THE RELATIONSHIP BETWEEN LEARNING POTENTIAL, ENGLISH LANGUAGE PROFICIENCY AND WORK-RELATED TRAINING TEST RESULTS

by

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DECLARATION

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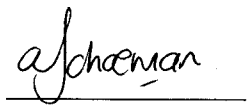
I, the undersigned, hereby declare that the dissertation entitled "The relationship between learning potential, English language proficiency and work-related training test results" is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.



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SUMMARY

THE RELATIONSHIP BETWEEN LEARNING POTENTIAL, ENGLISH LANGUAGE PROFICIENCY AND WORK-RELATED TRAINING TEST RESULTS

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Continuous change and competition in the working environment necessitate increased efficiency and productivity which require different and enhanced skills and abilities. It is therefore important that the right people with the right skills are selected and employees are developed to enable them to meet the organisational and national demands of the future.

This dissertation investigates the relationship between learning potential, English language proficiency and work-related training test results to establish why some production employees perform better on work-related training test results than others.

The results indicate that there is no significant relationship between the work-related training test results and either learning potential or English language proficiency. There is, however, a significant correlation between learning potential and English language proficiency. It might be worthwhile exploring the availability and adequacy of assessors as well as the motivational level of the production employees as factors that influence the progress made with work-related training test results.

Key terms

Learning potential; learning potential computerised adaptive test (LPCAT); psychometric testing; English language proficiency; training test performance; intelligence testing, work-related training

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

The world of work is continuously changing and economic, political, technological and sociocultural changes have profound effects on the way work will be managed in the future (Greenhaus & Callanan, 1994). World competitiveness appears to be more uncertain than ever before with the imminent threat of a period of economic slowdown or recession (Garelli, 2001). The World Competitiveness Yearbook scorecard (Garelli, 2001) highlights the "horizontal" relationships between several nations based on 286 criteria related to economic performance (including employment rates), the efficiency of government administration, business efficiency (education and productivity of the workforce) and infrastructure. During 2001, South Africa was ranked 42nd out of 49 countries, with the USA in number one position. This means that South Africa is not regarded as competitive when it comes to its people's level of education and productivity.

In a global market, nations are exposed to the demands of organisations for investments in the country. The emphasis is on promoting the attractiveness of a country as a business location. This not only creates a favourable environment for investment but also draws the best human capital. The world is changing into a knowledge-based economy, where the most competitive nations also have the power to attract the best people. Many skilled people leave South Africa for other prosperous working environments and better opportunities (Garelli, 2001). This is only one of the dilemmas that South Africa is currently facing which Garelli (2001) refers to as the "war of the best brains".

Although South Africa is in great need of people with the necessary skills and abilities, it was rated 48th out of 49 competing countries on the total public expenditure on education as a percentage of gross domestic product (GDP) (Garelli, 2001). This causes a second

dilemma, namely that those who remain in the country do not receive enough training or are not learning fast enough to keep up with the rest of the global market.

For leaders to create capable and competitive organisations, there is a need for a shift from structure, forms, rules and roles to a focus on capability (Ulrich, Zenger & Smallwood, 1999). Technological advancements are reducing the workforce (Foot & Stoffman, 1996) and the remaining employees now require a different set of skills and abilities than before (Chowdhury, 2000). The complexities and competitiveness of the global market require a collective and collaborative environment and not simply a grand strategist at the top (Senge, 1990). Employees should not only be able to adapt to the changing work environment but should also have the necessary ability to use new and complex equipment.

Continuous investment should thus be made in terms of training and competence improvement (Lessing & Maritz, 2001). Education levels and aspirations of the workforce are changing, and business qualifications in addition to a first degree are often required (Pearn, Roderick & Mulrooney, 1995). Hands-on operating has changed to advanced systems and information management, which require different skills and abilities (Toffler, 1981).

These fundamental changes in the marketplace require higher levels of cognitive ability or intelligence. Intelligence is defined by some as the capacity to learn from experience and adapt to one's environment (Gregory, 1996), and cognitive assessment is widely used for selection and placement purposes as well as for the prediction of performance or success (De Beer, 2000a). Owing to the cultural diversity of South Africa and previously related discriminatory practices, learning potential measurement became more viable for the assessment of cognitive functioning (Budoff, 1986).

The Polymers Company in South Africa supplies the market with various grades of high-value polymers, produced by adding value to chemical feedstock supplied by a petrochemical company. The company comprises a full-scale factory with two

production units, extrusion and polymerisation and various support functions such as Logistics and Research and Development. The Safety, Health, Environment and Quality Department is an entity on its own because of the inherent risks of the process.

During February 1999 a fire ignited which caused the extrusion section of the polymers plant to explode. It took hours of hard work to extinguish the fire – fortunately no one was killed.

Taking the above into account, there are several reasons why the Polymers Company should have able and competent people:

- the economic and competitive situation of South Africa in comparison with the global market

- the skills shortage and brain drain (Garelli, 2001)

- the safety risks involved in the chemical industry

It is therefore vital that people with the appropriate learning potential be selected and developed to meet future organisational and national demands.

All measures should be taken to ensure that hazardous incidents similar to the one in 1999, do not happen in the future. Since the above-mentioned incident, training shifts have been introduced whereby each production employee undergoes 38 hours of formal training per month in order to complete 165 tests and assessments. Production employees are obliged to undergo competency tests and assessments based on unit standards accredited by the Chemical, Oil and Allied Industries Training Board (COAITB), now called the Chemical Industries Education and Training Authority (CHIETA), to ensure that they are not only knowledgeable but fully competent in running the plant. Initially, no detailed progress on tests and assessments was monitored, but since December 2000 progress per employee per month has been monitored and reported.

Work-related training test results improved from an average number of tests and assessments passed of 61,27 on 1 December 2000 to 101,71 on 31 December 2001, an average improvement of 40,44 number of caps. The maximum improvement obtained by a production employee was 99 (an additional 99 tests were passed) and the production employee with the least improvement managed to pass only one additional test during this period.

1.2 PROBLEM STATEMENT

A considerable amount of money and time has been spent on the training of employees, and if similar incidents are to be avoided at all cost, it is essential to determine the causes of differences in terms of the work-related training test results of the various production employees. Some employees with many years of service, do not manage to make progress in terms of the successful completion of the required tests, while other newly appointed less experienced employees advance at a rapid pace. Learning potential was regarded as one of the factors that could influence the progress made by the production employees. English proficiency was considered as another possible influencing factor since only five of all the production employees included in the sample were English mother tongue speakers. This could influence the learning process, since all training material, assessments and tests are conducted in English.

Although the training results of the production employees could be influenced by various other factors, it was decided to limit this study to learning potential and English language proficiency. The general question of the research is to establish whether there is a relationship between learning potential, English language proficiency and work-related training test results. The specific questions are:

- What is meant by learning potential and how is it measured?

- What is the learning potential of the production employees and how is it measured?
- What is the English language proficiency of the production employees and how is English language proficiency measured?
- What are the work-related training test results of the production employees and how is work-related training measured?
- Is there a relationship between learning potential and work-related training test results?
- Is there a relationship between English language proficiency and work-related training test results?

1.3 OBJECTIVES

The objectives of the study are formulated from the above-mentioned research problem and research questions. The general objective of the study is to determine whether there is a relationship between learning potential, English language proficiency and work-related training test results. Specific objectives are

- to determine what is meant by learning potential and how it is measured
- to determine the learning potential of the various production employees and indicate how learning potential is measured
- to determine the English language proficiency of the various production employees and indicate how English language proficiency is measured

- to determine the work-related training test results of the various production employees and how training is measured

- to determine the relationship between learning potential and work-related training test results

- to determine the relationship between English language proficiency and work-related training test results

1.4 PARADIGM PERSPECTIVE

The research is conducted within the field of industrial psychology encompassing the subdisciplines of psychometrics and organisational and personnel psychology. The paradigm perspective provides a framework within which the research is conducted (Mouton & Marais, 1992). Different paradigm perspectives are used for the variables of this research. Learning potential is based on humanism (every organism has an inherent growth potential or self-actualising tendency) (Meyer, Moore & Viljoen, 1989) because it is regarded as changeable (De Beer, 2000). Work-related training test results are based on behaviourism (behavioural responses follow mechanically on stimuli) (Meyer et al., 1989).

1.5 RESEARCH DESIGN AND METHOD

A literature review as well as an empirical study were conducted and will be reported on in the next chapters. The literature review will focus on learning potential. It will provide a broad overview of the definitions and measurement of intelligence and why intelligence as a construct became inappropriate. Thereafter, learning potential will be introduced as an alternative strategy for the measurement of cognitive ability, discussing its theory and measuring devices. The influence that English language proficiency has on the success of work-related tests and assessments will be discussed.

An empirical study was conducted to determine the learning potential, English language proficiency and work-related training test results of the production employees as well as the relationship between the mentioned variables. The sample consisted of 52 male production employees of the Polymers Company from different cultural groups. The Learning Potential Computerised Adaptive Test (LPCAT) was used to measure the learning potential of the sample (only 51 of the production employees were tested on the LPCAT). A Proficiency Test English Second Language (Advanced Level) for grades 10 to 12 was used to determine the English language proficiency level of the sample. To ensure consistency, the total sample was tested even if their first language was English. Work-related competency tests and assessment results were used to establish the progress over a period of 13 months (beginning December 2000 to end December 2001). The organisation has been accredited as a training provider. Tests and assessments meet the requirements as set by CHIETA. It could thus be said that the training results are valid and reliable, although the following are some of the limitations which influenced the study:

- A pass rate of 90% on work-related tests was required.
- Three opportunities were provided to pass a particular test or assessment.
- The marks obtained do not really distinguish between production employees because of the high percentage pass rate required.
- The progress made on tests and assessments was measured and reported in terms of the number of tests and assessments passed and not in a percentage mark obtained or the level of performance in the particular work-related test or assessment.

Data collection was done using the above-mentioned information as well as biographical data (age, years of relevant experience at the Polymers Company, culture, home language and years of formal education) obtained from personnel records. Descriptive statistics, correlations and regression analysis were performed to analyse the data obtained. The

results are reported in terms of learning potential, English language proficiency and work-related training test results of the various production employees and the relationship between the three variables. Additional information was obtained to investigate why some production employees performed better on work-related training test results than others by interviewing three high performers and three low performers.

Chapter 3 provides more information on the empirical study.

1.6 OUTLINE OF THE CHAPTERS

Chapter 1 provides an orientation to or the background of the study. Reasons for conducting the study are provided as well as the subject of the research and how the study is to be conducted.

Chapter 2 provides a theoretical review of learning potential. Intelligence, the definition and measurement thereof, as well as the problems experienced with the definition and measurement of intelligence are discussed. Thereafter the concept of learning potential is introduced as an alternative method of measuring cognitive ability.

Chapter 3 provides information on the empirical study that was conducted. The methodology used is explained including information on the sample, the measuring instruments used, how information was gathered and the hypotheses formulated.

Chapter 4 provides the results of the study – in other words, whether there is a relationship between learning potential, English language proficiency and work-related test results for the sample which was researched.

Chapter 5 draws conclusions, outlines the limitations of the study and makes recommendations for possible further research.

1.7 CONCLUSION

This chapter dealt with the background to and motivation for the study. Worldwide change, the economic and political situation and skills shortage in South Africa were discussed, followed by the specific competence requirements of the Polymers Company. The objective of the study is to determine the relationship between learning potential, English language proficiency and work-related training test results in order to establish why certain employees progress faster than others, given the same opportunities.

CHAPTER 2

LEARNING POTENTIAL

2.1 INTRODUCTION

Chapter 1 provided an overview of the purpose and objectives of this study. Reasons were advanced explaining why change is inevitable from a macroeconomic viewpoint, focusing on competitiveness and globalisation as drivers for business optimisation. The impact of change on the South African economy including the unique dilemmas facing South African organisations was discussed. The chapter ended by exploring the unique problems faced by the Polymers Company with specific emphasis on the role of the human factor in a changing world of work in the global competitive arena. Emphasis was placed on factors which could influence productivity, individual performance and learning efficiency, namely cognitive ability and English language proficiency. This chapter will provide an overview of cognitive ability and its measurement by means of intelligence testing and learning potential assessment. Definitions, information on measurement and the limitations thereof will be provided. This will be followed by a discussion of the influence of English language proficiency on learning efficiency.

2.2 DEFINING AND MEASURING INTELLIGENCE

During the early 1960s, the usefulness of the measurement of intelligence was questioned (Eysenck, 1988), since it was believed that the measurement of intelligence was discriminating and not applicable for the accurate measurement of intelligence of diverse cultures (Jensen, 1980). The lack of a single theory of intelligence and the absence of an agreed definition have been criticised (Aiken, 1996; Eysenck, 1988). According to Eysenck (1988), some of the most useful definitions of intelligence refer to what intelligence may be expected to do.

Theories of intelligence, however, are useful to the extent that they provide psychologists and educators with an understanding of intellectual functioning (Ittenbach, Esters & Wainer, 1997).

2.2.1 Defining intelligence

There is no scarcity of definitions of intelligence, although there is in fact no commonly accepted definition (Aiken, 1996; Eysenck, 1988). The layperson associates intelligence with problem solving, cleverness and thinking (Eysenck & Kamin, 1981).

Binet viewed intelligence as "a fundamental faculty, the alteration or lack of which, is of the utmost importance for practical life. This faculty is judgment otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. To judge well, to comprehend well, to reason well, these are the essential activities of intelligence" (Binet & Simon, 1905, pp. 42-43).

Wechsler (as cited in Gregory, 1996, p. 153) defined intelligence as "the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment".

Most definitions of intelligence include intelligence as the ability to learn and adapt to one's environment (Aiken, 1996; Brown & Ferrara, 1985; Eysenck & Kamin, 1981) although it is questioned in terms of the ability-as-capacity trait or the ability-as-developed trait (Ackerman, 1994). Eysenck and Kamin (1981), however, define intelligence as the level of ability that is visible in behaviour; the interplay between genetic potential and environmental stimulation. This therefore includes both the ability-as-capacity and ability-as-developed traits. Intelligence can further be distinguished in terms of fluid and crystallised intelligence. Fluid intelligence does not depend on

knowledge, education or cultural factors, and is thus similar to genetic potential, whereas crystallised intelligence draws on knowledge acquired (Eysenck & Kamin, 1981).

A comprehensive view of intelligence includes both maximal as well as typical performance. Maximal performance refers to optimal performance or capacity to perform which is relatively stable, whereas typical performance refers to the normal, day-to-day or average level of performance elicited (Ackerman, 1994).

According to Eysenck (1988), intelligence resembles three different concepts, namely biological intelligence, psychometric intelligence and social or practical intelligence.

(1) Biological intelligence refers to the biological conditions necessary for the development of intelligence that is inherited from parents (Haywood & Tzuriel, 1992). It also refers to the structure of the human brain, is responsible for individual differences between human beings and can be measured by means of electroencephalograph (EEG), galvanic skin response (GSR), and so forth (Eysenck, 1988).

(2) Psychometric intelligence refers to performance on intelligence tests (Eysenck, 1988; Haywood & Tzuriel, 1992). Intelligence is thus seen to be what the tests measure (Lidz, 1987).

(3) Social or practical intelligence is the range of performance that is hidden or unknown and can be activated under certain conditions (Haywood & Tzuriel, 1992).

According to Thorndike (1997, p. 11), however, there are two main kinds of intelligence, namely

(1) social intelligence – "...the ability to understand and work successfully with people"

(2) mechanical intelligence – "...the ability to understand and deal with concrete things and spatial concepts"

It is important to discriminate between the various concepts of intelligence to ensure correct understanding and meaningfulness of any discussion (Eysenck, 1988). It is no longer considered fruitful to find a common acceptable definition of intelligence, but rather to shift the focus from what intelligence is to how intelligence can be used (Aiken, 1996). Constructs such as the motivational level and the attention of the individual may influence the accuracy of the measurement of maximal performance and should be taken into account in the measurement of intelligence (Ackerman, 1994).

2.2.2 Measuring intelligence

Measurement is the process whereby numerical values are assigned to test results according to some rule or socially and scientifically agreed-on criteria of classification, whereas assessment is the process whereby the researcher formulates hypotheses and then tests them by means of a scientific method (Ittenbach, et al., 1997).

Galton was recognised as the founder of formal testing (Ittenbach, et al., 1997) and started the idea of the intelligence test as well as the nature-nurture debate (Fancher, 1985). Galton believed that genius is inherited but also that intelligence is a product of the speed and refinement of responses to environmental stimuli (Aiken, 1996). Cattell's research focused on individual differences. He developed a set of 10 "mental tests" and although it became evident that the tests did not measure what they were designed to measure (Fancher, 1985), his research contributed in terms of reaction time in the field of cognitive abilities (Eysenck, 1988).

Binet learned from Galton and Cattell and introduced the first meaningful measurement of individual differences in intelligence (Fancher, 1985). Binet argued that intelligence cannot be separated from actual experiences, circumstances and personal association. He

related level of ability to age (Thorndike, 1997) and expanded his research to include memory, suggestibility, judgement and imaginative exercises in word association, inkblot interpretation and story telling. Binet recognised the need for some "standard" dimensions to be used for comparability between individuals (Fancher, 1985).

Spearman was inspired by Galton's belief in the way in which sensory acuity could reflect differences in intelligence (Fancher, 1985). Spearman, like Galton, focused on the nature principle or heredity in his research. He investigated the individual correlations between six variables: Classics, French, English, Maths, Pitch and Music and found that all the correlations were positive and arranged themselves in a nearly perfect hierarchy (Fancher, 1985). He argued that there must be an overall or all-embracing cognitive ability that influences reasoning, problem solving and general cognition and called it "g" or general intelligence (Eysenck & Kamin, 1981; Fancher, 1985). In Spearman's two-factor theory of intelligence, any intellectual act consists of, firstly, a combination of "g", which is available to the same degree to all the intellectual acts that the individual performs, and secondly, the "s" factor which is specific to that act (Fancher, 1985; Thorndike, 1997). Spearman interpreted "g" as brain power – "...as the general level of mental energy which led people to perform well or poorly on all sorts of intellectual acts, but particularly those requiring abstract thinking" (Fancher, 1985, p. 95).

Stern classified individuals according to types, norms and deviations (Fancher, 1985). He introduced the well-known concept of intelligence quotient (IQ) by interpreting each individual's intelligence test score as a particular mental age (Fancher, 1985). The IQ score is determined by dividing mental age by chronological age (Fancher, 1985). IQ was initially viewed as innate and constant but with subsequent research it became apparent that education or special training could induce changes in IQ (Locurto, 1991).

Since Stern's testing and research focused only on children and adolescents and failed to increase mental age scores after adolescence, Wechsler decided to focus on adults (Fancher, 1985). He introduced the Wechsler Bellevue Scale in 1939 and revised it, and in 1955 introduced the Adult Intelligence Scale (WAIS) (Francher, 1985; Thorndike,

1997). The two most widely used intelligence tests are the Wechsler and the Stanford-Binet tests (Sternberg, 1997).

Initially, simple mathematical and statistical techniques were used to analyse test results. Intelligence tests consisted of observation and equipment such as lighted matches, wooden cubes, food and various weights used for comparison purposes. Pen-and-paper, picture arrangement and block designs were then introduced. Computer technology opened up further opportunities for testing. Computers were used for scoring, report writing and test administration and eventually to individualise the tests for each examinee. Adaptive testing, using computer technology and item response theory (IRT) is becoming increasingly popular (Ittenbach, et al., 1997). Item response theory is used to predict the likelihood that an examinee will answer the question correctly. A low score indicates that the item is too difficult for the examinee (ie regarding ability), while a high score indicates that the item is too easy for him/her. The examinee's position on a trait is referred to as his/her proficiency level or his/her position on an unobserved or latent trait (Ittenbach, et al., 1997).

Test reliability (internal consistency, alternate forms and test-retest reliability) has been included in test development from as early as Spearman's time. During the 1930s and 1940s it became apparent that all tests could not be used on all people and the validity of instruments became more prominent. Only with the publication of the Technical Recommendations for Psychological Tests and Diagnostic Techniques in 1954, did all four principal types of test validity (content, predictive, concurrent and construct) receive equal status (Ittenbach, et al., 1997).

2.2.3 Problems with defining and measuring intelligence

Individuals from certain ethnocultural and low socioeconomic subgroups regularly perform below the normal levels of functioning on ability tests. Hence the accuracy of

these tests for such subcultures became questionable (Feuerstein, 1979). Concerns and criticism regarding intelligence testing centred around the following themes:

- defining intelligence
- nature of intelligence
- psychometric measures and practice
- use of intelligence testing

As mentioned earlier, there are various definitions of intelligence, with no commonly accepted one (Aiken, 1996). This causes difficulties in measuring intelligence and brings us back to the statement that intelligence is seen to be what the test measures (Lidz, 1987).

The nature-nurture debate questions whether IQ is relatively stable and attributable to heredity factors (nature) or changeable and influenced by environmental factors (nurture). In the mental development of human beings, inherited ability is complemented with a programme of intensive and specialised training or environmental stimulation (Fancher, 1985), and therefore any useful test on intelligence should predict aspects of current and future performance (Ackerman, 1994), thus taking both aspects into account (Fancher, 1985). Most intelligence tests, however, deal with the permanence of the trait that has been developed over a period of time (Feuerstein, 1979) and influenced by education and parental guidance (Eysenck, 1988), placing inadequate emphasis on environmental factors (Haywood & Tzuriel, 1992). Often IQ tests measure general ability (Lidz, 1987) and do not predict the potential to perform in the future (Narrol & Giblon, 1984). Various criticisms were raised against the psychometric measures and practices of conventional IQ tests:

- Scores on intelligence tests are not perfectly reliable since they may be affected by examiner bias, the examinee's level of motivation, practice or coaching and expectancy levels (Aiken, 1996).

- Precision of measurement decreases, since only a limited aspect of intelligent behaviour is measured, called abstract intelligence (Thorndike, 1997).

- Standardised tests consist of mainly items based on white middle-class values and experiences and penalise individuals with different linguistic styles from the dominant culture (Hegarty, 1988).

- Although it is used to predict learning ability, it does not have subtests to assess learning ability and provides little information about the individual's ability to learn (Gupta & Coxhead, 1988).

- It often fails to understand the process that caused the individual's particular level of functioning which hinders the desired remediational changes in the individual (Feuerstein, 1979).

- Many tests were not developed from well-researched and empirically supported theoretical frameworks and failed to assess the cognitive processes and abilities associated with academic achievement (Flanagan, Andrews & Genshaft, 1997).

- The use of intelligence tests has been criticised in terms of their application in selection and placement decisions (Flanagan, et al., 1997; Foxcroft, 1997).

- Information obtained from testing is often inadequate or interpreted selectively (Flanagan, et al., 1997), which could damage self-concepts, lower teachers' expectations and assign individuals to inappropriate educational programmes (Hegarty, 1988).

- Labelling resulting from conventional psychometric measurement has had extremely detrimental effects on the individual's prospects in life (Feuerstein, 1979).

- Bias in assessment of minorities became a general issue on testing and the equality of opportunities (Gupta & Coxhead, 1988). It was believed that blacks are genetically inferior to perform intellectually. Although the ability to learn is a common attribute of people from all classes, cultures and ethnic groups, it is clear that what is learnt is different (Gupta & Coxhead, 1988). Not all people receive equal access and have frequent access to appropriate school preparatory experiences and they may learn differently. According to Ceci and Williams (as cited in Sternberg, 1997), the scores of intelligence tests correlate with the amount and quality of schooling received, and certain abilities are valued above others. Test scores may also be influenced by perceptions of the test process, low expectations of success, speed requirements, poor test takers and unfamiliar content of test items (Budoff, 1986).

- Language may influence the test performance of an individual, especially when the test is not administered in his/her home language or when the individual received his/her formal school training in a different language. Fair testing requires testing of the individual's language proficiency in the language in which the test is to be administered prior to the actual assessment. A bilingual assessment is desirable, especially when the test measures prior learning since some individuals have not received prior education in their home language (Foxcroft, 1997).

- Cognitive limitations are generally caused by improper and inappropriate mediated learning experiences or guidance, which can be enhanced and optimised to reach full learning potential (Narrol & Giblon, 1984).

- Lastly, people can also be influenced by a self-fulfilling prophecy in terms of the reactions and expectations of others (Narrol & Giblon, 1984).

These concerns suggest that psychometric tests may be less relevant than was previously thought, and could be damaging when individuals are led to believe that they do not have the ability to perform certain tasks (Feuerstein, 1979). In South Africa, tests were not developed for a multicultural and multilingual population owing to the apartheid policies

of the past (Foxcroft, 1997). Many of the tests, however, failed because they still remained focused on the assumption of intelligence being a fixed entity (Feuerstein et al., 1987), measuring present cognitive abilities and not permitting the assessment of the individual's capacity to apply acquired skills, strategies and operations in new situations (Feuerstein, 1979). Taking the above-mentioned into account, it became imperative to either abolish the use of static tests or to develop different techniques (Foxcroft, 1997). This gave rise to techniques referred to as culture-fair or developmental tests (Feuerstein et al., 1987) such as learning potential assessment (Budoff, 1986).

2.2.4 Culture-fair tests

Various approaches have been introduced to address the problems experienced with the measurement of intelligence. The first approach used in producing cultural-fair testing was to develop separate norms for different cultural groups. These cultural-fair tests, however, have not been designed for use with the low socioeconomic, ethnocultural subgroups, and do not provide more valid and reliable information on the cognitive functioning of these groups (Feuerstein, 1979). Thereafter an attempt was made to adapt the nature of the tasks assigned to cultural minorities (Feuerstein, Rand, Jensen, Kaniel & Tzuriel, 1987) by selecting items which do not penalise the individual for his/her social, ethnic or experiental background (Feuerstein, 1979). Lastly, measuring instruments have been developed to measure learning potential.

2.3 LEARNING POTENTIAL

Learning potential assessment has been developed as an alternative strategy for the assessment of cognitive functioning (Budoff, 1986) to address the inadequacy of conventional intelligence testing (Feuerstein, 1979).

2.3.1 Defining learning potential

Potential is often defined as an individual's unrevealed innate capacities which are possibly greater than his/her manifest level of functioning (Feuerstein, Feuerstein & Gross, 1997). Learning potential measures both an individual's present level of ability as well as the potential for improvement with help (Haywood & Tzuriel, 1992). Bronfenbrenner (as cited in Haywood & Tzuriel, 1992), describes learning potential assessment as the process of discovering how the individual can become what he/she is not yet. Learning ability can be conceptualised as, firstly, the individual's performance on learning tasks, and secondly, as the rate of learning when other variables are held constant (Hegarty, 1988).

Learning tests can provide information about the individual's attention span, perseverance and learning style which are of importance in future success (Gupta & Coxhead, 1988).

2.3.2 Background to the assessment of learning potential

After the early 1920s approaches to the assessment of intelligence, similar to the concept of dynamic assessment, were investigated. In dynamic assessment, training is incorporated in the assessment to allow for differences in prior learning experiences and background (De Beer, 2000a). Buckingham (as cited in Lidz, 1987, p. 4) concluded that "a measure ... either of the rate at which learning takes place or of typical products of learning will constitute a measure of intelligence" (as cited in Lidz, 1987, p. 4). Learning potential is what is measured, while dynamic assessment is the way in which learning potential is measured (De Beer, 2000a). Dynamic assessment developed as an attempt to deal with "... the dissatisfaction with existing procedures as well as a positive attempt to design a model that is theory-based, provides a meaningful description of cognitive functioning and links assessment with instruction" (Lidz, 1997, p. 281). The purpose of

dynamic assessment is not to replace, but to function as an addition to current approaches (Lidz, 1987).

Vygotsky laid the theoretical base upon which dynamic assessment and the measurement of learning potential has been built (Haywood & Tzuriel, 1992) with his concept of the zone of proximal development (ZPD) (Vygotsky, 1978). The zone of proximal development manifests in the interaction of the child with other more capable individuals, thus the difference between the level obtained functioning on his/her own and the level obtained through interaction and assistance from another individual (Haywood & Tzuriel, 1992; Lidz, 1997). The child, for example, first experiences active problem solving activities in the presence of others and is then gradually required to perform these activities independently. The examiner promotes internalisation of the sociocultural environment through, say, language, and interventions take place according to a test-teach-retest approach (Lidz, 1997). This process of internalisation of cognitive activities should, however, be transferred to situations other than the traditional testing milieu (Brown & Ferrara, 1985). The zone of proximal development includes both estimates of efficiency of learning and breadth of transfer – fast learning and wide transfer (Brown & Ferrara, 1985).

Vygotsky also introduced the concept of the zone of actual development which is characterised by test items that the examinee is able to solve independently (Haywood & Tzuriel, 1992; Lidz, 1997). Information about both proximal and actual zones of development are required for complete understanding of the learner (Lidz, 1997). Vygotsky compared assessment with an orchard which should not only be measured in terms of the trees that have matured and borne fruit, but also those trees in the process of maturing (Haywood & Tzuriel, 1992). Dynamic assessment therefore begins where traditional psychometric assessment ends (Lidz, 1997).

2.3.3 Measuring learning potential

Researchers have employed different approaches, procedures, techniques and measures in their use of dynamic assessment. Approaches differ in terms of the method of conducting the assessment as well as in the focus of the measurement. Two distinct approaches to the measurement of learning potential will be discussed on the basis of the way in which Vygotsky's theory has been interpreted and operationalised as well as the desired outcome (De Beer, 2000a).

2.3.3.1 The enrichment approach

The enrichment approach to the measurement of learning potential focuses on the individual's learning outcome. It attempts to change the individual's cognitive ability and achieve structural changes in cognitive functioning (Feuerstein et al., 1987).

Feuerstein based his research on the clinically oriented cognitive enrichment approach to the measurement of learning potential. He focused on the modifiability of cognitive functioning and mediated learning - in other words, the extent to which cognitive structures can be changed in response to teaching, coaching or facilitation by a mediator (Haywood & Tzuriel, 1992). The aim is therefore to provide mediated learning opportunities to improve cognitive functioning. This approach is also based on Vygotsky's ZPD principle, although the emphasis is on social interaction and qualitative aspects of the learning process. Emphasis is placed on developing those functions that are in the process of maturing (De Beer, 2000a). Feuerstein's dynamic approach to testing is known as the learning potential assessment device or LPAD which will be discussed later in this chapter.

2.3.3.2 The psychometric approach

The psychometric approach to the measurement of learning potential refers to performance in intelligence tests (Eysenck, 1988; Haywood & Tzuriel, 1992). Tests are standardised to ensure measurement accuracy and are used for comparison purposes between individuals (Eysenck, 1988; Haywood & Tzuriel, 1992). Intelligence is thus seen to be what the test measure (Lidz, 1987). It focuses on the immediate levels of functioning and testing is not used to change the individual (Feuerstein et al., 1987), but rather to evaluate the capacity for acquiring new skills or knowledge when training is provided (De Beer, 2000a).

The psychometric approach to the measurement of learning potential is also based on Vygotsky's ZPD theory but focuses on the measurement component. Both the zone of proximal development as well as the zone of actual development are used. The pretest provides the actual developmental level, while the difference between the post-test and the pretest is taken as the ZPD measure (De Beer, 2000a). The psychometric approach has been used effectively in the development of learning potential measurement devices by Taylor (1997) and De Beer (2000a).

Taylor (1997) developed two tests to measure cognitive capabilities and potentialities, namely the TRAM-2 and the Ability, Processing of Information and Learning Battery (APIL-B). The TRAM-2 is based on the acquisition of skills during the testing period in order to predict success in a number of work-related activities, thus focusing on whether a person would be able to acquire the necessary skills within a reasonable period of time if he/she is given training and developmental opportunities (Taylor, 1998). The aim of the APIL-B is to identify people who are likely to have the cognitive capacity to master the intellectual challenges of tertiary education or could possibly be developed to play managerial or higher-level technical work roles. Both tests focus on obtaining standardised measures and not changing cognitive ability (Taylor, 1997).

The aim of De Beer's (2000a) research was to construct, standardise and evaluate a computerised adaptive test for the measurement of learning potential aimed at a target population of people from all culture groups in South Africa. Her aim was not to change or modify the cognitive ability of the examinees, although training formed part of the assessment procedure (De Beer, 2000a). She developed two versions of the Learning Potential Computerised Adaptive Test, namely the LPCAT-1 and LPCAT-2 which will be discussed later in this chapter.

2.3.4 Learning potential instruments in use

Although there are various learning potential instruments, commonly used instruments can be categorised according to the enrichment and psychometric approaches.

2.3.4.1 The enrichment approach

Feuerstein's dynamic approach to testing is known as the learning potential assessment device or LPAD and was developed to counteract the misclassification and misdiagnosis stemming from traditional tests (Narrol & Giblon, 1984) with specific emphasis on those children from culturally deprived backgrounds. The major goal of the Learning Potential Assessment Device was to discover the hidden potential of the individual, which was unrevealed by his/her manifest level of functioning (Feuerstein, Feuerstein & Gross, 1997).

Whereas the purpose of conventional testing is to classify the individual's presumed stable and irreversible level of functioning, the LPAD focuses on determining how the examinee's modifiability can best be enhanced to enable him/her to achieve higher levels of cognitive functioning. The LPAD rejects comparability and replaces tests with instruments or tools that allow learning to occur. It produces information about the nature, type, amount and the intensity of the intervention required to overcome

deficiencies identified in the examinee's cognitive functioning (Jensen, Feuerstein, Rand, Kaniel & Tzuriel, 1988).

The LPAD evaluation consists of four tests, namely the Organisation of dots test, the Raven Progressive Matrices Test, the Plateaux Test and the Representational Stencil Design Test (Narrol & Giblon, 1984).

2.3.4.2 The psychometric approach

The TRAM-2 Battery, the APIL-B and the LPCAT are instruments currently in use which focuses on the psychometric approach to learning potential measurement.

TRAM-2 is a learning potential assessment instrument developed in South Africa, which measures the learning that takes place during the testing process (Taylor, 1998). This functionality relates to Vygotsky's theory of potential development since learning takes place through doing, but no guidance is provided by a more capable individual. The learning that took place during the test is measured. No previous knowledge or competence is required and this ensures that all examinees have an equal opportunity to acquire the skill during the testing period. It thus measures whether the necessary skills can be acquired within a reasonable time. TRAM-2 consists of three main sections - the Concept Formation Test (standard level), the SymTran Test and the Memory and Understanding Test. The SymTran is devided into Phase A and Phase B with a dictionary for each. The battery produces scores on six dimensions: conceptual reasoning, automatisation, transfer, memory and understanding, speed and accuracy as well as a composite score which incorporates all the scores. The TRAM-2 was developed for examinees with an educational level from grades 10 to 12 and both English and Afrikaans versions are available. A total testing time of two hours and 45 minutes is required and the test is marked with a scoring mask. The scores are captured in a computer program which produces the TRAM-2 reports (Taylor, 1998).

The Ability, Processing of Information and Learning Battery (APIL-B), also developed in South Africa, measures a set of capabilities and potentialities and not already acquired skills or abilities. It provides a profile of eight scores: capacity to think abstractly, speed, accuracy and flexibility of information processing, learning rate, overall work output in a learning exercise, capacity to memorise and master concepts and capacity to transfer learning to novel applications. The complete APIL-B does not have to be administered, although the complete battery does provide more reliable information. The test items are presented in a geometric-diagrammatic medium which minimises cultural content. The APIL-B has been developed for examinees with 12 years of education or even tertiary education. The complete battery takes three hours and thirty minutes to administer. The test is marked with a scoring mask and the information is captured on a computer program (Taylor, 1997).

The learning test which forms part of the APIL-B relates to Vygotsky's theory of proximal development since learning takes place through doing, but no guidance is provided by a more capable individual. During the learning test, the examinee is subjected to the same task on four occasions and is given three study periods. The scores form a curve of learning (COL) and the learning rate is a function of the improvement in performance (Taylor, 1997).

The Learning Potential Computerised Adaptive Test (LPCAT) was developed in South Africa following extensive research over a period of six years. The LPCAT measures learning potential in the general nonverbal reasoning domain and can be used for all culture groups in South Africa (De Beer, 2000c). It measures both the individual's present level of performance as well as the extent to which he/she is able to improve upon present performance when relevant training is provided (De Beer, 2000c). The LPCAT is intended to serve as a screening instrument ensuring no discrimination against previously disadvantaged groups (De Beer, 2000c). The LPCAT is administered on a computer and makes use of adaptive testing using a test-teach-retest approach/strategy. There are two versions of the LPCAT namely LPCAT-1 and LPCAT-2. The main difference between the LPCAT-1 and LPCAT-2 is the administration thereof. In the administration of the

LPCAT-1, the examinee reads the relevant information in English or Afrikaans on the computer screen and completes the test independently in his/her own time. A grade 6 language proficiency level in English or Afrikaans is required (De Beer, 2000b). In the LPCAT-2, no instructions are given on the screen. Instructions are read to the examinee while the example figures appear on the screen. Instructions for the LPCAT-2 have been translated and are available in all 11 official South African languages (De Beer, 2000a). The examiner can read the instructions to the examinee in his/her own language. No language proficiency level is required for the LPCAT-2 and it can therefore be administered to unskilled individuals. Both versions use the same practice examples and item banks but the LPCAT-2 has a slightly lower entry level and thus starts off with easier items (De Beer, 2000b).

The LPCAT is a combination of the item response theory (IRT) based on the adaptive testing technique and Vygotsky's theory of the "zone of proximal development" (ZPD). The IRT approach allows for more accurate measuring of the difference between the pretest and the post-test in the test-teach-test application.

Weiss (1983, p. 5) defined adaptive testing as follows: "Adaptive testing, also sometimes called tailored testing, involves the selection of test items during the process of administering a test so that the items administered to each individual are appropriate in difficulty for that individual". Adaptive testing has three important characteristics: variable entry, individual branching during the test and variable termination (Schoonman, 1989; Weiss, 1983; Weiss, 1985). The aim of adaptive testing is to lessen the total testing time by adapting the items to the level of the examinee (Schoonman, 1989; Weiss, 1985) and therefore fewer items need to be administered (Weiss, 1985). The LPCAT administers between eight and 12 items in the pretest, depending on the individual's performance and between 10 and 18 items in the post-test (De Beer, 2000). Basically, each individual potentially receives a different set of test questions depending on his/her status on the trait being measured. Each version (LPCAT-1 and LPCAT-2) has a specific starting point. Based on the examinee's responses, additional questions are selected from a database of items of known difficulty. When the individual answers a

question incorrectly, the estimated ability is adjusted downwards and the next question is easier. When the individual answers a question correctly, the estimated ability is adjusted upwards and the next question is more difficult. Test items are thus based on and adapted interactively to the individual's estimated ability level. Test termination is based on the number of items that have been administered as well as an accuracy index (ie accuracy of the ability estimation) which is based on the psychometric properties of the items that have been administered. When the accuracy index is at the appropriate level, the test can terminate when the minimum number of items have been administered. If the accuracy index is not yet at the required level after the minimum number of questions have been administered, more items (up to the maximum number) will be administered. The test will then terminate either when the accuracy index reaches the required level, or when the maximum number of items have been administered – whichever occurs first. Since the LPCAT is administered by computer, the results are available immediately (De Beer, 2000d).

The item types used in the LPCAT are figure analogies, pattern completion and figure series items. These items are typical of the figural items found in most cognitive ability tests. The items used were selected to try and minimise culture loading by not using words, letters, numbers or pictures of familiar objects. The items therefore consist of lines, curves, circles and squares, et cetera, and involve universal concepts such as up/down, right/left, open/closed and the like. A pool of 270 items, 90 of each item type, of varying difficulty was constructed. A total of 188 items remained after a selection process. Items were excluded on the basis of their psychometric properties not meeting the required standards or if they showed bias in terms of level of education, gender, culture or language group.

The selected items were allocated to the pretest and the post-test item banks sequentially in a 1:2 ratio and done separately for each of the three item types to ensure an even spread of item types and item difficulties in both tests (De Beer, 2000c).

In order to attempt to make the LPCAT as culture-fair as possible, specifically in the South African context, De Beer (2000d) took the following factors into consideration:

- The dynamic (test-teach-test) approach to assess learning potential was used, thereby limiting the influence of prior knowledge or learning.

- The test instructions were available in all 11 official South African languages and language as a basis of the contents of test items was excluded.

- The test content used does not reflect prior school learning.

- Test items are figural nonverbal material including lines and other geometric figures and shapes that are reasoned to be equally familiar/unfamiliar to most examinees.

- IRT-based item analysis was done for the LPCAT items on the basis of the information obtained from a multicultural sample of 2554 examinees.

- No time limits are set for the overall testing time, although the typical time the LPCAT takes to administer is between one hour and one hour and twenty minutes. The only time limit set is that each item appears on the screen for a maximum of three minutes. If an item is not answered within this time, it will be replaced by an easier next item (De Beer, 2000d).

Multicultural groups were used for item analysis, standardisation and validation of the test (De Beer, 2000a). Information on the reliability and validity of the LPCAT is provided in the *Technical Manual* (De Beer, 2000b).

The LPCAT has been used for this study because it is valid for multicultural groups – thus similar to the sample being researched. The LPCAT is also administered and scored electronically which saves the researcher time.

2.4 ENGLISH LANGUAGE PROFICIENCY

English as a second language influences the learning, training and performance of individuals (Huysamen, 1999; Van Eeden, De Beer & Coetzee, 2001).

2.4.1 Defining English language proficiency

In an everyday context, English language proficiency is based on speaking, understanding, reading and writing English. Language proficiency is not only a result of a specific curriculum in which training has occurred but also the result of language contact and use (Chamberlain & Van der Schyff, 1991).

2.4.2 Measuring English language proficiency

The purpose of an English proficiency test is to determine the examinee's knowledge of and skills in English, and it is not always related to a specific syllabus. The Proficiency Test English Second Language which is used for the purpose of this study consists of multiple-choice questions related to the denotation and connotation of words, phrases sentences and reading passages as well as acceptable language usage (Chamberlain & Van der Schyff, 1991).

2.4.3 Problems with English language proficiency

The South African Constitution stipulates that everyone has the right to receive education in the language of his/her choice, where practicably possible. Despite the fact that all 11 South African languages have the same status, most black people prefer to receive education in English (Rossouw, 1999). Studying in a second language is one of the dilemmas facing most South Africans. The acquisition of second language literacy is influenced by proficiency in the first language, the incentive to learn the second language as well as cultural determinants such as one's own culturally-bound awareness of what is read and heard. To be academically literate, South Africans need to master English for

academic purposes over and above English as second language. This means that English must be used for communication, conveying knowledge, explaining, reasoning, reading, writing and debating (Gruenewaldt, 1999). A further problem is that teachers in black schools often lack the English proficiency required for effective teaching (Rossouw, 1999). When the language of instruction is not mastered, understanding the content of what needs to be learned is difficult and also influences the results obtained (Gruenewaldt, 1999). Van Rooyen' study (2001) indicated that home language was a significant predictor of academic success for students on an university bridging programme. Academic performance is therefore a function of proficiency in English (Van Eeden, et al., 2001). Huysamen (1999) also indicated that the command of the language used for assessment influences the prediction of tertiary academic performance. Measurement error is to be expected, when there is poor language proficiency exists in the language in which assessment takes place (Huysamen, 1999).

2.5 CONCLUSION

Although intelligence has been researched for many years, there is no common definition of the concept. This is mainly because of the nature/nurture debate – the paradox of whether intelligence is static and inherited or whether it is changeable and enhanced through learning. The genetic and developmental parts of intelligence should be seen to complement each other.

The importance of cognitive functioning is probably even greater today, because it is a prerequisite for adaptation to change (Feuerstein, 1979). Cultural bias in psychological tests highlighted the necessity for research on measuring the dynamic part of intelligence. Opportunity for learning and growth must be provided, particularly in the South African context, since all individuals have not had the same exposure and therefore not the same starting point. Furthermore, to ensure test fairness, test items should be culture-fair, by ensuring that all cultures attribute the same meaning to the specific item. The TRAM, APIL and LPCAT Batteries are excellent examples of South African culture-fair tests.

Item response theory made computer-based adaptive testing possible, whereby the test can be adapted to the proficiency level of the specific individual being tested. This saves time, for both the examinee and the examiner, since the individual can perform at his/her specific proficiency level. Fewer items need to be administered to attain accuracy comparable to that of much longer paper-and-pencil tests. The fact that the test is computerised also saves time when the examiner scores the test.

English is a significant predictor of academic performance (Van Eeden, et al., 2001) especially when learning and assessment take place in English. Studying in a second language is thus also one of the dilemmas facing most South Africans. To be academically literate, South Africans need to master English for academic purposes, over and above English as second language. This means that English must be used for communication, conveying knowledge, explaining, reasoning, reading, writing and debating. When the language of instruction is not mastered, understanding the contents of what needs to be learned is difficult and also influences the results obtained (Gruenewaldt, 1999). The above emphasises the disadvantage of having English as a second language when studying (Van Eeden, et al., 2001).

The Polymers Company continuously optimises the technology used in the production process which requires individuals with a higher cognitive ability and level of education than ever before. The company is culturally diverse which makes learning potential measurement a more effective and fair selection instrument than traditional intelligence testing, although the focus should be on developing employees on the basis of the enrichment approach and not only on measuring learning potential in a psychometric approach. Cognitive ability or learning potential is, however, not the only determinant of optimal performance of employees. The business language of the company is English - hence training, tests and assessments are conducted in English. English does not only influence the training and assessment process, but a lack of sufficient English proficiency may also lead to miscommunication which could be detrimental in crisis situations.

CHAPTER 3

EMPIRICAL STUDY

3.1 INTRODUCTION

Research was conducted within the Polymers Company in South Africa, investigating whether there is a relationship between learning potential, English language proficiency and work-related training test results of production employees over a period of 13 months (from the beginning December 2000 to the end of December 2001). The study focuses specifically on finding reasons why some people perform better than others on work-related training test results, although everyone is afforded the same opportunity for development. The work-related training tests were based on NQF unit standards developed for the specific work environment and approved by the Chemical, Oil and Allied Industries Training Board (COAITB). Owing to the diversity of the workforce and sample, learning potential instead of conventional intelligence tests was used as the predictor variable.

3.2 THE SAMPLE

The sample of the study consisted of 52 production employees of the Polymers Company. With two exceptions due to absenteeism on the days of testing, the entire production workforce, who were obliged to write work-related tests, participated in the study. All the production employees were male but were from different cultural and educational backgrounds, different ages and levels of experience as presented in tables 3.1, 3.2 and 3.3.

TABLE 3.1: DISTRIBUTION OF SAMPLE BY AGE (N=52)

Age	N	%
20-29	22	42,31
30-39	19	36,54
40-49	10	19,23
50-59	1	1,92

Ages varied between 20 and 59, with most employees in the categories 20–29 and 30–39. The average age of the production employees is 32,58 years.

Figure 3.1 presents the distribution of the sample by race.

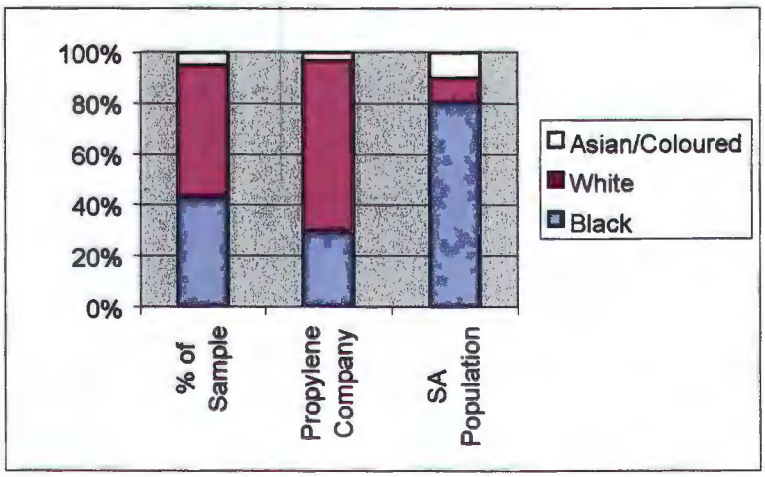

Figure 3.1: Race distribution of the sample in comparison with that of the company and the country

As previously mentioned, the sample consisted of males only. As indicated in figure 3.1, the sample is not culturally representative of the South African population or of the Polymers Company as on 31 December 2001.

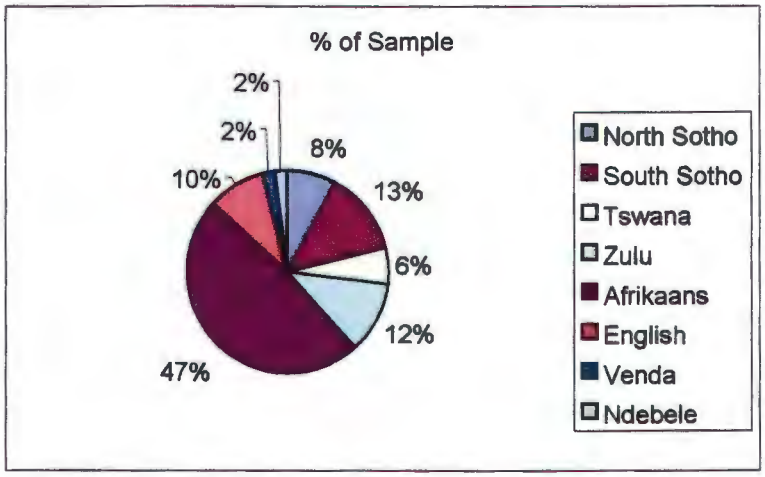

Figure 3.2: Distribution of the sample based on home language

Information about home language has been included, since it indicates that most employees' home language is different to the official business language used which is also the language of instruction for training. This could have influenced test performance.

Table 3.2 presents the distribution of the sample by years of relevant experience at the Polymers Company.

TABLE 3.2: DISTRIBUTION OF SAMPLE BY YEARS OF EXPERIENCE (N=52)

Years' Experience	N	%
1-2	10	19,23
3-5	13	25,00
6-10	10	19,23
11-13	19	36,54

Although it does not form part of the study, work-related experience or years of service were reported since it may have had an influence on the results of the study. Work-

related experience of the sample ranges from one to 13 years. The Polymers Company had employed 36,54% of the sample for longer than 10 years.

Table 3.3 presents the distribution of the sample by years of education.

TABLE 3.3: DISTRIBUTION OF SAMPLE BY YEARS OF EDUCATION

Years of education	Frequency	Percent
10	8	15,40
11	3	5,80
12	31	59,60
15	1	1,90
16	9	17,30
Total	52	100,00

The minimum years of education received by a production employee was 10 years and the employees with most years of education had studied for 16 years. The average years of education of the production employees are 12,38 years. Thirty-one of the 52 production employees had received 12 years of formal education. Based on the frequency distribution of educational level, 59,60% of the sample had an educational level of grade 12 or 12 years of education.

3.3 MEASURING INSTRUMENTS

Three measures were used to obtain the required information, namely the LPCAT for the measurement of learning potential, an English language proficiency test and the results of NQF Unit standard tests and assessments developed for the Polymers Company's production employees for the measurement of performance on work-related training.

3.3.1 THE LPCAT

Rapid change in all spheres of society in South Africa influenced psychological measurement and necessitated measuring instruments which could address the concerns about the comparability of test scores across cultures. When used properly, tests can be beneficial for education, training and employment. De Beer (2000a) saw the need for culturally appropriate measures and developed the Learning Potential Computerised Adaptive Test (LPCAT) which measures learning potential in the domain of nonverbal reasoning ability. The LPCAT was published in 2000, after six years of intensive research.

3.3.1.1 Aim

The LPCAT was developed mainly to address some of the issues concerning the multicultural assessment of cognitive ability in South Africa by taking into account the various cultural groups and different opportunities for prior learning. Emphasis was placed on cultural fairness, in line with the present-day requirement as set out in the Employment Equity Act 55 of 1998 by using nonverbal figural item content which minimises the influence of language proficiency and prior educational opportunities (De Beer, 2000b).

3.3.1.2 Description

The LPCAT makes use of a dynamic test-train-retest format and is based on Vygotsky's concept and theory of the zone of proximal development referring to the difference in learning that takes place with and without help. By means of computerised adaptive test techniques (based on IRT), test items are selected according to the appropriate level of difficulty to match the estimated ability level of the specific individual during the process of administering a test (De Beer, 2000b).

Two forms of the test are available: The LPCAT-1 is used for people with an English or Afrikaans reading proficiency of at least grade 6 level. Instructions, explanations and feedback on examples are provided in text format on the computer screen. In the other version, examiners have to read the instructions to the examinees since there are no instructions on the screen. The latter instructions are available in all 11 official languages in the *User's manual* (De Beer, 2000b). The entire test takes approximately one hour to administer, although there is no fixed time limit set. Being completely computerised, test results are immediately available after testing. No computer literacy is required since only the space bar and enter key are used during the testing process.

The LPCAT results consist of four scores:

(1) The pretest score represents the level of performance at the end of the pretest, representing present level of performance.

(2) The post-test score represents performance level at the end of the post-test, indicating the potential level of performance.

(3) The difference score (ZPD) indicates the difference between the pretest and the post-test performance, representing the magnitude of undeveloped potetial.

(4) The composite score is a combined score, incorporating the pretest score and a proportional credit for the improvement that took place during the test.

The four scores can be used to emphasise different uses or richness of interpretation of the LPCAT. Using only the pretest scores would provide the same type of information as that obtained in standard static tests. When only the post-test scores are used, the altered performance after training is taken into account, which could limit information on the distinction between two examinees in terms of their present level of performance. When

only the difference score is used, this assumes comparable pretest performance, which is not always the case. When the composite score is used, both the initial level of performance as well as the ZPD can be used together in one score. This option allows the comparison of people at different initial levels of performance and with different ZPD scores.

The LPCAT results are provided as standard scores in the form of T-scores, stanines and percentile rankings. The norm group is the grade 10 pupil who has a comparative T-score of 50.

- T-scores have a mean of 50 and a standard deviation of 10 resulting in a range between 20 and 80.

- Stanines represent a normalised nine-point standard scale with a mean of 5 and standard deviation of 1,96.

- Percentile ranks range from 1 to 100 and represent the percentage of examinees who obtain a score below that particular score.

For this study, it was decided to use the composite scores since they represent a justifiable and reasoned combination of the pretest, ZPD and post-test scores, allowing for easier comparison of the cognitive developmental level of different persons. T-scores are also used for interpretation purposes since they can be used not only to compare the examinees with one another but also with the norm in terms of level of education as shown in table 3.5.

Table 3.4 presents examples of the interpretation of LPCAT scores compared with a typical grade 10 level of nonverbal figural reasoning (De Beer, 2000b).

TABLE 3.4: INTERPRETATION OF LPCAT SCORES

T-Score (LPCAT score)	Description	Stanine
20–33	Low	1
34–42	Below average	2-3
43–47	Low average	4
48–52	Average	5
53–57	High average	6
58–68	Above average	7-8
69–80	High	9

Table 3.5 presents the comparable academic levels for various levels of LPCAT performance.

TABLE 3.5: COMPARABLE ACADEMIC LEVELS FOR VARIOUS LEVELS OF LPCAT PERFORMANCE (De Beer, 2000d)

ABET/NQF	Academic	LPCAT
ABET Level 1	Grade 0–3	
ABET Level 2	Grade 4–5	35
ABET Level 3	Grade 6–7	40
ABET Level 4	Grade 8–9	45
NQF Level 1	Grade 9	47
NQF Level 2	Grade 10	50
NQF Level 3	Grade 11	
NQF Level 4	Grade 12	52
NQF Level 5	Diplomas or certificates	55
NQF Level 6	First degree	60+
NQF Level 7	Higher degree	
NQF Level 8	Doctorate/further research	

A LPCAT performance of 52 is equivalent to approximately grade 12 and LPCAT performance of 55 and above would typically indicate a tertiary level of reasoning ability. More information on the interpretation of the LPCAT is available in the *Technical manual* (De Beer, 2000c). This interpretation is important for the practical utility of test scores for the present research project.

3.3.1.3 Reliability

Reliability refers to consistency or stability and can be defined as the extent to which the same results are obtained when responses are measured at different times (Christensen, 1997). Generally, test reliability coefficients of 0,80 and higher can be regarded as satisfactory. The LPCAT has internal consistency reliability values ranging from 0,92 to 0,98 with reliability values above 0,9 for Africans, coloureds and whites as well as both males and females. The LPCAT's reliability can therefore be considered satisfactory.

3.3.1.4 Validity

A test is valid to the extent that inferences made from it are appropriate, meaningful and useful (Gregory, 1996). The construct as well as the predictive validity of the LPCAT is highly significant ($p < 0,01$). Validity results are available for five different sample groups representing a broad range of ability and educational levels. In all instances, the construct validity is obtained using LPCAT pretest, post-test and composite scores. Group 1 consisted of 92 technikon first-year students. The construct validity for this group compared with the GSAT ranged from 0,533 to 0,713 with verbal and nonverbal and total scores. The predictive validity correlations of the LPCAT with grade 12 results ranged between 0,207 and 0,450. The second group consisted of 223 first-year technikon students. The construct validity compared with the GSAT ranged from 0,563 to 0,645. The predictive validity correlations with first-year average (pretest and composite score) ranged between 0,158 and 0,213. This is the only instance where the predictive validity is not highly significant. The construct validity of the third group, which consisted of 37 grade 9 pupils is not available. Predictive validity correlations with term results ranged between 0,550 and 0,659. The fourth group consisted of 194 adult learners. The construct validity correlations with PPG verbal, nonverbal and total scores ranged from

0,400 to 0,645. Predictive validity correlations with ABET literacy and numeracy results ranged from 0,398 to 0,492. The last group consisted on 144 grade 8 pupils. The construct validity correlations with GSAT for this group ranged from 0,567 to 0,691. Predictive validity correlations with school term results ranged from 0,439 to 0,543 (De Beer, 2000d). Validity information of the LPCAT is available in the LPCAT *Technical manual* (De Beer, 2000d). The LPCAT also has face validity. Face validity is somewhat subjective, and refers to the evaluation by users as to whether the test seems relevant in terms of what it is supposed to measure (De Beer, 2000c).

When taking the above into account, the use of the LPCAT was considered appropriate for this research, since it is applicable to the multicultural or diverse workforce from which the sample is selected, giving each examinee the same and fair chance at performing in the test. Other benefits which made the LPCAT the most feasible option are its adaptive functionality, the automatic computerised scoring of the test and the immediate availability of results (De Beer, 2000b). The above-mentioned features decrease the administrative load as well as administration time. Furthermore, the version in which the instructions are given on screen was used for the purpose of this study since it is targeted at people with an English or Afrikaans reading proficiency of at least grade 6. The lowest level of education of the sample is 10 years, equal to grade 10, and the examinees therefore should have at least a English language proficiency at grade 6.

3.3.2 Proficiency test English second language advanced level

The proficiency test English second language advanced level (grades 10, 11 and 12), was developed by the Human Sciences Research Council in response to the needs of education departments in South Africa (Chamberlain & Van der Schyff, 1991).

3.3.2.1 Aim

The English language proficiency test measures a examinee's level of general language development, not attached to a specific syllabus. The test measures the reading comprehension through the denotation and connotation of words, phrases, sentences and reading passages as well as acceptable language usage (Chamberlain & Van der Schyff, 1991).

Table 3.6 indicates the various skills being tested by items in the test (Chamberlain & Van der Schyff, 1991).

TABLE 3.6: SPECIFICATION OF THE CONTENT OF THE ENGLISH LANGUAGE PROFICIENCY TEST

Skill being tested	No of items
Recognising paraphrased meaning of common idioms	2
Making general inferences based on the given text	8
Making inferences related to diction – writer's choice of words in the context	1
Making inferences related to writer's intention	3
Making inferences related to setting or atmosphere	1
Selecting appropriate language for audience/situation/circumstance	2
Accurately communicating summary of intended meaning: headlines, recognising redundancy	2
Accurately conveying expanded meaning of summarised text	2
Editing: Being consistent about time, ie recognising incorrect use of tenses	3
Combining of simple sentences to form complex sentences	1
Meaningful paragraphing – selecting best opening or concluding sentence or arranging sentences meaningfully	2
Selecting precise words to describe something in context	1
Selecting words/phrases used deliberately to express or stir emotions	1
Recognising correct idiomatic and functional use of verbs	3
Recognising correct idiomatic and functional use of conjunctions	1
Prefixes and suffixes	2
Word order	2
Changing actives to passives	1
Changing statements to questions	1
TOTAL	**40**

3.3.2.2 Description

The test consists of 40 multiple-choice items and has a time limit of 40 minutes. Test instructions and practice examples are worked through together with the test administrator. Answer sheets are provided and marked with a scoring stencil. Results consist of a percentile rank score, a T-score and a stanine score (Chamberlain & Van der Schyff, 1991). Refer to appendix 1 for more information.

3.3.2.3 Reliability

The reliability coefficient of this test is 0,89 which can be regarded as satisfactory (Chamberlain & Van der Schyff, 1991).

3.3.2.4 Validity

Content validity depends on the representativeness of its contents in relation to all possible items. The items for this test were accepted by a committee of subject experts (Chamberlain & Van der Schyff, 1991).

The proficiency test English second language, advanced level has been included in the study since the researcher suspected that English language could influence progress made with test results. All training material is written in English and the tests are also conducted in English. This specific test has been chosen because it is aimed at grade 10, 11 and 12 and is therefore applicable to the level of education of the sample. The test is also valid and reliable and is a registered test of the Human Sciences Research Council (Chamberlain & Van der Schyff, 1991).

3.3.3 Work-related training tests

The Chemical, Oil and Allied Industries Training Board (COAITB), now called the Chemical Industries Education and Training Authority (CHIETA), developed generic unit standards for the chemical industry.

3.3.3.1 Aim

The overall aim of the training and assessments were to ensure a competent and multiskilled production operations workforce as well as to increase productivity and efficiency. The particular training methodology was introduced for the production employees since it provides employees with a qualification which is transferable between companies, was seen as the best option available at the time of implementation as well as ensuring compliance to legislation with regard to skills development.

3.3.3.2 Description

The seven generic unit standards developed by CHIETA for the chemical industry and applicable to the Polymers Company are as follows (Spencer, 1999):

(1) preparation for start-up
(2) start-up
(3) normal operation
(4) reaction to emergency situations
(5) preparation for shutdown
(6) shutdowns
(7) maintenance contribution

With the unit standards as base documents, 165 plant-specific assessment training documents, assessments and tests (called "caps") were developed for use in the Polymers Company for assessments. Assessment checklists are lists with all the items relating to

knowledge and skills that are required for a particular plant-specific assessment or test. The assessment checklist covers the minimum standard as required by the unit standard, but also includes the additional requirements of the business where applicable.

For each assessment checklist, training modules were developed to assist the learner in his/her efforts towards assessment. The technical correctness/validity of the modules was confirmed by the process technicians (process experts) and the training technological correctness by the process trainers. In addition to the training modules, the candidates also learn on the job, with the assistance of a coach as appointed by the shift manager. Learners are given time to study the modules during formal training days, of which they have five every five weeks.

To build the foundation for the advanced plant specific learning, the OTS (Operations Training Scheme) modules were used. These modules were developed in the USA specifically for basic understanding of chemical industries. The Polymers Company has been accredited as a training provider by COAITB (Chemical Oil and Allied Industry Training Board)/CHIETA (Chemical Education and Training Authority). Table 3.7 presents the NQF levels, related grades and qualifications that could be obtained using this methodology. Each of the seven generic unit standards mentioned in 3.3.3.2 were covered in each of the qualification environments except for the generic continuous field operations. The use of the generic continuous field operations certificate was limited because all production employees working at the Polymers Company already had at least a grade 10 certificate.

TABLE 3.7: NQF LEVELS, RELATED GRADES AND QUALIFICATIONS APPLICABLE TO THE POLYMERS COMPANY

Accreditation date	NQF level	Equivalent	Qualification environment	Certificate
25 August 1998	1	Grade 9	Generic continuous field operations	Generic continuous field operations
	2	Grade 10	Equipment	Polymers continuous field operations level A
	3	Grade 11	Systems	Polymers continuous field operations level B
	4	Grade 12	Process operations	Polymers control room operations
4 August 1999	2	Grade 10	Equipment	Chemical continuous field operations level A
	3	Grade 11	Systems	Chemical continuous field operations level B
	4	Grade 12	Process operations	Chemical control room operations

Seven subject matter experts were trained as assessors by the internal verifier/moderator, who in turn was trained by the COAITB. A learner requires a total of 165 caps to be promoted to a journeyman position, which implies that he/she is a multiskilled process artisan. A cap consists of either a test or an assessment. Three different methods were used for administering tests and assessments: computerised multiple-choice tests, handwritten plant specific tests and plant specific practical assessments (demonstrated competence). The final assessment was evaluated by a panel of assessors. Table 3.8 presents the composition of competency tests and assessments required to become a journeyman.

TABLE 3.8: COMPOSITION OF COMPETENCY TESTS REQUIRED FOR A JOURNEYMAN

Description	Delivery method	Number of competency tests involved
OTS tests	Electronic	52
Polymerisation, plant-specific tests	Written	20
Extrusion, plant-specific tests	Written	10
Laboratory test	Written	1
Equipment level assessments	Assessment	10
Polymerisation systems assessment	Assessment	23
Extrusion systems assessment	Assessment	29
Polymerisation control room operation	Assessment	8
Extrusion control room operation	Assessment	8
Polymerisation exam, systems	Written	1
Extrusion exam, system	Written	1
Polymerisation exam, operations	Panel assessment	1
Extrusion exam, operations	Panel assessment	1
TOTAL		165

Table 3.8 indicates that a total of 165 competency tests and assessments is required using various methodologies of assessment. The Polymers Company plant consists of two sections, namely Polymerisation and Extrusion. The Polymerisation Section is covered by the chemical qualifications while the polymer qualifications cover the Extrusion Section. Each of the seven generic unit standards mentioned in 3.3.3.2 is covered in each of the competency tests except for the OTS tests. The sequence of tests mentioned in table 3.8 is based on the Polymers Company's business requirements and plant conditions. Notwithstanding the above, the OTS tests are a prerequisite to continue with either polymerisation or extrusion-related tests and assessments which should be conducted in the following sequence: plant-specific tests, systems assessment, control room operation, exam systems, and lastly, exam operations.

All tests and assessments are not equivalent in terms of difficulty level. Difficulty levels are, however, based only on the perception of the trainers. All the trainers together allocated a difficulty level – one to three – to each of the 165 caps. Each employee receives three chances to pass a test or assessment, whereafter special measures are taken by the Polymers Company. These measures complied with the Company's procedures for nonperformance. Results are captured on an excel spreadsheet in terms of number of caps obtained per month as well as percentage improvement per employee per month in terms of the number of caps completed. No numeric test results are captured, since a pass rate of 90% is required, and results are therefore captured as caps obtained. Hardcopies of results are filed for auditing purposes.

3.3.3.3 Reliability

No specific information is available on the reliability of the work-related tests and assessments.

3.3.3.4 Validity

Validity was ensured through the verification of the technical component of tests and assessments by technicians. The training department verified the methodological component. Assessors were subject matter experts and are trained in assessment. The internal verifier was continuously moderated by the COAITB/CHIETA to ensure that procedures and standards which regulate the training and assessment process, were in place and adhered to.

The above-mentioned assessment information was used for the research since the methodology used in the Company was to assess progress made with training within the production environment. Progress was measured in terms of number of caps acquired during the period of 13 months, 1 December 2000 to 31 December 2001.

3.4 DATA COLLECTION

Data were collected by using the instruments described in section 3.3. The criterion information covered 13 months of training over the period 1 December 2000 to 31 December 2001. The production department operates in five shifts with between eight and 12 employees per shift.

Information about the training process followed by the Company was obtained through interviews with the trainer who was responsible for establishing the training methodology. Results were obtained from the training department in the form of an excel spreadsheet indicating progress in terms of caps obtained by each employee on a monthly basis (see appendix 2).

The LPCAT and Proficiency Test English Second Language were administered during November and December 2001 on four different days. Shifts 2, 3 and 5 were assessed separately and shifts 1 and 4 simultaneously on one day. The purpose and background of

the tests were explained and the tests administered in accordance with the administrative guidelines provided in the test manuals. Since it is a time-based test, the Proficiency Test English Second Language was administered first, whereafter the LPCAT was administered for groups of five at a time (only five computers were available for assessment purposes). Employees who were not available on the above-mentioned days were tested individually. English language proficiency tests were scored using a scorecard, whereas the LPCAT results were available electronically. Both these sets of scores together with the work-related training test results were captured on an excel spreadsheet (see appendix 3).

Interviews were also conducted with three high performers and three low performers on the work-related training test results to extend the investigation and ascertain why some employees perform better than others. The interviews were recorded with the permission of the employees involved. The following questions were asked during an unstructured interview:

- "Tell me about your progress in the work-related training tests and assessments."
- "What influenced your progress in the work-related training tests and assessments?"

3.5 DATA PROCESSING

Analysis was done by first obtaining descriptive statistics. Thereafter correlations (Pearson's product moment) were done to establish whether there is any correlation between learning potential, English language proficiency, work-related training test results, years of education, age and years' experience. Regression analysis was done with the work-related training test results on 31 December 2001 (training 2) as the dependent variable, and learning potential, English language proficiency and years of education respectively, as the independent variables. Finally, all three of the above-mentioned

independent variables were used simultaneously in regression analysis with training 2 remaining the dependent variable to investigate whether the combined three independent variables can be used to predict the training results.

Since no satisfactory results were obtained from the above-mentioned statistics, additional analyses were done, by partialing out age, years of education as well as years of service.

The information obtained in the interviews was clustered and used to find common themes or new hypotheses.

3.6 HYPOTHESES

The following three hypotheses were initially formulated:

Hypothesis 1:

H_0: There is no significant relationship between learning potential and work-related training test results.

H_1: There is a significant relationship between learning potential and work-related training test results.

- Hypothesis 2:

H_0: There is no significant relationship between English language proficiency and work-related training test results.

H_1: There is a significant relationship between English language proficiency and work-related training test results.

- Hypothesis 3:

H_0: There is no significant relationship between learning potential and English language proficiency.

H_1: There is a significant relationship between learning potential and English language proficiency.

Although no formal hypotheses were formulated, investigations were also conducted to establish the influence of race, age, education, years of service at the Polymers Company as well as home language.

3.7 CONCLUSION

In this chapter information was provided on the present study, including the size, diversity and age distribution of the sample. An overview of the instruments for measuring the three variables in the research, namely that of learning potential, English language proficiency and work-related training test results, was also provided. A discussion on the research method and design followed. Additional information was obtained by interviewing three high performers as well as three low performers on work-related test results to investigate why some employees perform better than others. Chapter 4 deals with the results obtained from the study and the hypotheses investigated.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

Chapter 3 provided an overview of the methodology used for conducting the present study, providing information on the sample and instruments used for testing. This chapter deals chronologically with the results that emerged during the study, the results of the hypothesis testing and also addresses the specific research questions and objectives – that is, the relationship between learning potential, English language proficiency and the work-related training test results of the production employees.

4.2 LEARNING POTENTIAL

The learning potential of the production employees was measured by using the LPCAT instrument. Table 4.1 presents the descriptive statistics for the learning potential of the sample. Minimum, maximum, mean and standard deviation scores are provided for the various LPCAT scores. The LPCAT results of only 51 production employees were available for inclusion in the study.

TABLE 4.1: DESCRIPTIVE STATISTICS FOR LEARNING POTENTIAL (N=51)

	Minimum	Maximum	Mean	Std deviation
LPCAT pretest	34	67	55,20	6,59
LPCAT post-test	33	72	56,73	7,31
LPCAT composite	34	69	55,41	6,70
LPCAT difference	-4	6	1,59	2,22

LPCAT pretest and post-test scores represents the applicable T-scores. LPCAT difference scores indicate the difference between pretest and post-test performance. The mean difference score of the sample is 1,59, which represents the magnitude of undeveloped potential. The maximum score obtained during the LPCAT test increased from 67 (pretest) to 72 (post-test). It is interesting to note that the minimum score of the LPCAT post-test declined from 34 (pretest) to 33 (post-test). There is an increase in the means obtained from the pretest to the post-test of 1,53. The composite score is a combined score, incorporating the pretest score and a proportional credit for the improvement that took place during the test. The minimum composite score obtained is 34 and the maximum composite score obtained is 69, indicating that the sample varies within the total range of the LPCAT, from grade 0-3/ABET level 1 to tertiary education (degrees)/NQF levels 6 to 8. Figure 4.1 presents the composite score distribution of the sample.

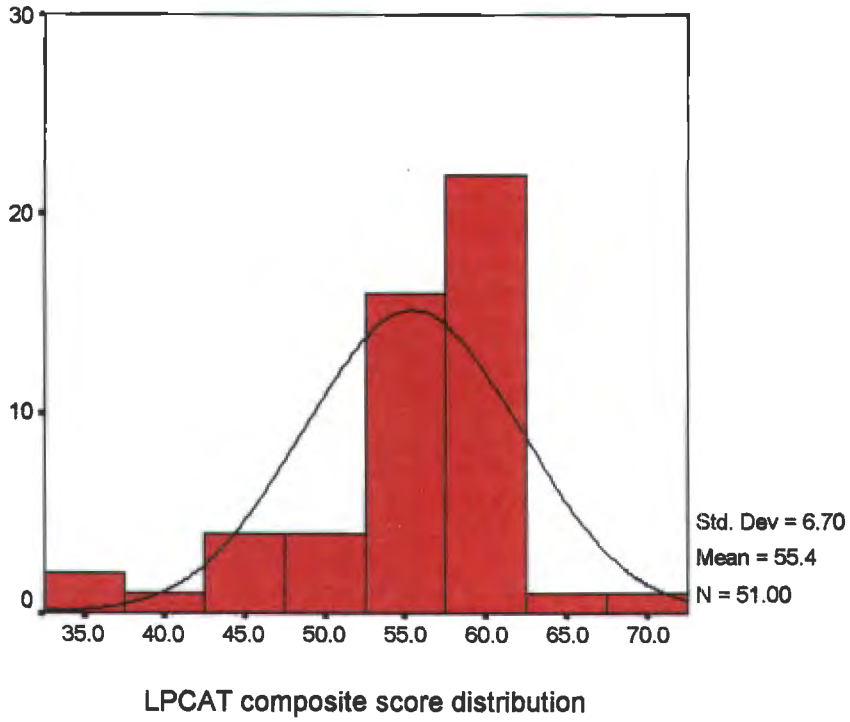

Figure 4.1: Distribution of LPCAT composite scores

The histogram shows that the distribution of the composite scores of the sample compared with a normal distribution curve indicates that the data do not display a good

fit and can be described as negatively skewed. This means that there is a higher frequency of high scores in the distribution. The mean score is 55,41 with a standard deviation of 6,70.

4.3 ENGLISH LANGUAGE PROFICIENCY

The English language proficiency of the production employees was measured by using the Proficiency Test English Second Language, Advanced Level. Table 4.2 presents the applicable descriptive statistics.

TABLE 4.2: DESCRIPTIVE STATISTICS FOR ENGLISH LANGUAGE PROFICIENCY (N=52)

	Minimum	Maximum	Mean	Std deviation
English raw	9	38	21,31	8,10
English percentile	8	99	53,12	27,18
English T-score	36	73	51,29	9,03
English stanine	2	9	5,19	1,86

The sample displays a wide spread of English language proficiency levels. The minimum raw score obtained by an individual of the sample is 9 indicating poor English language proficiency, when interpreted according to the test manual. The maximum raw score obtained by an individual in the sample is 38, indicating very good English language proficiency. The maximum raw score that can be obtained is 40. The mean T-score for English language proficiency is 51,29. Figure 4.2 presents the distribution of English language proficiency of the production employees, indicating an approximately normal distribution of scores.

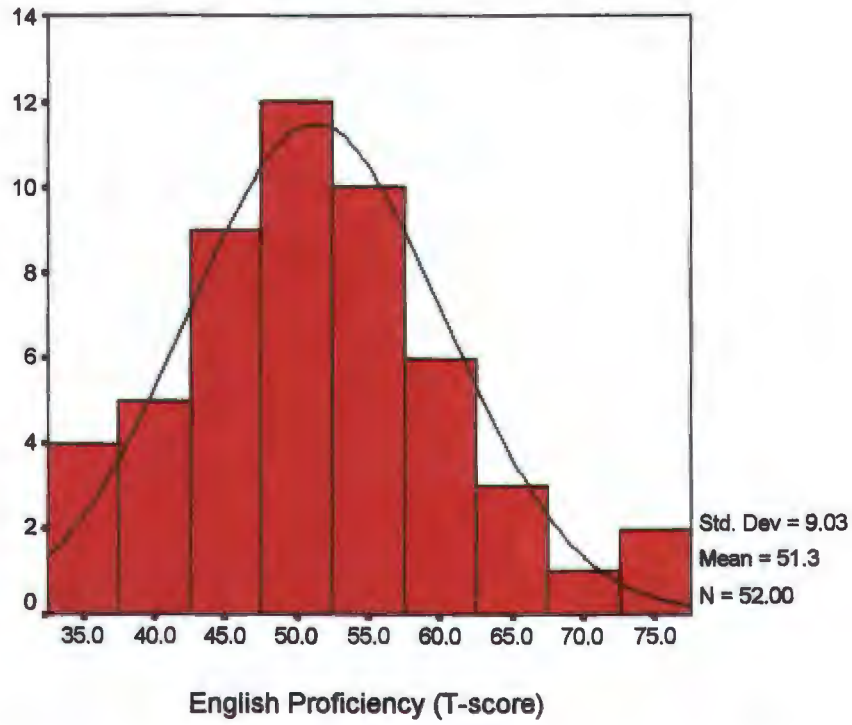

Figure 4.2: Distribution of English language proficiency scores

The sample displays a much better fit with the normal distribution with regard to English language proficiency compared with the LPCAT. Table 4.3 provides interpretive information for the distribution of the sample by English language proficiency.

TABLE 4.3: INTERPRETIVE INFORMATION FOR THE DISTRIBUTION OF SAMPLE BY ENGLISH LANGUAGE PROFICIENCY (N=52) (Chamberlain & Van der Schyff, 1991)

Description	Raw score	T-score	N	%
Very good	36-40	66-82	3	5,80
Good	33-35	63-65	3	5,80
Above average	28-32	58-61	6	11,50
High average	23-27	54-56	9	17,30
Average	18-22	49-53	13	25,00
Low average	14-17	44-47	9	17,30
Below average	11-13	39-42	4	7,70
Poor	8-10	34-38	5	9,60
Very poor	0-7	22-31	0	0,00

The mean T-score of English language proficiency is 51,30. The category with the highest frequency (13) is the average one. This indicates that, in general, production employees have average English language proficiency.

4.4 WORK-RELATED TRAINING TESTS

Table 4.4 presents descriptive statistics for work-related test results for the production employees over a period of 13 months. Training 1 indicates the number of tests passed by an employee on 1 December 2000, prior to the start of this study. Training 2 indicates the total number of tests obtained by the end date, 31 December 2001, after 13 months.

TABLE 4.4: DESCRIPTIVE STATISTICS FOR WORK-RELATED TRAINING TEST RESULTS (N=52)

	Minimum	Maximum	Mean	Std. Deviation
Training 1	0	124	61,30	37,85
Training 2	33	165	101,71	30,41
Improvement from T1 to T2	1	99	40,44	26,95

Newly appointed employees started off with no tests passed, whereas employees with more years' work experience had already passed some tests. The maximum number of tests passed by a production employee on 1 December 2000 was 124 and the minimum number of tests passed by a production employee on 31 December 2001 was 33 out of a possible 165 tests. There is an average improvement of 40,44 number of caps. The production employee with the poorest improvement on work-related training test results managed to pass only one additional test during the period 1 December 2000 to 31 December 2001, whereas the production employee with the best improvement managed to pass an additional 99 tests. Figures 4.3 and 4.4 indicate the distribution of the results of training 1 and training 2 respectively.

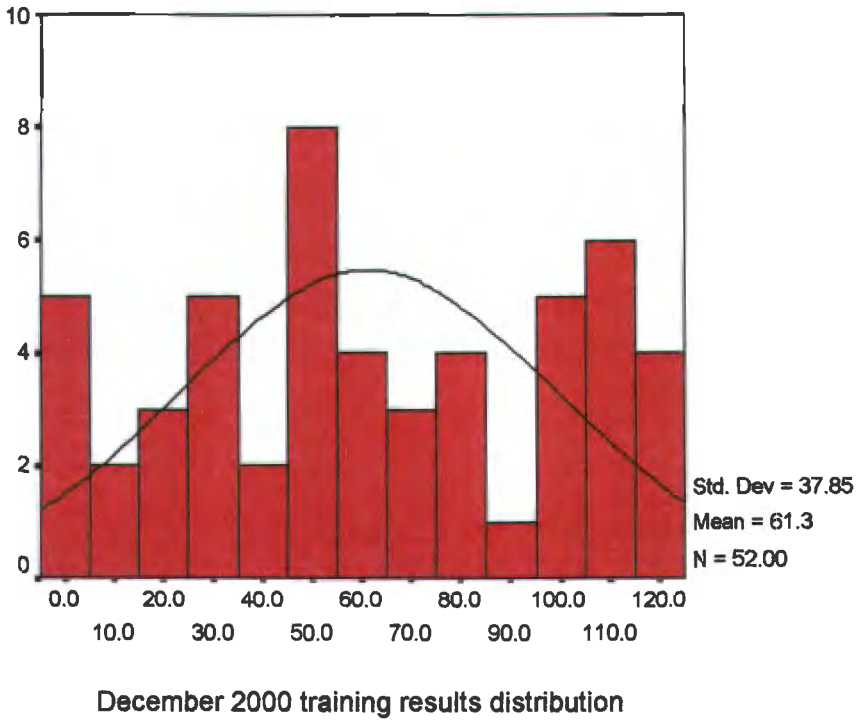

Figure 4.3: Distribution of the work-related training test results as on 1 December 2000

The mean of the work-related training test results at the start of the study was 61,3 with a very large standard deviation of 37,85 indicating an extremely wide distribution of results. This means that the distribution of work-related training test results range from very low performers to very high performers.

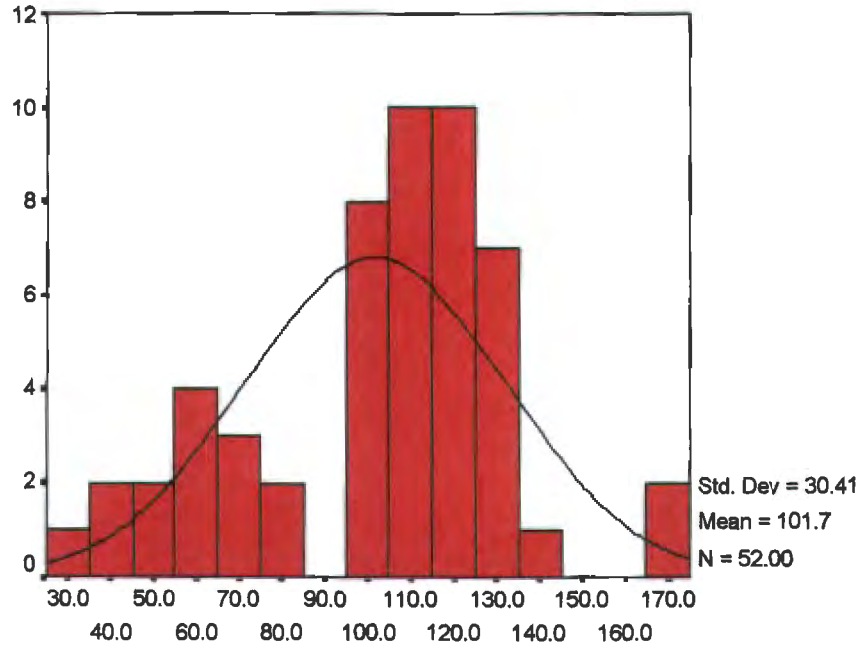

Figure 4.4: Distribution of work-related training test results as on 31 December 2001

The work-related training test results as on 31 December 2001 display a clear bipolar distribution for the group. These results will be discussed later in this chapter. Figure 4.5 shows the improvement on work-related training test results for the 13 month period.

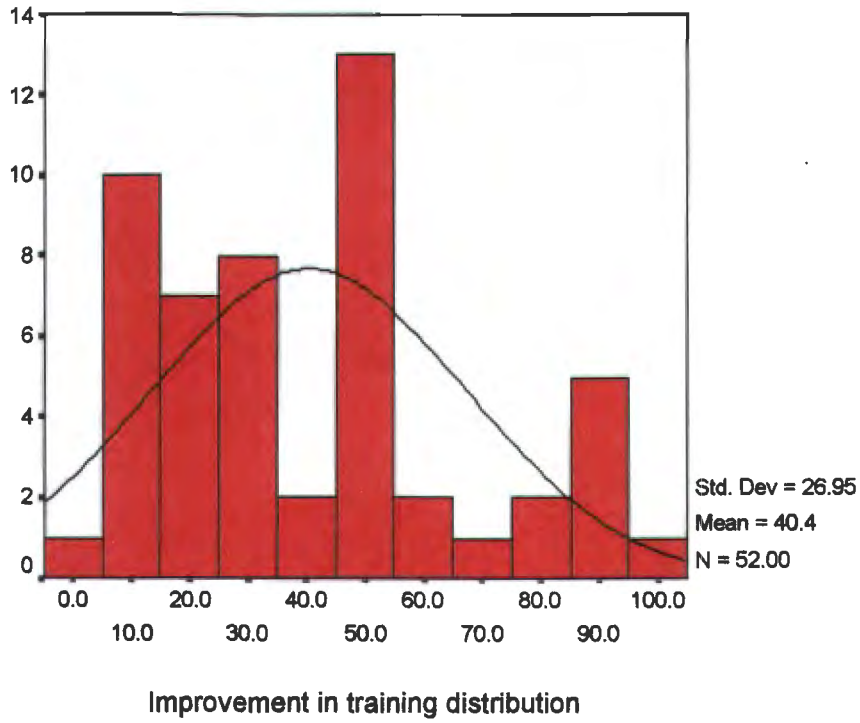

Figure 4.5: Improvement from training 1 to training 2

Training improved from a mean tests passed of 61,30 to 101,71. Only one employee succeeded in passing all the tests.

4.5 THE RELATIONSHIP BETWEEN LEARNING POTENTIAL, ENGLISH LANUAGE PROFICIENCY AND WORK-RELATED TRAINING TEST RESULTS

Results are first reported in terms of the statistical analysis done, following which the qualitative information obtained from interviews conducted with three high performers and three low performers on work-related test results will be reported.

4.5.1 Statistical analysis

Statistical analysis was done by first correlating learning potential, English language proficiency and work-related training test results. Secondly, regression analysis was done by using years of education, LPCAT pretest, LPCAT post-test and English language proficiency alternatively as the independent variable with work-related training test results as the dependent variable. Finally, the means were compared by dividing the sample into groups of high and low performers on learning potential, English language proficiency and work-related training test results as well as the two main cultural groups (white/Asian and African). This was done to investigate possible differences between subgroups.

4.5.1.1 Correlations

Correlations determine whether or not there is a relationship between the variables. Correlations were done between learning potential, English language proficiency and the work-related training test results obtained over a 13-month period. These are indicated in table 4.5.

TABLE 4.5: CORRELATIONS BETWEEN LEARNING POTENTIAL, ENGLISH LANGUAGE PROFICIENCY AND WORK-RELATED TEST RESULTS

		Years of education	English Raw	LPCAT pretest	LPCAT post-test	LPCAT composite	Training 1	Training 2
Years of education	Pearson Correlation	1						
	Sig (2-tailed)							
	N	52						
English raw	Pearson Correlation	0,16	1					
	Sig (2-tailed)	0,26						
	N	52	52					
LPCAT pretest	Pearson Correlation	0,29	0,45	1				
	Sig (2-tailed)	0,04	0,00					
	N	51	51	51				
LPCAT post-test	Pearson Correlation	0,26	0,51	0,96	1			
	Sig (2-tailed)	0,07	0,00	0,00	0,00			
	N	51	51	51	51			
LPCAT composite	Pearson Correlation	0,27	0,46	1,00	0,97	1		
	Sig (2-tailed)	0,06	0,00	0,00	0,00	.		
	N	51	51	51	51	51		
Training 1	Pearson Correlation	-0,25	0,05	0,05	0,07	0,07	1	
	Sig (2-tailed)	0,07	0,75	0,71	0,61	0,63	.	
	N	52	52	51	51	51	52	
Training 2	Pearson Correlation	-0,30	0,09	0,01	0,07	0,03	0,71	1
	Sig (2-tailed)	0,03	0,51	0,93	0,62	0,86	0,00	.
	N	52	52	51	51	51	52	52

The coefficient of correlation will always lie between –1 and +1. It is interpreted, as a correlation close to +1, indicating an extremely positive relationship in movement between two variables. Conversely, a correlation close to –1 will indicate a very strong negative correlation implying that as one variable increases, the other decreases.

Testing of the coefficient of correlation was done by means of the following hypotheses:

H_0 : $\rho = 0$ indicating that there is no linear relationship between the two variables

$H_1 : \rho \neq 0$ indicating that a linear relationship does exist between the two variables (Keller & Warrack, 2000)

The level of significance (two-tailed) which is also indicated in table 4.5, provides information on the amount of statistical evidence supporting the alternative hypothesis. The value indicated was therefore the probability of observing a test statistic at least as extreme as the one computed, given that the null hypothesis is true.

As expected there was an extremely positive relationship between the pretest, post-test and composite LPCAT test results. This indicates that individuals performed consistently in both the pretesting and post-testing in terms of learning potential. The relatively high level of LPCAT performance (see figure 4.1) and high level of average education for this sample probably indicate that most of the individuals in the present sample were already performing at or close to their optimal level in terms of the reasoning measured by the LPCAT.

Although not strong, there seems to be a positive correlation between English language proficiency and both the pretest and post-tests of LPCAT, in the 0,45 to 0,51 region. This could indicate that there is some relation between higher learning potential and mastery of the English language. The correlation is statistically highly significant ($p<0,001$). This suggests that there is overwhelming evidence to infer that the alternative hypothesis is true and that there is a linear relationship between English language proficiency and learning potential.

A worrisome trend is that although to a certain extent there is a positive correlation between years of education and learning potential, shown by both the pretesting and post-testing, there is a negative correlation between years of education and work-related training test results. This is confirmed by both the testing at the beginning and end of the test period. In other words, although the correlation between years of education and learning potential shows that people with more years of education should perform better in the work-related tests, based purely on learning potential of the individuals, this does

not happen in practice. In fact, they perform slightly worse than people with fewer years of education.

There is no significant relationship between the work-related training test results and either learning potential or English language proficiency, shown by the very small values of the Pearson correlation, typically in the region of 0,01 to 0,09.

Figure 4.6 presents the mean scores of LPCAT, English language proficiency and work-related test scores of the various levels of education.

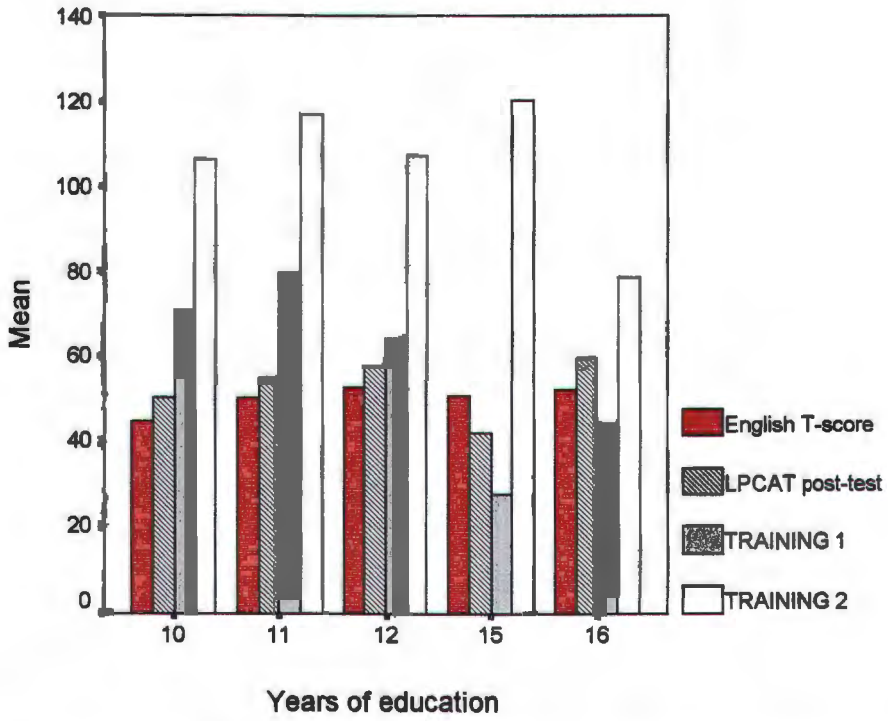

Figure 4.6: Means scores of LPCAT, English language proficiency and test scores for the various levels of education

Production employees with 16 years of education passed fewer tests during the period of 13 months than those with fewer years of education.

4.5.1.2 Regression analysis

Regression analysis is used to predict the value of one variable on the basis of other variables. Regression analysis assumes that the two variables are linearly related and an assessment is done to determine how well the linear model fits the data. When the model provides a good fit, it can be used to predict the particular value and estimate the expected value of the dependent variable (Keller & Warrack, 2000). Regression analysis was done by using years of education, LPCAT pretest, LPCAT post-test and English language proficiency alternatively as the independent variables with work-related training test results as the dependent variable.

Table 4.6 presents regression analysis, which was done with the work-related training results of December 2001 as the dependent variable.

TABLE 4.6: REGRESSION ANALYSIS WITH YEARS OF EDUCATION AS THE INDEPENDENT VARIABLE AND TRAINING RESULTS ON 31 DECEMBER 2001 (TRAINING 2) AS THE DEPENDENT VARIABLE

Model summary

Model	R	R square	Adjusted R square	Std error of the estimate
	0,30	0,09	0,07	29,26

a Predictors: (Constant), Years of education

ANOVA

Model		Sum of squares	Df	Mean square	F	Sig
1	Regression	4355,92	1	4355,92	5,09	0,03
	Residual	42812,76	50	856,26		
	Total	47168,67	51			

a Predictors: (Constant), Years of education

b Dependent Variable: Training 2

Coefficients

		Unstandardised coefficients		Standardised coefficients	T	Sig
Model		B	Std error	Beta		
1	(Constant)	162,58	27,29		5,95	0,00
	Years of education	-4,92	2,18	-0,30	-2,26	0,03

a Dependent variable: Training 2

The model used in this regression analysis is the simple linear regression model with the formula:

$$y = \beta_0 + \beta_1 x + \varepsilon$$

where y = dependent variable

x = independent variable

β_0 = y – intercept

β_1 = slope of the line

ε = error variable

The very small value of the R square indicates that a very small portion, only 9,2 %, of the variation in training results in December 2001 are explained by the variation in years of education.

The standard error of the estimate of 29,26 also indicates that the linear model does not fit the data well, and as such is not an effective analytical and forecasting tool.

The decision whether to discard the model should be based on the value of the standard error of the estimate, with a value of zero indicating that all the points fall on the regression line. Since there was no predefined upper limit on the value of the standard error of the estimate, there was no clear decision whether this model should be discarded. However, this value was relatively large – hence this is not a good model (Keller & Warrack, 2000).

Since this model will not be completely discarded, it is important to note the negative standardised beta coefficients of –3,04 that indicate that there is a negative correlation between years of education and work-related training test results. Also refer to the discussion of table 4.5 in this regard. The significance value of 0,03 indicates that there is strong evidence to show that the alternative hypothesis is true, suggesting that a linear relationship does exist between the two variables. This result is deemed to be significant.

TABLE 4.7: REGRESSION ANALYSIS WITH THE LPCAT PRETEST AS THE INDEPENDENT VARIABLE AND TRAINING RESULTS ON 31 DECEMBER 2001 (TRAINING 2) AS THE DEPENDENT VARIABLE

Model summary

Model	R	R square	Adjusted R square	Std error of the estimate
1	0,01	0,00	-0,02	30,28

a Predictors: (Constant), LPCAT pretest

ANOVA

Model		Sum of squares	Df	Mean square	F	Sig
1	Regression	7,74	1	7,74	0,01	0,93
	Residual	44936,18	49	917,07		
	Total	44943,92	50			

a Predictors: (Constant), LPCAT pretest

b Dependent variable: Training 2

Coefficients

		Unstandardised coefficients		Standardised coefficients	t	Sig
Model		B	Std error	Beta		
1	(Constant)	99,33	36,10		2,75	0,01
	LPCAT pretest	5,97	0,65	0,01	0,09	0,93

a Dependent variable: Training 2

The R square value equal to zero indicates that no variation in training results in December 2001 are explained by LPCAT pretest data.

The standard error of the estimate of 30,28 once again indicates that this linear model does not fit the data well and as such it is not an effective analytical and forecasting tool. The decision to discard the model is again not possible only from the analysis of the standard error of the estimate (Keller & Warrack, 2000).

The significance value of 0,62 indicates that there is weak evidence to infer that the alternative hypothesis is true, suggesting that a linear relationship does not exist between LPCAT pretest results and work-related training test results. This result is not statistically significant.

TABLE 4.8: REGRESSION ANALYSIS WITH THE LPCAT POST-TEST AS THE INDEPENDENT VARIABLE AND TRAINING RESULTS ON 31 DECEMBER 2001 (TRAINING 2) AS THE DEPENDENT VARIABLE

Model summary

Model	R	R square	Adjusted R square	Std error of the estimate
	0,07	0,01	-0,02	30,21

a Predictors: (Constant), LPCAT post-test

ANOVA

Model		Sum of squares	df	Mean square	F	Sig
1	Regression	226,73	1	226,73	0,25	0,62
	Residual	44717,19	49	912,60		
	Total	44943,92	50			

a Predictors: (Constant), LPCAT post-test

b Dependent variable: Training 2

Coefficients

		Unstandardised coefficients		Standardised coefficients	t	Sig
Model		B	Std error	Beta		
1	(Constant)	86,09	33,44		2,57	0,01
	LPCAT post-test	0,29	0,59	0,07	0,50	0,62

a Dependent variable: Training 2

The very small value of R square indicates that a very small portion, only 0,5 %, of the variation in training results in December 2001 are explained by LPCAT post-test results.

The standard error of the estimate of 30,2 again also indicates that this linear model does not fit the data well and as such the model is not an effective analytical and forecasting tool. The decision to discard the model is again not possible only on the basis of the analysis of the standard error of the estimate (Keller & Warrack, 2000).

The significance value of 0,62 indicates that there is weak evidence to infer that the alternative hypothesis is true, suggesting that a linear relationship does not exist between LPCAT post-test results and work-related training test results. This result is not statistically significant.

TABLE 4.9: REGRESSION ANALYSIS WITH ENGLISH LANGUAGE PROFICIENCY AS THE INDEPENDENT VARIABLE AND TRAINING RESULTS ON 31 DECEMBER 2001 (TRAINING 2) AS THE DEPENDENT VARIABLE

Model summary

Model	R	R square	Adjusted R square	Std error of the estimate
1	0,093	0,01	-0,01	30,58

a Predictors: (Constant), English raw

ANOVA

Model		Sum of squares	df	Mean square	F	Sig
1	Regression	410,11	1	410,11	0,44	0,51
	Residual	46758,56	50	935,17		
	Total	47168,67	51			

a Predictors: (Constant), English raw

b Dependent variable: Training 2

Coefficients

		Unstandardised coefficients		Standardised coefficients	t	Sig
Model		**B**	**Std error**	**Beta**		
1	(Constant)	94,25	12,04		7,83	0,00
	English Raw	0,350	0,53	0,09	0,66	0,51

a Dependent variable: Training 2

The very small value of R square indicates that a very small portion, only 0,9 %, of the variation in training results in December 2001, can be explained by English language proficiency.

The standard error of the estimate of 30,58 again also indicates that this linear model does not fit the data well and as such is an effective analytical and forecasting tool. The decision to discard the model is again not possible only from the analysis of the standard error of the estimate (Keller & Warrack, 2000).

The significance value of 0,51 indicates that there is weak evidence to show that the alternative hypothesis is true, suggesting that a linear relationship does not exist between English language proficiency and work-related training test results. This result is not statistically significant.

TABLE 4.10: REGRESSION ANALYSIS WITH LEVEL OF EDUCATION, ENGLISH LANGUAGE PROFICIENCY, LPCAT POST-TEST AS THE INDEPENDENT VARIABLES AND TRAINING RESULTS ON 31 DECEMBER 2001 (TRAINING 2) AS THE DEPENDENT VARIABLE

Model summary

Model	R	R square	Adjusted R square	Std error of the estimate
	0,36	0,13	0,08	28,82

a Predictors: (Constant), English raw, years of education, LPCAT post-test

ANOVA

Model		Sum of squares	Df	Mean square	F	Sig
1	Regression	5894,97	3	1964,99	2,37	0,08
	Residual	39048,95	47	830,83		
	Total	44943,92	50			

a Predictors: (Constant), English raw, years of education, LPCAT post-test

b Dependent variable: Training 2

Coefficients

		Unstandardised coefficients		Standardised coefficients	t	Sig
Model		B	Std error	Beta		
1	(Constant)	138,45	37,83		3,66	0,00
	LPCAT post-test	0,51	0,67	0,12	0,77	0,45
	Years of education	-5,73	2,23	-0,36	-2,58	0,01
	English raw	0,30	0,58	0,08	0,51	0,62

a Dependent variable: Training 2

The possibility of a linear relationship between three independent variables, that is, level of education, English language proficiency and LPCAT post-test was tested in a multiple regression model represented by the following equation:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon$$

where the independent variables were:

x_1 = LPCAT post-test

x_2 = years of education

x_3 = English language proficiency

and,

y = training results (dependent variable)

ε = error variable (Keller & Warrack, 2000)

The following hypotheses were tested:

$H_0 : \beta_i = 0$

$H_1 : \beta_i \neq 0$

The adjusted R square value, used for multiple regressions, is very low at 0,08 which shows that the multiple regression does not fit the data well and will therefore also not be an accurate model.

The results of the regression analysis can be summarised as follow:

In terms of learning potential, the significance value of 0,45 indicates, that there is no evidence that the alternative hypothesis is true, suggesting that a linear relationship does not exist between learning potential and work-related training test results. This result is not statistically significant. The null hypothesis is therefore not rejected.

In terms of years of education, the negative value of –0,36 of the standardised coefficient indicates a negative relationship, which corresponds with the analysis data of correlations presented in table 4.5. The significance value of 0,01 indicates that there is strong evidence that the alternative hypothesis is true, suggesting that there is a linear relationship between years of education and work-related training test results, although the relationship is negative. This result is deemed to be statistically significant. The null hypothesis is therefore rejected.

In terms of English language proficiency, the significance value of 0,62 indicates that there is no evidence that the alternative hypothesis is true, suggesting that a linear relationship does not exist between English language proficiency and work-related training test results. This result is not statistically significant. The null hypothesis is therefore not rejected.

Although the results are not statistically significant, the above-mentioned regression analysis results indicate that neither learning potential nor English language proficiency seems to influence the performance of production employees on work-related training tests results. Once again, the results also indicate that the performance of employees with more years of formal education is worse than that of employees with fewer years of formal education.

4.5.1.3 Comparison of means and variances of different groups

Additional analyses were done to further explore the relationship between learning potential, English language proficiency and work-related training test results as well as between the different cultural groups. The first analysis was done by dividing the group according to their performance on the LPCAT and then comparing the language proficiency and work-related training test results of the two groups.

a Comparison of individuals with high learning potential and individuals with low learning potential

The group was divided into two according to their learning potential scores to compare the two groups in English language proficiency and work-related training test results. The first group consisted of 13 (approximately the bottom 25%) low performers who obtained a score of lower than 55 on the LPCAT, while the second group consisted of 14 high performers (approximately the top 25%) who obtained a score higher than 60 on the LPCAT. According to the LPCAT, a score of 55 can be interpreted as having the ability to succeed at technikon level while a score of 60 indicates that the examinee has the

ability to succeed at university level. These two groups were compared in terms of their performance on the English language proficiency test as well as their work-related training test results as indicated in table 4.11.

TABLE 4.11: COMPARISON BETWEEN INDIVIDUALS WITH HIGH LEARNING POTENTIAL AND INDIVIDUALS WITH LOW LEARNING POTENTIAL

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	t	df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
Training 1	Equal variances assumed	1,93	0,18	0,82	25,00	0,42	10,92	13,32	-16,50	38,34
	Equal variances not assumed			0,81	22,98	0,43	10,92	13,43	-16,86	38,70
Training 2	Equal variances assumed	0,00	0,95	1,49	25,00	0,15	17,15	11,49	-6,51	40,81
	Equal variances not assumed			1,48	23,41	0,15	17,15	11,57	-6,76	41,07
English T-score	Equal variances assumed	4,29	0,05	-3,07	25,00	0,01	-11,02	3,60	-18,43	-3,62
	Equal variances not assumed			-3,12	21,87	0,01	-11,02	3,53	-18,35	-3,69

	Learning potential category	N	Mean	Std deviation	Std error mean
Training 1	1 (<55)	13	67,85	38,37	10,64
	2 (>60)	14	56,93	30,64	8,19
Training 2	1 (<55)	13	105,15	32,59	9,04
	2 (>60)	14	88,00	27,03	7,22
English T-score	1 (<55)	13	45,69	6,87	1,91
	2 (>60)	14	56,71	11,13	2,98

The means for the two groups on training 1 are 67,85 for the low learning potential group compared with 56,93 for the high learning potential group. The means for the two groups on training 2 are 105,15 for the low learning potential group compared with 88 for the high learning potential group. The mean scores for the low LPCAT score group are higher for both the training 1 and training 2 samples than the higher LPCAT score group. The p-values of 0,42 and 0,15 respectively, however, indicate that the results are not statistically significant.

The means of two groups on English language proficiency are 45,69 for the low learning potential group compared with 56,71 for the high learning potential group. At the significance value of 0,01, the difference is statistically highly significant.

The above-mentioned results indicate that the production employees with lower learning potential performed better on work-related training test results in both instances – that is, December 2000 and December 2001. There is, however, a statistically significant difference in the performance of the two groups in terms of their English language proficiency, which indicates that learning potential seems to influence English language proficiency.

b Comparison of individuals with high English language proficiency and individuals with low English language proficiency

Analysis of the work-related training test results and learning potential of individuals was done by comparing a group of production employees who performed well in the English language proficiency test with a group who did not perform well. The first group used for the analysis were 15 individuals who obtained a score of higher than 55 on the English language proficiency test. The second group were 15 individuals who obtained a score lower than 45 on the English language proficiency test. When analysed according to the interpretative information provided by the test used, a score of 55 can be described as a high average score and a score of 45 can be described as a low average score. These two groups were compared in terms of their performance on the LPCAT as well as their

performance in the work-related training test results. These results are presented in table 4.12.

TABLE 4.12: COMPARISON BETWEEN HIGH PERFORMERS AND LOW PERFORMERS IN ENGLISH LANGUAGE PROFICIENCY

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	t	Df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
Training 1	Equal variances assumed	0,07	0,79	0,29	28,00	0,77	4,27	14,59	-25,61	34,14
	Equal variances not assumed			0,29	27,95	0,77	4,27	14,59	-25,61	34,15
Training 2	Equal variances assumed	0,98	0,33	-0,01	28,00	1,00	-0,07	10,91	-22,42	22,29
	Equal variances not assumed			-0,01	26,63	1,00	-0,07	10,91	-22,47	22,34
LPCAT post-test	Equal variances assumed	0,386	0,06	-3,65	28,00	0,00	-8,13	2,23	-12,70	-3,57
	Equal variances not assumed			-3,65	22,22	0,00	-8,13	2,23	-12,75	-3,51

	English language proficiency category	N	Mean	Std deviation	Std error mean
Training 1	1 (<45)	15	64,67	39,13	10,10
	2 (>55)	15	60,40	40,75	10,52
Training 2	1 (<45)	15	102,53	26,28	6,79
	2 (>55)	15	102,60	33,10	8,55
LPCAT post-test	1 (<45)	15	53,47	7,50	1,94
	2 (>55)	15	61,60	4,27	1,10

The means of the training results of the two groups, low and high English language proficiency, are similar at the start and end of the period under investigation. The p-values of 0,77 and 0,99 respectively, also indicate that the differences between the means are not statistically significant.

There is, however, a significant difference between the mean learning potential scores of the two groups with a p-value of 0,00. This result is highly significant.

The above-mentioned results indicate that the English language proficiency of the production employees does not influence the work-related training test results in both instances – that is, December 2000 and December 2001. There is, however, a statistically significant difference in the performance of the two groups in terms of their learning potential. Employees with high English language proficiency also have high learning potential.

c *Comparison between individuals with high performance on work-related training test results and individuals with low performance on work-related training test results*

Owing to the results obtained from point 4.4 as well as the bipolar distribution of work-related training test results displayed in figure 4.4, the group was divided into two according to their work-related training test results. The first group consisted of individuals who had passed more than 90 tests before December 2001, while the second group consisted of individuals who had passed fewer than 90 tests before December 2001, based on the distribution of training test results as reflected in figure 4.4. These two groups were compared in terms of their means on the LPCAT pretest and post-test, their English language proficiency as well as the work-related training test results of December 2000.

TABLE 4.13: COMPARISON BETWEEN HIGH PERFORMERS (>90) AND LOW PERFORMERS (<90) IN WORK-RELATED TRAINING TEST RESULTS

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	T	df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
English T-score	Equal variances assumed	0,18	0,68	-0,45	50,00	0,66	-1,27	2,85	-6,99	4,44
	Equal variances not assumed			-0,45	23,05	0,66	-1,27	2,86	-7,19	4,64
LPCAT pretest	Equal variances assumed	0,40	0,53	0,70	49,00	0,49	1,49	2,13	-2,79	5,77
	Equal variances not assumed			0,61	16,75	0,55	1,50	2,47	-3,72	6,70
LPCAT post-test	Equal variances assumed	0,68	0,41	0,29	49,00	0,78	0,68	2,37	-4,08	5,44
	Equal variances not assumed			0,25	16,61	0,81	0,68	2,76	-5,16	6,52
Training 1	Equal variances assumed	3,32	0,08	-4,75	50,00	0,00	-47,09	9,93	-67,03	-27,16
	Equal variances not assumed			-5,73	35,62	0,00	-47,09	8,22	-63,73	-30,423

	Work-related training test category	N	Mean	Std deviation	Std error mean
English T-score	1 (<90)	14	50,36	9,16	2,45
	2 (>90)	38	51,63	9,08	1,47
LPCAT pretest	1 (<90)	13	56,31	8,16	2,26
	2 (>90)	38	54,82	6,05	0,98
LPCAT post-test	1 (<90)	13	57,23	9,16	2,54
	2 (>90)	38	56,55	6,69	1,09
Training 1	1 (<90)	14	26,86	22,56	6,03
	2 (>90)	38	73,95	34,39	5,58

The means of the two groups (high and low performers in the initial work-related training test results of December 2000) are shown to be 26,80 and 73,50 respectively. From the t-test for equality of means, the two-tailed significance level p-value is 0,00 and the difference between the means of the two groups is therefore highly significant.

The learning potential and English language proficiency results of the high and low work performance groups did not show any significant difference.

The above-mentioned results indicate that there is a significant difference between the two groups in terms of their initial performance in work-related training test results (December 2000), similar to the bipolar distribution of the work-related training test results of December 2001, displayed in figure 4.4.

Further analysis was done by dividing the group into two more extreme groups in terms of their performance in the work-related training test results (training 2). The first group consisted of the 13 lowest performers who had passed fewer than 80 of the 165 tests after the 13 months of training, while the second group consisted of the eight highest performers who passed at least 118 of the work-related training tests. These two groups were compared in terms of their performance on the LPCAT and English language proficiency as presented in table 4.14.

TABLE 4.14: COMPARISON BETWEEN HIGH PERFORMERS (>118) AND LOW PERFORMERS (<80) IN WORK-RELATED TRAINING TEST RESULTS

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	t	df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
LPCAT post-test	Equal variances assumed	0,04	0,85	0,29	19,00	0,78	1,11	3,86	-6,97	9,12
	Equal variances not assumed			0,30	17,27	0,77	1,11	3,67	-6,63	8,84
English Language	Equal variances assumed	0,42	0,52	-1,62	20,00	0,12	-5,89	3,64	-13,49	1,71
	Equal variances not assumed			-1,80	19,37	0,09	-5,89	3,26	-12,71	0,92
Training 1	Equal variances assumed	2,41	0,14	-4,43	20,00	0,00	-55,14	12,45	-81,11	-29,17
	Equal variances not assumed			-3,90	10,19	0,00	-55,14	14,14	-86,58	-23,71

	Category	N	Mean	Std deviation	Std error mean
LPCAT post-test	1 (<80)	13	57,23	9,16	2,54
	2 (>118)	8	56,13	7,49	2,65
English T-score	1 (<80)	13	50,36	9,16	2,45
	2 (>118)	8	56,25	6,09	2,15
Training 1	1 (<80)	13	26,86	22,56	6,03
	2 (>118)	8	82,00	36,18	12,79

Although slight differences can be seen on the calculated means on both the LPCAT and English language proficiency, the results are not statistically significant.

As expected, the mean initial training results of 26,86 and 82,00 for the two groups are significantly different, but the variances, according to Levene's test for equality of

variances are not statistically significant. The two groups therefore have more or less similar distributions, which clearly shows the existence of two distinct groups of performers with almost two normal distributions within the original sample.

The results indicate that there are two distinct groups, performers and nonperformers. Most of the production employees have the required qualifications as well as a learning potential of higher than 55, which indicates that they have the potential to obtain a post grade 12 qualification. Learning potential could therefore not have accounted for the distinct distribution of the two groups in terms of work-related training test results. The scores obtained in the English language proficiency test indicate that English proficiency could have had an influence on the bipolar distribution of work-related training test results, although the regression analysis indicates that there is no relationship between English language proficiency and the work-related training test results. Other reasons or explanations need to be investigated for the distinct division of the two groups.

d Comparison of means of the different race groups

The means of the different race groups are compared to establish whether race or culture has an influence on the learning potential and English language proficiency of the production employees. Table 4.15 presents the comparison of learning potential and English language proficiency results of the different race groups. Since the Asian race group was very small, and was similar to the white race group in terms of socioeconomic and educational indicators, they were added to the white race group for statistical purposes.

TABLE 4.15: LEARNING POTENTIAL AND ENGLISH LANGUAGE PROFICIENCY OF THE DIFFERENT RACE GROUPS

Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	t	df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
English T-score	Equal variances assumed	2,72	0,12	-2,20	50,00	0,03	-5,38	2,44	-10,29	-048
	Equal variances not assumed			-2,35	49,45	0,02	-5,38	2,30	-10,00	-077
LPCAT pretest	Equal variances assumed	0,10	0,76	0,04	49,00	0,97	0,07	1,90	-3,74	3,88
	Equal variances not assumed			0,04	43,92	0,97	0,07	1,89	-3,73	3.87
LPCAT post-test	Equal variances assumed	0,42	0,52	-0,36	49,00	723,00	-0,08	2,10	-4,96	3,47
	Equal variances not assumed			-0,36	44,46	0,72	-0,75	2,08	-4,94	3,44

	Race category	N	Mean	Std deviation	Std error mean
English T-score	African	22	48,18	6,53	1,39
	White/Asian	30	53,57	9,99	1,82
LPCAT pretest	African	21	55,24	6,56	1,43
	White/Asian	30	55,17	6,73	1,23
LPCAT post-test	African	21	56,29	7,16	1,56
	White/Asian	30	57,03	7,51	1,37

By looking at the two-tailed significance levels with p-values of 0,97 and 0,72 for the pre-and post-tests respectively, from the t-test for the equality of the means it can be concluded, that there is no significant difference between the learning potential of the two

race groups. There is, however, strong evidence to infer that there is a statistically significant difference between the mean English language proficiency scores of the two race groups, which is reflected by the p-value of 0,03. The white and Asian group has a mean score of 53,57 and the African group has a mean score of 48,18 on the English language proficiency test, which indicates that the white and Asian group performed better than the African group. The standard deviations of the two groups also differs, with the distribution of the white and Asian groups having a larger standard deviation than the African group. A reason for this could be that the African group had probably received formal education in a second or third language.

Race influences the learning potential of the production employees. The English language proficiency of the African group is lower than the white and Asian group which which could explain the influence on work-related training test results. This could be due to the fact that most African employees receive training and formal education in a second or third language. Table 4.16 presents the work-related training test results of the different race groups.

TABLE 4.16: WORK-RELATED TRAINING TEST RESULTS OF THE DIFFERENT RACE GROUPS

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig	T	df	Sig (2-tailed)	Mean difference	Std error difference	95% confidence interval of the difference	
									Lower	Upper
Training 1	Equal variances assumed	0,00	1,00	-2,93	50,00	0,01	-29,07	9,91	-48,98	-9,16
	Equal variances not assumed			-2,93	44,99	0,01	-29,07	9,94	-49,08	-9,05
Training 2	Equal variances assumed	2,90	0,10	-4,44	50,00	0,00	-32,43	7,30	-47,10	-17,77
	Equal variances not assumed			-4,39	43,27	0,00	-32,43	7,39	-47,33	-17,53
Improvement	Equal variances assumed	0,29	0,53	-0,44	50,00	0,66	-3,37	7,63	-18,68	11,95
	Equal variances not assumed			-0,44	45,25	0,66	-3,37	7,63	-18,79	12,01

	Race category	N	Mean	Std deviation	Std error mean
Training 1	African	22	44,50	35,64	7,60
	White/Asian	30	73,57	35,07	6,40
Training 2	African	22	83,00	27,17	5,79
	White/Asian	30	115,43	25,13	4,59
Improvement	African	22	38,50	27,26	5,81
	White/Asian	30	41,87	27,10	4,95

By looking at the two-tailed significance levels with p-values of 0,01 and 0,00 for training 1 and training 2 respectively, from the t-test for the equality of the means it can be concluded that there is a statistically significant difference between the work-related training test results as on 1 December 2000 (training 1) and the work-related training test results as on 31 December 2001 (training 2).

The white and Asian group obtained a mean improvement in training of 38,50 with a standard deviation of 27,26, while the African group obtained a mean improvement of 41,87 with a standard deviation of 27,10. This indicates that race did not influence the progress that the production employees made in terms of their work-related training test results.

4.5.2 Qualitative analysis

Additional information was obtained to investigate why some production employees performed better on their work-related training test results than others by conducting interviews with three high performers and three low performers on work-related training test results. High and low performers were chosen on a sample of convenience. All the employees who were interviewed felt that the availability of assessors had influenced their progress in the work-related training tests and they believed that there were not enough accredited assessors. Some even felt that friends wishing to be assessed by the assessors were given preference, although it was the employee's responsibility to arrange the assessment with the panel of assessors. Some of the lower performers indicated that they had initially progressed and then for some or other reason had lost interest in completing all the tests. One employee mentioned that external motivation influences the progress made by the production employees since the incentive provided in terms of money or other benefits is not worth the effort of studying the various modules. Another general comment made, especially by employees with fewer years of experience, was the time it takes to become competent in the practical operation of the two plants. Those who performed well, especially in the assessments, indicated that they already possessed the required experience on the two plants and that the assessments were completed quite easily. None of the employees interviewed felt that their English proficiency had influenced their learning process, although the results obtained from the English language proficiency tests indicated that the opposite might be true.

4.6 CONCLUSION

The learning potential of the production employees varied over the total range of the LPCAT, from grades 0 to 3/ABET level 1 to tertiary education (degrees)/NQF levels 6 to 8, with a mean score of 55 indicating a learning potential at a tertiary technikon level. Most production employees had average English language proficiency, ranging between very good to poor when classified according to the interpretive information provided by the test used. The average number of work-related training tests passed by the production employees on 1 December 2000 was 61,3 which increased to 101,71 by the end of December 2001 - an average increase in number of caps of 40,44.

Correlations and regression analysis were done to establish whether there is a relationship between learning potential, English language proficiency and work-related training test results. There is an extremely strong positive relationship between the pretest, post-test and composite LPCAT results, which probably indicates that most of the individuals in the present sample are already performing at or close to their optimal level in terms of the reasoning measured by the LPCAT. The results of the study further indicated that there is no significant correlation between the work-related training results and either learning potential or English language proficiency. This is also confirmed by the regression analysis since a linear relationship does not exist between learning potential or English language proficiency and work-related training test results. There is, however, a significant correlation between the various LPCAT scores and English language proficiency. There is a negative correlation between years of education and work-related training test results which was also confirmed by the regression analysis which indicated that there is a negative linear relationship between years of education and work-related training test results.

Some of these seemingly contradictory results could be the result of motivational or attitudinal factors as reflected in some of the comments made in the personal interviews with individuals.

With the division of the group into high and low performers in the LPCAT, a significant difference in English language proficiency was found. In terms of work-related training test results, training 1 and training 2, no significant difference of the means were found for the high and the low LPCAT performance groups.

With the division of the group into high and low performers in the English language proficiency test, a highly significant difference in LPCAT performance was found. In terms of work-related training test results, training 1 and training 2, a significant difference of the means was found for the high and low English proficiency groups.

With the division of the group into high and low performers in the work-related training test results, two distinct levels of performance were also shown by the bipolar distribution in figure 4.4 in comparing these two groups. Neither the learning potential (pretest and post-test) means nor the English language proficiency means show a significant difference.

There is no significant difference between the learning potential of the two race groups. There is, however, strong evidence to infer that there is a statistically significant difference between the mean English language proficiency scores of the two race groups. The white and Asian group performed significantly better in the English language proficiency test than the African group.

The results can be further summarised in terms of the hypotheses investigated:

- Hypothesis 1:

H_0: There is no significant relationship between learning potential and work-related training test results.

H_1: There is a significant relationship between learning potential and work-related training test results.

The learning potential of the production employees does not influence their progress in work-related training test results. Potential could therefore not be used as a reason or explanation for poor performance.

- Hypothesis 2:

H_0: There is no significant relationship between English language proficiency and work-related training test results.

H_1: There is a significant relationship between English language proficiency and work-related training test results.

The English language proficiency of the production employees does not influence their progress in work-related training test results. Since language proficiency in general has an influence on academic performance (Van Eeden, et al., 2001), and the overall performance of the production employees in the English language proficiency test was unsatisfactory. English proficiency seems to have had an influence on work-related training test results.

- Hypothesis 3

H_0: There is no significant relationship between learning potential and English language proficiency.

H_1: There is a significant relationship between learning potential and English language proficiency.

The relationship between learning potential and English language proficiency indicates that if an employee possesses the required learning potential, he/she seems better equipped to master English.

In conclusion, the results indicate that for hypotheses 1 and 2 the null hypothesis is accepted and for hypothesis 3 the null hypothesis is rejected and the research hypothesis not rejected.

There is a distinct division in the group between performers and nonperformers in work-related training test results, although the results indicate that neither learning potential nor English language proficiency influenced performance in work-related training test results. This means that other reasons should be sought to explain why some employees perform better than others.

Additional information was obtained from the interviews conducted that could provide some reasons why some production employees progressed better in the work-related training test results than others. Most of these reasons relate to an insufficient number of assessors and their nonavailability, the motivational level of production employees and the time taken to gain experience.

CHAPTER 5

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Worldwide change, the economic and political situation and skills shortages pose unique challenges for South African organisations. Technological changes also require more competent and more highly skilled employees than ever before. For organisations to remain in business today, they need to fully utilise their resources including their human capital.

This study investigated the relationship between the learning potential, English language proficiency and work-related training test results of production employees of a South African Polymers Company. The main purpose was to determine the possible reasons for differences in work-related training test results of the various production employees. Qualitative data on the relevant variables were obtained by interviewing three high performers and three low performers on work-related training test results.

5.2 LEARNING POTENTIAL

The LPCAT difference scores of up to 6 were found with a mean difference score of 1,59 which indicates that not all the production employees had fully developed their potential, although most of them were probably already performing at or close to their optimal level in terms of the reasoning measured by the LPCAT. The Polymers Company should, however, continue providing employees with learning opportunities. The LPCAT mean of composite scores is 55 and indicates that, on average, production employees have the potential to obtain a post-grade 12 diploma or certificate equal to NQF level 5. These employees should therefore be capable of mastering the work-related training tests without any problems. It is interesting to note that although the minimum qualification that any one of the production employees possessed was grade 10, the minimum

composite score obtained from the LPCAT was 34, thus equal to grades 0 to 3 or ABET level 1. This particular employee may have difficulty mastering the work-related training tests.

5.3 ENGLISH LANGUAGE PROFICIENCY

The English language proficiency scores ranged from 9, which indicates a poor English language proficiency, to 38, which indicate very good English language proficiency. The mean score obtained by the production employees is 21,3 which indicates an average English language proficiency when interpreted according to the information provided in the test manual. The English language proficiency is unsatisfactory, since the English language proficiency test used in the study was developed for grade 10 to 12 pupils with English as second language. Most of the sample had 12 years of education. This could possibly have influenced work-related test results, since all the training material is only available in English only and all the tests and assessments are conducted in English. It is recommended that the Polymers Company provide English language training to the production employees who would like to improve their English proficiency, who feel uncomfortable with the use of English or who obtained a score of average or lower than average when interpreted according to the information provided by the test manual. English is the official business language of the company and should miscommunication occur during crisis situations, this could have devastating results. The Polymers Company should therefore also include an English proficiency test as part of the selection criteria for the recruitment of production employees.

5.4 WORK-RELATED TRAINING TEST RESULTS

Taking into account the mean score of the learning potential of the production employees as well as the formal training time of 38 hours per month provided by the Polymers Company, it is to be expected that the work-related training test improvement should be higher than the actual improvement of 40,44 number of caps obtained. Progress made over the period of 13 months was therefore unsatisfactory. The work-related training test

results on December 2001 displayed a clear bipolar distribution of the group. No explanation could be found for this, even by dividing the group into two groups, high and low performers on work-related training test results, and comparing the means of other variables for these two groups. Most of the production employees had the required qualifications as well as a learning potential of higher than 55, which indicates that they had the potential to obtain a post-grade 12 qualification. Learning potential could therefore not have accounted for the distinct distribution of the two groups in terms of work-related training test results. The poor scores obtained in the English language proficiency test indicate that English proficiency could have had an influence on the bipolar distribution of work-related training test results, although the regression analysis indicates that there was no relationship between English language proficiency and work-related training test results. However, the results were not statistically significant. The pass rate of 90% on the work-related tests as well as the three opportunities provided to pass a test could have been factors that limited the investigation of this phenomenon. Further research could be done to investigate the reasons for the distinct bipolar distribution of the group. Based on the qualitative information obtained in the interviews, the attitude of the production employees as well as the availability of assessors seems to have been some of the reasons for the distinct bipolar distributions of work-related training test results.

5.5 RELATIONSHIP BETWEEN LEARNING POTENTIAL, ENGLISH LANGUAGE PROFICIENCY AND WORK-RELATED TRAINING TEST RESULTS

The extremely strong relationship between the pretest, post-test and composite LPCAT test results indicate that the individuals who were tested performed consistently in both the pretesting and post-testing. The relatively high level of LPCAT performance and high level of average education for this sample probably indicates that most of the individuals in the present sample were already performing at or close to their optimal level in terms of the reasoning ability measured by the LPCAT.

It is surprising to note that there was no significant relationship between learning potential and work-related test results of the production employees.

The results obtained could have been influenced by the following:

- The marks obtained were not used at all in the study since a pass rate of 90% on work-related tests was required.

- Three opportunities were provided to pass a particular test or assessment.

- The progress made on tests and assessments was measured and reported in terms of number of tests and assessments passed and not in the percentage mark obtained for the level of performance in the particular work-related test or assessment.

When dividing the group into two on the basis of their learning potential, the production employees with lower learning potential performed better on work-related training test results in both instances, December 2000 and December 2001. This could also have been for the above-mentioned reasons. However, there was a statistically significant difference in the performance of the two groups in their English language proficiency. Thus, learning potential seems to have influenced English language proficiency which was also confirmed by the positive correlation between learning potential and English language proficiency. This could indicate that the more potential an individual has, the more easily he/she may be able to master English.

The negative correlation between work-related test results and years of education was contrary to expectation. It could be because of a lack of motivation or a negative attitude, which was confirmed by the interviews conducted with performers and nonperformers on work-related training test results. Individuals with higher qualifications may have felt that it was unnecessary for them to master work-related training tests since they had already qualified.

The white/Asian group performed much better in the English language proficiency test than the African group. This could be because of prior school education in English or English as the mother tongue of some of the individuals in the group, because, as Gruenewaldt (1999) indicated, the acquisition of second language literacy is influenced by proficiency in the first language, the motivation to learn the second language as well as cultural determinants such as one's own culturally-bound awareness of what is read and heard. A further problem is that teachers in black schools themselves often lack the English proficiency required for effective teaching (Rossouw, 1999). The lower English proficiency of the African group could mean that it had either taken longer for them to master the training material or that they had misunderstood it. The African group could therefore have benefited from receiving English proficiency training. Although race influenced the number of caps obtained on 1 December 2000 (training 1) and 31 December 2001 (training 2), there is no significant difference between the two race groups in terms of the improvement in work-related training test results. This could be explained due to the fact that neither of the race groups received work-related training in their home language. Only 5 of the production employees are English mother-tongue speakers.

The results indicate that a linear relationship does not exist between English language proficiency and work-related training test results. This was also confirmed by the comparison of the means of high and low performers in English language proficiency, since English language proficiency did not influence the work-related training test results in both instances, December 2000 and December 2001. This results are interesting since a study by Van Rooyen (2001) indicated that home language is a significant predictor of academic success and Van Eeden, et al. (2001) found that academic performance is a function of proficiency in English when English is used for assessment. This was also confirmed by Huysamen (1999). Since the overall performance of the production employees in the English language proficiency test was unsatisfactory, it is recommended that the Polymers Company provide English language training to all the production employees to ensure that miscommunication would not result in incidents on the plant.

The qualitative information obtained through interviewing three high performers and three low performers on work-related training tests was used to develop common themes or hypotheses, namely:

- The limited number of assessors, and their availability influences employees' progress since they cannot be assessed timeously.

- A general lack of motivation or attitude could affect progress in work-related training test results.

- A lack of personal drive or tenacity could affect progress in work-related training test results.

- The timeous process of obtaining sufficient experience on the plant could also play a role.

The above hypotheses should be further investigated by the Polymers Company to establish why some production employees progressed faster in work-related training test results than others.

5.6 LIMITATIONS

Various factors influenced the research on why some production employees progressed faster in their work-related training test results than others. These are as follows:

- A pass rate of 90% on work-related training tests was required which made it impossible to distinguish clearly between the training test results of production employees.

- Three opportunities were provided to pass a particular test or assessment and only the last or final test or assessment was reported.

- The progress made in tests and assessments was measured and reported in terms of number of tests and assessments passed and not in the percentage mark obtained for the level of performance in the particular work-related test or assessment.

The above factors influenced the results obtained from the study since they had a direct impact on the measure used for the work-related training test results.

5.7 RECOMMENDATIONS

A possible solution to some of the above-mentioned problems could be to appoint more assessors, although this could influence the consistency of assessments. Thorough screening and selection methods should be introduced to ensure that new employees with the right attitude towards further development and training are appointed. All production employees would benefit from emotional intelligence training, which could be a way to address negative attitudes. Formal rotation schemes should be introduced to ensure that all production employees are afforded the same opportunities to become fully competent at running both plants in as little time as possible. Since the overall English language proficiency of the production employees are unsatisfactory, it is recommended that efforts should be made to improve English language proficiency through for example training. The above-mentioned hypotheses could be further investigated by the Polymers Company or other researchers to find additional information on why some employees progress better on work-related tests than others.

5.8 CONCLUSION

In conclusion the reason for production employees' slow progress in work-related training tests does not seem to be learning potential or the lack of reasoning ability. English language proficiency could be a problem and the Polymers Company could consider providing English language training. Information obtained in the interviews

may be worthwhile exploring with specific emphasis on the availability and number of assessors as well as the motivational level of the production employees.

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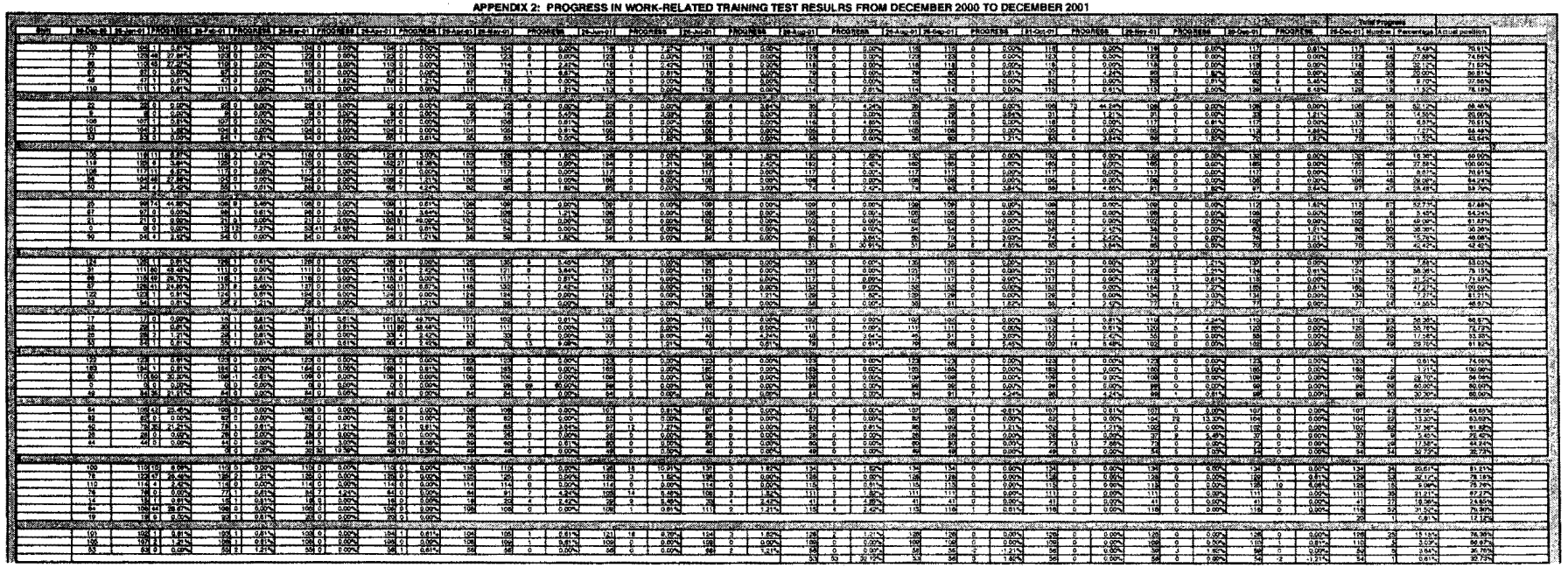
APPENDIX 1: NORMS: PERCENTILE RANKS, T-SCORES AND STANINES FOR ENGLISH LANGUAGE PROFICIENCY TEST

Raw score	Percentile rank	T-score	Stanine	Description
40	100	82	9	Very good
39	100	78		
38	99	73		
37	98	70		
36	97	66		
35	95	65	8	Good
34	93	63		
33	91	63		
32	88	61	7	Above average
31	86	60		
30	83	59		
29	80	59		
28	78	58		
27	75	56	6	High average
26	72	55		
25	69	55		
24	66	54		
23	62	54		
22	59	53	5	Average
21	55	52		
20	52	51		
19	48	50		
18	44	49		
17	40	47	4	Low average
16	36	46		
15	31	45		
14	27	44		
13	23	42	3	Below average
12	19	41		
11	15	39		
10	11	38	2	Poor
9	8	36		
8	5	34		
7	3	31	1	Very poor
6	2	29		
5	1	26		
0-4	0	22		

APPENDIX 2: PROGRESS IN WORK-RELATED TRAINING TEST RESULRS FROM DECEMBER 2000 TO DECEMBER 2001



APPENDIX 3: INFORMATION OBTAINED FROM THE SAMPLE

SHIFT	AGE	RACE	LANGUAGE	EDUCATION	EXP	EP RAW	EP P	EP T	EP S	LPT1	LPT2	LPS1	LPS2	LP P1	LP P2	LP COMP	LP DIFF	Dec-01	Dec-02	Improve
1	41	White	Afrikaans	M	13	15	31	45	4	58	58	7	7	79	77	58	0	103	117	14
1	41	White	Afrikaans	M	12	24	66	54	6	49	55	5	6	47	71	60	6	77	123	46
1	33	White	Afrikaans	Std 9	12	23	62	54	6	55	59	6	7	70	80	56	4	65	118	53
1	25	White	Afrikaans	M	5	18	44	49	5	60	62	7	7	83	87	60	2	67	100	33
1	41	Black	S. Sotho	Std 8	11	12	19	41	3	51	56	5	6	54	71	52	5	22	108	86
1	26	White	English	M	6	18	44	49	5	61	61	7	7	87	87	61	0	46	62	16
1	29	Black	Tswana	M + ND	3	26	72	55	6	53	54	6	6	60	66	53	1	106	117	11
1	26	White	Afrikaans	M	4	31	86	60	7	54	58	6	7	64	79	55	4	111	129	18
1	37	Black	Zulu	Std 8	12	9	8	36	2	44	43	4	4	26	25	44	-1	9	33	24
1	31	Black	Tswana	M	5	15	31	45	4	56	55	6	6	73	70	56	-1	101	113	12
1	24	Black	N. Sotho	S4-Chem Eng	1	9	8	36	2	61	64	7	8	87	92	61	3	53	72	19
2	46	White	Afrikaans	Std 8 + N3	12	26	72	55	6	51	50	5	5	55	50	51	-1	105	132	27
2	33	Black	S. Sotho	M	13	17	40	47	4	49	50	5	5	45	49	49	1	25	112	87
2	26	White	Afrikaans	M	4	36	99	73	9	67	72	8	9	95	98	69	5	106	117	11
2	30	White	Afrikaans	M	8	18	44	49	5	56	59	6	7	71	81	56	3	119	165	46
2	30	Black	S. Sotho	M	5	15	31	45	4	58	62	7	7	79	89	59	4	97	106	9
2	59	White	Afrikaans	Std 8	13	15	31	45	4	37	38	2	3	10	12	37	1	58	106	48
2	42	Black	N. Sotho	M	13	13	23	42	3	52	56	5	6	58	74	53	4	21	102	81
2	25	Black	Zulu	M + ND	2	19	48	50	5	61	61	7	7	87	87	61	0	50	76	26
2	23	White	Afrikaans	M	2	36	99	73	9	64	67	8	8	91	95	65	3	50	97	47
2	31	Black	Zulu	M	1	19	48	50	5	56	58	6	7	73	79	56	2	0	60	60
3	42	White	Afrikaans	Std 8	13	21	55	52	5	56	59	6	7	74	82	56	3	124	137	13
3	37	White	Afrikaans	M	12	24	66	54	6	56	59	6	7	70	82	56	4	31	124	93
3	37	White	Afrikaans	M	12	9	8	36	2	54	56	6	6	64	71	54	2	66	118	52
3	25	Asian	English	M	6	28	78	58	7	58	60	7	7	78	83	58	2	17	110	93
3	26	White	Afrikaans	M	5	27	75	56	6	61	60	7	7	87	84	61	-1	87	165	78
3	36	White	Afrikaans	Std 8	11	9	8	36	2	45	46	4	4	32	34	45	1	122	134	12
3	30	Black	Zulu	M	7	19	48	50	5									28	55	29
3	28	Asian	English	M +NTC3	6	20	52	51	5	41	42	3	3	18	20	41	1	28	120	92
3	26	Black	S.Sotho	M + ND	1	22	59	53	5	58	59	7	7	79	81	58	1	53	102	49
3	22	White	English	M	1	37	98	70	9	59	64	7	8	80	91	60	5	53	77	24
4	45	White	Afrikaans	Std 8	12	27	75	56	6	58	59	7	7	79	81	58	1	122	123	1
4	39	White	Afrikaans	Std 8	12	25	69	55	6	61	59	7	7	85	81	61	-2	60	109	49
4	45	White	Afrikaans	Std 9	4	17	40	47	4	46	49	4	5	35	44	46	3	110	125	15
4	43	Black	S.Sotho	Std 9	12	20	52	51	5	58	57	7	6	79	75	58	-1	64	107	43
4	35	Black	S. Sotho	M	12	16	36	46	4	34	33	2	1	5	4	34	-1	28	37	9
4	31	White	Afrikaans	Std 8	4	11	15	39	3	47	43	4	4	37	24	47	-4	49	99	50
4	26	Black	Tswana	M + ND Chem	2	21	55	52	5	61	61	7	7	87	87	61	0	44	73	29
4	25	Black	S.Sotho	M + ND Chem	1	20	52	51	5	61	64	7	8	86	92	61	3	0	54	54
4	28	Black	Zulu	M	4	20	52	51	5	56	56	6	6	73	71	56	0	82	104	22
4	34	Black	N. Sotho	M + S4 Chem	6	29	80	59	7	60	63	7	8	83	90	60	3	40	102	62
5	34	White	Afrikaans	M	11	14	27	44	4	57	56	6	6	76	72	57	-1	100	134	34
5	27	White	Afrikaans	M	8	35	95	65	8	61	66	7	8	86	94	62	5	76	129	53
5	24	Black	N. Sotho	M	3	14	27	44	4	58	58					58	0	105	110	5
5	28	White	Afrikaans	M	9	29	80	59	7	55	59	6	7	69	80	56	4	76	111	35
5	30	Asian	English	M	4	34	93	63	8	58	61					58	3	101	126	25
5	38	White	Afrikaans	M	11	30	83	59	7	61	63	7	8	87	89	61	2	14	41	27
5	29	White	Afrikaans	M	9	10	11	38	2	53	53					53	0	64	116	52
5	24	Black	Venda	M + S4 Chem	2	29	80	59	7	58	58	7	7	78	77	58	0	0	54	54
5	28	Black	Ndebele	M + ND	2	27	75	56	6	56	56	6	6	71	71	56	0	53	59	6
5	31	Black	Zulu	Std 9 + NTC3	3	12	19	41	3	59	58	7	7	82	78	59	-1	0	70	70
5	42	White	Afrikaans	M	9	34	93	63	8	57	56	6	7	74	79	55	4	0	99	99