,00	4,78	22,8484
6	85,00	100,00	15,00	225,00
			63,31	947,9273

$$t = \frac{\sqrt{N - 1}\ \Sigma D}{\sqrt{N\ \Sigma D^2 - (\Sigma D)^2}}$$

$$= \frac{\sqrt{5} \times 63,31}{\sqrt{6 \times 947,93 - (63,31)^2}}$$

$$= \underline{3,46}$$

If df - 5, p = 2,571 at 5% level and 4,032 at 1% level.
Therefore p < 3,46 at 5% and p > 3,46 at 1% level.

The results on tables 6.11 to 6.16 indicate that, with the exception of average stanine 1 the boarding schools had more passes than day schools when aptitude was controlled. The results of the t-test on table 6.17 indicate a t-value of 3,46 which is larger than a p-value of 2,571 at 5% level of significance and smaller than p = 4,032 at 1% level of significance for a two-tail test. From these results it can be concluded that there are significant differences in the academic achievement of standard 10 pupils attending boarding and day schools even when aptitude is controlled. The research hypothesis is therefore accepted and the null hypothesis rejected at 5% level of significance.

6.6.3 The differences between urban and rural schools in academic achievement when aptitude is controlled

Subhypothesis 7. When aptitude is controlled there is still a significant difference between urban and rural schools in academic achievement.

To test this subhypothesis the schools were paired according to average stanine 1 to 5 and the differences between the percentage passes for each category were calculated. The results indicate higher percentage passes in boarding schools than in day schools, with the exception of average stanine 1 and 6 (see tables 18 to 22). A t-Test for the significance of the difference between the correlated groups was calculated and the result appear on table 6.23.

TABLE 6.18

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 1 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Endakane	(U)*	18	12	5	1					6
Khombindlela	(U)	47	42	5						5
Mpophomeni	(U)	44	13	8	14	7	2			31
Thukela	(U)	6	5	1						1
Igagasi	(U)	24	21	3						3
Total		139	93	2	15	7	2			46
Percentage			66,91							33,09
Dwaleni	(R)*	10	6	1	3					4
Ekucabangeni	(R)	4	4							0
Masibumbane	(R)	11	6	4	1					5
Mbusi	(R)	30	21	7	1	1				9
Total		55	37	12	5	1				18
Percentage			67,27							32,73
Difference (U) - (R)			0,36							0,36

* (U) refers to urban schools
(R) refers to rural schools

TABLE 6.19

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 2 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Endakane	(U)*	71	48	20	3					23
Khombindlela	(U)	104	70	23	9	2				34
Mpophomeni	(U)	40	11	6	15	4	4			29
Thukela	(U)	42	33	5	4					9
Igagasi	(U)	116	97	15	3	1				19
Total		373	259							114
Percentage			69,44							30,56
Dwaleni	(R)*	36	13	13	8	2				23
Ekucabangeni	(R)	21	10	8	2	1				11
Masibumbane	(R)	37	23	10	3	1				14
Mbusi	(R)	59	35	16	6	1	1			24
Total		153	81							72
Percentage			52,94							47,06
Difference (U) - (R)			16,50							16,50

* (U) = urban schools

(R) = rural schools

TABLE 6.20

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 3 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Endakane	(U)*	49	21	18	10					28
Khombindlela	(U)	138	26	7	3	2				12
Mpophomeni	(U)	9	1		1	5	1	1		8
Thukela	(U)	41	35	4	2					6
Igagasi	(U)	81	46	26	5	4				35
Total		218	129							89
Percentage			59,17							40,83
Dwaleni	(R)*	19	2	2	5	5	2			14
Ekucabangeni	(R)	19	6	7	4	1	1			13
Masibumbane	(R)	12	5	5	2					7
Mbusi	(R)	19	9	6	3	1				10
Total		69	25	20	14	7	3			44
Percentage			36,23							63,77
Difference (U) - (R)			22,94							22,94

* (U) = urban schools

(R) = rural schools

TABLE 6.21

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 4 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Endakane	(U)*	20	11	2	5	1	1			9
Khombindlela	(U)	9	3	1	4	1				6
Mpophomeni	(U)	1					1			1
Thukela	(U)	9	6	2		1				3
Igagasi	(U)	20	12	3	2	2	1			8
Total		59	32							27
Percentage			54,24							45,76
Dwaleni	(R)*	9	3	1	1	2	1	1		6
Ekucabangeni	(R)	5	1	1	1	2				4
Masibumbane	(R)	7	3	1	1	1	1			4
Mbusi	(R)	5	3	2						2
Total		26	10							16
Percentage			38,46							61,54
Difference (U) - (R)			15,78							15,78

* (U) = urban schools

(R) = rural schools

TABLE 6.22

FREQUENCY DISTRIBUTION OF SYMBOLS OF STANDARD 10 PUPILS WHO OBTAINED AVERAGE STANINE 5 IN THE AAT TOTAL

Schools		Total	Fail	F	EE	E	D	C	B	Pass
Endakane	(U)*	5	1			2				3
Khombindlela	(U)	1			1					1
Mpophomeni	(U)	-	-	-	-	-	-	-	-	-
Thukela	(U)	3	1	2						3
Igagasi	(U)	-	-	-	-	-	-	-	-	-
Total		9	2	2	1	2				7
Percentage			22,22							77,78
Dwaleni	(R)*	2			1			1		2
Ekucabangeni	(R)	1			1					1
Masibumbane	(R)	-	-	-	-	-	-	-	-	-
Mbusi	(R)	-	-	-	-	-	-	-	-	-
Total		3		2	1	2				3
Percentage			0							100
Difference (U) - (R)			22,22							22,22

* (U) = urban schools

(R) = rural schools

TABLE 6.23

A t-TEST FOR THE DIFFERENCES BETWEEN URBAN (U) AND RURAL (R) SCHOOLS IN PERCENTAGE PASSES FOR EACH STANINE GROUP

AAT Average Stanine	Pass percentage		Differences	
	Urban Schools	Rural Schools	D	D^2
1	39,09	32,73	0,36	0,1296
2	30,56	47,06	16,50	272,259
3	40,83	63,77	22,94	526,2436
4	45,76	61,54	15,78	249,0084
5	77,78	100,00	22,22	493,7284
			77,80	1541,36

$$t = \frac{\sqrt{N - 1}\ \Sigma D}{\sqrt{N\ \Sigma D^2 - (\Sigma D)^2}}$$

$$= \frac{\sqrt{4} \times 77,80}{\sqrt{5 \times 77,80 - (77,80)^2}}$$

$$= \underline{3,8260}$$

If df = 4, p = 2,776 at 5% and 4,604 at 1%, therefore
p < 3,8260 at 5% level.

The results of the analysis of the number of passes the urban and rural schools had, for the pupils obtaining the same average stanine, are as follows: with the exception of average stanine 1 (see table 6.18 to 6.22) the rural schools had more passes in standard 10 than urban schools. On the basis of the t-test, which indicated a t-value of t = 3,8260 the research hypothesis which states that even when aptitude is controlled the differences between the urban and rural schools in academic achievement exists is accepted and the null hypothesis is rejected at 5% level of significance.

6.7 DISCUSSION OF RESULTS

6.7.1 The best predictors of academic achievement

The results of testing the first main hypothesis, on the best predictors of academic achievement, indicated that the best subset of aptitude variables explain the largest amount of variance in the aggregate pass percentage in comparison with affective and school variables. The aptitude variables are some of the cognitive variables that have been studied for their predictive validity. The results of this study agree with the findings of the previous studies that the cognitive variables are the best predictors of academic achievement. For instance the 'best' subset consisting of the aptitude variables explained 26% (R^2 = 0,26) of variance in academic achievement. After a review of the predictive validity of cognitive variables Lavin (1968) came to a conclusion that the cognitive variables explain about 25% (R^2 = 0,25) of variance in academic achievement, which is almost equal to the findings of this study.

With specific reference to intelligence, Bloom (1976) reported the R^2 of about 0,25 between intelligence and achievement and the R^2 of about 0,50 between cognitive entry behaviours and achievement. Van der Westhuizen (1987) found R^2 = 0,2536 between aptitude and standard 10 aggregate achievement.

From the results of this study it can be generalised that the aptitude variables are the best predictors of standard 10 academic achievement in comparison with affective and school variables.

6.7.2 Additiveness of the affective variables to cognitive variables in the prediction of standard 10 academic achievement.

Previous studies have established that the cognitive variables have the largest contribution to R^2. This investigation aimed

at determining whether the addition of affective variables (i.e. interest and personality) can bring about a statistically significant increase in R^2, and whether the contribution is significant for practical educational purposes.

The results of multiple regression indicated that the best subset of the interest variables explain about 2% (R^2 = 0,02) of variation in the aggregate pass percentage in standard 10. The best subset of (HSPQ) personality variables explained about 9% (R^2 = 0,09) of variance in standard 10 academic achievement (APP). Scott (1984) found the R^2 of 0,0476 between the HSPQ variables and standard 10 achievement (APP), which is slightly smaller than the one obtained in this study. As was remarked by Van der Westhuizen (1987) (see paragraph 3.3.5) the interest variables explain less variance in the APP than the personality variables.

To determine the additiveness of the affective variables to the cognitive variables, the best subsets of the interest and the personality variables were added to aptitude variables. In both cases there was an increase of 0,01 and 0,02 in R^2 respectively. The results agree with those of Scott (1984) who also found that personality variables bring about an increase of 1% (in R^2) when added to control set of variables. The results of this study also agree with the results obtained by Van der Westhuizen (1987) who found an increase of 0,0146 (approximately 1%) when personality variables were added to a control set of variables. Van der Westhuizen (1987) also found an increase of approximately 1% (0,0057) when the interest variables were added to the control set of variables. Van der Westhuizen (1987:325) found the contribution of interest and personality variables to R^2 to be of small educational value. The same conclusion was arrived at by Scott (1984) with respect to personality variables only. In this study too, the evaluation of the increase in R^2, as a result of the addition of affective variable to aptitude variables, with the use of f^2 formula and the application of Cohen's criteria for size effect, the increase was found to be

of small practical value. Similar conclusions were also arrived at by Bloom (1976:194) that the affective entry characteristics contributed relatively little over what has already been contributed by cognitive entry behaviours.

In this study a step further was taken to determine which of the personality factor(s) make(s) this small but significant contribution to R^2. Using the stepwise regression only factor B (intelligence) entered the equation. With the exclusion of factor B the rest of the factors would not contribute significantly to R^2. A similar conclusion was arrived at by Schoeman (1976:9) who stated that besides factor B the personality variables have a correlation which is less than R = 0,4 with academic achievement.

Concerning the vocational interest, only the interest in the natural science as a variable entered the stepwise regression equation with the smallest contribution of 0,001 to R^2. This contribution is statistically significant but it is of very little practical value in education. The same conclusion was arrived at by Von Mollendorf (1978:279) and also by Van der Westhuizen (1987:262).

As a result of the very small effect size of both personality and interest variables, the two measures (of interest and personality) were not included in the control set of predictors used in the modifier variable study. To put it in simpler terms, it is not practically valuable to let pupils respond to the items relating to HSPQ B (intelligence) and VIQ 4 (Natural Sciences) only in the two inventories and leave out the rest of the items unanswered for the purpose of obtaining predictor scores.

6.7.3 The additiveness of school variables to cognitive variables in the prediction of standard 10 academic achievement

The third main hypothesis which states that the school variable total is additive to cognitive variables in the prediction of academic achievement was accepted. The results of this study agree mainly with the results obtained by Venter (1984) who found that the total school environment has even more influence on achievement than intelligence (see table 4.3). The results of this study also agree with the results of the study that was conducted by Brookover et al. (1977), which investigated among other variables the influence of the school social system variables on mean school achievement using a random sample of 68 Michigan Elementary Schools. All the 21 variables were used in the multiple regression analysis. Using the multiple stepwise regression analysis the result indicated R^2 - 0,858 which is explained by all the 21 variable (Brookover, et al., 1977:313).

The results of this study confirm the previous studies by Brookover (1977) and Venter (1984) that the school variable total contributes significantly to R^2. From the results of the analysis of this study it can be generalised that the school variable total has significant influence on academic achievement.

In the following paragraph a discussion of the variables that account for the variation between the schools in academic achievement will be made.

6.7.4 The influence of modifier variables on R^2

6.7.4.1 Influence of school quality on R^2

The first subhypothesis that the school quality has significant influence on R^2 directed inquiry into the influence of school

quality (very good, medium, and weak schools) on academic achievement. The results of this investigation indicated that there are significant differences between the R^2s for the schools of different quality. These results agree with those obtained by Jencks and Brown (1975) using the sample of the best, average and worst schools. The study of the 10 best schools in England indicated that these ten best schools achieved better than average generally. The between school variance that is reported in this study and in the cited studies, was also established by Kellaghan et al. (1979).

From the results of this study it can be stated that school quality has significant influence on academic achievement. The implication is that the pupils with the same intelligence or aptitude or cognitive entry behaviours would attain higher achievement grades in very good schools than they would in weak schools (see Jencks and Brown, 1975:282).

6.7.4.2 Influence of education stream on R^2

The second subhypothesis investigated the influence of the academic stream on academic achievement. The results of the investigation indicated that there are significant differences between the R^2s for the different education streams. There is no study, among those which were available, that investigated the influence of the education stream on R^2. Von Mollendorf (1978) divided his sample into two streams: Mathematics and non-Mathematics. The mathematics group consisted of those students who answered the number comprehension test (AAT 5) and the Mathematics proficiency test (AAT 10). Those who did not write these two aptitude tests were grouped as non-Mathematics group. The multiple regressions based on this grouping were not calculated, and therefore the comparisons with the present study are not possible (Von Mollendorf, 1978:283). In this study the large R^2s are for the science and the commercial streams (0,43 and 0,42 respectively) and the R^2 for the general stream was the smallest (R^2 = 0,21).

On the basis of the very significant differences between the R^2s for the three streams it can be generalised that the education stream has significant influence on R^2.

6.7.4.3 The influence of school situation on R^2

The third subhypothesis directed an inquiry into the influence of the school situation (urban/rural) on R^2. The results of this investigation indicated significant differences between the R^3s for the urban and rural schools. The rural schools had a larger R^2 (0,43) than the urban schools (R^2 = 0,31) with the F-ratio which is significant beyond 1% level.

The results of this investigation, to some extent, contradict the findings of previous studies. The results of previous studies showed a tendency of urban schools to perform better than rural schools although no definite conclusion could be arrived at regarding which schools do better (see paragraph 4.2.2.3). This tendency of urban schools to do better than rural schools was also reported by Venter (1984:45) after a review of literature. The results of this study contradict the results obtained by Van der Westhuizen (1987:281) who found no significant difference between the R^2s for urban and rural pupils. Van der Westhuizen concluded that the residential area does not serve as a moderator variable in the prediction of standard 10 achievement; but it serves as one in this study.

As a result of the size of the F-value and its significance beyond 1% level, a generalization can be made from the results of this study that in rural schools academic achievement is better predictable than in urban schools (a note should be made that the study was made while there was unrest in the urban areas and the rural schools were better places for learning).

6.7.4.4 The influence of school type on R^2

The fourth subhypothesis directed an inquiry into the influence of school type on R^2. School type referred to boarding and day schools. The results of the regression analysis indicated a significant statistical difference between the R^2s for boarding and day schools, with boarding schools having a larger R^2 = 0,45 and day schools a smaller R = 0,18. These results indicate that the academic achievement of pupils in boarding schools is more predictable than that of pupils in day schools.

In this regard the study by Marklund (1969) in Sweden, on the effect of travelling to and from school on academic achievement did not show the differences which were statistically significant. This study by Marklund does not contribute much towards the understanding of the differences in the achievement of pupils in boarding and day schools, in terms of school situation, teacher quality, teacher - pupil ratio, staff turn-over, physical facilities, class and school size, etc, as detailed on table 5.3. According to Cohen and Manion (1981:394) the superior performance of boarding schools is attributable to the physical facilities that are available in boarding schools.

In the case of KwaZulu schools the large R^2 for boarding schools can be attributed to the largest school variable total (54) which indicates the effectiveness of the following variables; hostels, laboratories, libraries, principal's leadership and organisation, and the dedication of staff, on academic achievement (see table 5.3). Another contributory factor is small class size (standard 10) in boarding schools as compared to large standard 10 classes in day schools. There seems to be no marked differences in school size, teacher qualifications, school situation and teacher-pupil ratio between the boarding and the day schools sampled for this study (see table 5.3).

The results of this study are supported by the fact that the average percentage of passes in the boarding schools, that were sampled, is larger than that of the day schools (see table 5.3).

On the basis of the statistical significance of the differences in R^2 between boarding and day schools it can be generalised that boarding schools perform better than day schools.

6.7.4.5 The influence of sex on R^2

The fifth subhypothesis directed the investigation into the influence of sex on R^2. Sex was operationalised in terms of boys and girls. The results of the statistical analysis indicated no statistically significant differences between the R^2s for boys and girls. Van der Westhuizen (1987:276-277) did not calculate the variance analysis of the differences between the R^2s for boys and girls (using 1R program) with respect to standard 10 aggregate achievement, to have comparisons with this study. The results of the variance analysis with respect to Afrikaans and History showed no significant differences between the R^2 for boys and that for girls, but there was a significant difference with respect of the achievement in mother tongue (Van der Westhuizen, 1987:278). From the results of this present study it can be generalised that there are no statistically significant differences between boys and girls in the aggregate pass percentage of standard 10 pupils in KwaZulu schools.

6.7.5 Cross validation of the findings with respect to the influence of school situation and school type on academic achievement

6.7.5.1 Introduction

During the review of literature it was constantly reported in various studies that when the socio-economic status and

intelligence are controlled the differences between urban and rural schools disappear (see paragraph 4.2.2.2). The same was reported with respect to class and school size (see paragraph 4.2.3.5). It is therefore necessary to control for aptitude in order to determine the influence of school situation and school type on academic achievement.

6.7.5.2 The differences between boarding and day schools in academic achievement when aptitude is controlled

The results of testing the hypothesis that there are no differences between boarding and day schools when aptitude is controlled indicate that there are significant differences between boarding and day schools in academic achievement even when aptitude is controlled. The evidence that was cited in chapter 4 that when intelligence and the socio-economic status is controlled the differences between the schools disappear is not supported in this study; although the variables controlled are not exactly the same. As in other less industrial countries (cited in chapters 1 and 4) the school appears to have a significant influence on the academic achievement prediction.

Although the findings by Venter (1984) are not very comparable with the results of this study, in terms of study population which learns in the mother language and the general socio-economic status of the first as against that of the third world, the results, however, confirm the findings by Venter (1984) in that the school has influence on academic achievement. Brookover (1978) had also found, in his study, that the schools do bring about a difference in academic achievement.

From the evidence of this present study it can be generalised, as was also supported by previous studies, that the school has significant influence on academic achievement.

6.7.5.3 The differences between urban and rural schools in academic achievement when aptitude is controlled

The null hypothesis which states that the differences in academic achievement between urban and rural schools disappeares when aptitude is controlled, was rejected at 5% level of significance. To evaluate these findings, aptitude was controlled and the schools were paired according to situation and compared according to the number of passes. The t-test was also applied to test for the significance of the differences.

The results indicated that there were differences between the urban and rural schools in academic achievement even when aptitude was controlled. From the results of this investigation it can be generalised that there are significant differences between the academic achievement of urban and rural schools even when aptitude is controlled.

The hypothesis was stated in such a way that a two-tailed test of the differences between the means was required and the results were interpreted as such. It is, however, important in this discussion paragraph to indicate the direction of the differences for educational purposes. Here specific reference is made to the percentage of passes in boarding and day schools as reflected on tables 6.18 to 6.22 and as summarized on table 6.23. In all pairs, except for average stanine 1, the rural schools had a higher percentage of passes than urban schools. This does not agree with the findings by Engelbrecht (1972:280) who found that more successful pupils are found in urban areas.

The conclusions by Dent (1946:23), Silver (1973:359), Randwa and Fu (1973:300), and Blau (1981:10) all cited in paragraph 4.2.2 are not in agreement with the findings of this study. The findings of this study support the conclusion that was made by Marklund (1969:311) that, conditions being the same, the rural schools provide as good an environment as the urban schools.

Another feature that is revealed by tables 6.19 to 6.23 is that class size in urban schools is generally larger than in rural schools. This might have contributed to the better performance in rural schools than in urban schools. In the study of literature (see paragraph 4.2.4.3) no conclusion was arrived at concerning the differences between class size and academic achievement. It should also be noted that, as in previous studies urban schools are larger than rural schools as in this sample (see table 5.3).

6.7.6 Results of a cross validation study of the best subset of the aptitude (AAT) predictors

6.7.6.1 Introduction

In order that the results of this study are of practical value the external validity should be determined. The external validity can be determined by means of discriminant analysis. Discriminant analysis requires that the prediction model be applied to a different sample in order to determine whether similar results can be obtained. For the purpose of this study the 'best' subset of the Academic Aptitude Test (AAT) predictors were applied to the same sample of schools but in 1985. This was also repeated with the 1986 standard 10 population. The results are reported briefly below.

6.7.6.2 Results of the multiple regression of the 'best' subset of aptitude predictors on the aggregate pass percentage of the 1985 sample

TABLE 6.24

MULTIPLE REGRESSION OF THE APP ON AAT BEST SUBSET USING 1985 SAMPLE

Variable (AAT)	Regression coefficient	T-value	Standard error
Non-Verbal Reasoning	0,01	0,54	0,02
Verbal reasoning	0,10	8,56	0,02
English vocabulary	0,21	9,92	0,02
English Reading Comprehension	0,11	5,48	0,02
Number comprehension	0,20	10,79	0,02
Afrikaanse woordeskat	-0,02	-0,75	0,03
Afrikaanse leesbegrip	0,11	4,76	0,02
Constant	6,56	8,29	0,79

ANALYSIS OF VARIANCE

Source	df	Mean squares	F-value	P-value
Regression	7	25002,41	173,38	0,00
Residual	2258	144,21		
Total	2265			

Residual Standard Error	12,01
R-Squared	0,35
Multiple Correlation coefficient	0,59
Durbin-Watson statistic	1,42

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The same 17 schools sampled in 1983 formed the cross validation sample in 1985. The 17 schools formed 9% of the 185 high schools. The 2265 pupils in the 17 schools formed 12% of 19592 pupils of the 1985 population. The reason for using the same schools, as were sampled in 1983 was to control the influence of school type, school situation and to a certain extent of school quality on the prediction of academic achievement.

From table 6.24 the results of multiple regression indicate that the 'best' subset of aptitude (AAT) variables explain 0,35 of variance in academic achievement. The R^2 obtained in 1985 with a different sample of pupils (but in the same sample of schools) is larger than that which was obtained in 1983. This indicated an improvement in the predictability of the standard 10 academic achievement in the sampled schools, two years after 1983.

The variation between the schools was controlled by keeping to the same sample of 17 schools. The results do not prove generalisability to the population with a wider variation (in school quality) between schools and a much wider variation in student population considering the ratio of boarding to day schools which is 1:7, urban to rural schools which is 1:10 and many other extraneous variables which were not controlled in this study.

Applying the 'best' subset of the aptitude predictors to the standard 10 population in 1986 was aimed at determining the extent to which the aptitude test scores (of the 'best' subset) correlate with the overall academic achievement of the population of standard 10 pupils. The results of the multiple regression analysis appear on table 6.25 below.

6.7.6.3 Results of the multiple regression of the 'best' subset of the aptitude predictors on the aggregate pass percentage of the 1986 population

TABLE 6.25

MULTIPLE REGRESSION OF THE AAT 'BEST' SUBSET USING 1986 STANDARD 10 DATA (KwaZulu population)

Dependent Variables	Set of independent variables								R	R^2	N
		AAT 1	AAT 2	AAT 3	AAT 4	AAT 5	AAT 6	AAT 7			
APP		NVR	VR	EV	ERC	NC	AW	ALB	,41	,17	14 449
APP	Size	NVR	VR	EV	ERC	NC	AW	ALB	,43	,19	14 449
APP	Qlty	NVR	VR	EV	ERC	NC	AW	ALB	,43	,19	14 449
Zulu		NVR	VR	EV	ERC	NC	AW	ALB	,28	,08	14 605
Afrikaans		NVR	VR	EV	ERC	NC	AW	ALB	,44	,20	14 589
English		NVR	VR	EV	ERC	NC	AW	ALB	,52	,27	14 587
Biology		NVR	VR	EV	ERC	NC	AW	ALB	,38	,14	13 221
Science		NVR	VR	EV	ERC	NC	AW	ALB	,42	,18	2 257
Maths		NVR	VR	EV	ERC	NC	AW	ALB	,49	,24	5 203

Key:

AAP refers to the aggregate pass percentage obtained by the pupils in standard 10 examinations. The percentages were arrived at by converting the pass or fail symbol to a percentage using a table. The same was applied to the symbols obtained by the pupil in each examination subject.

SIZE refers to the number of standard 10 pupils per class.

AAT refers to the Academic Aptitude Test Battery NVR = non-verbal reasoning, VR = Verbal reasoning, EV = English vocabulary, ERC = English reading comprehension, NC = Number comprehension, AW = Afrikaanse woordeskat, ALB = Afrikaanse leesbegrip. The standard scores were used in the regression analyses.

QLTY refers to school quality which is the average pass percentage of the pupils in a particular school over a number of years as from 1983.

The above table shows the multiple regression analysis of 14605 (73%) standard 10 pupils with all data. The results on table 6.25 indicate R^2 = 0,17 when the aggregate pass percentage is regressed on the 'best' subset of aptitude predictors. When school size was added to the aptitude predictors the R^2 increased to 0,19. The same increase was obtained when school quality (i.e. average performance of the school over four years) was added to the aptitude predictors. The variance explained by the 'best' subset of predictors is very small and this indicates that in the population about 81% of variance is explained by other variables than aptitude. A larger number of weak schools than good schools in the population is one of the causes of low variance explained in academic achievement (see also table 6.6).

A very low R^2 obtained when the population was used necessitated a finer analysis of the number of passes per average stanine.

The technique of discriminant analysis whereby the R^2 for pass and fail can be calculated was not possible in this study since fail had no variations, only FAIL was available as an overall symbol of achievement (see table 5.15). The multiple correlation between FAIL (i.e. 16) and the aptitude scores were impossible to calculate because of the absence of the variation in the criterion. It was, therefore, necessary to calculate the percentage of passes in each average stanine group. The results of such an analysis would indicate the chances of academic success of the pupils obtaining a particular average stanine.

The following table indicates the achievement tendency in each stanine group for the years 1983 to 1987.

6.7.6.4 Percentage distribution of standard 10 symbols per average stanine group for a period of 5 years from 1983 to 1987

TABLE 6.26

PERCENTAGE DISTRIBUTION OF SYMBOLS PER AVERAGE STANINE

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 1										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	67,0	19,2	8,4	4,2	1,2				33,0	240
1984	85,2	11,1	3,0	0,4	0,1				14,8	1 953
1985	82,0	12,2	5,0	2,0	,3				18,0	3 430
1986	62,1	20,6	11,6	4,0	1,0	0,01	0,01		37,9	4 187
1987	61,1	21,6	10,8	5,3	1,14	0,09			38,9	7 910
Average	71,5	16,9	7,8	3,1	0,74	0,05	0,01		28,5	3 544

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 2										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	62,0	21,0	10,0	4,0	2,0				38,0	724
1984	69,0	20,7	7,6	2,4	0,2	0,1			31,0	6 519
1985	68,0	17,0	9,0	4,0	2,0				32,0	8 740
1986	47,0	24,5	17,4	8,2	2,0	0,1			53,0	7 194
1987	41,2	24,5	18,5	10,8	4,9	0,1			58,6	3 673
Average	57,4	21,5	12,5	5,8	2,3	0,0			42,5	5 370

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 3										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	48,0	23,0	16,0	7,0	5,0	1,0			52,0	501
1984	51,5	25,0	14,0	6,0	2,5	1,0			48,5	3 795
1985	46,0	22,0	14,0	10,0	7,5	0,5			54,0	3 570
1986	28,0	19,5	24,2	17,2	10,5	0,6			72,0	2 944
1987	24,9	14,7	23,6	19,9	14,9	2,0			75,1	2 468
Average	39,7	20,8	18,3	12,0	8,0	1,0			60,3	2 656

TABLE 6.26 (Continued)

PERCENTAGE DISTRIBUTION OF SYMBOLS PER AVERAGE STANINE

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 4										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	36,0	17,0	18,0	13,0	15,0	1,0			64,0	221
1984	41,0	19,0	17,0	14,0	9,0	0,0	0,0		59,0	1 065
1985	20,0	10,0	20,0	25,0	21,5	4,0	0,0		79,0	669
1986	12,5	7,1	21,5	25,7	28,5	4,6	0,1		87,5	603
1987	9,5	4,5	15,9	23,4	36,3	9,9	0,5		90,5	402
Average	23,8	11,5	18,4	20,2	21,9	3,9	0,1		76,0	592

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 5										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	16,0	4,0	18,0	24,0	27,0	9,0	2,0		84,0	56
1984	12,5	11,5	16,4	22,0	30,5	6,3	0,8		87,5	231
1985	7,0	2,9	12,0	20,0	35,1	21,0	2,0		93,0	107
1986	2,2	8,0	15,0	19,3	37,1	15,0	3,4		97,9	88
1987	3,9	1,3	10,5	13,2	40,7	23,6	6,8		96,1	76
Average	8,3	5,5	14,4	19,7	34,0	14,9	3,0		91,6	112

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 6										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983	13,0	13,0	9,0	22,0	30,0	9,0	4,0		87,0	23
1984	5,4	16,2	10,8	8,1	40,5	19,0	0,0		94,6	37
1985	10,0	0,0	0,0	20,0	30,0	25,0	15,0		90,0	20
1986	0,0	7,0	7,0	20,0	33,0	33,0	0,0		100,0	15
1987	10,0	0,0	0,0	10,0	50,0	30,0	0,0		90,0	10
Average	7,7	7,2	5,3	16,0	36,7	23,2			93,3	21

PERCENTAGE DISTRIBUTION OF SYMBOLS FOR AVERAGE STANINE 7										
YEAR	FAIL	F	EE	E	D	C	B	A	PASS %	N(Pass)
1983					33,3				100	3
1984						50,0	50,0		100	2
1985				20,0		60,0	20,0		100	5
1986					100,0				100	1
1987					33,34	66,7			100	3
Average	0	0	0	20,0	55,5	58,9	35,0		100	2,8

TABLE 6.27

SUMMARY OF THE ACHIEVEMENT TENDENCIES OVER 5 YEARS

AVERAGE STANINE	X N 5 yrs	1983 (sample) % PASSES	AVERAGE % PASSES (5 yrs)	AVERAGE % PASSES (1986 & 87)
1	3 544	33,0	28,5	38,4
2	5 370	38,0	42,5	55,8
3	2 656	52,0	60,3	73,6
4	592	64,0	76,0	88,5
5	112	84,0	91,6	92,0
6	21	87,0	93,3	95,0
7	3	100,0	100,0	100,0
8	-	-	-	-
9	-	-	-	-

The results on table 6.26 indicate that:

i the standard 10 pupils who obtain average stanine 1 have about 28,5% chances of passing at the end of the year;

ii the standard 10 pupils who obtain average stanine 2 have about 42,5% chances of passing at the end of the year;

iii the standard 10 pupils who obtain average stanine 3 have about 60,3% chances of passing at the end of the year;

iv the standard 10 pupils who obtain average stanine 4 have about 76,0% chances of passing at the end of the year;

v the standard 10 pupils who obtain average stanine 5 have about 91,6% chances of passing at the end of the year;

vi the standard 10 pupils who obtain average stanine 6 have about 93,3% chances of passing at the end of the year;

vii the standard 10 pupils who obtain average stanine 7 have 100% chances of passing at the end of the year as indicated by the average for 5 years.

The averages for the last 2 years, appearing on table 6.27 indicate an upward trend in the achievement of pupils. This was forecast by the larger R^2 obtained in 1985 (see table 6.24).

The analysis on table 6.27 also indicates that there has been no improvement in the achievement of pupils in the Academic Aptitude Tests (AAT) as shown by majority of students who obtain less than average stanine 4, over the period of 5 years.

On the contrary academic achievement has improved probably because of the availability of the aptitude test scores at the beginning of the year. This is illustrated in the histograms for the past 5 years.

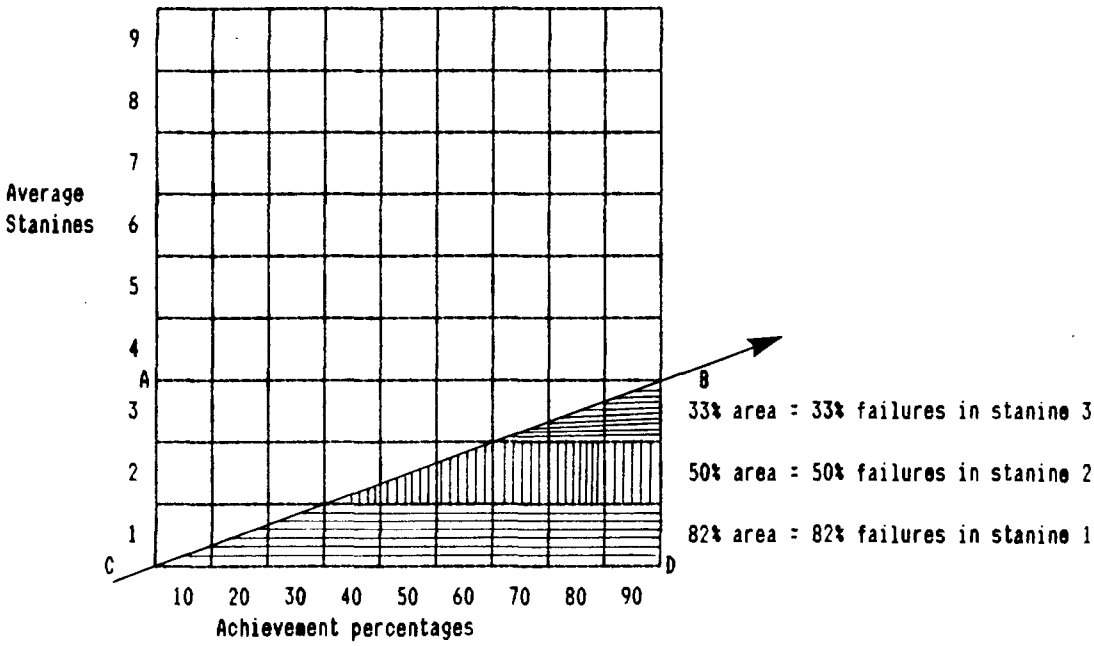
6.7.6.5 Histograms showing the percentage of passes per average stanine group during the years 1983 to 1987 in standard 10

The expected percentage of passes is based on the assumption that if 40% (symbol E) is equivalent to stanine 4 all pupils who obtain average stanine 4 should pass, hence the minimum for a pass in standard 10 is $33^1/_3$%. The following rectangle shows the percentage of the total area occupied by pass and fail if the diagonal line is drawn from C through B. Adjustment was made for stanine 3 by raising the number of failures from 18% (equal to 18% area) to 33% due to previous observations.

Figure 6.11 illustrates how the intervals in the expectancy table (see annexure E) were arrived at on the basis of the above assumptions. The expectancy tables were used since 1985 to correlate the average aptitude score with the aggregate pass percentage (APP) of KwaZulu standard 10 pupils in each school. This was done with the purpose of determining the external validity of the best subset of aptitude predictors.

FIGURE 6.1

RECTANGLE SHOWING THE TOTAL AREA OCCUPIED BY THE PERCENTAGE OF PASSES AND FAILURES PER AVERAGE STANINE GROUP

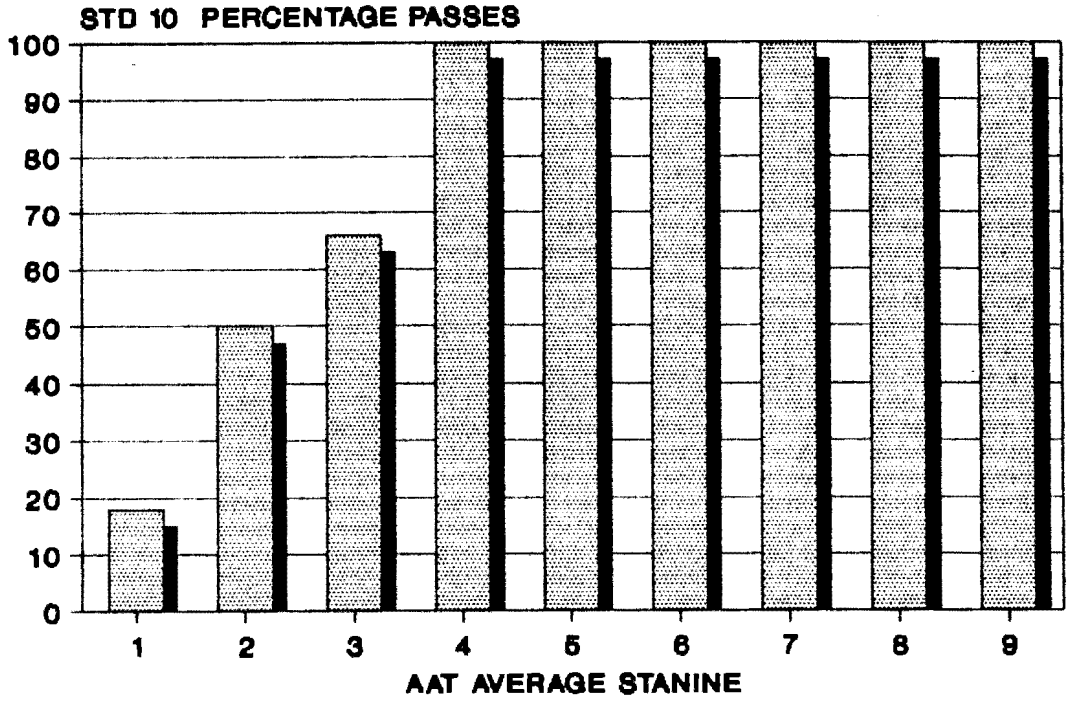


The area above the CB line indicates passes. Therefore, all the students obtaining average stanine 4 and above are expected to pass.

The following histograms illustrate the expected and the actual passes per average stanine.

FIGURE 6.2

HISTOGRAM OF EXPECTED PERCENTAGE OF PASSES PER STANINE GROUP



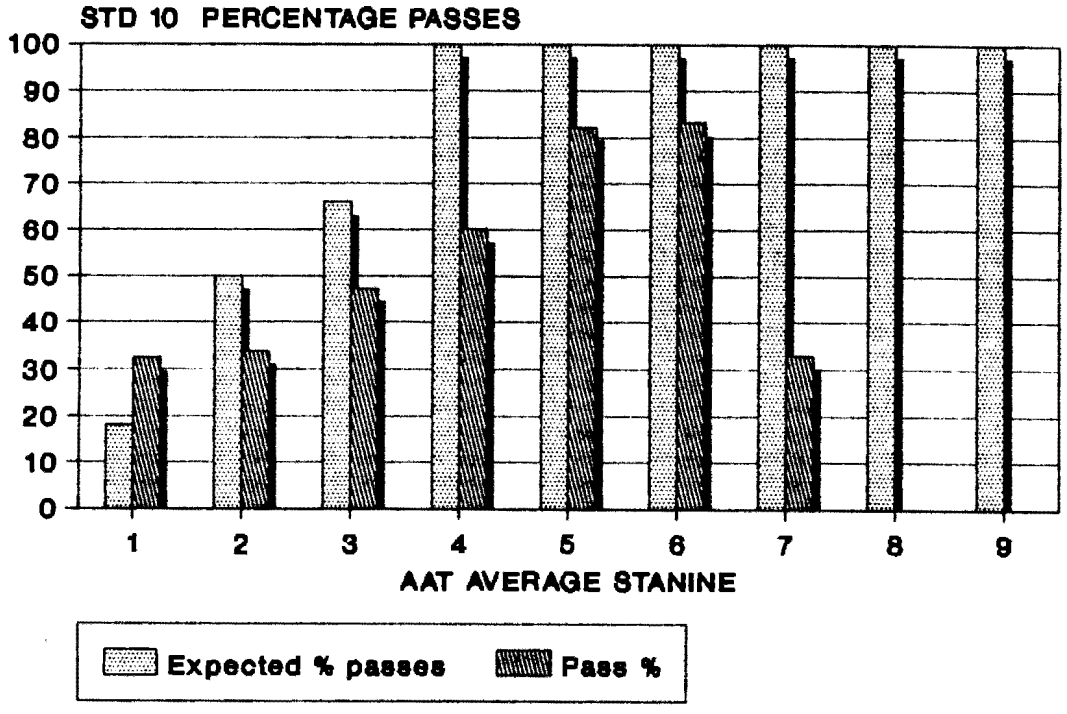
Stanine	1	2	3	4	5	6	7	8	9
Pass %	18	50	66	100	100	100	100	100	100

Figure 6.2 indicates the expected percentage of passes per average stanine group.

The following histograms show the differences between the expected and actual percentage of passes. The influence of the extraneous variable account for the differences between the actual and the expected passes.

FIGURE 6.3

HISTOGRAM OF PERCENTAGE PASSES PER AVERAGE STANINE GROUP IN 1983 SAMPLE

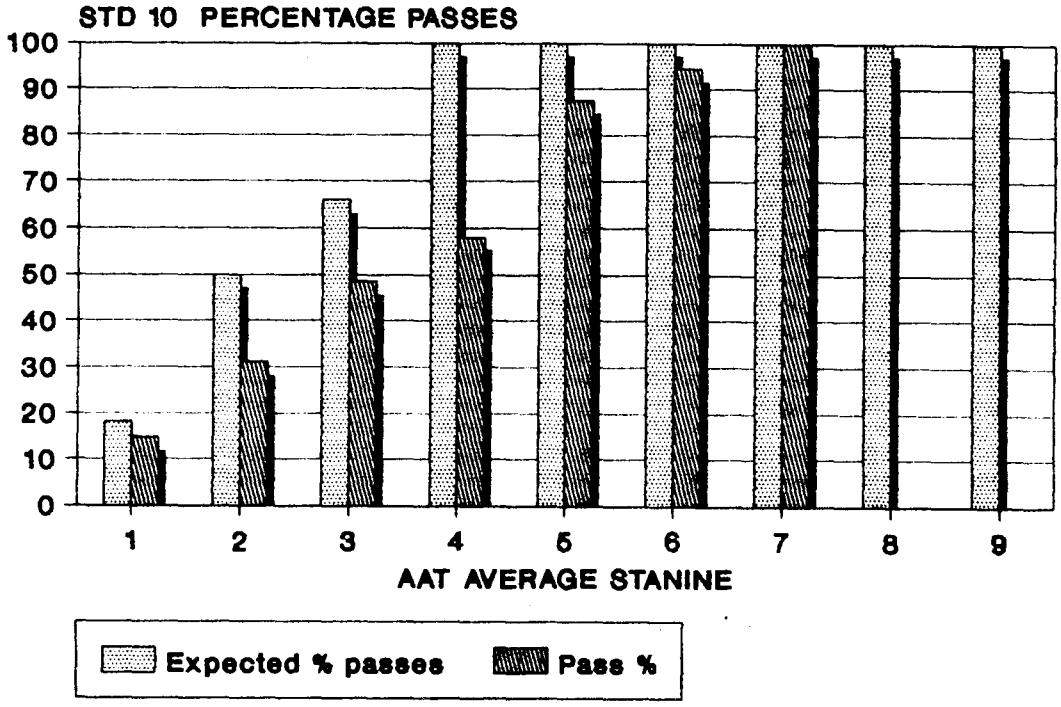


Stanine	1	2	3	4	5	6	7	
No. Passed	73	232	305	115	37	20	1	Total = 783
Pass %	32,4	33,8	47,3	60,2	82,2	83,3	33	
Expected % passes	18	50	66	100	100	100	100	

Figure 6.3 indicates the relationship between the aptitude scores and the aggregate pass percentages obtained by pupils in the 17 schools selected at random, in 1983. The histogram shows a great difference between what was expected and what actually happened. What was expected is that the pupils should perform according to their potential or do better, but this did not happen. The students under achieved.

FIGURE 6.4

HISTOGRAM OF PERCENTAGE PASSES PER AVERAGE STANINE GROUP IN 1984 POPULATION

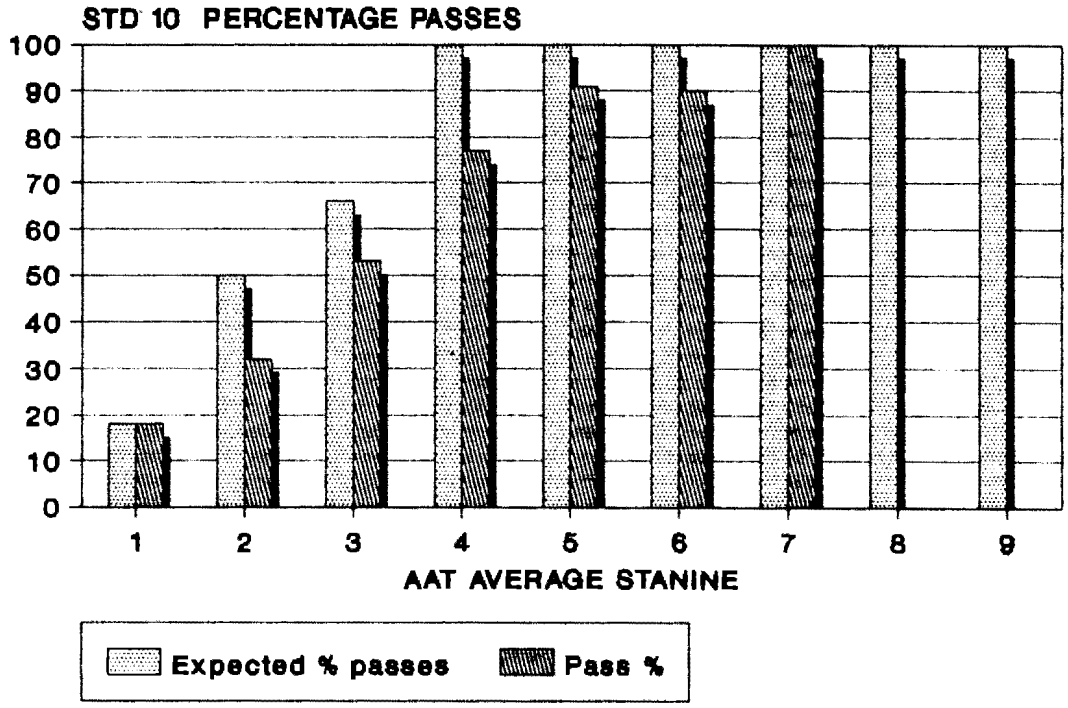


Stanine	1	2	3	4	5	6	7	
No. Passed	287	2018	1842	619	203	35	2	Total = 5006
Pass %	14,7	31,0	48,5	58,1	87,4	94,5	100	
Expected % passes	18	50	66	100	100	100	100	

Figure 6.4 for 1984 shows slight improvement in the percentage of passes per average stanine. Pupils generally achieved below expectation.

FIGURE 6.5

HISTOGRAM OF PERCENTAGE PASSES PER AVERAGE STANINE GROUP IN 1985 POPULATION

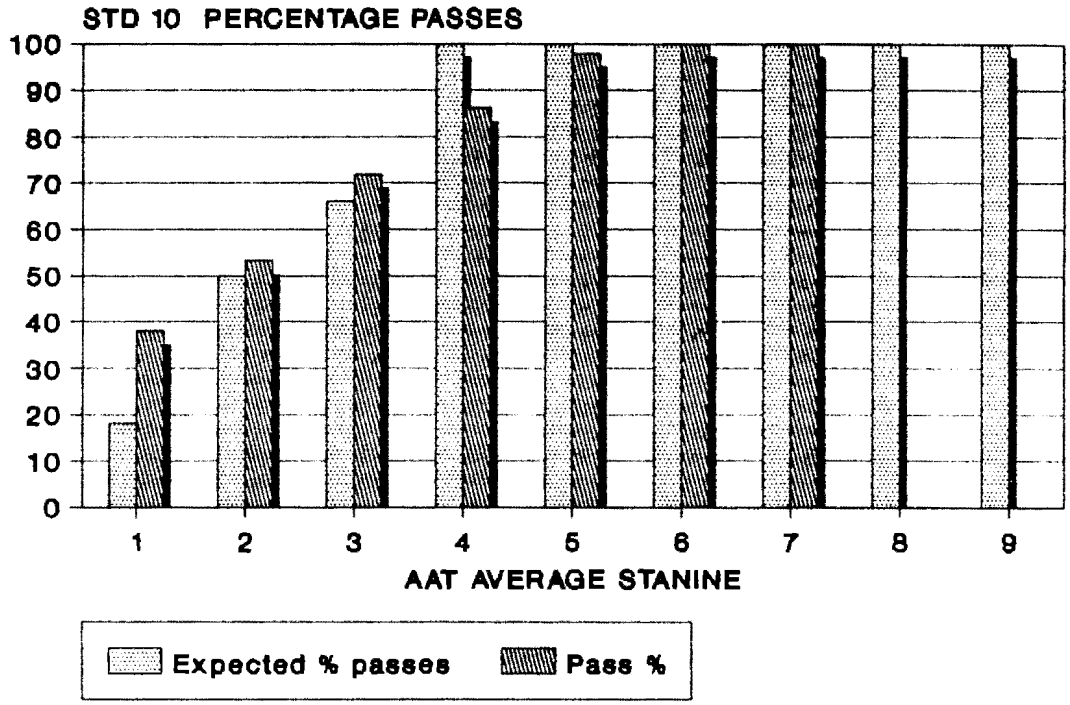


Stanine	1	2	3	4	5	6	7	
No. Passed	640	2790	1904	518	97	18	5	Total = 5972
Pass %	18	32	53	77	91	90	100	
Expected % passes	18	50	66	100	100	100	100	

Figure 6.5 indicates the exact percentage of passes that were expected of the pupils who obtained average stanine 1, i.e. 18%. The rest of the group underachieved; but performed better than the 1984 group.

FIGURE 6.6

HISTOGRAM OF PERCENTAGE PASSES PER AVERAGE STANINE GROUP IN 1986 POPULATION

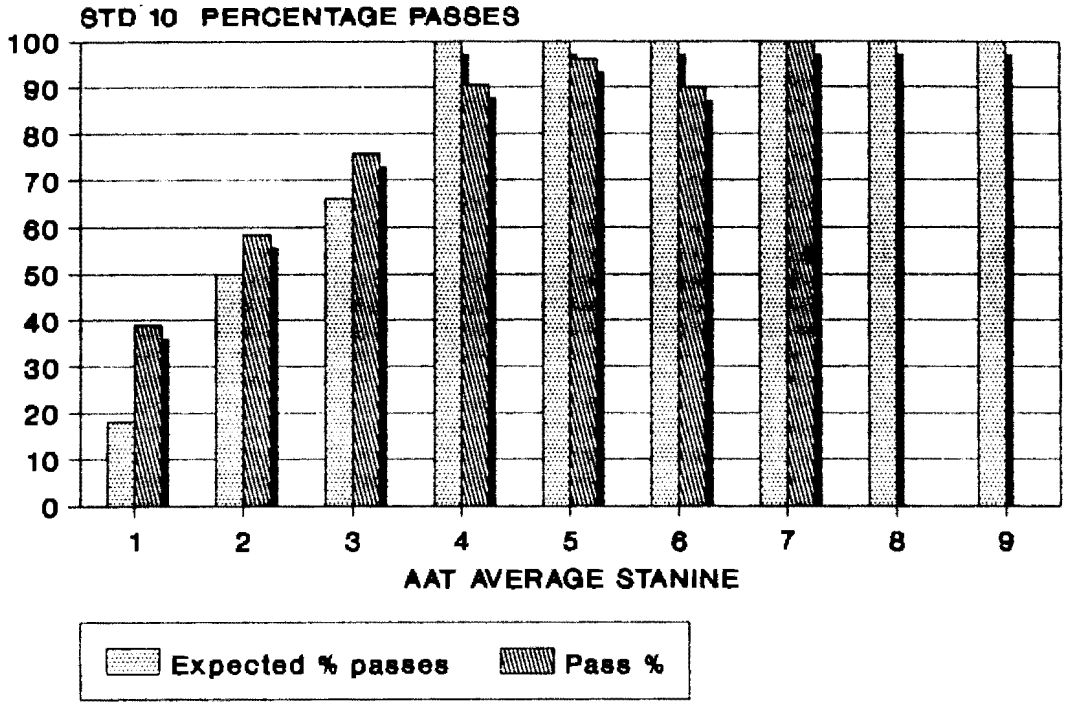


Stanine	1	2	3	4	5	6	7	
No. Passed	1586	3833	2120	520	86	15	1	Total = 8161
Pass %	38	53,2	72	86,2	98	100	100	
Expected % passes	18	50	66	100	100	100	100	

Figure 6.6 indicates improvement in the achievement of pupils. All groups performed almost as was expected, with the exception of stanine 1 and 2 group which overperformed. The large numbers of students in these two groups caused a low R^2 as a result of performing far above their aptitude.

FIGURE 6.7

HISTOGRAM OF PERCENTAGE PASSES PER AVERAGE STANINE GROUP IN 1987 POPULATION



Stanine	1	2	3	4	5	6	7	
No. Passed	3084	5075	1853	364	73	9	3	Total = 10461
Pass %	38,9	58,5	75,8	90,5	96,1	90	100	
Expected % passes	18	50	66	100	100	100	100	

This 1987 histogram does not differ greatly from that of 1986.

6.7.6.6 Summary of the results of cross validation

Cross validation with the 1985 sample of pupils in the same schools that were used in 1983 revealed improved predictability of academic achievement by means of the 'best' subset of the

aptitude predictors. The application of the same predictors to the 1986 population of schools with standard 10 pupils revealed a very low multiple R^2. This necessitated the re-analysis of the number of passes per stanine group and the illustration by means of histograms in an attempt to explain the cause of a low R^2 for the population.

The results of the analysis per stanine group indicated that there are passes in all categories and there is a significant increase in the number of passes among the pupils who obtained average stanine three and below, thus lowering the R^2. The decrease in the predictive validity of the AAT when applied to the population does not take exactly the same form as the decline in the predictive validity of the Scholastic Aptitude Test (SAT) reported in paragraph 2.4.2.5. In this analysis the following deductions can be made:

i the standard 10 pupils underscore in the aptitude tests and overperform in the examinations. This results in a low R^2 (see figures 6.6 and 6.7).

ii the availability of the aptitude results early in the year might have motivated the teachers to work harder to beat the prediction. This can lower the R^2 too, as the case was with grade inflation and SAT reported in paragraph 2.4.2.5.

iii the norms may be outdated to be of value in prediction but the new norms can only be established after a study of systematic variables.

iv the results of 1986 analysis cannot be taken as contradicting the 1985 analysis. This is in agreement with the statistical fact that the R^2 increases with the reduction in sample size, and decreases with increase in sample size (Roscoe, 1975:378). In this case the 1985 sample was N = 2265 and the 1986 population was N = 14605. The larger R^2s have been obtained with the use of small

samples by previous researchers like Schoeman (1976) and others especially when a technique of descriminant analysis was used. A larger R^2 was also obtained in this study when small subsamples were used (see table 6.6) and a small R^2 when a large population was used.

The analysis on paragraph 6.2 made it possible to predict the academic achievement of the groups (not individuals) of standard 10 pupils inspite of low aptitude scores they usually obtain, thus making the establishment of the norms not a matter of urgency before the systematic variables are studied. The new expected percentage passes for each stanine group will therefore replace the ones appearing in paragraph 6.7.6.3. The expectancy tables will indicate the new cut-off points.

6.8 SUMMARY AND CONCLUSION

The three main hypotheses and the seven subhypotheses were stated in paragraph 5.2.2 to direct the investigation for the solution of the problems stated in paragraph 1.3.

The results of multiple regression, that were used in the selection of the 'best' subset of predictor variables from the cognitive, affective, and school variables, indicated that the cognitive variables are the best predictors of academic achievement, in comparison with interest, personality and school variables. The comparison of interest, personality, and school variables with respect to their contribution to R^2, indicated that the school variable total explained the largest amount of variance in the APP. Actually, besides English Vocabulary (AAT 3) there is no other independent variable that is a better predictor of academic achievement than the school variable total, hence it entered the regression equation second. The smallest, amount of variance in aggregate pass percentage (APP) was explained by the best subset of interest variables. A

larger amount of variance in the APP was explained by the personality variables. As a result of this analysis, using the Mallow's Cp-method, the main hypothesis, that the cognitive variables are the best predictors of academic achievement, was accepted and the null hypothesis rejected. The results of this study were in agreement with the findings of previous researchers. It was then generalised that the cognitive variables are the best predictors of the academic achievement of standard 10 pupils in KwaZulu schools.

The other hypothesis that was tested related to the additiveness of affective (interest and personality) variables to cognitive variables in the prediction of academic achievement. This hypothesis was tested by calculating the significance of the difference between the full model (AAT + VIQ, and AAT + HSPQ) and the reduced model (AAT only). Using the F-test both the interest and personality variables contributed significantly to R^2 when added to aptitude variables, and the main hypothesis was accepted and the null hypothesis rejected.

To test the main hypothesis that the school variable total is additive to aptitude variables in the prediction of academic achievement, the significance of the difference between the full model (R^2 fm) (AAT + SVTOT) and the reduced mode (R^2 rm) (AAT only), indicated that the SVTOT contributes significantly to R^2. The main hypothesis was accepted and the null hypothesis rejected.

Since the ultimate aim was to arrive at the best predictor variables, it was necessary to go further to determine whether the size of the contribution of R^2 is of practical significance for educational purposes. Cohen's f^2-test for the effect size indicated that the interest variables were of no practical significance for educational purposes. The personality variables, using Cohen's criteria, were found to be of small practical value in education. The contribution of the school variable total was of medium effect for practical educational

purposes. As a result of this further analysis of the results, it was decided to leave out the interest and the personality variables from the control set. The analysis by the stepwise regression indicated that it is the intelligence factor in the HSPQ that made this significant contribution to R^2 and not a true personality factor. The control set, therefore, consisted of the AAT and the SVTOT variables.

The predictive validity of the control set of variables was tested by determining the influence of the modifier variables, (school quality, education stream, school type, school situation and sex) on R^2. The results of the analysis of the variance among the regression coefficients, indicated that with the exception of sex all other modifier variables have significant influence on R^2.

Previous research indicated that when intelligence and socio-economic status are controlled the differences between the schools disappear. To test this hypothesis aptitude was controlled in this study and the achievement of pupils in boarding and day schools, and the achievement of pupils in urban and rural schools was compared. Using a t-test for correlated groups the results indicated that there were significant differences between boarding and day schools, and between urban and rural schools in achievement. The null hypothesis was in both cases rejected at 5% level of significance and not at 1% level. This led to a conclusion that the school has significant influence on the academic achievement of standard 10 in KwaZulu schools. This conclusion is in agreement with the findings of other researchers especially in less industrialised countries.

The results of cross validation with the 1985 sample, and the 1986 population indicated that the 'best' subset of the AAT predictors are underpredicting as a result of improved academic achievement without improvement in the scores in the aptitude tests. This resulted in the low R^2 for the population. The new AAT norms are necessary for more accurate predictions.

CHAPTER 7

SUMMARY, CONCLUSION, AND RECOMMEDATIONS

7.1 SUMMARY

7.1.1 Aim and method of study

The aim of this study was to evaluate certain cognitive, affective, and school variables as predictors of standard 10 academic achievement in KwaZulu schools. To reach this aim the investigation was done in two parts:

i The survey of literature with the purpose of identifying the predictor variables and how they have been operationalised in previous studies;

ii The empirical investigation to solve the problems that were stated as a result of literature review.

7.1.2 Review of literature on the predictive validity of the cognitive variables

7.1.2.1 Predictive validity of intelligence

In this study the cognitive variables refer to intelligence, previous achievement, and aptitudes. The relationship of these cognitive variables with academic achievement was reviewed and literature indicated the following. With reference to intelligence it was indicated that intelligence correlates with academic achievement in the region of 0,25 (25%) depending on the academic level of the pupils and on the school subjects learned. For instance, it was found that intelligence is a good predictor of academic achievement in the lower grades and its

predictive validity decreases with the rise in the academic standards (see paragraph 2.2.3).

In this study intelligence was not included among the cognitive predictors because there was no standardised measure for intelligence that was meant for the Black standard 10 pupils. Pupils, however, responded to the (HSPQ) items that assess general intelligence, for prediction purposes.

7.1.2.2 Predictive validity of previous achievement

Another cognitive variable that was reviewed is previous achievement. The review of literature indicated that previous achievement is the best predictor of academic achievement. Previous achievement is a function of the intellectual level of the child, quality of instruction, and many other variables. The correlation between academic achievement and previous achievement, whether in the form of high school rank or grade point average has never been perfect as revealed by all the studies reviewed including the detailed study by Bloom (1979). This also made Lavin (1967:16) assert that reliance on previous grades as the only predictors is unwarranted (see paragraph 2.3.2).

Previous achievement could not be used in this study because there were no properly kept records of standard 9 achievement.

7.1.2.3 Predictive validity of aptitude

Aptitude was defined and its distinction with intelligence, ability and achievement was made (see paragraphs 2.4.2.1 to 2.4.2.4). In summary it could be said that aptitude is mainly used to predict achievement and it is the potential ability, while achievement indicated accomplishment or the level of performance in a well-defined task.

A review of the controversy on the predictive validity of the aptitude tests, especially the Scholastic Aptitude Test (SAT) indicated that coaching has very little effect on performance in the SAT (see paragraph 2.4.2.5).

Aptitudes were operationalised in terms of non-verbal reasoning, verbal reasoning, vocabulary and reading comprehension in the languages, spatial perception (two- and three-dimensional) clerical speed, mathematics proficiency, classification, co-ordination, memory, filing, comparison and mechanical insight. For the Academic Aptitude Test Battery only the first ten aptitudes were operationalised (see table 2.4).

The review of simple correlations between aptitude and achievement scores indicated high correlation coefficients between the achievement in the school subjects and the related aptitudes. Simple correlations of 0,706 were noted. There were also correlation coefficients as small as 0,09 with the subjects having unrelated content (see tables 2.5 and 2.6). This confirms the findings by Bloom (1976) that the cognitive entry behaviours are good predictors of academic achievement (see paragraph 1.2.3). That, if the content of the aptitude test is to some extent related to the content of the criterion measured, the correlation coefficient is generally high, indicates that aptitude tests are to some extent measures of previous learning.

The review of studies on sex differences in the various aptitudes revealed a mixed picture. While girls performed better than boys in language ability tests, boys did better than girls in number comprehension tests. In intelligence and spatial perception tests there were no significant differences between the sexes that have been reported (see paragraph 2.4.5.6). This led to an expectation that there would be no difference in the predictability of standard 10 boys and girls in this study.

The studies conducted in the western countries, however, indicate that girls out-perform boys generally while some studies conducted in Africa, among the Blacks in particular, indicate that boys out-perform girls in academic achievement (see paragraph 2.4.5.6).

The review of the studies on the multiple correlation of aptitudes with academic achievement revealed the correlation coefficients which are higher than simple correlation coefficients. This indicated that multivariate studies explain more variance in academic achievement than single variable studies.

7.1.3 The predictive validity of the affective variables

7.1.3.1 The predictive validity of the personality variables

Personality was defined, and reference was made to the theories of Allport, Murray, and Cattell. The operationalisation of personality was traced from the source traits to the final compilation of the High School Personality Questionnaire by Cattell (see paragraph 3.2.2 to 3.2.3).

The simple correlation of personality factors with academic achievement revealed that there is no general agreement among the researchers as to which of the personality factors are the best predictors of academic achievement. The factor, however, that has appeared in most studies, is Factor B (intelligence). Besides this factor are factors G (super ego strength), (ego-strength), E (dominance), and factor Q_2 (self-sufficiency). In general, personality factors explain less than 20% of variance in academic achievement (see paragraph 3.2.4).

Literature on the multiple correlation of personality variables with academic achievement indicated multiple correlation coefficients of about 0,13. When the personality factors are

added to cognitive variables in the prediction of academic achievement the American studies indicated a significant increase in R^2, while South African studies did not have statistically very significant increase in R^2. From the South African studies it was generalised that the personality variables are not very useful as predictors of academic achievement (see paragraph 3.2.3).

7.1.3.2 Predictive validity of the interest variables

Interest was defined with special reference to the definitions by Strong (1943), Anastasi (1968), Block (1971), Coetzee (1975), and Smith (1984). In summary it can be stated that interest is within the domain of personality and motivation and is characterised by relative stability from adolescence to adulthood. The relative stability of interests makes it possible to make predictions (see paragraph 3.3.2).

The operationalisation of interest by Strong (1943) and by Kuder (1966) served as background for the operationalisation of the Vocational Interest Questionnaire (VIQ) by the Human Science Research Council (HSRC) in 1975 (see paragraph 3.3.4). In the Vocational Interest Questionnaire, interest was operationalised into ten fields of interest (see table 5.11).

Previous studies on the relationship of the interest variables with academic achievement is scarce, and a few studies that were cited indicated very weak simple correlations with academic achievement. Van der Westhuizen (1987) calculated the multiple correlation of the VIQ variables with academic achievement and found that the VIQ variables had a significant but small contribution towards the prediction of standard 10 achievement. Von Mollendorf (1978) on the other hand had found that the VIQ was of no significant value in achievement prediction. The study by Van der Westhuizen brought to light again that the

personality variables make a larger contribution to R^2 than the interest variables (see paragraph 3.3.5).

7.1.4 Relationship of school variables with academic achievement

In the review of the relationship of the school variables with academic achievement, particular attention was paid to the structural variables like school situation and size, class size and physical facilities, and to teacher characteristics such as teacher quality (qualifications), teacher-pupil relationship, and school management. The review of literature indicated a tendency for urban schools to do better than rural schools (see paragraph 4.2.2.3). The tendency was also for larger schools to do better than small schools (see paragraph 4.2.3.5). Small classes were found to have significant influence on achievement in certain school subjects and in remedial classes in the primary schools (see paragraph 4.2.4.3). Concerning the effect of physical facilities on academic achievement literature indicated a contribution of less than 5% (see paragraph 4.2.5.3). More than the physical facilities, the interaction between the pupils and the teacher was emphasized in literature. The interaction between pupil characteristics and the quality of the school was illustrated in the study of the Ten Good Schools in England and by the study conducted by Brookover (1975) which indicates that good schools achieve generally better than weak schools.

The school was operationalised by giving ranks indicating the effectiveness of the following variables in the achievement of the pupils in a particular school: hostels, library, laboratory, discipline, staff motivation and school administration. These variables appeared important in literature as factors that contribute towards school achievement.

The school appeared to have more influence on academic achievement in less industrial countries than in industrial countries.

The problems to be investigated in this study were stated at the end of the review of literature (see paragraph 4.6.6).

7.1.5 The empirical investigation

7.1.5.1 The aim of the study and the statement of the hypotheses

The aim of this study was to identify the subset of the best predictors of academic achievement of standard 10 pupils in KwaZulu schools, and to evaluate their predictive efficiency in a modifier variable study. The modifier variable study was conducted to determine how good the subset of the best predictors can predict academic achievement in urban and rural, and in boarding and day schools. The investigation went further to determine how good the subset of the best predictors can predict the academic achievement of standard 10 pupils taking a general, science, and a commercial combination of subjects, and whether the predictive efficiency of the selected predictors is the same for both boys and girls.

These aims were an attempt to solve the problems stated in paragraph 1.3. To solve these problems the hypotheses, based on the review of literature, were stated in paragraph 5.2.2. To determine whether the results of the analysis were not attributable to chance factors, it was necessary to state the null hypothesis which had to be rejected at 1% or 5% level of significance to prove the significant influence of the independent variables on academic achievement.

7.1.5.2 The investigation procedure for this study

The empirical investigation was done in two stages: (i) sampling and data collection, (ii) data processing and interpretation.

STAGE 1

The target population for this study consisted of 170 KwaZulu standard 10 schools whose pupils wrote the examinations in 1983. From this population a random sample of 10% (17) of the schools was selected. The sample consisted of 1912 standard 10 pupils who underwent the Guidance Testing Programme during the first semester and who wrote the examinations in November in 1983.

The Guidance Testing Programme provided data on aptitude, interest and personality variables. The data from the standardised measures were scored by the optic reader and processed by the computer. The Chief School Psychologist was responsible for the application of these tests in the sampled schools to ensure uniformity in test application and in the testing conditions. In this way the intertester and the interscorer variations were controlled and could not confound the between school variations in achievement (see paragraph 5.3 and 5.4).

The details of the measuring instruments were given in paragraph 5.5 and particular attention was paid to the composition, standardisation, reliability, validity, independence of subtests or the multicollinearity of the subtests, and on the standard scores of each measure. This involved both the criterion and the predictor variables, namely, the aptitude, interest, personality, school, and the examination results.

STAGE 2

The second stage of the empirical investigation consisted of the analysis of data and the interpretation of the results. Before the analysis of data was done, the research design was stated and described in full. This was followed by the full description of the methods that were used in the selection of the 'best' subset of predictor variables (using the Mallow's Cp-criterion, and the stepwise method). While the Mallow's Cp-method was used in the selection of the 'best' subset of predictors from aptitude, interest, and personality measure, the stepwise was used in ordering all the variables in all the best subsets together according to the magnitude of their contributions to R^2. This pool of variables included the school variable total. The decision to include one measuring instrument (with its selected variables) in the modifier variable study was taken on the basis of the results of the stepwise regression analysis. This was done with the purpose of evaluating the predictors objectively.

To maintain objectivity various statistical techniques, for testing the significance of the R^2, the significance of the contribution to R^2 by the added variables, the effect size of the contribution to R^2, were described in paragraph 5.9.2. The statistic for the analysis of variance between the subsamples was also described in the same paragraph.

The statistical analysis and interpretation of data was done in chapter 6. This was, however, preceded by the statement of the null hypothesis (see paragraph 6.1). The results of the empirical investigation were summarized with particular reference to the testing of the hypotheses.

MAIN HYPOTHESIS 1

The first main hypothesis that the cognitive variables are the best predictors of standard 10 academic achievement in comparison with interest, personality and school variables was accepted and the null hypothesis was rejected. The R^2 for aptitude variables (0,26), the R^2 for school variable total (0,16), the R^2 for personality variables (0,09), and the R^2 for interest variables (0,02) were calcutaled (see table 6.3). The rejection level of the null hypothesis was not given since no statistic was applied to compare the R^2s for the best subsets of predictor variables. Additional information to support the rejection of the null hypothesis was obtained from the results of the stepwise regression analysis in which one affective variable and a school variable total was included among the nine variables (seven of which were cognitive) in the equation for the aggregate pass percentage (APP).

MAIN HYPOTHESIS 2

The second main hypothesis that the affective variables are additive to cognitive variables in the prediction of standard 10 academic achievement was accepted and the null hypothesis was rejected at 1% level of significance. The effect size of the contribution of the affective variables to R^2 was of small practical value for educational purposes according to Cohen's criteria (see paragraph 5.9.2.4).

MAIN HYPOTHESIS 3

The third main hypothesis that the school variables are additive to cognitive variables in the prediction of academic achievement was accepted and the null hypothesis was rejected at 1% level of significance. The effect size of the contribution of the school variable total on R^2 was of medium practical value for

educational purposes. As a result of testing the first three main hypothesis and according to the results of the stepwise regression analysis, the decision was made to include aptitude and school variables in the control set of predictor variables to be evaluated in the modifier variable study.

The results of testing the subhypothesis relating to the modifier variable study are as follows:

SUBHYPOTHESIS 1

The first subhypothesis that school quality has significant influence on the prediction of standard 10 academic achievement was accepted and the null hypothesis was rejected at 1% level of significance.

SUBHYPOTHESIS 2

The second subhypothesis that the education stream has significant influence on the prediction of standard 10 academic achievement (APP) was accepted and the null hypothesis rejected at 1% level of significance.

SUBHYPOTHESIS 3

The third subhypothesis that the school situation (urban/rural) has significant influence on the prediction of standard 10 academic achievement (APP) was accepted and the null hypothesis rejected at 1% level of significance.

SUBHYPOTHESIS 4

The fourth subhypothesis that the school type (boarding or day) has significant influence on the prediction of standard 10 academic achievement (APP) was accepted and the null hypothesis rejected at 1% level of significance.

SUBHYPOTHESIS 5

The fifth subhypothesis that sex (boy/girl) has significant influence on the prediction of standard 10 academic achievement (APP) was rejected and the null hypothesis accepted at 5% level of significance.

SUBHYPOTHESIS 6

The sixth subhypothesis which states that there is still a significant difference between boarding and day schools in academic achievement (APP) even when aptitude is controlled, was accepted and the null hypothesis was rejected at 5% level of significance for a two - tailed test.

SUBHYPOTHESIS 7

The seventh subhypothesis which states that there is still a significant difference between urban and rural schools in academic achievement (APP) even when aptitude is controlled was accepted and the null hypothesis rejected at 1% level of significance.

The results of the modifier variable study brought to light that the predictive efficiency of the control set of predictors is affected by school quality, education stream, school situation, and school type. It was also brought to light that the control

set predicts equally for both sexes and that the control of aptitude does not bring about the disappearance of the differences between boarding and day schools and between urban and rural schools, in academic achievement.

The results of the cross validation study indicate that the standard 10 pupils continue to perform better than is indicated by the expectancy table. The expectancy tables (see annexure E) indicate low performance in the Academic Aptitude Test, as the bulk of them obtain average stanine 1, 2 and 3 (see also table 7.4); but about 40% manage to pass standard 10, sometimes with very good symbols. The discrepancy between achievement in aptitude tests and in the standard 10 examinations is responsible for the low R^2 of 0,17. Other factors operating during examinations (see paragraph 5.6.2) contribute towards the low R^2.

The cross validation study has made it possible to establish new cut-off points (pass/fail) for each stanine group in the place of those indicated in paragraph 6.7.6.3. Advice should, however, be given to the users of the test scores that predictions are made to the group of students and not the individuals.

The prediction of the achievement of the individual student at the end of the year cannot always be accurate with the use of one variable (aptitude). Annexure E indicates for instance that even the pupils who obtain average stanine 1 can obtain symbol E while some students who obtain average stanine 6 fail. It is the tendency of the group that can be predicted with fair accuracy, with respect to pass and fail, and not the individual symbols.

The results of this study have significant implications for education and further research.

7.2 RECOMMENDATIONS

7.2.1 Recommendations for the school educational psychologist

The results of the selection of the control set of predictors indicated that when the prediction of the results of the standard 10 pupils is done, the school quality must always be considered.

Although the average of the previous years results provides a significant, if not the best, index for stating whether the school will produce the results which are better than, almost like, or worse than the number of passes estimated during the first semester, the school quality as measured by the effect of the libraries, laboratories, hostels, school management, discipline and staff morale on academic achievement, should be considered during the first semester when results are predicted.

It is strongly recommended that the school educational psychologist should make the teachers challenge the predictions and be determined to do better than predicted. Motivated in this way, the teachers will continue to improve the standard 10 results, provided testing is done early in the year.

In the absence of a computer the school education psychologist can compile an expectancy table for predicting the results by scattering the Academic Aptitude Test results, preferably the average stanines (see Lemke and Wiersma, 1976:117 with respect to the scattergram). An example of such an expectancy table is attached (see annuexure E). The new cut-off point should be used (see paragraph 6.7.6.4).

7.2.2 Recommendation for the education planner

The results of this study indicate that the students in boarding schools do generally better than the students in day schools.

The reasons for superior performance of boarding schools is attributable to the contribution of the following physical facilities to effective teaching: the hostel, the library and the laboratory. While it is not possible to increase the number of the existing boarding schools the present ones should be extended (hostels as well as classrooms and cottages for teachers) to accommodate more students. The extension of the boarding schools should be accompanied by the provision of more books and separate laboratories for Biology and Physical Science. For commercial students there should be typewriters and if possible, computers.

7.2.3 Recommendations for the administrator

The results of this study have indicated that English (English vocabulary) is the best predictor of academic achievement. The implication here is that academic achievement is to a large extent a function of competence and performance in English as a medium for learning. It is, therefore, unequivocally recommended that English at high schools, should be taught by very good teachers.

Besides English, the second best predictor is number comprehension. The administrator should staff high schools with competent Mathematics teachers. The continuous evaluation of Mathematics teachers should be done by the Chief Inspectors with the assistance of Subject Advisor for Mathematics.

At each and every high school (standards 6 to 10) there should be a full-time Guidance Teacher to assist the pupils in choosing the right combination of subjects according to their abilities. The rationalebehind this is that the different education streams have influence on the predictability of academic achievement. Matching the potential abilities of pupils with the subjects chosen will improve the prediction of academic achievement.

7.2.4 Recommendations for teacher education

That the school quality as a variable accounts for variance between the schools implies the significant role of the principal in the academic achievement of his school. At present it is the personality of the school principal that accounts for his ability to run his school well and not the learned skill. If the principals can undergo a course (full-time or part-time) for principals, there can be uniformity in the running of the schools and the variations between the schools can be reduced. In short a teacher must have a specialisation diploma for teaching a particular school subject, the principal a diploma for principalship and an inspector a diploma for general inspection, to qualify for the job as in the case of the various types of psychologists and other professionals.

7.2.5 Recommendations for further research

7.2.5.1 Differences between urban and rural schools in academic achievement

Further research is needed to re-evaluate the differences between the achievement of urban and rural schools. Previous research has shown that students in urban schools tend to perform better than students in rural schools. This study has disproved this although the study was confined to the existence of the differences and not to the direction of the difference. Studies for the direction of the differences are recommended to determine whether the results of this study were not a result of the reverse mobility of students from urban to rural schools as a results of unrests in the urban areas. Such a study should, however, control for the influence of the socio-economic status and aptitude on academic achievement, and also control for the influence of unrest on academic achievement.

7.2.5.2 The effect of the school and aptitude on academic achievement when aptitude is controlled

Further research is needed to determine the influence of the school on the achievement of pupils with equal aptitude or intelligence. Previous research indicated the disappearance of the differences between schools when intelligence and the socio-economic status was controlled, but in this study the differences persisted even when aptitude was controlled thus indicating a significant influence of the school on academic achievement.

7.2.5.3 Influence of the education stream on academic achievement

There is a need for further research on the influence of the combination of school subjects on academic achievement. This is the first study conducted in Kwa-Zulu that investigated the influence of the education stream on the prediction of academic achievement. The results of a study like this will provide information for education guidance in the choice of standard 10 examination subjects and for the improvement of the results.

7.2.5.4 Inclusion of vernacular in the AAT battery

Table 6.25 indicated a very low R^2 when Zulu was an independent variable. Research is necessary to justify its inclusion in the battery, for the purposes of improving the predictive validity of the AAT.

7.2.5.5 Operationalisation of school quality

There is a need for further research on the operationalisation of school quality to include the process variables. A study of

the process variables would provide more information on the quality of the school and the changes it brings about in the performance levels of the pupils during the year.

7.3 LIMITATIONS OF THIS STUDY

In the operationalisation of the school variables attention was paid to the effect of physical facilities and the teacher characteristics on academic achievement. This study did not go further to measure the teaching and the learning processes which brought about changes in students' involvement, in time spent on studies, in the self-concept of academic achievement, and consequently in the rate of learning.

The quality of schools, as defined in terms of physical facilities and teacher characteristics, is expected to have an effect on the learning rate and the level of performance of the students in the different schools. A measure of the process variables would have provided additional information for explaining the causes of variability between the schools.

The second limitation is that previous achievement was not included among the cognitive predictors. The reason for this is that the schools did not properly keep the records of Standard 9 pupils which were intended for use in this study. Previous achievement would have accounted for additional variance in academic achievement. The school previous achievement was however a significant variable in the allocation of ranks in the sense that the rating of the schools as good, average or weak was also based on the results of the schools in the previous years. The aptitude tests are also to a certain extent a measure of previous learning (in the subject contents) which may not necessarily be related to the school syllabi.

7.4 CONTRIBUTION OF THIS STUDY

As a result of this study a few contributions to knowledge were made.

(i) The investigation of the variance that can be explained by all variables measured by the Academic Aptitude Tests indicated that the maximum variance in the academic achievement of Standard 10 pupils is explained by the first seven tests of the battery. This information was not available before this study was conducted.

(ii) Previous studies focussed on the relationship of the school (with its different aspects) with academic achievement. This study investigated the possibility of operationalising the school as a predictor variable which can be added to the cognitive variables in the prediction of academic achievement. The results of the study indicated that the school quality can be quantified and used in multiple regression analysis.

(iii) For this study the scores on standardised measures were available in the form of stanines, and were used as such. The previous studies that were consulted used raw scores. This study provided information that the standard scores can as well be used in research because the computer caters for the differences in scales.

(iv) This study made information available on the predictability of the aggregate pass percentage of KwaZulu standard 10 pupils by means of the Academic Aptitude Tests (AAT) and the school variable total (SVTOT). This information can serve as the basis for the motivation teachers and students by the inspectors to improve the results, as it was originally the aim (see paragraph 1.1).

7.5 CONCLUSION

Academic achievement is to a large extent the function of cognitive and affective variables. It is also a function of the school variables which are grouped under physical facilities and teacher characteristics. Other variables like the socio-economic status are not directly responsible for performance in a particular class and within a period of six months. The results of this comprehensive study indicated that the prediction of the academic achievement, of standard 10 pupils in black schools, should include the school as the context in which learning takes place. This study has opened more avenues for further research in the study of school variables as predictors of academic achievement.

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ANNEXURE A

A LIST OF SAMPLED SCHOOLS AND ADDITIONAL INFORMATION

NAME OF SCHOOL	SCHOOL CODE	SCHOOL TYPE	SCHOOL SITUA-TION	1983 STD 10 ROLL	STREAM G	S	C	1983 Pass %	1983 TO 1985 x Pass %	1983 TO 1987 x Pass %
AMANZIMTOTI	404	B	R	43	X	X	X	94,6	97,6	97,4
DLANGEZWA	414	B	R	225	X	X	X	74,4	80,6	
DWALENI	417	D	R	79	X	X	X	64,6	58,2	60,2
EKUCABANGENI	419	D	R	50	X	X	X	58,0	51,7	66,2
ENDAKANE	427	D	U	139	X	X	X	43,6	44,8	
IGAGASI	437	D	U	258	X	X	X	22,0	57,8	56,7
IMPUMELELO	440	B	R	139	X	X	X	94,4	86,5	87,4
KHOMBINDLELA	452	D	U	227	X	X	X	30,3	36,7	43,0
MASIBUMBANE	461	D	U	59	X	X	X	46,0	55,4	68,3
MBUSI	472	D	U	117	X	X	X	33,8	66,9	82,9
MONTEBELLO	479	B	U	25	X	X	X	100,0	99,4	99,7
MPOPHOMENI	478	D	U	93	X	X	X	73,5	30,2	23,5
SIYAMUKELA	516	B	U	192	X	X	X	43,6	59,8	52,7
VUKILE	539	B	R	78	X	X	X	19,8	39,2	43,0
OHLANGE	499	B	U	157	X	X	X	27,4	41,9	51,6
STAR OF THE SEA	521	B	R	29	X	X	X	93,3	91,3	92,1
THUKELA	526	D	U	107	X	X	X	32,5	48,9	51,1

B = BOARDING SCHOOL

D = DAY SCHOOL

R = RURAL SCHOOL

U - URBAN SCHOOL

G = GENERAL STREAM

S - SCIENCE STREAM

C - COMMERCIAL STREAM

ANNEXURE B

QUESTIONNAIRE USED IN OCTOBER 1983 FOR RANKING SCHOOLS ACCORDING TO SIX VARIABLES

Directions:
Indicate the effect of the indicated variables on achievement at the indicated school. 1 = absence or no effect; 5 = medium effect, and 9 = great effect on pupil achievement this year 1983.

1. AMANZIMTOTI

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

2. DWALENI

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

3. EKUCABANGENI

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

4. **ENDAKANE**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

5. **IMPUMELELO**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

6. **KHOMBINDLELA**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

7. **MASIBUMBANE**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

8.	**MBUSI**			
	Hostels	1	5	9
	Library	1	5	9
	Laboratory	1	5	9
	Discipline	1	5	9
	Staff motivation	1	5	9
	School admin	1	5	9
9.	**MONTEBELLO**			
	Hostels	1	5	9
	Library	1	5	9
	Laboratory	1	5	9
	Discipline	1	5	9
	Staff motivation	1	5	9
	School admin	1	5	9
10.	**MPOPHOMENI**			
	Hostels	1	5	9
	Library	1	5	9
	Laboratory	1	5	9
	Discipline	1	5	9
	Staff motivation	1	5	9
	School admin	1	5	9
11.	**OHLANGE**			
	Hostels	1	5	9
	Library	1	5	9
	Laboratory	1	5	9
	Discipline	1	5	9
	Staff motivation	1	5	9
	School admin	1	5	9

12. **STAR OF THE SEA**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

13. **THUKELA**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

14. **VUKILE**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

15. **IGAGASI**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

16. **SIYAMKELA**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

17. **DLANGEZWA**

Hostels	1	5	9
Library	1	5	9
Laboratory	1	5	9
Discipline	1	5	9
Staff motivation	1	5	9
School admin	1	5	9

ANNEXURE C

CORRELATION MATRIX

		Area 1	School 2	Pupil 3	Sex 4	SV1 5	SV2 6
Area	1	0,0000					
School	2	0,0000	1,0000				
Pupil	3	0,0000	-0,2159	1,0000			
Sex	4	0,0000	-0,0638	-0,0214	1,0000		
SV1	5	0,0000	0,4162	-0,1320	0,0309	1,0000	
SV2	6	0,0000	0,2776	-0,1818	0,0375	0,8351	1,0000
SV3	7	0,0000	0,4911	-0,0624	-0,0199	0,7245	0,7764
SV4	8	0,0000	-0,4788	0,0239	0,1362	-0,0862	-0,0449
SV5	9	0,0000	-0,2322	-0,0962	0,1207	-0,1886	-0,1864
SV6	10	0,0000	-0,1938	-0,2901	0,1004	0,2070	0,1141
SVTOT	11	0,0000	0,1475	-0,1835	0,1033	0,8203	0,8166
AAT1	12	0,0000	0,0364	-0,0521	-0,1372	0,1853	0,1567
AAT2	13	0,0000	0,1182	-0,1014	-0,1095	0,2780	0,2187
AAT3	14	0,0000	0,1565	-0,1199	-0,1408	0,2080	0,1553
AAT4	15	0,0000	0,0882	-0,1665	-0,0742	0,2424	0,2378
AAT5	16	0,0000	0,0169	0,0047	-0,0689	0,0548	0,0719
AAT6	17	0,0000	0,0183	-0,0662	-0,0516	0,1748	0,1801
AAT7	18	0,0000	-0,0518	-0,1011	0,0481	0,1885	0,2357
AAT8	19	0,0000	-0,0169	-0,0774	-0,2111	0,1449	0,1338
AAT9	20	0,0000	-0,2131	0,0479	-0,1839	-0,0610	-0,0060
A	21	0,0000	0,0602	-0,0515	-0,0273	0,0307	0,0252
B	22	0,0000	-0,0033	-0,0067	-0,0362	0,0759	0,0503
C	23	0,0000	0,0165	0,0093	-0,1077	-0,0450	-0,0876
D	24	0,0000	-0,0539	-0,0084	0,0709	-0,0963	-0,0655
E	25	0,0000	-0,0350	0,0490	-0,0910	-0,0757	-0,0745
F	26	0,0000	-0,0035	0,0532	-0,0049	-0,1051	-0,0443
G	27	0,0000	0,0769	-0,0459	-0,0390	0,0358	0,0132
H	28	0,0000	0,0478	0,0363	-0,1128	-0,1087	-0,1480
I	29	0,0000	-0,0140	-0,0651	0,1888	0,1227	0,1163
J	30	0,0000	0,0639	0,0557	-0,0910	-0,0129	-0,0316
O	31	0,0000	-0,0443	0,0064	0,1320	0,1340	0,1672
Q2	32	0,0000	0,0176	0,0575	0,0165	-0,0791	-0,0752
Q3	33	0,0000	-0,0421	0,0502	0,0362	-0,0254	-0,0819
Q4	34	0,0000	-0,0189	-0,0473	0,0781	0,0189	0,0487
VIQ1	35	0,0000	0,0352	0,0356	-0,2823	-0,0365	-0,0686
VIQ2	36	0,0000	0,0132	-0,0591	-0,0227	0,0012	-0,0298
VIQ3	37	0,0000	0,0329	-0,0523	0,2357	0,0209	0,0053
VIQ4	38	0,0000	0,0307	-0,0158	0,0337	0,0202	-0,0043
VIQ5	39	0,0000	0,0750	-0,0197	0,0244	-0,0265	-0,0380
VIQ6	40	0,0000	0,0231	0,0016	-0,0617	-0,0380	-0,0337
VIQ7	41	0,0000	0,0112	-0,0236	0,1004	0,0116	0,0581
VIQ8	42	0,0000	0,0799	0,0008	-0,1149	-0,0274	-0,0400
VIQ9	43	0,0000	0,0278	-0,0044	-0,1045	-0,0895	-0,0714
VIQ10	44	0,0000	0,1071	-0,0657	-0,0555	-0,0496	-0,0290

CORRELATION MATRIX (continue)

		SV3 7	SV4 8	SV5 9	SV6 10	SVTOT 11	AAT1 12
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7	1,0000					
SV4	8	-0,5397	1,0000				
SV5	9	-0,6462	0,9010	1,0000			
SV6	10	-0,0129	0,2947	0,3280	1,0000		
SVTOT	11	0,4943	0,3325	0,2075	0,4074	1,0000	
AAT1	12	0,1553	-0,0595	-0,0754	0,1294	0,1382	1,0000
AAT2	13	0,1739	-0,0485	-0,0355	0,1552	0,2280	0,5376
AAT3	14	0,1632	-0,0880	-0,0401	0,1881	0,1766	0,1502
AAT4	15	0,1836	-0,0577	-0,0499	0,1763	0,2204	0,2953
AAT5	16	0,0926	-0,1228	-0,1163	0,0014	0,0341	0,3255
AAT6	17	0,1434	-0,0253	-0,0436	0,1321	0,1725	0,1871
AAT7	18	0,1761	-0,0216	-0,0730	0,1442	0,2042	0,2141
AAT8	19	0,1110	-0,0771	-0,1000	0,0838	0,1170	0,4618
AAT9	20	-0,0415	-0,0292	-0,0790	-0,0269	-0,0506	0,3076
A	21	-0,0150	0,0379	0,0415	-0,0004	0,0341	0,0297
B	22	0,0637	-0,0309	-0,0507	0,1412	0,0570	0,1441
C	23	-0,0733	-0,0246	-0,0319	-0,1160	-0,1062	0,0235
D	24	0,0051	-0,0603	-0,0507	0,0830	-0,0758	-0,1080
E	25	-0,0838	0,0568	0,0579	-0,0028	-0,0568	-0,0664
F	26	-0,0189	0,0095	0,0124	-0,0637	-0,0766	-0,0567
G	27	0,0267	-0,1113	-0,0809	-0,0423	-0,0149	0,1231
H	28	-0,0909	-0,0858	-0,0479	-0,1026	-0,1618	0,0571
I	29	0,0462	0,0747	0,0771	0,1729	0,1829	0,0268
J	30	0,0440	-0,0720	-0,0611	-0,0162	-0,0427	-0,0699
O	31	0,1292	0,0653	0,0216	0,1223	0,1949	0,0042
Q2	32	-0,0169	-0,0405	-0,0440	-0,1351	-0,1097	-0,1019
Q3	33	-0,0508	-0,0245	-0,0422	-0,0424	-0,0780	-0,0119
Q4	34	0,0661	-0,0169	-0,0041	0,1294	0,0542	0,0354
VIQ1	35	0,0014	-0,0415	-0,0528	-0,0123	-0,0702	0,0487
VIQ2	36	-0,0108	-0,0249	-0,0023	0,1501	0,0129	-0,0146
VIQ3	37	-0,0207	0,0734	0,0745	0,0708	0,0515	-0,0448
VIQ4	38	0,0175	-0,0135	-0,0157	0,0504	0,0171	0,0817
VIQ5	39	-0,0342	-0,0224	0,0085	-0,0290	-0,0227	0,0133
VIQ6	40	0,0037	-0,0677	-0,0674	-0,0373	-0,0538	0,0808
VIQ7	41	-0,0081	0,0874	0,0861	0,0268	0,0614	0,0589
VIQ8	42	0,0155	-0,0630	-0,0564	-0,0605	-0,0557	0,0001
VIQ9	43	-0,0239	-0,0589	-0,0572	-0,0361	-0,0940	-0,0689
VIQ10	44	0,0624	-0,0789	-0,0644	0,0168	0,0079	-0,0263

CORRELATION MATRIX (continue)

		AAT2 13	AAT3 14	AAT4 15	AAT5 16	AAT6 17	AAT7 18
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7						
SV4	8						
SV5	9						
SV6	10						
SVTOT	11						
AAT1	12						
AAT2	13	1,0000					
AAT3	14	0,3385	1,0000				
AAT4	15	0,4810	0,4021	1,0000			
AAT5	16	0,3966	0,0780	0,1855	1,0000		
AAT6	17	0,3285	0,3719	0,3224	0,1275	1,0000	
AAT7	18	0,3299	0,2705	0,3799	0,1842	0,3888	1,0000
AAT8	19	0,4140	0,2114	0,2605	0,2331	0,2304	0,1653
AAT9	20	0,2230	0,0502	0,1055	0,1674	0,0968	0,0385
A	21	-0,0006	-0,1011	0,0196	-0,0347	-0,0038	-0,0340
B	22	0,2011	0,2744	0,2392	0,1432	0,1755	0,1634
C	23	0,0082	-0,0477	-0,0579	-0,0133	-0,0140	-0,0524
D	24	-0,1440	-0,1170	-0,1315	-0,0684	-0,0827	-0,0862
E	25	-0,0596	-0,0768	-0,0889	0,0117	-0,0646	-0,0764
F	26	-0,0910	-0,1019	-0,1006	-0,0522	-0,0347	-0,1100
G	27	0,1178	0,1094	0,0996	0,0686	0,0986	0,0908
H	28	0,1027	0,0632	0,0928	0,0214	0,0574	-0,0491
I	29	0,0416	0,0752	0,1054	-0,0063	0,1025	0,0933
J	30	-0,0241	0,0675	0,0122	0,0438	-0,0086	0,0440
O	31	0,0450	0,0184	0,0417	0,0510	-0,0272	0,0832
Q2	32	-0,1003	-0,0272	-0,1268	-0,0349	-0,0509	-0,0084
Q3	33	-0,0225	0,0093	-0,0189	0,0284	-0,0095	-0,0134
Q4	34	0,0688	0,0433	0,0422	0,0485	0,0128	0,0976
VIQ1	35	0,0224	-0,0498	-0,0042	0,1085	0,0396	0,0238
VIQ2	36	-0,0225	-0,0096	-0,0099	0,0205	0,0088	-0,0357
VIQ3	37	0,0041	-0,0907	0,0398	-0,0060	0,0161	0,0289
VIQ4	38	0,0960	-0,0507	0,0560	0,1215	0,0566	0,0469
VIQ5	39	0,0234	-0,0333	0,0064	-0,0185	0,0128	-0,0066
VIQ6	40	0,0801	-0,0664	0,0212	0,0542	-0,0180	-0,0021
VIQ7	41	0,0369	-0,0370	0,0995	-0,0535	0,0115	0,0147
VIQ8	42	-0,0203	0,0201	-0,0020	-0,0123	0,0235	0,0000
VIQ9	43	-0,0945	-0,1221	-0,0857	-0,0436	-0,0095	-0,0342
VIQ10	44	0,0169	0,0653	0,0952	0,0082	0,0741	-0,0694

CORRELATION MATRIX (continue)

		AAT8 19	AAT9 20	A 21	B 22	C 23	D 24
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7						
SV4	8						
SV5	9						
SV6	10						
SVTOT	11						
AAT1	12						
AAT2	13						
AAT3	14						
AAT4	15						
AAT5	16						
AAT6	17						
AAT7	18						
AAT8	19	1,0000					
AAT9	20	0,4016	1,0000				
A	21	0,0126	-0,0415	1,0000			
B	22	0,1177	0,0667	-0,1273	1,0000		
C	23	0,0417	0,0302	0,1496	-0,0468	1,0000	
D	24	-0,1085	0,0032	-0,1098	-0,0271	-0,1262	1,0000
E	25	-0,0214	-0,0682	0,0643	-0,0583	0,0117	0,0376
F	26	-0,0317	-0,0699	0,1811	-0,1271	-0,0181	-0,0010
G	27	0,0926	0,0138	-0,0053	0,0867	0,0625	-0,0429
H	28	0,0644	0,0528	0,1647	0,0564	0,2199	-0,2178
I	29	0,0108	-0,1255	0,0869	0,0499	-0,0853	0,0138
J	30	-0,0235	0,0034	-0,1230	0,0675	-0,0615	0,0808
O	31	-0,0340	-0,1089	-0,0878	0,0179	-0,2140	0,0870
Q2	32	0,0076	0,0417	-0,0747	-0,0528	0,0061	0,0323
Q3	33	-0,0218	0,0390	-0,0843	0,0090	0,1168	-0,0231
Q4	34	-0,0071	-0,0026	-0,1471	0,0249	-0,1810	0,1853
VIQ1	35	0,1044	0,0892	-0,0633	0,0393	0,0118	0,1059
VIQ2	36	-0,0237	-0,0262	-0,0963	0,0905	-0,0399	0,1020
VIQ3	37	-0,0767	-0,0444	0,0850	0,0285	-0,0691	0,0816
VIQ4	38	0,0367	0,0292	-0,0372	0,0541	-0,0027	0,1074
VIQ5	39	-0,0017	0,0333	0,0636	0,0146	0,0191	0,0680
VIQ6	40	0,0841	0,0862	0,0216	0,0281	0,0397	0,0705
VIQ7	41	0,0015	-0,0045	0,1589	-0,0221	-0,0312	0,0682
VIQ8	42	0,0480	0,0385	0,0078	-0,0196	0,0036	0,0563
VIQ9	43	-0,0150	0,0288	0,0080	-0,0150	0,0172	0,1072
VIQ10	44	0,0259	-0,0013	0,1107	0,0396	0,0412	-0,0032

CORRELATION MATRIX (continue)

		E 25	F 26	G 27	H 28	I 29	J 30
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7						
SV4	8						
SV5	9						
SV6	10						
SVTOT	11						
AAT1	12						
AAT2	13						
AAT3	14						
AAT4	15						
AAT5	16						
AAT6	17						
AAT7	18						
AAT8	19						
AAT9	20						
A	21						
B	22						
C	23						
D	24						
E	25	1,0000					
F	26	0,1095	1,0000				
G	27	-0,0976	-0,0795	1,0000			
H	28	0,0274	0,0146	0,0861	1,0000		
I	29	-0,0020	0,0152	0,0069	-0,0192	1,0000	
J	30	-0,0462	-0,0495	0,0596	-0,0285	-0,0410	1,0000
O	31	0,0170	0,0929	-0,1198	-0,1198	0,0540	-0,0021
Q2	32	-0,0391	-0,0392	-0,0339	-0,0790	-0,1555	0,1009
Q3	33	-0,0411	-0,1304	0,0729	0,0695	-0,0078	0,1037
Q4	34	-0,0098	-0,0291	-0,0232	-0,1635	0,0909	0,0641
VIQ1	35	0,0969	0,0364	-0,0315	-0,0174	-0,0710	0,0628
VIQ2	36	0,0252	-0,0014	-0,0605	0,0012	-0,0266	0,0966
VIQ3	37	0,0024	0,0790	-0,0342	0,0295	0,0754	0,0063
VIQ4	38	0,0169	0,0094	0,0033	0,0252	-0,0382	0,0557
VIQ5	39	-0,0148	0,0190	-0,0353	-0,0409	0,0162	0,0260
VIQ6	40	0,0284	0,0273	0,0093	-0,0262	-0,0625	0,0229
VIQ7	41	-0,0012	0,1188	-0,0519	-0,0235	0,2063	-0,0349
VIQ8	42	0,0224	0,1183	-0,0737	0,0673	-0,0129	0,0944
VIQ9	43	0,0621	0,0835	-0,0085	-0,0164	-0,0290	0,0871
VIQ10	44	0,0074	0,0345	0,0252	0,0700	-0,0290	0,0564

CORRELATION MATRIX (continue)

		O 31	Q2 32	Q3 33	Q4 34	VIQ1 35	VIQ2 36
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7						
SV4	8						
SV5	9						
SV6	10						
SVTOT	11						
AAT1	12						
AAT2	13						
AAT3	14						
AAT4	15						
AAT5	16						
AAT6	17						
AAT7	18						
AAT8	19						
AAT9	20						
A	21						
B	22						
C	23						
D	24						
E	25						
F	26						
G	27						
H	28						
I	29						
J	30						
O	31	1,0000					
Q2	32	0,0043	1,0000				
Q3	33	-0,0448	0,0269	1,0000			
Q4	34	0,1148	0,0255	-0,0219	1,0000		
VIQ1	35	-0,0211	0,0187	0,0241	-0,0127	1,0000	
VIQ2	36	0,0256	0,0221	0,0200	0,0064	0,3655	1,0000
VIQ3	37	0,0436	-0,0304	0,0894	0,0323	0,1959	0,3667
VIQ4	38	-0,0285	-0,0030	0,0855	0,0229	0,4364	0,4152
VIQ5	39	-0,0130	-0,0345	0,0245	0,0650	0,1363	0,1995
VIQ6	40	-0,0056	-0,0562	0,0031	0,0649	0,2778	0,1948
VIQ7	41	0,0661	-0,0840	0,0358	0,0058	0,0640	0,1044
VIQ8	42	-0,0261	0,0021	0,0473	-0,0251	0,3972	0,3902
VIQ9	43	-0,0261	0,0065	0,0100	0,0026	0,2703	0,3685
VIQ10	44	-0,0572	0,0600	0,0199	-0,0611	0,1168	0,2393

CORRELATION MATRIX (continue)

		VIQ3 37	VIQ4 38	VIQ5 39	VIQ6 40	VIQ7 41	VIQ8 42
Area	1						
School	2						
Pupil	3						
Sex	4						
SV1	5						
SV2	6						
SV3	7						
SV4	8						
SV5	9						
SV6	10						
SVTOT	11						
AAT1	12						
AAT2	13						
AAT3	14						
AAT4	15						
AAT5	16						
AAT6	17						
AAT7	18						
AAT8	19						
AAT9	20						
A	21						
B	22						
C	23						
D	24						
E	25						
F	26						
G	27						
H	28						
I	29						
J	30						
O	31						
Q2	32						
Q3	33						
Q4	34						
VIQ1	35						
VIQ2	36						
VIQ3	37	1,0000					
VIQ4	38	0,5744	1,0000				
VIQ5	39	0,3053	0,1366	1,0000			
VIQ6	40	0,1935	0,1711	0,7236	1,0000		
VIQ7	41	0,3142	0,2100	0,2039	0,1574	1,0000	
VIQ8	42	0,2806	0,3290	0,2947	0,2852	0,2857	1,0000
VIQ9	43	0,2150	0,0952	0,4870	0,5452	0,1430	0,3620
VIQ10	44	0,3719	0,3424	0,3392	0,2426	0,2759	0,2771

CORRELATION MATRIX (continue)

		VIQ9 43	VIQ10 44
Area	1		
School	2		
Pupil	3		
Sex	4		
SV1	5		
SV2	6		
SV3	7		
SV4	8		
SV5	9		
SV6	10		
SVTOT	11		
AAT1	12		
AAT2	13		
AAT3	14		
AAT4	15		
AAT5	16		
AAT6	17		
AAT7	18		
AAT8	19		
AAT9	20		
A	21		
B	22		
C	23		
D	24		
E	25		
F	26		
G	27		
H	28		
I	29		
J	30		
O	31		
Q2	32		
Q3	33		
Q4	34		
VIQ1	35		
VIQ2	36		
VIQ3	37		
VIQ4	38		
VIQ5	39		
VIQ6	40		
VIQ7	41		
VIQ8	42		
VIQ9	43	1,0000	
VIQ10	44	0,1640	1,0000

ANNEXURE D

MULTIPLE REGRESSION ANALYSIS TABLE SHOWING THE BEST SUBSET FOR DIFFERENT STREAMS IN 1983

Statistics for best subset	General	Science	Commerce
Mallow's CP	4,67	4,26	6,36
R^2	,22	,39	,41
R	,47	,63	,64
Adjusted R^2	,22	,39	,39
Res Mean Sq.	129,42	114,13	142,98
SE-est	11,38	10,68	11,96
F- statistics	55,51	56,47	31,82
Numerator df	5,00	6,00	6,00
Denominator df	978,00	515,00	279,00
Variables: AAT	AAT 3	AAT 2	AAT 1
SVT	AAT 4	AAT 3	AAT 3
	AAT 6	AAT 4	AAT 5
	AAT 7	AAT 5	AAT 6
	SVT	AAT 7	AAT 8
		SVT	SVT

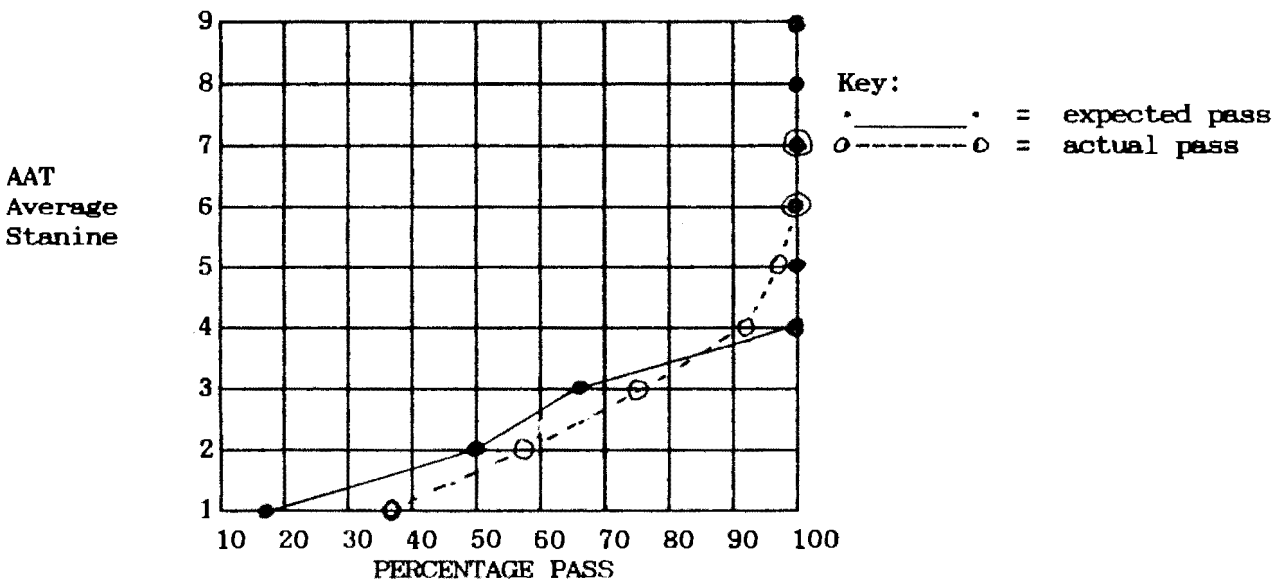
ANNEXURE E

1987 ANALYSIS OF STANDARD 10 RESULTS

School: All schools Circuit: 25 circuits

f	AAT X	Std 10 Frequency of symbols								Pass	Fail
		Fail	F	EE	E	D	C	B	A		
	9										
	8										
3	7					1 1	2 1	1		3	0
10	6	1			1 3	5 3	3 4			9	1
76	5	3		8 25	10 25	31 26	18	6		73	3
402	4	38	18 134	64 134	94 134	146	40	2		364	38
2468	3	615 822	362 822	582 823	492	370	47			1853	615
8673	2	3598 4336	2116 4337	1593	943	406	17			5075	3598
7910	1	4826 6486	1715 1424	857	415	90	7			3084	4826
19542		16%	36%	42%	47%	54%	64%	75%	80%		

Expected	11644	6718	982	162	30	5	1		7898	11644
Actual	9081	4211	3104	1955	1049	134	8		10461	9081



ANNEXURE F

A

DEPARTMENTAL CIRCULAR NUMBER 3 OF 1986 FILE NUMBER 5|3|2

Department of Education and Culture
Private Bag X 04
ULUNDI
3838

29 January 1986

TO ALL :

Circuit Inspectors
KWAZULU GOVERNMENT SERVICE

RAND FOR RAND BUILDING SUBSIDIES : 1986|87 FINANCIAL YEAR :

DEPARTMENTAL CIRCULAR NUMBER 34 OF 1982 DATED 17|05|82 REFERS :

1. The Department of Education and Culture has decided to raise a Subsidy from a maximum of R2 500,00 per classroom to a maximum of R5 000,00 per classroom or half the cost of the erection whichever is less with effect from 29|01|86.

2. The suggested formula of assessing and evaluating completed structures shall be as outlined below :-

2.1 CLASSROOMS :-

Category A : classroom of very good value
8m X 7,5m= 60m² at R200,00 per sq metre = R12 000,00.

Category B : classroom of good value
8m X 7,5m = 60m² at R167,00 per sq metre = R10 020,00.

Category C.: classroom of satisfactory value.
8m X 7,5m = 60m² at R160,00 per sq metre = R9 600,00.

Category D : classroom of low value
8m X 7,5m = 60m² at R157,00 per sq metre = R9 420,00.

Category E : classroom of lowest value.
8m X 7,5m = 60m² at R140,00per sq metre = R8 400,00.

2.2 LIBRARIES :-

Category B : Library of good value
9m X 15m = 135m² at R167,00 per sq metre R22 545,00

Category C : Library of satisfactory value
9m X 15m = 135m² at R160,00 per sq metre = R21 600,00

Category D : Library of Low value
9m X 15m = 135m² at R157,00 per sq metre = R21 195,00

Category E : Library of Lowest value
9m X 15m = 135m² at R140,00 per sq metre = R18 900,00

2.3 LABORATORIES :-

Category B : Laboratory of good value.
9m X 12m = 108m² at R167,00 per sq metre = R18 036,00

Category C : Laboratory of satisfactory value.
9m X 12m = 108m² at R160,00 per sq metre = R17,280,00

Category D :

Category D : Laboratory of low value.
9m X 12m = 108m² at 157,00 per sq metre = R16 956,00

Category E : Laboratory of Lowest value.
9m X 12m = 108m² at 140,00 per sq metre = R15 120,00

3. It should please be noted that although a classroom may be built of good quality material of high value in cost, the maximum subsidy will remain at R5 000,00 per classroom Owing to economic climate of the country we cannot afford to subsidise offices, storerooms, and toilet buildings.

SECRETARY FOR EDUCATION AND CULTURE
MPP/nfh

ANNEXURE G

Departmental Circular No. 36 of 1986
(File 8/4/6/1)

Department of Education and Culture
Private Bag X04
ULUNDI
3838

TO:

The Circuit Inspector
Chief Invigilator

STANDARDIZATION OF THE SYLLABUS COMPONENT(S) COVERED IN QUESTION PAPERS FOR AFRIKAANS AND ENGLISH, STANDARD 10 (FIRST AND SECOND LANGUAGE HG, 1986.

1. Confusion presently exists, especially among candidates, as a result of the anomy that the syllabus component(s) of correspondingly numbered question papers in the various grades of Afrikaans and English differ in some cases. Consequently, candidates cannot easily determine what component of the subject matter of the syllabus (literature, writing (composition/letter) or language) is covered in a specific question paper. For example, the literature component is covered in the 1st paper of English First Language HG, but in the 3rd paper of English First Language SG.

English First Language HG, Std 10

1st paper - 2 hrs - Original Writing
2nd paper - 2½hrs - Language and Comprehension
3rd paper - 3 hrs - Literature

English First Language SG, Std 10

1st paper - 2hrs - Original Writing
2nd paper - 2 hrs- Language and Comprehension
3rd paper - 2½hrs- Literature

English First Language LG, Std 10

1st paper - 1hr - Original Writing
2nd paper - 1hr - Language and Comprehension
3rd paper - 1hr - Literature

English Second Language HG, Std 10

1st paper - 3hrs - Creative Writing, Comprehension, Language
2nd paper - 1½hrs- Literature

English Second Language SG, Std 10

1st paper - 3hrs - Creative Writing, Comprehension, Language
2nd Paper - 1½hrs- Literature

English Second Language LG, Std 10

1st paper - 2hrs - Creative Writing and Literature
2nd paper - 1hr - Comprehension and Language

2/.....

Further particulars on external examinations in respect of LG level (Std 10 only) will be introduced as soon as they become available but in the meantime it can be stated that National Standard 10 external examinations at LG level will be conducted only in respect of Department of Education and Training's candidates who are receiving full-time instruction at departmental schools. Part-time and non-departmental candidates will not be permitted to enter for or write the Nationa external examinations at LG level.

2. It would be appreciated if the contents of this Examination Instruction could be brought to the attention of all Standard 10 candidates entering for the November 1986 and following National examinations.

3. The previous examination instruction is No. 51 of 1985. (Revised syllabuses for Standards 5-10; examining of History, Standard 10; and printing error on 1981 syllabuses for Economics SG, Std 10(English text).

4. Circuit Inspectors must please ensure that each of their sub.centres recei a copy of this Examination Instruction forthwith.

SECRETARY FOR EDUCATION AND CULTURE : EXAMINATIONS

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