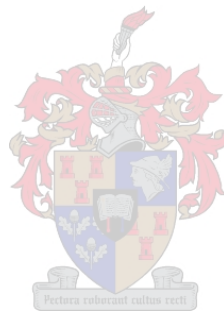**MODIFICATION, ELABORATION AND EMPIRICAL EVALUATION OF THE DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL: RISING ABOVE ADVERSITY**

Dirk J Pretorius

Thesis presented in partial fulfilment of the requirements for the degree of Master of Commerce in the Faculty of Economic and Management Sciences at Stellenbosch University

Supervisor: Ms M Visser
Co-supervisor: Prof DJ Malan
Department of Industrial Psychology

December 2014

DECLARATION

I herewith declare this work to be my own, that I have acknowledged all the sources I have consulted in the assignment/essay itself and not only in the bibliography, that all wording unaccompanied by a reference is my own, and that no part of this assignment/essay has been directly sourced from the internet without providing the necessary recognition.

I acknowledge that if any part of this declaration is found to be false I shall receive no marks for this assignment/essay, shall not be allowed to complete this module, and that charges can be laid against me for plagiarism before the Central Disciplinary Committee of the University. I acknowledge that I have read the Guidelines for Writing Papers in Industrial Psychology and have written this paper accordingly, and that I will be penalised for deviating from these guidelines.

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ABSTRACT

The current study is an attempt to acknowledge the existing inequalities South Africa faces, while presenting a solution to reach the ideal of equal opportunities so many South Africans strive for each day. The catalyst for the current study is the observed shortage in skills, knowledge and general abilities among those South Africans who were previously denied developmental and equal educational opportunities. Through addressing the challenges faced by those most at risk of not achieving learning performance success, an attempt is launched to uncover the factors that should be considered when evaluating learning potential. The study is directly aimed at addressing the failures of previous affirmative development attempts. The core belief of the author remains in line with the current government's view, namely that successful affirmative development is the most effective way to correct the injustices of the South Africa's past.

Through scientific assistance to the corporate sector, Industrial Psychologists can play a leading role by using the practice of selection as a vehicle to drive the process of affirmative development in a responsible manner through selective developmental opportunities. The author has attempted to identify cognitive and non-cognitive learning performance variables that are to be considered when considering learning performance success. The current study is an elaboration of previous research presented by De Goede (2007) that was based on the findings of Terry Taylor (1989, 1992, 1994, 1997).

The current learning potential structural model is an elaboration of the De Goede (2007) learning potential structural model. The author has proposed additional non-cognitive variables as an attempt to gain a more thorough understand with respect to what constitutes success in learning performance. By adding more variables to the existing nomological network that constitute learning performance, the author attempted to uncover a more holistic insight into the construct of learning performance success.

The research was conducted using a sample of 395 grade 9 school learners from previously disadvantaged communities in the Cape Town area, including Bonteheuwel, Mannenberg and Goodwood. All the learners in the sample group successfully completed term 1 and 2 passing English first language, Afrikaans second Language, Mathematics and Science.

The proposed hypothesised expanded learning potential structural model was empirically evaluated. The fit of the measurement model achieved exact fit. The researcher extended the investigation by considering the full range of fit indices, standardised residuals, modification indices and parameter estimate. From the results obtained the researcher modified the structural model, by removing one of the interaction effects. The results of the final revised structural model achieved good fit. Only five of the paths in the final model were empirically corroborated. Support was found, indicating that a statistical significant positive relationship exist between Learning Motivation and Tenacity, Conscientiousness and Resilience, Parental Quality and Learning Motivation, Grit and Cognitive Engagement as well as Grit and Learning Motivation. In addition to these findings, the researcher also presented some limitation to the research methodology, practical implications as well as recommendations for future research.

OPSOMMING

Die huidige studie verteenwoordig 'n poging om erkenning te gee aan die heersende ongelykhede wat Suid-Afrika in die gesig staar, terwyl 'n oplossing gesoek word om die ideaal van gelyke ontwikkeling, waarna soveel Suid-Afrikaners elke dag streef. Die katalisator vir die huidige studie is die waargenome ongelykhede in vaardighede, kennis en algemene vermoëns onder daardie Suid-Afrikaners van wie ontwikkeling- en gelyke opvoedingsgeleenthede weerhou is. Deur die huidige uitdagings aan te spreek, wat die individue in die gesig staar met die grootste risiko om nie leerprestasie-sukses te behaal nie, word 'n poging geloods om die faktore te identifiseer wat oorweeg behoort te word wanneer leer potensiaal geëvalueer word. Hierdie studie is direk daarop gemik om die mislukkings van vorige regstellende aksie pogings aan te spreek. Die outeur se kernoortuiging is in lyn met die huidige regering se sienswyse, naamlik dat 'n suksesvolle regstellende ontwikkelingspoging die mees effetiewe manier is om die ongeregtelikhede van Suid-Afrika se verlede te korrigeer.

Deur wetenskaplike ondersteuning aan die korporatiewe sektor, kan Bedryfsielkundiges 'n leidende rol vervul deur die gebruik van seleksiepraktyke wat daarop afgestem is om die proses van regstellende aksie aan te dryf op 'n verantwoordelike manier, deur selektiewe ontwikkelingsgeleenthede. Die outeur het gepoog om kognitiewe en nie-kognitiewe leerprestasie-veranderlikes te identifiseer wat oorweeg moet word ten einde leerprestasie-sukses te bevorder. Die huidige studie is 'n uitbreiding van vorige navorsing deur De Goede (2007) gebaseer op die bevindinge van Terry Taylor (1989, 1992, 1994, 1997).

Die huidige leerpotensiaal strukturele model is 'n uitbreiding van De Goede (2007) se leerpotensiaal strukturele model. Die outeur het addisionele nie-kognitiewe veranderlikes voorgestel in 'n poging om dieper insig te verkry in dit wat leerprestasie-sukses konstitueer. Deur die toevoeging van meer veranderlikes tot die bestaande nomologiese netwerk wat leerprestasie konstitueer, poog die outeur om 'n meer holistiese insig te openbaar in die konstruk van leerprestasie-sukses.

Die navorsingstudie was toegepas om n groep van 395 graad 9 skooliere van voorheen benadeelde gemeenskappe in die Kaapstad omgewing, insluitend Bonteheuwel, Mannenberg en Goodwood. Al die leerlinge in die steekproef het kwartaal 1 en 2 suksesvol geslaag met die vakke Engels eerste taal, Afrikaans tweede taal, Wiskunde en Wetenskap.

Die voorgestelde leerpotensiaal strukturele model was empiries ge-ëvalueer. Die passing van die metingsmodel het n presiese passing getoon. Die navorser se ondersoek is uitgebrei deur die volle spektrum pasgehaltemaatstawwe, gestandaardiseerde residue, modifikasie-indekse en parameter skattings te oorweeg. Die resultate het daartoe gelei dat die navorser besluit het om 'n wysiging te maak deur een van die interaksie- effekte te verwyder. Die resultate van die finaal-gewysigde strukturele model het n goeie passing getoon. Slegs vyf van die bane in die finale model kon empiries bevestig word. Ondersteuning is gevind wat aantoon dat a statisties beduidende positiewe verhouding bestaan tussen Leer Motivering en Volharding, Pligsgetrouhied en Veerkragtigheid, Ouer Ingesteltheid en Leer Motivering, Volharding en Kognitiewe Inspanning, so wel as Volharding en Leer Motivering. Die navorser het addisioneel tot hierdie bevindinge, ook sekere beperkinge van die navorsings metodiek, praktiese implikasies van die studie, asook toekomstige navorsing bepreek.

ACKNOWLEDGEMENTS

After seven years of pursuing my academic dream, this thesis is testimony to my dedication, perseverance and resilience. In one's life many odds might present themselves, but it is up to oneself to choose to rise above those odds. A friend once told me that chance favours the prepared mind; today I can say that she was right. When I started my study career, it was against all odds. My academic success however, was the outcome of a few key individuals that never lost faith in my abilities. Today I would like to reflect on those special individuals that supported me over the years.

When I considered studying, there was one person who believed in my abilities, dreams and goals. Through her advice, encouragement and support over the years, I was able to believe in myself and my own abilities when everyone else said I will not make it. To my dear friend Liezl, words cannot describe my appreciation for your friendship. Thank you.

To my good friend, flatmate and now attorney, Jéan, thank you for your support over all these years. Together we started our academic careers at Stellenbosch, thinking at times all hope is lost, looking back on all the hours on campus, the endless discussions on life and late nights studying, I believe it was worth it after all.

I would also like to thank, Prof Malan, Mrs Visser and Prof Theron. The past couple of years have been a great journey in your presence. You were truly inspirational in my life; without all your assistance and support this thesis would never have resulted.

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I would like to dedicate this thesis to Ms Leana Loxton.

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CHAPTER 1

INTRODUCTORY ARGUMENT

1.1 INTRODUCTION

In 1948, South Africa under the leadership of the National Party and the then prime minister Dr D.F. Malan instigated a system of segregation known as "Apartheid". The newly established system then, and the haunting doctrine South Africa still faces today, meant that individuals of different races were treated in an unequal manner. The National Party segregated the services of the people living in South Africa, including education, providing black inhabitants with services inferior to those of white inhabitants. Under the 1953 Bantu Education Act, separate systems of education were constructed for black and white learners in an attempt to 'prepare' black learners to be agents of the labouring class. This segregation and separate developmental opportunities were extended to the tertiary institutions like universities as well (Pretorius, 2012).

In the years since 1948 we have seen government leaders transform our country from an oppressed, violent and abused society serving the minority, to a prospering nation which is regarded by the international community as a "miracle society", working together to serve every inhabitant of South Africa. Unfortunately this is a partial truth. The reality in 2013 is, however, far from what was promised to the majority of hard working and decent South Africans, hoping for a better life for themselves and their children. Yes, the South African government has made progress in terms of addressing those factors that are part of the injustices of South Africa's past, but the question remains, have the government done enough to secure a future for a next generation?

Today an atmosphere of despair is casting a shadow over the pride of so many freedom fighters, as the growing sense of disappointment of a dream for freedom and prosperity that once served as inspiration has yet to be reflected on the everyday lives of the majority of so many of South Africans, especially the youth. Now more than eighteen years after our country's suppressed defeat of apartheid, the cracks of South Africa's democratic governance is starting to show; a reality that is threatening our ideal of prosperity, on which this great nation has reinvented itself.

The question to be considered is; are "we" as citizens of South Africa at this moment in time simply acting as bricklayers for those who can be defined and seen as the architects of poverty. Putting it in simple terms, are "we" merely managing the decline of a great nation or are we really actively contributing in a manner that is bringing change by putting "our" expertise at work, supporting and challenging those who are responsible for leading "our" country. This is a fundamental question as "our" own futures are at stake. In some respects, as a nation, "we" have been governed by "our" history for too long, while losing sight of "our" philosophies of what can be and acting on it.

South Africa's National Planning Commission found during the year 2011 that the biggest burden still facing the nation today is poverty and inequality (Ramphele, 2012). These findings come at a time when the country is preaching socio-economic justice for all, as set out in our national constitution, while in practice South Africa's GINI coefficient is a

staggering 0.631[1], while eighty percent of schools in the country are dysfunctional and 51, 3% of youth (aged 15-24 years) are unemployed or not enrolled at any educational institution (Ramphele, 2012). This reality is not ideal, as the path to a successful society needs to point in the direction of the development of human capabilities as its core success catalyst. Without this mode of thinking, the country is wasting human and intellectual capital, which could have been utilised for enhancing the economy and developing social and cultural infrastructure, ensuring a prosperous future (Ramphele, 2012).

The call that is to be echoed is how the citizens, with the focus on the youth, can be re-mobilised to become shareholders of South Africa, through engaging in developmental opportunities where their individual potential can be recognised and utilised. The challenge that is to be considered is what tools are available or to be developed, that could be utilised in this process of identifying human potential and the acknowledgement thereof. If the GINI coefficient is considered, the challenge the country faces is critical, however attempting to correct the imbalances the country is facing, will mean that the focus should fall on an evidence-based approach. The evidence-based approach will allow South Africa to accurately portray the masked failures the nation faces as a society. However, for such an approach to be fruitful a culture of accountability is needed to acknowledge the shortfalls, while actively developing self-responsibility for a viable future. The success however, will only be realised if a link exists between hard work (including utilising training opportunities) and excellence (competent output) in performance and the rewarding thereof.

This stated ideal is to some extent a first world reality and a South African dream. The status quo, as portrayed by the figures above, will worsen if no action is taken to improve South Africa's current reality. South Africa on a daily basis implements new strategies to correct the injustices of its dark past, but few succeed. In spite of the country's educational and social efforts, children are still dropping out of school and the business sector is still unable to grant those most deserving of opportunities a chance to improve their circumstances (Ramphele, 2012). Today South Africa is still a country where in many cases the historical advantaged minority is earning and living positively unequal to their previously disadvantaged counterparts and this inequality simply breeds more inequality. One of South Africa's highest prioritised topics today is still the matter of equality and employment equity in terms of which the country is failing miserably; and so much more in the eyes of those freedom fighters that wanted a better life for the next generations to come.

The current South African, African National Congress (ANC) led government implemented a reform strategy known as Affirmative Action since coming to power in 1994, to correct these aforementioned injustices of the country's pre-democratic past. According to Kalula and Woolfrey (1994, p.6) affirmative action can be defined as a strategy aimed at "treating persons belonging to a specific group differently so that they obtain an equitable share of a specific good". This strategy serves a valuable purpose, as mentioned earlier, regarding the move for citizens to become equal shareholders of their country. However, this is only viable if those in power of the democracy practice their rights in a competent manner, through fruitful practices that deliver successful output. Looking back a decade and a half, South Africa's democracy has made improvements with regard to many things; but it, however, didn't succeed in delivering on the promise of equality. The question now becomes, considering this reality, should South Africa give up the dream of equality, or is the country to consider alternative strategies to reach this dream? Could the country utilise the

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[1] The Gini coefficient is a summary statistic of income inequality that varies from 0 (in the case of perfect equality where all households earn equal income) to 1 (in the case where one household earns all the income and other households earn nothing). Although this score has dropped from .7 in 2008, it is still an alarming figure as in the year 1994 the Gini Coefficient of South Africa was .43 (Naudé, 2012).

corporate sector as a vehicle to drive affirmative development as an alternative? This question poses a serious challenge to government and business as, for South Africa to maintain a healthy and competitive economy; a proper, sustainable and competent labour supply is required.

If South Africa is to maintain a competitive advantage, it is vital that goods and services are produced in the most effective, efficient and productive manner. The manner in which organisations create real economic value is by means of a three cycle process of input – conversion - and output, and human resources play a critical role in this pursuit (Prinsloo, 2012). The way organised business can insure that these human resources contribute to the economic success is by selecting individuals with the highest potential to complete the necessary task assigned to them successfully. This is a critical point to take cognisance of, as it has the implication that the future of South Africa is partially in the hands of the human actors driving the production of goods and services. The challenge today is upon business to ensure that those with the highest potential are selected for the positions offered. The question becomes, how can organised business ensure this in our modern day global competitive industries?

The answer can be found in effective human resource management. In this respect management refers to the effective regulation of human capital, as well as the maintenance and development thereof. Selection practices can serve as a valuable activity in acquiring the most adequate human capital. However, a paradigm shift should be made with respect to the existing knowledge about personnel selection, as well as the associated current practices in South Africa. This critical mind shift does not only entail focusing on considering our past and the unjust selection that took place, but also on establishing a more viable and fair method of acquiring human capital. When considering this novel approach to selection, the focus should fall primarily on identifying individuals for selective developmental opportunities, which can serve as a respected mechanism in the process of settling of our countries unjust past. It should be acknowledged that it is economically impossible for organised business in our developing country to present every single disadvantaged individual with a developmental programme. However, concern should be raised regarding governments attempt to foster these developmental opportunities. It was only very recently that the call for youth labour subsidies has been agreed by the South African as a mechanism to dampen the countries work shortage for young South Africans. However, as with any new system, the youth labour subsidies is yet to show its effectiveness.

 In South Africa it is not unrealistic to view the unequal reality, especially the difference in education levels among different race groups, as a result of South Africa's previous injustices which had a negative effect on the knowledge, skills and ability attainment of the previously disadvantaged groups. Today this problem still persists despite our government's attempts to achieve equality, as the previously advantaged groups are still outperforming others in terms of the conventional assessments in the workplace (Taylor, 2002). This places the majority of individuals in a position that aggravates the adverse impact already experienced. The question that should be asked is, is it possible to turn this adversity into advantage?

For this advantage to be realised, it should be acknowledged by the fraternity of psychologists specialising in selection that the injustices mentioned, impacted directly on the level of development required to perform successfully. The adverse impact was not, however, as marked on the psychological and cognitive potential of those that are adamant to acquire a better future for themselves. This presents a case of hope for South Africa in that the injustices of the past, although challenging, are not permanent. As a nation, it should be realised that with an adequate amount of effort our country is able to change the face of history. This requires intense introspection and active participation among

organised business, human resources and government to see to it that a more equal distribution is achieved within the labour market through presenting selective developmental opportunities to those individuals who were denied it previously. If the current status of South Africa is considered, the question could be asked as to whether the call for effort among the different stakeholders is that simple? This question needs to be answered in the negative.

If human resource management is considered among the mentioned stakeholders, two avenues exist regarding an optimal contribution towards the challenge at hand, namely effective regulation of the flow of the workforce into, through and out of organisations and secondly, maintenance and development of the human capital supply (Milkovich & Boudreau, as cited in De Goede, 2004). Where the first options is considered with the practices of recruitment, selection, downsizing, succession, promotion and placements, and the latter with training, motivation, compensation and labour relation (Marias, Steel & Theron, 2002). If the specific human resource processes as mentioned is properly and effectively managed, it is possible for organised business to yield a competitive positive return.

Given the specific human resource practices relating to the flow of human capital, adequate selection is the most important practice to contribute effectively to the challenge at hand regarding selective developmental opportunities. Considering the current situation in the South African labour market; the oversupply of labour in relation to the demand. Despite the oversupply of labour, South Africa is currently facing a skills shortage which is threatening the country's foothold in the global market place (Ramphele, 2012). What is worsening this reality is the fact that skilled individuals are sourced from outside the Republic, and this is not only dimming the optimism for those actively seeking work, but it has also recently sparked violence (Ramphele, 2012). The fact that there is an undersupply of skilled individuals in South Africa is a direct reflection of the challenges in the education sector. Not many school leavers are eligible for further studies in the directions where skills shortages are occurring. It should also be stated that less than half of those individuals that are enrolled for grade one eventually matriculate (Sebusi, 2007).

Given the country's current statistics, a situation is presented where engagement with the selection practices is needed. The main objective of selection practices is to identify individuals in the group with the highest possibility of success on the job. There is however a challenge associated with this activity, in that when organisations[2] consider the selection of new employees, they are faced with the challenge of being unable to obtain direct information on measurement [Y] of the final criterion [η] at the time of the selection (Theron, 2011). However, there is a solution to this dilemma, in the form of obtaining substitute information [X] on the desired criterion (Theron, 2011). The success of this approach is dependent upon its scientific accuracy. This enables the selection decision-maker to accurately predict performance on the criterion (predictor-criterion relationship[3]) critical for success on the actual job (Austin & Villanova, 1992; Theron, 2011).

The challenge of obtaining substitute information can be overcome by two approaches namely, the [a] construct orientated approach and [b] the content orientated approach or route. Although the two approaches differ in their underlying logic regarding the substitute criterion that is generated, both arguments maintain that effective, though not necessarily efficient, selection is contingent on the identification of a substitute for the criterion which shows a statistically significant relationship with an operational measure of the ultimate criterion (Theron, 2011).

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[2] Including Organised business, Human Resources and Government

[3] Formally X, and therefore by implementing E[Y|X], it could be considered a substitute for Y if and to the extent that $|\rho [X|Y]| > 0$ [p<0.05] and if measure of X can be obtained at the time of or prior to the selection decision.

It should be realised, irrespective of the favoured approach in obtaining the substitute measures for the final criterion, that it is vital for the selection procedure to be valid, fair, to show optimal utility [contributing economically] and to minimise adverse impact (Theron, 2011). However, this is not always possible and attainable in terms of application in a diverse population like South Africa. The challenge is due to differences in the criterion distribution across the previously advantaged and previously disadvantaged groups in South Africa as referred to earlier.

De Goede (2004) presents four scenarios explaining the complexity and challenges of these differences regarding selection. By presenting four selection scenarios De Goede argues how the selection approach can become invalid and unfair if selection occurs from a diverse applicant group which consists of those individuals from the previously disadvantaged majority $[\pi_1]$, and the previously advantaged minority $[\pi_2]$, as in the case of South Africa. In the first scenario De Goede presents a case were the distribution[4] of the predictor and criterion of both groups coincide (i.e. $\mu[Y|\pi_1] = \mu[Y|\pi_2]$ and $\sigma^2[Y|\pi_1] = \sigma^2[Y|\pi_2]$). What this scenario depicts, assuming positive validity, is that individuals from both groups with high or low predictor outcomes will tend to have high or low criterion outcomes. In the Cleary-interpretation, utilising top-down selection based on E[Y|X], the selection decision will not result in systematic non-zero errors of prediction and fair selection will be possible, if those with the highest scores are to be selected. Adverse impact from this procedure is unlikely, which would mean higher utility at a fixed selection ratio, validity coefficient and optimal selection cost.

In the second scenario, De Goede presents a case where differences in the predictor distribution between the two groups exist, however the criterion distribution coincides (i.e. $\mu[Y|\pi_1] = \mu[Y|\pi_2]$ and $\sigma^2[Y|\pi_1] = \sigma^2[Y|\pi_2]$). What can be inferred is that a possibility exist that alternative determinants of criterion performance are present which leads to the minority outperforming the previously disadvantaged majority. Thus, scale bias in the measurement of the underlying predictor construct may exist. It should however, be realised that having a single predictor cut-off score, set the same across both groups, is deemed inappropriate. It will unavoidably lead to selecting more of the minority group, although the probability of success on the job would be the same across both groups. Through utilising this process, unfair adverse impact would set in and utility would be limited. Thus, the solution would lie in a multiple regression approach, which makes provision for the differences in intercept, maintaining fairness. The outcome would be optimal utility $(r(E[Y|X; \pi_i],Y) > r(E[Y|X],Y)$ and adverse impact would be eliminated, ultimately leading to optimal selection ratio and cost.

In the third scenario, De Goede presents a case where there is no significant difference in the predictor distribution, however, members of the previously disadvantaged group have a propensity to perform worse on the job than those previously advantaged (i.e. $\mu[Y|\pi_1] < \mu[Y|\pi_2]$ although $\sigma^2[Y|\pi_1]= \sigma^2[Y|\pi_2]$). This scenario does lend itself to the belief that more determinants of criterion performance may exist on which the minority outperforms the majority. This presents a case of under [for the minority] and over [for the majority] prediction, resulting in an unfair selection decision and poor overall utility. Here however, no adverse impact would occur. By utilising, a multiple regression equation, and selecting the most promising from the top would result in fair selection, although adverse impact are now

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[4] The assumption is that the criterion construct (Ŋ) is multi-dimensional and that Y, thus is a weighted linear composite representing Ŋ. Although it is true that specific dimensions would be more susceptible to ethnic or gender differences and that the dimension weights thus play an important role in determining adverse impact and validity, this aspect is not considered here.

present. This outcome is due to the fact that a real difference on criterion performance does exist between the groups. Thus, although satisfying most of the selection objectives, minimising adverse impact remains a challenge.

With the final scenario presented by De Goede, validity is presented to be equal across both groups. However, in this scenario the majority group scores lower than the previously advantaged minority group, as they score lower on the predictor and job performance. In this case, if a strict top-down selection method based on $E[Y|X, \pi_i]$ would be utilized, adverse impact would still occur, although the selection decision is deemed to be fair. This scenario would present optimal utility, although adverse impact would not be totally eradicated. The important point that should be realised is that adverse impact (although not ultimately desirable) would be fair and defensible and inescapable, given that utility and fairness are given primary status.

Considering these four mentioned selection scenario's De Goede (2007) writes:

> In all four scenarios the assumption was that this selection procedure is equally valid for both groups and that the selection procedure that could be justified in terms of the relevance of the information provided by the predictor. Available empirical evidence generally supports the assumption that differential validity is not a pervasive phenomenon (Arvey & Faley, 1998; Schmidt & Hunter, 1981). If the selection decision is fair in scenarios one and two, in terms of the Cleary-interpretation of fairness, and if strict top-down selection is followed based on expected criterion performance, then the objective of minimising adverse impact and maximising utility can subsequently also be satisfied. If no differences in criterion performance would exist, no need for developmental interpretation of affirmation action would exist.
>
> However, in scenarios three and four, all four objectives can no longer be satisfied simultaneously. If selection decisions are fair, in terms of the Cleary-interpretation of fairness, and selection occurs strictly top-down, based on $E[Y|X; \pi_i]$, then the objective of fairness and utility can be satisfied, but the objective of minimising adverse impact cannot be satisfied. In these two cases the objective of minimising adverse impact could be satisfied through quotas or race norming, but only if the utility objective is sacrificed (Theron, 2001). The sacrifice required be top-down hiring within each group (race norming) would depend on the magnitude of the differences in the criterion distribution (p.17).

The question that should really be asked is why adverse impact and unfairness should be regarded as ultimately undesirable, and so much more so in the South African milieu, considering out past. As mentioned in the first few paragraphs, inequality remains pervasive in the South African society, and the battle is not won. Given the country's past, South Africans are currently faced with major challenges related to fairness, social justice and equity. If industry were to utilise invalid tests that have adverse impact [AI] on individuals, it may screen out qualified employees, discriminate unfairly and reduce equal representation as prescribed in South Africa's labour legislation. Through validation and fairness analysis such practices can be counteracted. The question is to what extent industry or industrial psychology should exclusively focus on psychometric tests in the pursuit of the solution, and to what extent industry is obligated to focus on change that directly addresses the past injustices.

Predictive bias is a challenge when psychometric tools are utilised to select human resources, while fair selection is based on the absence of predictive bias. Bias refers to systematic groups differences in item responses and test scores [e.g. previously advantaged and previously disadvantaged groups]. The presence of bias leads to differences in item responses, test scores, or other assessments for reasons unrelated to the trait being assessed, due to systematic group differences. The effect of this bias would be realised if a group of test takers, defined in terms of a common characteristic, is favoured by the nature of the stimuli or the way it is presented. What complicates the South Africa challenges even more are the levels of cultural diversity. If an item shows cultural bias, the acceptable response depends

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on skills or information common to a specific culture but not to another. This is believed to be a common problem in South Africa. If a culturally biased psychometric instrument like this were to be used, it could be regarded as an act of discrimination. Discrimination means that a deliberate distinction is made between applicants based on their expected criterion performance. Unfair discrimination means that people from different backgrounds, including different cultural backgrounds, with equal probabilities of success on a job, have unequal probabilities of being hired for the job. The focus should be on fair discrimination distinguishing those highly likely from those less likely to achieve a performance standard (Theron, 2011).

On the other hand, test bias should also be considered. Test bias is a psychometric term which refers to the distortion from unwarranted sources of variance in the scores of different groups (Theron, 2011). Test bias produces scores with systematically different meanings for people who are alike on the characteristics being measured. If the outcome is considered, the interpretation of test scores is biased for or against members of groups or people matched on the trait measured, when the different scores are due to one or more sources of variance related to group membership. In South Africa the groups referred to are the minority, previously advantaged, and the majority, previously disadvantaged, groups (Theron, 2011).

The variance referred to is supposed to be due to the same sources in all groups, without extraneous influences that influence scores in one group, but not in the other [e.g. stereotype threat]. This is known as adverse impact and occurs when members of one group have a reduced likelihood or chance of selection for a specific job. This happens when a substantial difference in the rate of selection between groups operate to the disadvantage of members belonging to a specific group (Guion, as cited in De Goede, 2007). What is important to take note of is the fact that adverse impact in itself is not discrimination. The burden therefore remains on the employer to prove that the inference derived from the predictor scores are fair.

How organised business, human resources and government should respond to the problem of adverse impact in selection would depend on why the systemic differences in the criterion distribution exist. Remedial intervention with respect to this dilemma will only succeed if the root cause of the problem is appropriately solved. Considering the observed differences in the performance-related criterion distributions between the minority and majority groups today, it indicates legitimate differences on several critical dispositions and attainments required to succeed in the world of work, which have resulted from the systematic denial of access to developmental opportunities. Thus, the question that should be asked, is how to set this previous injustice right? The answers are to be found in a multi-pronged approach; however a good catalyst in counteracting the past injustices would be to present selective developmental opportunities to those who have been previously denied the privilege. The vast scale of those who are in need of development is, however so large, and the resources available too limited to make a significant impact. To meet this challenge means that an alternative is to be presented that will be effective in managing this dilemma. The fair alternative is to present those with the highest potential a developmental opportunity[5]. The direct implication of this strategy is that only those

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[5] Although this strategy is at the heart of the current study, it would seem naïve to consider it the as the only alternative. Considerations outside of the scope of this particular study also arises, given the practicality and reach of offering developmental opportunities to high potential individual from designated groups, in South Africa. Further consideration that should also be concentrated on is the cost-effectiveness and sustainability of this type of developmental interventions. Lastly, concern arises given the vast amount of applicants and the limited number of vacancies which is available to accommodate these high potential cohorts for development. In the area of applied psychology these matters is important to consider as credibility is at stake if the practical implementation becomes impossible. However, getting closer to the ideal solution may involve challenging practicality, utility

individuals with the highest probability of success on the job will be presented with a s*elective developmental opportunity*. The process needs to consist of two separate, but related selection procedures focused at two qualitatively different criteria, namely maximizing learning performance and secondly, maximizing the selected group's performance on the job performance criteria.

The challenge is to find a method to identify individuals who will gain maximum benefit from selective developmental opportunities in South Africa. Cognisance should additionally be taken of the fact that neither learning performance nor job performance are random events - competence on the criteria consists of an intricate nomological network of latent variables that determine individual success on the criteria (Theron, 2011). In order for individuals to achieve a certain level of job performance or learning performance, they need to satisfy the preconditions as set out by the nomological network.

Taylor (1997) proposed such a learning potential model, which clarifies the latent variables that jointly constitute learning potential. The model represents a competency model, in that it clarifies the behaviour that constitutes learning performance, as well as the competency potentials that determine such performance. Taylor argued that learning comprises of two main competencies namely, transfer of knowledge and automatisation. The model, however, is very narrowly defined and structured, in that, if non-cognitive determinants are to influence learning performance, they are surely expected to do so through other learning competencies (De Goede, 2004). It should be realised that the only way to "crack the code" with respect to learning performance is to identify and understand the push and pull forces that constitute the nomological network that defines this construct.

De Goede (2007) suggested that the original model proposed by Taylor should be elaborated. De Goede (2007) argued that a definite distinction should be made regarding the endogenous latent variable learning performance proposed by Taylor (1997). De Goede suggested that it is more meaningful if the variable of learning performance is separated into two variables, job competency potential latent variable and job competency latent variable. Additionally, De Goede proposed an elaboration of the model in the form of presenting a linkage with Automatisation exerting a causal influence on Transfer of Knowledge. De Goede was of the conviction that Abstract Thinking Capacity and Information Processing Capacity remain the main learning competency potential variables. The current author is convinced, however, that these two variables are not the exclusive predictors of learning performance success and that more cognitive and non-cognitive variables should be explored.

Burger (2012) writes that it is highly unlikely that a single explanatory research study will result in an accurate understanding of the comprehensive nomological network of latent variables that determine the phenomenon of interest. The likelihood of meaningful progress towards a more expansive and more penetrating understanding of the psychological process underlying the phenomenon of interest will be increased if explicit attempts are made to formally model the structural relations governing the phenomenon of interest and if successive research studies attempt to expand and elaborate the latest version of the explanatory structural model. The call for greater continuity in and integration of successive research studies is not new. Rather than abandoning the De Goede (2007) model and starting afresh with the development of a new model, the foregoing argument suggests that a more prudent option would be to

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and feasibility. The real consideration remains, should any cost or effort be saved if we can change the lives of those effected by the vast amount of injustice suffered, if a solution existed that had the potential to create an equal and inclusive country.

modify and elaborate the existing model. However, a sense of urgency is to be acknowledged from the current research presented.

Ramphele (2012) writes:

> …one cannot but agree with the statement in the National Planning Commission (NPC) Diagnostic Review published mid-2011 that: One of apartheid's greatest crimes was the provision of substandard education to black people…the NPC goes in to admit that efforts by the post-apartheid governments to raise the quality of education for poor children have largely failed…the critical question is what the cause is of this failure? Should we not be asking ourselves as citizens of a democratic South Africa why successive post-apartheid governments are continuing to commit such crimes against the majority of children today? Why are we so tolerant of the fact that 80 per cent of schools serving largely black children are dysfunctional? Why are we passive witnesses of the destruction of opportunities of successive generations of children by an education and training system based on low expectations of what our children can achieve?...(p.134).

The fact that a very small percentage of those who do matriculate enrol for further studies is also a reality. What is of greater concern is the fact that the labour markets are not equally accepting and welcoming to those with professional qualifications as the matter of equality is yet to be resolved in South Africa. The result is that many of those who professionally qualify do consider the outcome of emigration. What makes this worse is that there are more than 800,000 vacancies for skilled professionals, slowing down South Africa's ability to grow at a sustainable pace. The ratios of those skilled professionals leaving, compared to those individuals qualifying (not forgetting Employment Equity) and entering the labour market, and the qualified professionals being imported, constitute the grim reality of the South African brain drain. It is estimated by the Economic Commission for Africa (ECA) that between the year 1960 and 1989, some 127,000 highly qualified African professionals left the continent, which is worsened by the figures released by the International Organisation for Migration (IOM) indicating that 20,000 professionals have left Africa each year since 1990. To fill this human resource deficit, Africa employs almost 150,000 expatriate professionals at a figure reaching US$4 billion per annum. This outcome poses a threat to South Africa's development, and raises the concern for adequate human resource development. However, adequate human resource development means that the human resources are expected to contribute to a better tomorrow. Although the rise of the South African middle and upper classes should be valued, especially the entry of young black professionals and business individuals (also referred to as the Black-Diamonds), it is crucial to realise as a society that "having" should never be regarded as superior to "being" (Ramphele, 2012).

In addition to the reality of the skills shortages and intellectual capital leaving South Africa, the country is also facing the general high unemployment rates. Among the youth 51,3 per cent of the 15-24 year olds and 29 per cent of the 25-34-year olds were unemployed in South Africa during the year of 2010 (Ramphele, 2012). This outcome reflects the fact that more than three million young people between 15 and 35 years of age are not in education, not employed and not in training of some kind (Ramphele, 2012). These high unemployment figures is directly responsible for the growing inequality undermining the social justice[6] of South Africa, enlarging the gap between those who have and the have-nots'. The South African Institute for Race Relations (SAIRR) claimed that for the year 2009/2010 the annual per capita income for all racial groups between 1996 to 2009 rose; for Africans the situation changed positively with 270 per cent, while for whites it changed with 229 per cent. However, the growing inequality between the two groups will not subside before a fundamental transformation of socio-economic relations take place.

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[6] According to Ndlangisa (2011), 13 million South Africans received social assistance grants.

A more macro concern that should be realised is the matter of global competitiveness. The Global Competitiveness Report graded South Africa as 45th among 133 countries in the year 2009/2010. Embarrassingly South Africa's Health and Primary Education Sectors were ranked 125th out of 133, while the Higher Education and Training were ranked 65th out of 133 (Timaeus, Simelane & Letsoale 2012; Ramphele, 2012). These figures paint a gloomy picture of South Africa in the global market place and the question that should be asked is whether South Africa can operate sustainably without being able to keep-up with world developments and standards?

Although many challenges facing South Africa have been discussed in this overview, the current study is geared towards challenging the country's desperate status with respect to skills development through the vehicle of the knowledge base of Industrial Psychology. Today the selection of human resources for developmental opportunities places a heavy burden on organisations and practitioners, as the numbers of the possible candidates that have to be assessed are simply staggering. The challenge that this poses is not so much the number of people that should be identified for these opportunities, but the selection of those with the highest potential to succeed given such an opportunity. These selective opportunities are critical to empower those that have been denied skills development previously. However, this is not a random event, the selection practitioners should go about it by meticulously weighing up current skills against the requirements of the specific position applied for. So many individuals selected for certain positions require additional training, through developmental programmes. The organisations facing the challenge of a skills deficit usually respond with a skills development intervention, and count on a return on investment. In order to attain maximum utility from the pool of candidates producing an efficient yield on investment, the strategy that is utilised should empower those candidates, that are believed to be the best suited, to successfully master the training material presented and to exhibit the ability to competently do the task required after being appointed. But the challenge that organisations face is, how do those charged with the selection task attain this effective outcome. The challenge presupposes that selection practitioners are able to identify the most competent individuals from the pool of applicants for the skills development programme.

In order to be able to make predictions with respect to trainee success requires that selection practitioners understand what constitutes learning performance success. The selection practitioner should be able to understand the complexity of the factors constituting learning performance success, as well as the factors that threaten learning performance success. The current study focuses on some of the antecedents of learning performance success, in accordance with the to-be-developed learning potential structural model.

The current study is based on previous learning potential research by De Goede (2007), which was based on the work of Taylor (as cited in De Goede, 2007). Learning potential is the extent to which individual's exhibit the attributes required to successfully execute a certain learning task. These attributes include a combination of cognitive and non-cognitive learning competencies. De Goede (2007) argues in favour of those individuals who had no previous developmental opportunities. This is an all too common South African reality. De Goede (2007) attempted to expose those trainees who would reap the benefit of affirmative development to opportunities. De Goede's (2007) attempt was based on the structure of the nomological network of the APIL-B test battery as developed by Taylor. However, it is naïve to exclusively consider cognitive variables, as many non-cognitive variables constitute learning success, which are all part of a rich and multi-facetted interwoven network.

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Burger (2012) and Prinsloo (2013) also made valuable contributions to the findings of De Goede (2007). Burger (2012) expanded De Goede's (2007) work by presenting additional variables to consider including, time cognitive engaged, academic self-efficacy, conscientiousness, learning motivation and academic self-efficacy. From the work presented by Prinsloo (2013) which was an elaboration of Burger's contribution; the results confirmed that conscientiousness, academic self-efficacy, learning motivation, academic self-leadership, hope, optimism, resilience and time cognitively engaged, influence the success of affirmative development opportunity.

The learning potential structural model that was developed in this study is based upon De Goede's vision that learning performance is a multifaceted construct. The current learning potential structural model represents an attempt to expand the original model presented by De Goede (2007) with additional learning competencies. As mentioned earlier, a single study is not enough to uncover the endless array of variables that constitute learning performance. The current expanded model should be considered as a nudge in the direction of the truth with respect to the cognitive and non-cognitive variables fostering learning performance success. The researcher's aim with the current study is to operationally test an elaborated version of the De Goede (2007) learning potential structural model which includes variables outside the realm of cognitive ability.

1.2   RESEARCH OBJECTIVE

Given the introductory argument, the specific objective of this research thesis is to achieve the following:

- The modification and extension of the model presented by De Goede (2007), by adding additional learning competencies and learning competency potential variables.
- Testing the newly expanded model
- Reporting on the findings of the current learning potential structural model

If the current study is successful, given the number of argued hypotheses, it should contribute to a better understanding regarding the push and pull forces that constitute the nomological network of variables that influence the attainment of successful learning performance, required by the previously disadvantaged individuals, in order to create a degree of equality in the current labour market of South Africa.

CHAPTER 2

LITRATURE STUDY

2.1 INTRODUCTION

The objective of this study is to elaborate and modify De Goede's (2007) learning potential structural model, as well as test the elaborated model. In the current study De Goede's (2007) findings will be analysed and evaluated. This study is committed to expanding the model proposed by De Goede (2007) by adding additional variables which can be regarded as valuable considering the attempt to understand, define and ultimately explain the forces which constitutes Job Competency (Learning Performance). In this section of the research study, all additional proposed constructs will be discussed, in order to propose a rational structure to the central argument. However, first a brief overview will be presented of the importance of expanding De Goede's work.

De Goede (2007) initially based his investigation of the internal structures of the APIL-B on the original research of Taylor. Although De Goede made a valuable contribution by expanding Taylor's research, this project is set to redefine the thoughts of De Goede on elements constituting learning performance while ultimately attempting to get closer to the truth on qualities needed by affirmative trainees to show successful learning performance. In order to get as close to the ideal nomological network of constructs that constitutes the learning performance of previously disadvantaged individuals, the author will first briefly discuss the importance of distinguishing those individuals with the highest potential of success in a learning environment, before considering Taylor's contribution.

At the moment, the South African business sector is under major pressure to conform to equitable employment practices, in order to make it more representative of the country's demographic profile. The call echoed by government to change the demographics in the labour sector is not that simple. Transformation starts with the human practice of selection. However, in a country like South Africa were the playing field of those competing for a limited number of available vacancies is not equal, a challenge is presented by strict-top-down[7] selection practices. Given the unequal playing field, strict-top-down selection practices have created a situation where adverse impact takes place. Creating a situation where government's call for equal representation is not fostered. The question then should be asked is, why does strict-top-down selection practices create an unequal and under-representative labour market? The answer is to be found in South Africa's history, as equal uniform developmental opportunities were not offered to all citizens. Thus, attributing the systematic differences in the criterion distribution to South Africa's dark past does not seem unrealistic. It is therefore naïve to expect that each citizen should exhibit the same required standard of knowledge and abilities in a selection process. Given this background, a different approach to selection is needed to adhere to government's call for a more equal representation in the labour market today.

Considering the argument, that those individuals competing for jobs in the labour are not competing from an equal level of education, knowledge and skill, it seems unreasonable to expect a more equal representative labour force in the country. However, if the variance in criterion performance between the previously advantaged and previously disadvantaged can be linked to differences in the level of competency potential latent variables required to succeed on a specific job, then it only seems fair to investigate the specific competency potential latent variables required and present those underperforming with a developmental opportunity.

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[7] In the Cleary sense.

The aim of this study is to investigate those competency potential latent variables required for success on the job. However, although the specific competency potential latent variables may not currently be on par for a specific job, the need for presenting developmental opportunities is based upon an understanding of the demand created by the injustices of the past. This demand poses a challenge given the amount of resources available to present training opportunities. Thus, a selection process for these developmental opportunities is needed. This process is challenging, as those individuals with the highest learning performance, given the specific learning outcomes, is to be identified. This presents a case for identifying those learning competencies that foster successful learning, whereby a construct approach to selection can be implemented.

Considering the argument presented, the author is convinced that there are more to learning than cognitive ability as a measure of learning success. Therefore, although respecting Taylor's (1994) contribution, the author is of the stance that non-cognitive determinants are also to be investigated as drivers of learning performance, in addition to Transfer of Knowledge and Automatisation. From the argument presented, the author will consider the contributions made by De Goede (2007), while enriching the philosophy on the determinants of learning performance by presenting additional learning performance competency variables.

2.2 THE DE GOEDE (2007) LEARNING POTENTIAL STRUCTURAL MODEL

In the following section the findings by De Goede (2007) would be discussed as the foundation of the current elaborated learning potential structural model. The work proposed by the De Goede (2007) as an elaboration of Taylor's original learning potential model, is graphically portrayed below in Figure 2.1.

2.2.1   Learning Competencies

According to Taylor (1992, 1994) successful learning performance and ultimately learning performance during evaluation is exclusively determined by two dimensions namely, *transfer of knowledge* and *automatisation* (De Goede, 2007).

2.2.1.1 Transfer of knowledge

De Goede (2007) presented transfer of knowledge as a critical factor influencing learning competency. De Goede (2007) explains that, in order to create meaningful structures of learning material presented, it is critical that existing knowledge and skills is applied to make sense of novel stimuli. Transfer is presented in the research by Taylor (1992) as the core learning competency for success in learning performance. According to Cattell (1971), transfer in learning context is described as the process through which crystallised abilities develop from the interaction between fluid intelligence and novel stimuli. This view is acknowledged by Burger (2012) stating that transfer is the adaption of knowledge and skills to address challenges which are different to those already encountered through past experiences. Thus, when an individual is presented with unfamiliar stimuli, he/she can access already established knowledge and apply it to the novel situation, in an attempt to construct meaning out of new learning material. The critical element of transfer of existing knowledge is that it is usually transferred to a situation which is slightly unlike those a learner has faced before, so that the exercise is not a simple repetition. Burger (2012, p25) writes: "…transfer is constitutively defined as the adaption of knowledge and skills to address problems somewhat different from those already

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encountered…".Transfer is included in the current learning potential structural model as it is viewed as a critical learning competency.

2.2.1.2 Automatisation

If efficiency is to be considered on the job, individuals have the ability to increase their effectiveness through automization of skills needed on the job. According to Sternberg (1984) if an employee is to exert minimum effort, automatisation of a substantial portion of the tasks is required. This is even more important when the complex elements of a specific job with multiple tasks are considered.

Sternberg (1984) proposed that information processing happens through automatisation and automatic information processing. The first suggests that when controlled information processing takes place it happens through a hierarchical and conscious direction of an individual's thoughts. A further distinction should be made among executive and non-executive processes, in that during controlled processing, executive processes direct non-executive process. Tasks such as planning, monitoring and revising strategies of information processing are all elements of executive processes. On the other hand non-executive processes consist of selecting, monitoring and revising of information processing. The second way of processing, automatic information processing, happens pre-consciously and is not hierarchical nor under the direction of the individual self. Here all processes function at a single level of analysis without any distinctions.

When the information processing of individuals is considered, the research suggests that information from existing domains, which are entrenched by the individual's nature, and which is relied upon constantly/ automatically, can be regarded as local processing (Sternberg, 1984). Sternberg (1984, p.278) writes:

> "A central executive initially activates a system consisting of locally applicable processes and a locally applicable knowledge base. Multiple local systems can operate in parallel. Performance in these systems is automatic and of almost unlimited capacity; attention is not focused upon task at hand. Only knowledge that has been transferred to the local knowledge base is available for access by the processes utilized in a given task and situation. A critical point is that activation is by executive processes in the global system to the local system as a whole. The executive processes can instantiate themselves as part this local system; when used in this instantiation, they do not differ functionally form processes of any other kind."

 This means that performance is automatic and of unlimited capacity, while attention is not solely focussed at the task at hand. However, in order to utilise information for a specific given task or situation, knowledge has to be transferred to the local knowledge base. Thus, activation takes place through processes in the global system to the local level as a complete whole (Sternberg, 1984).

What the latter suggests is if control is passed to an existing local system and an executive process has recognised the specific situation, the local system will act upon the given challenge as a production structure with pre-established productions. The structure of the production system's function includes executive and non-executive processes, integrated into one hierarchical structure (Sternberg, 1984).

If an individual is faced with a novel experience of stimuli and none of the production systems is able to explain the stimuli, global processing is used to re-evaluate the condition present and decide how to manage the situation. However, in the case were stimuli are successfully managed by the system it is moved from the global to the local processing system. This enables an individual to access understanding of a certain experience easier, as it is not necessary to move beyond local processing. Thus, the scope of expertise developed is dependent on the individual's ability to organise novel information into local processing systems and a manner to access these systems with ease. Thus, successful

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transfer of knowledge can be realised in terms of a collective of an individual's fluid intelligence and abstract reasoning capacity, as applied during local processing capacity of novel stimuli. An individual's fluid intelligence enables him/her to transfer existing relevant, but not directly applicable skills, knowledge and abilities into the solution of the novel problem experienced. Once this process has been mastered, a pool is build-up of existing knowledge and skills to which can be referred when needed, as well as added to, as mastering of novel experiences accumulate (Sternberg, 1984). This loop, whereby information and processing is gathered into the local system, makes accessing information to handle a novel situation automated for an individual faced with new challenges (De Goede, 2007).

According to Sternberg (1984), in order for an individual to successfully process multiple parts of information at once, information processing through local resources is necessary, which develops from the global processing system. It is only when the local resources are operating, that parallel processes are possible. Thus, problem-solving occurs exclusively through successful application of local resources and system processes. Thus, in order to achieve maximum learning competency, the dynamic process of automatisation is vital for success on the job. Automatisation is a critical element of learning competency, measured against the backdrop of utility, as well as fairness regarding selective developmental opportunities in South Africa. Thus, creating a situation where those individuals that are granted developmental opportunities, have the ability apply the knowledge they receive successfully in the workplace.

From the above research it is evident that when an individual is faced with stimuli that are routine and unchanged, automatisation of the specific skill has the potential to lead to more efficiency in practice. This will mean that the task can be completed more effectively through skills mastered previously regarding the routine activity. However, this is only possible if an appropriate algorithm is laid out and captured for later retrieval, to be utilised in a similar situation. If this process doesn't take place, an individual will be faced with novelty every time he faces the specific task to be repeated. Thus, the value of automatisation of specific skills ensures that less mental effort is utilised to complete a particular task.

2.2.2   Learning Competency Potential

In addition to the two learning competencies proposed by Taylor (1992, 1994), it is additionally argued that the capacity to create abstract concepts and to process information efficiently is determined by the leaner's level of intelligence. According to Taylor (1992, 1994) a distinction should be made between the two dimensions of intelligence, namely *abstract thinking capacity* and *information processing capacity*. According to De Goede (2007), the two learning competencies *transfer of knowledge* and *automatisation* is dependent on the two learning competency potentials for successful learning to occur.

2.2.2.1 Abstract Thinking Capacity

Although many views and paradigms regarding intelligence have been presented over decades including contributions by Galton and Binet, the dispute over it being a unitary general cognitive ability or multiple independent abilities has been concluded in the form of it being more of a statistical artefact of past reasoning (Eysenck, 1986). From the work proposed by Eysenck (1986), intelligence should rather be viewed in terms of a general factor of intelligence. This view is supported in the early work of Spearman (1904, 1927) which is of the stance that human intelligence lies in a unitary, general intelligence factor, which accordingly can be seen as the *g*-factor *(g)*. However, Eysenck (1986) suggests that independent from this specific *g*-factor, group factors/ primary abilities exist that explain the total variance in cognitive

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evaluation. Although Eysenck (1986) admits to the presence of the other elements of intelligence, he maintains that g is the most prominent element.

Cattell (1971), although supporting of the g-factor concept, disagrees with the unitary factor theory and states that it consists of two distinct elements, termed fluid- (Gf) and crystallised (Gc) intelligence. De Goede (2007) states that Cattell's Gf can be seen as similar to g theory, while Gc is the same as the group factors/ primary abilities presented by Eysenck (1986). Considering the model of fluid and crystallised intelligence and the views of Eysenck and Spearman, it presents valuable insights into the human intelligence construct and the reason for the differences in ability among individuals.

If the two proposed elements of Cattell (1971) are considered, Gf can be seen as innate intelligence which is applied to all novel problem-solving, and is concerned with how an individual perceives difficult challenges, forms concepts and engages in abstract reasoning. According to Cattell (1971), concept formation and abstract reasoning is the most prominent building blocks in solving novel problems. In order to form and acquire new abilities and knowledge Gf is required. An important point mentioned by De Goede (2007) is that Gf is formless, and independent from experience and education. Jensen (1998) states that the fact that Gf is independent of prior knowledge, means that prior acquisition of cognitive abilities, general skills and knowledge has no advantage during mental evaluations (i.e. Ravens).

Although Gf doesn't require prior knowledge, Gc is the product which arises from acquired abilities and knowledge experience during activities such as schooling, cultural practices and environmental mastery, and can be dubbed consolidated knowledge (Jensen, 1998). Outcomes of Gc, like verbal and numerical mastery are direct products of the scholastic and cultural foundation on which it resides (Jensen, 1998).

If transfer of knowledge is considered, it can be argued that G$f,$ as well as G$c,$ are vital for finding solutions to novel challenges, with specific focus on Gf in action. According to De Goede (2007), Gc is elaborated via transfer by Gf through already established Gc. If affirmative development opportunities are considered, such as on the job training, a practical challenge arises, as Gf utilises existing Gc in solving novel challenges through transfer. Thus, it is vital to take current or existing Gc in consideration in the prediction model as the chance of success in coping with novel, cognitive demanding learning material relies on the exchange of stimuli between crystallised knowledge and the capacity to transfer (De Goede, 2004).

From this understanding, considering the challenges facing South Africa, it is unrealistic to view those individuals that qualify for affirmative development as ready to cope with novel, cognitive demanding learning material. Having a high level of Gf will prove to be fruitless, if the necessary level of crystallized knowledge and abilities are not aligned with the developmental intervention presented. De Goede (2007) goes on to write that G$f,$ unlike G$c,$ would correspond to a dispositional learning competency potential.

According to Taylor (1994), "the potentiality to think abstractly and form concepts develops as fluid intelligence. It consists of a set of general cognitive tools and strategies for application to novel problems". Additionally Taylor (1994) is of the stance that fluid intelligence is thus abstract thinking capacity, and it can be evaluated through challenging testees with novel stimuli, while structuring questions in a manner that the testees should discover the underlying concept present.

From the above views and research presented it is evident that abstract reasoning capacity has a critical role, not only in dealing with novel problems, but also in learning. De Goede (2007, p44) writes:

> "Therefore an individual's level of fluid intelligence or abstract reasoning capacity would (as dispositional learning competency potential) either contribute or inhibit the individual's capacity to make sense of the learning task, allowing the learning and acquisition of new knowledge, skills and abilities (via transfer), especially when the learning task becomes more complex in nature"

2.2.2.2 Information Processing Capacity

According to Jensen (1998) information processes can be viewed as hypothetical constructs that are building blocks utilised by cognitive theorists to explain how humans apprehend, discriminate, select, and attend to elements of the multiple stimuli they face, including internal representations which can be transformed, manipulated and stored; while having the ability to retrieve such information at a later stage to make decisions and exhibit behaviour under certain conditions. Jensen (1998) continues to explain that the information referred to is any given stimulus which has the ability to reduce uncertainty under certain conditions. Information processing is a process that relies on the structural and physiological properties of the human brain, which is activated when individuals face novel challenges and actively exert effort to reduce the novelty (Jensen, 1998).

It is important not to view information processing as a single element constituting cognitive ability (Taylor, 1994). Taylor (1994) continues to say that it is not fruitful to consider a simple chronometric[8] measure, measuring behaviour in a simple task, as the ultimate and adequate measure of human intelligence. Hunt (1980) supports this view, and suggests that no single measure of information processing has the ability to fully explain the true nature of intelligence. The current researcher supports these views, in the sense that cognitive ability is more complex in nature and the constructs that determine cognitive ability should be investigated.

De Goede (2007) writes that when the learning context is considered and novel stimuli are presented, it causes uncertainty for the learner, and naturally the learner will attempt to reduce this uncertainty. As per Sternberg (1984), the learner does this through utilising executive processes to work through bits of information, while focussing on selecting a strategy; followed by utilising non-executive processes to carry out the selected strategy. This process, according to De Goede (2007), can be seen as information processing by the individual. According to Underwood (1978), processing information is not predetermined, individuals/processors have the ability to accept certain processes and reject other. Hunt (1980) additionally goes on to write that when account is taken of the individual's specific problem-solving strategy, alignment among information-processing and psychometric outcomes is more equivalent.

According to Underwood (1978), the specific strategy that an individual chooses to overcome certain challenges or solve a given problem has the ability to either contribute to or impinge on the individual's capacity to solve the problem effectively. Underwood (1978) writes:

> our limitations in solving problems ……, will be a composite of the speed of comprehension and assimilation of the information comprising the problem, of the storage limits of working memory, of the forgetting characteristics of the memory system used, of the efficiency of the access code for retrieving information stored in permanent memory, and which may be relevant to the problem, and of the speed and efficiency of any other system used in the total activity (p.2)

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[8] Measure of time

This presents clear evidence that the manner in which information is retrieved does have a major impact on the overall success of processing information.

According to Taylor (1997), three broad information processing capacity parameters exist which include (a) the speed or agility of processing difficult information, (b) the accuracy of processing information of a moderate difficulty level and (c) cognitive flexibility in the problem-solving approach and the appropriateness thereof. If the first parameter is considered, individuals who are slow in processing information may fall behind in the learning environment, due to limited time given to investigate properly and present a solution. If processing accuracy is considered, Taylor (1997) argues that lapses of concentration may occur when inaccurate processing takes place, accompanied by a lack of proper quality control of processing information. Finally, cognitive flexibility, which represents the approach used to deal with problems, can be regarded as a toolkit of strategies, the more appropriate an approach is, the more intelligent the behaviour is regarded. Those who continue selecting a poor approach (from their toolkit) has a more limited capacity to process information (De Goede, 2004).

According to Taylor (1994) it should be realised that an individual's capacity to process information is largely determined by genetics. The implication is that although processing of information is not regulated by culture and opportunities, a genetic limit may set a threshold on personal performance. De Goede (2007) writes that this may well be a good explanation for why failure has occurred in attempts to relate information processing to intelligence scores in normal subjects, while on the other hand success has been shown regarding information processing capacity (Hunt, 1980).

From the views and research presented, it is obvious that those individuals who have a more flexible, accurate and quick grasp of the novel stimuli in the learning context have the ability to work more effective and efficient in processing the stimuli. According to De Goede (2007) this enables individuals with these traits to acquire more, learn faster and ultimately perform more optimally. For this reason, it is evident why Taylor (1994) includes information processing capacity into his theory.

2.2.3 Learning Performance

Like job performance, learning performance can be conceptualised on a behavioural level or on a learning outcome level. Learning performance is defined in terms of the extent to which an individual will experience success within the context of the learning environment (i.e. assessment outcomes). From the work presented by De Goede (2007), learning performance can be regarded as the extent to which an individual has acquired specific skills, knowledge and abilities. De Goede's stance is extended to include the manifestation and successful performance of the specific skills, abilities and knowledge in action on the specific job (De Goede, 2007; Taylor, 1989.

In Figure 2.1 De Goede's (2007) Learning Potential Structural Model is presented, as an elaboration of Taylor's work. Although De Goede's contribution is highly valued, given the added variables as discussed, not all the paths were supported. De Goede proposed that Job Competency Potential will have a positive influence on ultimate Job Competency on the actual job. This idealised outcome has not been measured in practice, and extends beyond the scope of what De Goede's investigation entailed. In the following section an overview is presented on De Goede's research results.
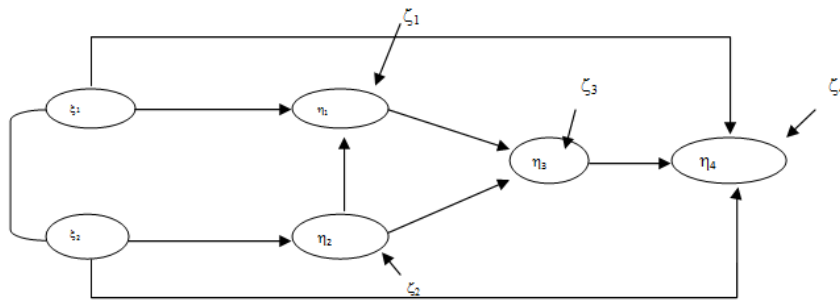
Figure 2.1 Graphical portrayal of the extended De Goede (2007) learning potential structural model

Learning Competency Variables:

ξ_1= Abstract Thinking Capacity

ξ_2= Information Processing Capacity

Learning Competencies:

η_1= Transfer of Knowledge

η_2=Automisation

η_3=Job Competency Potential

η_4=Job Competency

The original De Goede [2004] structural model can be expressed as a set of structural equations representing the research problem that will be investigated:

$\eta_1 = \gamma_{11}\xi_1 + \beta_{12}\eta_2 + \zeta_1$

$\eta_2 = \gamma_{22}\xi_2 + \zeta_2$

$\eta_3 = \beta_{31}\eta_1 + \beta_{32}\eta_2 + \zeta_3$

$\eta_4 = \beta_{43}\eta_3 + \gamma_{41}\xi_1 + \gamma_{42}\xi_2 + \zeta_4$

The original structural model can again be portrayed mathematically in terms of a series of matrices:

- A 4x2 Γ (gamma)- matrix of path/ regression coefficients γ describing the strength of the regression of η_i on ξ_i in the structural model;
- A 4x4 systematic B (beta)- matrix of regression/ path coefficients (β) describing the strength of the regression of η_i on η_i in the structural model;
- A 2x2 systematic matrix ϕ (phi)- matrix of variance and covariance terms describing the variance in (ϕ_{ii}) and the covariance between (ϕ_{ij}) the exogenous latent variables ξ_I and ξ_j;

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- A 2x1ξ (ksi) column vector of exogenous latent variables;
- A 4x1η (eta) column vector of endogenous latent variables;
- A 4x1ζ (zeta) column vector of residual error terms.

More specifically, the hypothesis causal relationship can be expressed in matrix form as follows:

$$\begin{pmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{pmatrix} = \begin{pmatrix} 0 & B_{12} & 0 & 0 \\ 0 & 0 & 0 & 0 \\ B_{31} & B_{32} & 0 & 0 \\ 0 & 0 & B_{43} & 0 \end{pmatrix} \begin{pmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \end{pmatrix} + \begin{pmatrix} \gamma_{11} & 0 \\ 0 & \gamma_{22} \\ 0 & 0 \\ \gamma_{41} & \gamma_{42} \end{pmatrix} \begin{pmatrix} \xi_1 \\ \xi_2 \end{pmatrix} + \begin{pmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{pmatrix}$$

- $\eta = \beta\eta + \Gamma\xi + \zeta$

In the following section, a discussion of all the constructs contained in the model will be presented, as well as the development of theoretical arguments justifying the proposed path influences.

2.3   EMPERICAL EVALUATION OF THE De GOEDE (2007) LEARNING POTENTIAL STRUCTURAL MODEL

De Goede (2007) obtained reasonable fit for his proposed structural model (Figure 2.2) as indicated by the goodness-of-fit-statistics. The outcome indicates that the close fit null hypothesis was not rejected ($p > 0.05$). The Statistical Analysis of the De Goede's (2007) contribution indicates a significant ($p<0.05$) relationship among *Information Processing Capacity* and *Automatisation*, *Information Processing Capacity* and *Learning Performance*, as well as between *Automatisation* and *Transfer of Knowledge*. Additionally the outcome of the study supported the indirect effect of *Information Processing Capacity* on *Learning Performance,* which is mediated by the construct of *Automatisation*.
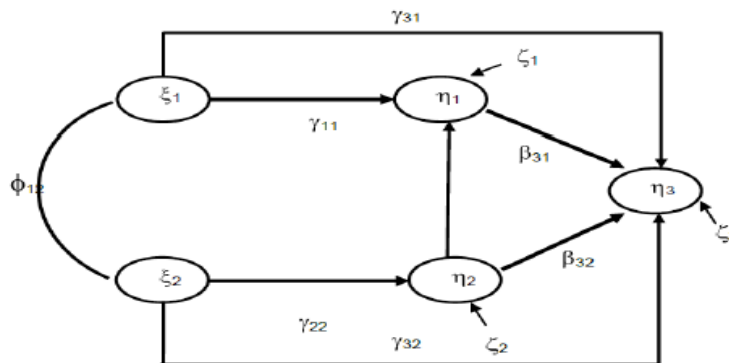
Where: ξ_1 = Abstract Thinking Capacity η_1 = Transfer of Knowledge

ξ_2 = Information Processing Capacity η_2 = Automatisation

η_3 = Learning Performance [*Job Competency Potential Targeted by Affirmative Training Interventions*]

Figure 2.2 Graphical Portrayal of the De Goede (2007) Learning Potential Structural Model

2.3.1 Considering the De Goede (2007) Model

Today the actual competence on the job, among employees in the workplace remains a challenge in South Africa. This challenge creates a situation where companies are being forced to their knees due to the lack of optimal performance by those in critical positions, due to skills shortages. This is a rising reality not only in the private sector but also in the state owned and public sectors. The challenge that companies face is one of adequate selection and successful training of their human resources. Selection is a method by which the best or those with the highest potential for success in the specific task are favoured for a position. The goal and objective is to ensure optimal performance by employees on the job, as well as during training, with the ultimate outcome of accepting or rejecting a candidate (Burger, 2012).

If the desired outcome is ultimately successful performance on the job or during training, the focus should be on the criterion construct, which in the current study is learning performance. The objective of the current study is to explore the constructs that constitute successful learning, with the optimistic goal to uncover those that are ultimately most critical for success during developmental and educational opportunities. The study presented by De Goede (2007) is only a limited reflection of the constructs that foster learning performance. This presents an opportunity to develop a more comprehensive learning performance structural model that has the ability to explain additional variance in learning performance. A successful model will facilitate the development of a selection battery to be utilised in selection and placement. This is, however, only possible if a comprehensive understanding exists of the competencies that constitute fruitful learning performance.

Since 1994, many previously disadvantaged individuals in South Africa have been granted occupational and developmental opportunities, under the banner of affirmative development. However, over time the strategy of affirmative development has been associated with limited success. This increases the urgency of identifying the learning competencies that foretell which individuals have a better chance of success, acquiring the intellectual job competencies required to deal with demanding novel challenges. The exercise of presenting opportunities to "qualifying" candidates is doomed to failure if the specific learning objectives cannot be achieved. Thus, it is vital that the specific learning objectives exceed the critical minimum job competencies, which is necessary to ultimately achieve the outcome of the task.

Theron (2011) writes:

> since learning potential refers only to the ability to benefit from learning/development opportunity, and since learning is not solely a function of ability, additional aspects probably need to be considered and assessed to identify those that would maximize the return on developmental investment (p.6).

This is critical and the current study is set out to explore more person-centred characteristics, with the exception of environmental unfavourableness as a variable, that influence learning performance. The challenge that arises is that, although some attainments are malleable; many constructs (i.e. an unfavourable environment) are not (Burger, 2012).

The current research is an extension of the learning potential model presented by De Goede (2007). The original causal paths as hypothesised by De Goede (2007) will remain the foundation of the current learning potential structural model. In order to acquire a more comprehensive understanding of learning, non-cognitive factors have been included.

Hypothesis 1: In the proposed learning potential structural model it is hypothesised that *Information Processing Capacity* positively influences *Automatisation*, that *Automatisation* mediates the impact of *Information Processing*

Capacity on *Transfer of Knowledge* and that *Abstract Reasoning Ability* positively influences *Transfer of Knowledge***.**

2.4   ADDITIONAL LEARNING COMPETENCIES PROPOSED FOR INCLUSION IN THE CURRENT LEARNING POTENTIAL STRUCTURAL MODEL

De Goede (2004) based his research on the research of Taylor. De Goede (2004) included the argument by Taylor that cognitive ability is strongly determined by two learning competencies namely, *Transfer and Automatisation.* De Goede's (2007) main stance, as hypothesised in his structural model, was that Information Processing capacity directly and positively influences Automatisation, and indirectly, through Automatisation, affects Transfer of Knowledge. De Goede (2007) further hypothesised that Abstract Thinking Capacity positively influences Transfer of Knowledge.

Although the author agrees with the structural model presented by De Goede (2007) it is vital to have a more comprehensive notion with respect to the competencies and learning outcomes that foster learning performance success; and so much more on behalf of those most vulnerable and at risk of not succeeding. The author thus suggests that the model presented by De Goede (2007) should be expanded to a more comprehensive nomological structure in an attempt to have a more encompassing understanding of the nature of Learning Success. It should be realised that in order to attain the desired learning outcomes, critical learning competencies are vital and should be understood as expressed by the interaction of the nomological network fostering the relationship and interaction taking place between the learning competency potentials, attainments and dispositions.

The current study has set out to uncover additional non-cognitive behavioural learning competency latent variables which are necessary for success in the learning situation. The current learning potential structural model is an expansion of the model of the De Goede (2007) and the hypothesized paths claimed by De Goede (2007) were retained in the current study. In the following section the author will present an overview of the proposed elaborations of De Goede's model.

2.4.1 Cognitive Engagement (Time-at-Task)

Burger (2012) researched a number of further variables that were seen as playing a role in learning success, which included engagement in task-oriented goals. Thus, by directing effort towards the learning task, the learner attempts to transfer existing/current knowledge to the novel task. According to Skinner and Belmont (1993):

> engagement in learning refers to the intensity and emotional quality of an individual's involvement in initiating and carrying out learning activities. Individuals who are engaged show sustained behavioural involvement in learning activities. They select tasks at the borders of their competencies, initiate action when given the opportunity and exert intense effort and concentration in the implementation of learning tasks; they generally show positive emotions during on-going action, including enthusiasm, optimism, curiosity and interest (p.572).

This definition refers to the subtle cognitive, behavioural and affective indicators of student engagement when faced with a specific task. This should not be confused with student's willingness to attend class or barriers to engagement due to situational and environmental unfavourableness.

According to Derabi, Nelson and Paas (2007), the attributes of learning engagement include (1) sustained, effort and enthusiastic participation, (2) positive attitude, (3) intense effort, (4) focussed attention, and (5) goal directedness.

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Burger (2012) writes that individuals who are engaged in their work, show sustained involvement in their learning activity, while utilising opportunities presented to them with extreme effort and concentration during the performance of the specific learning activity. Skinner and Belmon (1993) claimed that three groups of criteria could be identified, namely cognitive, behavioural and affective criteria. Cognitive criteria refer to the level of mental effort utilised in the learning task presented. Secondly, behavioural criteria refer to the extent of active responses to the learning task presented. Finally, affective criteria refer to the level of investment and reaction to the specific learning task the learner faces.

Student engagement can be considered as one of the few critical elements that can predict learning performance. It is evident that the more an individual practices his/her subject matter, the more learning and improvement in ability takes place (Carini, Kuh, & Klein, 2004). According to Ramphele (2012), it is a fact that there are challenges regarding the level of crystallised intelligence that many previously disadvantaged individuals have attained and that denial represents an obstacle to attempts to rectify this. The research indicates that it is specifically those individuals referred to as low ability students who potentially benefit most from higher engagement levels (Burger, 2012; Carini, Kuh, & Klein, 2004). This means that those individuals with low intellectual ability benefit more, in terms of learning (transfer), when they spend more time academically engaged. Hence undoubtedly Cognitive Engagement/Time-at-Task is a critical learning competency.

The ultimate outcome of cognitive engagement is transfer of existing knowledge and skills which can ultimately assist in solving novel problems. This is only possible if meaningful structures are created through continued and almost obstinate intellectual battling.

Hypothesis 2: In the proposed learning potential structural model it is hypothesised that *Cognitive Engagement* will positively influence *Transfer of Knowledge*.

2.4.2 Conscientiousness

 According to Burger (2012), conscientiousness is associated with the degree of organisation, persistence, control, and motivation in goal-directed behaviour. Those individuals who tend to score high in the personality construct of conscientiousness (as per Big Five Personality Factors), are more organised, reliable, hard-working, self-directed, punctual, scrupulous, ambitious, and persevering. The construct of conscientiousness can be defined in terms of six main facets including Competence, Order, Dutifulness, Achievement-striving, Self-Discipline and Deliberation (Colquitt, LePine, & Noe, 2000). The first facet of **Competence** refers to an individual's capability, sensibility and the degree of accomplishment.   **Order** refers to the extent to which a person is organized within his environment. **Dutifulness** can be defined in terms of adherence to specific standards of conduct and the manner in which principles are observed. **Achievement-striving** is the effort to strive for excellence. **Self-discipline** refers to persistence in the face of difficulty or general challenges. It can be said that those individuals with low levels of self-discipline have lower level of persistence. **Deliberation** can be described as the level of caution, planning and general thoughtfulness (Colquitt, LePine, & Noe, 2000).

According to Barrick and Mount (1991) conscientiousness is the single best predictor of workplace performance among many different job categories. Conscientiousness has also been proven to be a valuable predictor of academic success

beyond cognitive ability (Goff & Ackerman, 1992). It is also indicated that conscientious individuals are hard-working, achievement striving, organised and self-disciplined, and conscientiousness is highly correlated with exam success (O'Connor & Paunonen, 2007). This is also true in the sense of training proficiency (Hogan & Ones, 1997). According to a study by Nakayama, Yamamoto and Santiago (2007) it was found that diligent learners expended additional effort, spent more time on learning and engaged more with their learning material to achieve a high academic outcome.

The above research is in line with the fact that conscientious individuals are more driven to succeed in their task. Thus these individuals can be regarded as more cognitively engaged in their task, as discussed earlier and are also more motivated (achievement-striving) and focussed on long term success (i.e. achievement of a three year degree). This view of long term success through current effort can be defined in terms of the concept of Grit which is dis cussed later.

Hypothesis 3: In the proposed learning potential structural model it is hypothesised that *Conscientiousness* will positively influence *Cognitive Engagement*.

In a fairly recent study by Fayombo (2010), an investigation was launched regarding the relationship between the Big Five personality traits and the construct of psychological resilience. The study comprised of 397 Caribbean secondary school adolescents. In the study resilience was defined as:

> a process of capacity for, or outcome of successful adaption despite challenging or threatening circumstances and that resilient adolescents are characterized by social competence, problem-solving skills, mastery, autonomous and a sense of purpose and future…resilient adolescence have high expectations, a meaning for life, goals, personal agency, and interpersonal problem-solving skills which work together to prevent the debilitating behaviours that are associated with learned helplessness (p.105).

The available literature suggests that the Big Five personality traits are empirically supported dimensions of personality, which are defined as Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The current study focuses only on the relationship between conscientiousness and resilience. The conscientious personality can be described as organised, thorough, planning ahead, and displays a strong impulse control. According to Goleman (1997), many of the behaviours associated with conscientiousness can be found under the broad category of emotional intelligence. Salgado (1997) writes that conscientiousness is the most reliable indicator of performance on the job, and that those employees high in conscientiousness are generally more reliable, motivated and hard working.

Fayombo (2010) found that conscientiousness was associated with openness to experience ($r = 0.142$, $p<0.05$) which indicates that a learner who is organised, thorough and plans ahead, is also likely to be intellectually curious among other things. This means that they will spend extra time on material that they find interesting and stimulating which support the current hypothesis with respect to *cognitive engagement*. Secondly, the measure of conscientiousness accounted for .21 of the variance in psychological resilience. These findings support the second hypothesis with respect to *resilience*.

Hypothesis 4: In the proposed learning potential structural model it is hypothesised that *Conscientiousness* will positively influence *Resilience*.

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2.4.3 Learning Motivation

Learning motivation[9] is a vital element of the learning potential construct as it should be realised that transfer will only occur when trainees have both the ability and the motivation to engage with the learning material presented to them in order to acquire and apply new skills (Wexley & Latham, 1981). According to Burger (2012) the interaction between motivation and ability is also found in the theory of motivation. Ability in the absence of motivation or motivation in the absence of ability does not yield adequate learning performance. Motivation can be explained in terms of behaviours expressed by an individual that are not attributable to cognitive ability or external situational forces governing the direction, intensity and persistence of action (Gibson, Ivancevich, Donnelly, & Konopaske, 2006; Kanfer, 1991). Motivation involves a choice, by the individual, to expend energy towards one particular set of behaviours (Nunes, 2003). Motivation to learn can be defined as an act or desire on behalf of the trainee to study the training material presented (Ryman & Biersner, 1975).

From the research presented by Baldwin, Magjuka, and Loher (1991) and Tannenbaum, Mathieu, Salas, and Cannon-Bowers (1991) there appears to be a well-established positive relationship between motivation to learn and learning outcomes. The research by Mathieu and Zajac (1990) indicates that motivation to learn is a critical forerunner for training programme completion and effective transfer. Motivation also has an incremental role over and above cognitive ability in explaining variance in learning performance (Colquitt, LePine, & Neo, 2000).

The current author is, however, convinced that motivation to learn is closely linked to the non-cognitive trait of tenacity. In order for a trainee to be tenacious in his knowledge acquisition and programme completion, while facing the challenges of personal adversity, the trainee needs a rationale for expanding his effort vigorously. Thus, the trainee needs to focus his efforts on the greater goal of knowledge attainment through staying cognitively engaged. Nunes (2003) also claims that motivation is about an individual's choice[10] to exercise energy in the direction of a specific behaviour to learn. According to Gibson, Ivancevich, Donnelly and Konopaske (2006) motivation can be considered as a force acting on an individual that initiates and directs behaviour. In order to expend effort towards the greater goal, the trainee needs a motivational catalyst that ignites the tenacious effort towards goal achievement; which in the current study is described as *learning motivation*.

Hypothesis 5: In the proposed learning potential structural model it is hypothesised that *Learning Motivation* positively influences *Tenacity*.

According to Theron (2013), if the construct of tenacity in isolation is considered it can be argued that the construct in itself is without direction, it is *scalar*. If a construct is *scalar* it refers to the fact that the construct's *direction does not apply; the construct is specified by magnitude (degree to which) or quantity alone* (Arfken, 1985; Feynman, Leighton, & Sands, 2006). The current author agrees with Theron (2013) in that, although a trainee can be highly tenacious the obstinate effort will have no purpose if it's not expended in a specific direction which is driven by 'n internal or external motivation to attain a certain goal. This is parallel to the argument presented by Kanfer (1991), which states that motivation should be considered as a psychological mechanism governing the direction of effort and persistence, apart

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[9] Although De Goede (2007) in his learning potential structural model did acknowledge the effect of cognitive abilities on learning performance, by including the abilities of abstract reasoning capacity and information processing capacity, De Goede failed to give credit to the role of learning motivation and its effect on learning performance.

[10] According to Nunes (2003) motivated individuals are more primed, or ready to learn. Although individuals may enjoy a training programme, they will not learn very much unless they are motivated to learn, as only then will they be prepared to learn.

from individual differences. This is confirmed in the research presented by Ryman and Biersen (1975) indicating that motivation can influence the amount of effort exerted (time cognitively engaged) during a training session.

Hypothesis 6: In the proposed learning potential structural model it is hypothesised that *Learning Motivation* positively influences *Time Cognitively Engaged.*

2.4.4 Environmental Unfavourableness

The promise of the ideal South Africa which was presented and promised to many desperate individuals in the year 1994, is yet to become true. Today so many South Africans are still living in dire need of the most basic of goods and services. If the socio economic realities of South Africa are considered today, two of the main challenges remaining are the supply of adequate infrastructure (including educational systems), as well as community safety, which is more prevalent in impoverished communities than elsewhere. In the current study the term Environmental Unfavourableness is defined in terms of Socio-Economic Status (SES), as SES is a primary contributor to Environmental Unfavourableness. SES is a multifaceted construct which refers to three main dimensions including, namely occupation, education and wealth (Western, Mc Millan, & Durrington, 1998). Van den Berg and Louw (2006, p.2) writes: "Education research consistently found home background (socio-economic status) to be an important determinant of educational outcomes".

Western, McMillan, and Durrington (1998) writes that the most prominent influence on learners in the educational context is their socio-economic background. The economic prosperity of the learner's community, their culture and social background profoundly influences learner's beliefs, attitudes, expectations and values about education. According to Martin (1994) students with low SES participates the least in educational activities. This view is supported by Western et al. (1998) who attributes this reality to lower aspirations and less support from family. It has also been found that the participation of parents in schools has a very positive influence on learners' overall academic achievements (Gene & Stoneman, 1995). An additional contributor to lack of learning engagement in low socio-economic rural South Africa is the limitation of the subject choices presented, which is not so much in congruence with the learner's aptitudes (Cosser & Du Toit, 2002).

The lack of a proper learning engagement due to socio-economic conditions has been widely researched in South Africa. Although many factors have been taken into account in explaining and understanding this phenomenon, little action has been taken to address the situation. A recent South African study by Timaeus, Simelane and Letsoalo (2012) investigated children's schools progress against the backdrop of poverty and race. Information was collected on the demographics of the households, including dwelling area, access to utilities and household income. The sample included 7,304 household interviews, as well as more than 28,000 individual interviews. The research investigated earlier findings by the National Income Dynamics Study (NIDS), providing a current perspective on the socio-economic status of the sample, which was used in the study, in terms of household backgrounds and personal environmental favourableness. The outcome of the study indicates that, it is evident that family background or socio economic status accounts for the lower attainment of educational outcomes among African and rural school children. The researchers claimed that children raised in poor SES households (which is mostly African) experienced major educational disadvantages compared to their peers and counterparts form higher SES households, as compared to income and wealth indicators. The study confirmed this finding even after controlling for household address, as those learners form wealthier households still outperformed those with poor SES. The fact that household poverty has a statistically

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significant impact on learner school outcome has also been confirmed in studies by (Anderson, Case, and Lam, 2001; Timaeus and Boler, 2007; Lam, Ardington, and Leibrandt, 2011).

South Africa has been characterised by a tendency for high quality schools to be restricted to neighbourhoods with equal socio-economic status of households (Van der Berg & Louw, 2006). This is no longer true, as there are schools of equal quality in neighbourhoods of differing socio-economic status. The study by Timaeus, Simelane and Letsoala (2012) has found that inequalities in educational attainment may originate purely from the characteristics of children's households and the favourableness thereof. This view is supported by Van der Berg (2008) in that "better-off children benefit more from attending better schools than poor children". This view is supported by the tendency of parents from higher SES households to encourage and assist their children more while intervening more frequently to ensure principals and teachers attend to their duties conscientiously (i.e. making sure homework is done ; and ensuring that marking homework is done appropriately) (Timaeus, Simelane & Letsoale, 2012).

A recent study by NIDS found that the school quality variable ends up statistically insignificant when controls for other household characteristics are added to the regression model of grade repetition. Timeaeus et al. (2012) writes:

> …earlier studies may have overestimated the role played by inadequate teaching and weak leadership in accounting for the poor test results of the least successful schools, because they were unable to adjust fully for the adverse family circumstances of pupils attending such schools (p.16)

An additional interesting outcome from the study was the matter of educated mothers, as they seem to be more committed to their children's educational attainments than uneducated mothers and that even after controlling for the resources available to the household; the mothers' commitment remained a significant element in learner's schools progress. What the study ultimately revealed is the fact that race in itself is no longer a constraint in terms of the fruitfulness of educational outcomes; however, where the current political platform still fails is to make poverty less of a constraint with respect to children's educational attainment (Timaeus et al., 2012).

The findings of a multi-dimensional South African study by Frempong, Reddy and Kanjee (2011) confirmed the fact that home- and SES background accounts for the most variance in students learning engagement. The evidence again concluded that the quality of learners' and their parents' engagement and participation in the schooling process has the most significant effect on learning outcomes. Additionally the study found that the "contextual effect[11]" also had a significant impact on the learning outcomes of learners. It was again confirmed that in high-achieving schools, learners with a lower SES background are not as successful as their higher SES counterparts.

What is realised from these studies is the need to consider the fact that SES background does play a significant role in the level of learning engagement. Thus, the more positive SES a learner experiences, the more positive the potential learning outcome gained. The question that should be considered is, whether schools/ learning institutions can compensate for the disadvantagement experienced and facilitate successful learning independent of the learner's background characteristics.

Hypothesis 7: In the proposed learning potential structural model it is hypothesised that Environmental Unfavourableness negatively influences Cognitive Engagement.

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[11] Peer effect associated with bright and motivated learners working together.

2.4.5 Tenacity

Bandura (1997, p.43) writes: "… people who have a tenacious belief in their capabilities will persevere in their efforts despite innumerable difficulties and obstacles. They are not easily overwhelmed by adversity…"Over the past few decades it has become more evident that there are more elements to be considered in determining educational performance than simply focussing on intelligence in isolation (Petrides, Chamorro-Premuzic, Frederickson, & Furnham, 2005). The reality that many individuals do not complete school poses serious consequences for future economic growth. The questions that should be considered are why so many individuals do not complete school and learning opportunities, and fail to work hard to achieve academic success? Could it be attributed to the characteristics of the learner or the learning institutions they are enrolled in?

The available literature seems to point to motivational and non-cognitive factors. These factors include their personal feelings about school and self-control, but the main area of interest in this section is the non-cognitive factors influencing achievement (Duckworth & Seligman, 2005). According to Heckman, Stixrud and Urzua (2006, p.413) some factors offer: "promising levers for raising the achievement of underprivileged children and, ultimately, closing achievement gaps based on race and income". It is vital that the mind-set and non-cognitive skills that influence learning engagement be understood in the educational setting.

Considering the fact, that the theory points out that there are many elements or levers that affect the learning performance of those learners, coming from low socioeconomic backgrounds, it would seem naïve to focus exclusively on one or the other. Considering cognitive or psychological functioning as the exclusively driver of learner performance is wrong. More elements should be considered, impacting on the learning performance of those most affected by their low socioeconomic circumstances, this way a better understanding will be achieved of the drivers hampering successful learning performance. It should be realised that an element such as adversity has a profound effect on human beings' level of learning ability. However, the manner in which those effected by adversity responds to their circumstances may have a profound effect on the level of learning performance achieved. The manner in which someone responds to their socioeconomic circumstances can be seen as a non-cognitive behavioural factor, driving learning performance. In many instances people from the same level of socioeconomic circumstances will differ in their level of learning performance. This presents a case for considering non-cognitive elements when evaluating a given level of learning performance achieved. Considering the theory, one such non-cognitive behavioural trait driving learning performance is tenacity (Heckman et al., 2006; Heckman & Rubinstein, 2001). A person who is tenacious can be described as an individual who persists when faced with difficult challenges, while pushing personal limits (Heckman, 2003). In the current study the construct of tenacity will be described under the definition of 'Academic Tenacity'.

Academic tenacity, at its most basic level can be regarded as working hard and smartly over a long period of time, with a long-term view directed at higher-order goals accompanied by perseverance (Dweck, Walton, & Cohen, 2011). This is true of students who consider school (or the learning environment) as a means to a future desired end, such as wanting a better life for themselves and caring for their family and community. They are also engaged in their learning and view this effort positively, while challenging the status quo. The challenge of social and intellectual interaction does not derail the academic tenacious individual, while setbacks are viewed as opportunities. Finally, this type of learner knows how to remain engaged over a long period of time, while strategies for moving effectively forward is successfully implemented continuously (Dweck, Walton, & Cohen, 2011).

It is evident in the educational realm that variation in student intellectual ability predicts academic performance outcomes, however, the performance outcomes of those with the same ability may also differ. According to the research, students with the same intellectual ability can respond to frustrating situations remarkably different, some will enjoy the challenge and other will prefer to quit (Bandura, 1978; Diener & Dweck, 1978). This difference in response has a profound effect on the long term perseverance with respect to learning (Dweck, Walton, & Cohen, 2011).

A study by Hensley and Kinser (2001) investigated the persistence of adult learners who enrolled for an academic course, after giving up previously in their study careers. The study investigated the persistence (tenacity) with which they approached their learning. Those that succeeded in acquiring their academic achievement believed it was due to the fact that they turned academic obstacles into strengths. The study confirms that those that succeeded in their academic goals where those that were tenaciously persisting throughout the course duration. The authors also indicate that the tenacious persisting behavioural trait should be considered as a critical success factor of post-secondary studies. This is confirmed in the work presented by Walpole, Burton, Kanyi, and Jackenthal (2002), which indicated that tenacity is a critical non-cognitive factor for graduate success.

Although many previous studies found a strong relationship between resource availability and competence, the question remains as to how do those learners without the necessary resources achieve learning success? According to Bandura (1997) one critical element of academic tenacity is students' beliefs about their own academic ability. However, the belief a learner has of his/her own ability to perform successfully can be delicate and a critical question for academic tenacity that should be considered is how well a learner's self-efficacy will endure when confronted with inevitable challenges and setbacks. According to Dweck et al. (2011) it is vital that learners develop a growth mind-set and a resilient self-efficacy. This will allow learners to view setbacks and challenges as an opportunity to learn. Learners with an open mind-set will consider a challenge in a constructive way (e.g. "Maybe I must try harder") and with feelings of excitement and behavioural persistence. Dweck et al. (2011, p.24) writes: "a critical aspect of academic tenacity is the ability to transcend immediate concerns and respond to academic setback with resilience".

In the South African context, many learners face strenuous circumstances not only at home but also in the class room. The challenges can range from a lack of financial resources, to completely overcrowded houses and classrooms. In order for these learners to remain successful in the learning environment they should not only be able to work hard and continuously, they should also be able to continue to do so when difficulty crosses their path. Being able to continue to study while facing adversaries is an outcome of being a tenacious person. It is thus evident from the literature that tenacity plays a critical role in academic performance, taking into consideration SES.

In the proposed expanded learning potential structural model *Tenacity* does positively moderate the relationship between *Environmental Unfavourableness* and *Cognitive Engagement*. This suggests that individual non-cognitive behavioural traits do have a significant effect on learning persistence, which is necessary for transfer of knowledge.It is consequently proposed that *Tenacity* positively influences the relationship between *Environmental Unfavourableness* and *Cognitive Engagement*.

Hypothesis 8: In the proposed learning potential structural model it is hypothesised that Tenacity moderates the relationship between Environmental Unfavourableness and Cognitive Engagement.

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2.4.6 Grit

In the beginning of the twentieth century, William James was the first to enquire about the types of human abilities that existed and how diverse means could be utilised to unleash these abilities.   Although research over the past century has provided enough evidence of the different types of human abilities that exist, not many studies have provided information that explains why certain individuals accomplish more than others with the same cognitive abilities, and how. Moving away from the obvious cognitive attributes, one non-cognitive behavioural trait that seems to be shared by the most successful individuals is a combination of perseverance and passion for long term goals, also known as Grit (Duckworth, Peterson, Matthews, & Kelly, 2007).

The Gritty individual is someone who works actively and constantly at challenges, maintaining effort over a long period of time while not quitting despite many adversities. These individuals approach achievement and success as a "marathon", maintaining stamina at an obstinate pace (Duckworth, Peterson, Matthews, & Kelly, 2007). Thus, the Gritty individual has the capacity to prolong effort, as well as interest in projects that have a duration of a month or longer, independent of positive feedback (Duckworth & Quinn (2009). It is also suggested that although Grit overlaps with achievement aspects of conscientiousness, it deviates in the sense that the focus is on long-term stamina and not short-term success. Those individuals who exhibit Grit not only complete their current task at hand; they also have the ability to pursue a particular aim over many years (Dweck, Walton, & Cohen, 2011).

The literature regarding the Big Five taxonomy of personality indicates that, although any given personality trait may account for less than 2% of achievement variance, more narrowly defined facets of the Big Five factors have the ability to predict more particular achievement outcomes (Paunonen & Ashton, 2001). The most reliable trait for predicting job performance is conscientiousness. Conscientious individuals can be described as thorough, careful, reliable, organised, industrious and self-controlled. According to Duckworth et al. (2007) the correlation between conscientiousness and job performance can range from $r = .09$ to $.13$. This is supported by Tett, Jackson and Rothstein (1991) who confirmed a correlation of $r = .12$ between conscientiousness and job performance. This outcome means that, as conscientiousness increases, so does the level of job performance. Hough (1992) suggests that it is important to make a distinction between the achievement and dependability elements of conscientiousness. Achievement- orientated learners are those who work hard and attempt to do a good job, while completing their current task. On the other hand dependable individuals are self-controlled and conventional. Through a meta-analyses of studies on achievement orientation Hough (1992) found that it was significantly related ($r = .29$) to educational success. According to Duckworth et al. (2007) Grit overlaps with the achievement element of conscientiousness, however it differs in the sense that it focuses more on long-term stamina than short-term intensity. Duckworth et al. (2007, p 1089) writes: "The Gritty individual not only finishes the task at hand but pursues a given aim over years".

Grit also differs from the dependability aspect of conscientiousness (including self-control) in that the specification of goals is more consistent. In addition Grit differs from need of achievement in terms of the drive to complete manageable goals. From the literature it is evident that the Gritty individual will not swerve from his/her original desired goal even in the absence of positive feedback. According to McClelland, Koestner, and Weinberger (1992) need for achievement is a non-conscious drive for implicit rewards. In contrast to this, Grit is related to implicit or explicit rewarding goals (Duckworth, Peterson, Matthews, & Kelly, 2007).

Duckworth et al. (2007) conducted six studies to understand the relationship between Grit and individual variables. The individual variables included controlling for age, educational attainment, a challenging environment, task completion and time-on-task. In the first study the researcher considered whether Grit and age is correlated in the sense that Grit increases with age. The findings indicated that more educated individuals scored higher on Grit than their less educated counterparts. Those that scored the highest Grit score were postgraduate individuals. When educational level was controlled for, Grit increased monotonically with age. Duckworth et al. (2007, p1090) writes: "…our intuition is that Grit grows with age and that one learns from experience that quitting plans, shifting goals and starting over repeatedly are not good strategies for success..."

The purpose of the second study was to establish whether Grit provided incremental predictive validity over and beyond the Big Five traits and if Gritty individuals switch careers more often. The research indicated that Grit was significantly related to Conscientiousness ($r = .77$, $p<.001$); to Neuroticism ($r = -.24$, $p<.001$), Agreeableness ($r= .24$, $p<.001$), Extraversion ($r= .22$, $p<.001$) and Openness to Experience ($r = .14$, $p<.001$). This means, as Grit increases, there is an increase in individual's level of Conscientiousness, Agreeableness, Extraversion and Openness to Experience, and a decrease in the level of Neuroticism experienced. However, Duckworth et al (2007) found that Grit demonstrated incremental predictive validity of success measures over and beyond conscientiousness, although it is highly correlated. The study also concludes that individuals who were a standard deviation higher in Grit than average were 35% less likely to make frequent career changes.

The third study by Duckworth et al (2007) investigated the relationship between Grit and GPA[12] scores among undergraduates at an elite university. The study also investigated whether Grit was orthogonal to intelligence, explaining variance in GPA over and above that explained by intelligence. The outcome confirmed that more Gritty students outperformed their less Gritty peers. Grit was also associated with lower SAT scores, meaning that amongst the elite undergraduates, smarter students may be less Gritty than their peers. Duckworth et al. (2007, p.1093) writes: "…among relatively intelligent individuals, those who are less bright than their peers compensate by working harder and with more determination…"

The fourth study by Duckworth et al. (2007) investigated what predicts success best in more challenging environments. The study was conducted among 900 members of the West Point branch of the United States Military Academy. The results of the study indicated that Grit predicted cadets' completion of their rigorous summer training programme better than alternative predictors. The study proved that cadets who were a standard deviation higher than average in Grit were more than 60% more likely to complete their summer training programme. Duckworth et al. (2007, p1096) wrote the following:

> "…these findings support Galton's (1892) contention that there is a qualitative difference between minor and major accomplishments. Earning good grades during the academic year at West Point requires regulation efforts from moment to moment, primarily by resisting "hourly temptations" to procrastinate, daydream, or indulge in unproductive diversions…"

The fifth study by Duckworth et al. (2007) was a follow-up on study four, in that, the researchers investigated if Grit had incremental predictive validity for summer attrition over and beyond Big Five Conscientiousness. The findings

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[12] Grade Point Average

suggested that Grit is the most superior predictor of summer retention of cadets. It should also be noted than when all three predictors are combined (Grit, conscientiousness and Whole Candidate Score) into a binary logistical regression model, Grit was the only predictor predicting summer retention successfully.

In the final study Duckworth et al. (2007) investigated the importance of Grit to exceptional extracurricular accomplishments, to avocational rather than vocational pursuits. The study was conducted among the participants in the 2005 Scripps National Spelling Bee. The first findings indicated that for those individuals higher in Grit it predicted advancement to further rounds in the competition, finalists scored a standard deviation in Grit above the mean for same-aged finalists and were 41% more likely to advance to further rounds. This finding can be explained in that, Gritty finalists outperformed their less Gritty peers, at least in part, because they studied longer (cognitive engagement). Weekend hours of practice, at least partially, mediated the relationship between trait-level Grit and performance. Duckworth el at (2007, p1098) writes: "…Gritty children work harder and longer than their less Gritty peers and, as a consequence, perform better…"

From the above literature the following two hypotheses are concluded;

Hypothesis 9: In the proposed learning potential structural model it is hypothesised that Grit will positively influence Learning Motivation.

Hypothesis 10: In the proposed learning potential structural model it is hypothesised that Grit will positively influence Learning Performance mediated through cognitive engagement (Time-on-task).

2.4.7 Resilience

According to Dyer and McGuinness (1996, p.276) resilience can be defined as: "the ability to bounce back from adversity". Garmezy and Masten (1991, p.459) write: "resilience is a process of, or a capacity for, or the outcome of successful adaption despite challenging and threatening circumstances".

The concept was first explored almost two hundred years ago by Phillipe Pinel in his investigation of the suffering psychiatric patients faced (Rutter, 1985). The concept of resilience assists in explaining why certain individuals react differently to the adversity they face. It can be described as a process of providing promise to those facing misfortune that good can arise. More originally the concept of resilience has been utilised to describe the elasticity of organs or substances (Harriman, 1958). The current research acknowledges the fact that resilience is a dynamic process highly influenced by protective factors. Protective factors can be described as competencies necessary for resilience to be successfully elicited. There are three main competency spheres, including individual, interpersonal and familial (Dyer & McGuinness, 1996).

Anthony (1974) and Rutter (1985) wrote that there exists a sense of balance among vulnerability and resilience. This creates a situation where the outcome of adversity may have a steeling or scaring effect on those who experience it. The concept of a shifting balance is active, which in some cases may intensify an individual's vulnerability, while the opposite is also true in that protective factors may enhance resilience of those facing adversity. Protective factors can be defined in terms of specific competencies that are necessary for the process of resilience to occur. Thus, certain life

events may heighten a person's vulnerability, while protective factors may enhance resilience. Managing a specific outcome is possible by those facing adversity, as long as a workable balance is reached (Dyer & McGuinness, 1996).

According to Dyer and McGuiness (1996) the primary developmental antecedent of resilience is adversity. Dryer and McGuiness (1996, p277) writes:"…the consequence of resilience includes a toughening effect, a sense of having overcome one situation so that active mastery of other situations is possible; effective coping being the primary consequence…". The construct of resilience is influenced by multiple attributes including, *rebounding and carrying on*, *a sense of self*, *determination* and a *prosocial attitude* (Dyer & McGuinness, 1996). Rebounding and carrying on refers to the quality of bouncing back while carrying on (with malleability) towards a direction in life, after adversity is present in resilience. A sense of self refers to an individual's unique path in life, not self-esteem exclusively. Wagnild and Young (1990) wrote that sense of self should be regarded as a person's life and experiences, also referred to as equanimity. It can additionally be regarded as appreciation and acceptance of events which has transpired in life. Ultimately, the foundation of sense of self is weaved by the thread of enduring values (Dyer & McGuinness, 1996). Determination is the "stick-to-it-iveness" possessed by a resilient individual; persevering until the task is complete or the goal achieved. The resilient individual clearly acknowledges life's difficulties with conviction and tenacity (Dyer & McGuinness, 1996). Finally a prosocial attitude is a compassionate attitude which encourages affection to those which understand and assist the development of resilience. It is believed that the individual facing adversity can benefit from those people supporting the concept (Dyer & McGuinness, 1996).

Resilience however, should not be confused with the construct of Hardiness, although both describe reaction to adversity and is often used synonymously although they are not exactly the same. Kobasa (1979, p4) writes:

> Hardiness with its components of control, commitment and challenges, is a difficult concept to apply to those who have grown up in detrimental circumstances such as an alcoholic home, with neglect and abuse, or with a mentally ill parent. How does a child control a mentally ill or alcoholic parent? How does a child conceptualize challenges? Yet there are resilient children who emerge from these difficult upbringings (p.4).

This extract from Kobasa (1979) clearly indicates that resilience is a unique construct that should be regarded as one that explains the capacity of certain individuals to face stress without being incapacitated.

The current study is focused on the understanding of the construct of resilience in the context of learning performance of those most vulnerable and helpless against the backdrop of poor socioeconomic conditions in South Africa. According to Rutter (1979):

> there is a regrettable tendency to focus gloomily on the ills of mankind and on all mankind and on all that can and does go wrong…The potential for prevention surely lies in increasing our knowledge and understanding of the reason why some children are not damaged by deprivation…(p49).

Thus, if the terminology "achieving success against-all-odds" can be dissected, a clear understanding (although in isolation) would exist with respect to how it is possible that some individuals, with the specific focus on those coming from the most deprived backgrounds, can have a higher learning performance score than others facing the same adversities.

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Although Masten developed a "short list" of Assets and Protective Factors which reflect the fundamental adaptive system supporting human development, the current study will specifically focus on the South African context and resiliency process from a developmental perspective. In order to understand an individual's development in the learning context, it is vital to consider not only the cultural background, but also the broader social context (Bronfenbrenner, 1979). According to Schonert-Reichl and LeRose (2008) a highly complex interaction exists between an individual and his/her surrounding environment. From the literature it is evident that as an individual's environment is changing, his or her competence will change or adapt to the newly established circumstances. Schonert-Reichl and LeRose (2008, p.11) writes: "while a child must act to demonstrate competence, the environment in which a child finds himself or herself can impart competence".

Since the initial research findings by Normal Garmezy, Michael Rutter and Emmy Werner 50 years ago, many additional studies have been conducted in the field of resiliency. Four key research findings have been made over the past few decades. The first relates to the critical role that *relationships* play in developing resiliency. Luthar and Brown (2007, p. 944) writes: "the single most deleterious environmental risk is the sustained presence of neglect and abuse, and conversely, committed, loving relationships have high protective potential".

This view is supported by the National Scientific Council on the Developing Child (2004, p.1) stating: "…relationships are the active ingredient of the environment's influence on healthy human development. They incorporate the qualities that best promote competence and well-being…".The second key finding relates to the importance of considering the school context and the concept of *belonging*. Ryan and Powelson (1991) writes:

> …perceiving positive and strong connections to school has implications for current school functioning, as well as future education plans…children's engagement or disengagement in institutions, such as schools, depends largely on whether children's fundamental needs for belonging, autonomy and competence are being fulfilled (p51).

The third key refers to the *ordinariness of resilience*, according to Masten (2001, p.235): "…resilience does not come from rare and special qualities, but from…normative human resources in minds, brains and bodies of children, in their families and relationships and in their communities…". Thus, it is possible for all and not simply the luck of the draw for those facing harsh adversities; however, it can be said that it is possibly utilised more by those in challenging environments, like a learning environment or home setting. The final research finding refers to the *Circle of Courage,* which is captured in the Native American philosophy of child-rearing, in that resilience is based on four main spiritual pillars namely belonging, mastery, independence and generosity (Ryan & Powelson, 1991). The spirit of belonging can be defined in terms of the universal longing for human bonds, which is cultivated by relationships of trust, which translates into the concept of being able to say: "I am loved". The spirit of mastery can be defined as a thirst for learning, which is cultivated by learning to cope with the world, while being able to say: "I can succeed". The spirit of independence can be defined in terms of having the free will which is cultivated by being able to say: "I have the power to make a decision". Finally, the spirit of generosity can be defined in terms of character, which is cultivated by having a concern for others while being able to say: "I have a purpose for my life" (Brendtro, Brokenleg, & Van Bockern, 1990). These critical key factors are, however, not present in the lives of those who are regarded as most at risk.

The implication of not having the resource of resilience as a non-cognitive behavioural construct, presents a challenge to those vulnerable and at risk of not attaining learning performance success. It is important to understand the value of resilience and its "buffering" effect, in that the absence of resilience for those most at risk, as their reaction to a given

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situation in ordinary circumstances can lead to maladaptive outcomes (Taylor & Thomas, 2001). This presents a case that resilience should be viewed as existing both in individuals and in relationships between and among people. With specific reference to the extent that it enhances, rather than inhibits learners at risk, with respect to life opportunities and their achievement in selective developmental programmes. This positive constructive mind-set of resilience is critical for academic success, thus resilience positively moderates the relationship between *Environmental Unfavourableness* and *Cognitive Engagement*.

Hypothesis 11: In the proposed learning potential structural model it is hypothesised that resilience will positively moderate the relationship between Environmental Unfavourableness and Cognitive Engagement.

2.4.8 Parental Quality

According to Kermyt (2003), investment in children is crucial as their educational outcomes rely on the result of a cumulative effort from their households and the broader community. Differential outcomes in children's education attainment are due to differential investment in their education (Kermyt, 2003). This level of investment in the current study is exclusively based on the parental quality that exists in the relationship between a set of parents and their specific child, influencing the child's effort toward educational outcomes (Kermyt, 2003). Parental quality is a term which is influenced by many variables. Some of these variables include elements such as parental educational level, income, parental aspiration for their children's future, as well as community school quality. If these specific attributes are considered it is clear to see that our country has not ensured an equal playing field for all.

Parental quality as presented in the current study as a term utilised to describe parental support for their children's educational development. The underlying factors include [1] how often parents check school homework, [2] assist with homework, [3] presenting motivational incentives for good grades, [4] and have an expectation of completing school successfully. Heystek and Louw (1999, p.22) writes: "the relationship between parents and schools should change from a client type of relationship to a partnership relationship". Thus, a shared sense of purpose, mutual respect, sharing of information, responsibility and accountability is important for this partnership to be successful. It is crucial to initiate a process were parents, of those learners most at risk, are involved.

Masten, Hubbard, Gest, Tellegen, Garmezy, and Ramirez (1999), investigated the relationship between intellectual functioning and parenting quality related to multiple dimensions of competence over time, from childhood to late adolescence, particularly in the context of adversity. They also investigated how resilient adolescents differ from maladaptive peers who have not succeeded in the context of adversity, and from competent peers who are also successful, but have not experienced serious adversity.

The study included a sample of 205 individuals, evaluated over a period of 10 years. The main aim of the study was to examine competence in relation to adversity and resources, utilizing both a variable-focussed dimensional approach and a person-focused categorical approach. The study uncovered four main findings: (a) the development of competence is related to psychosocial resources, (b) good resources are less common among children growing up in the context of adversity, (c) if reasonably good resources are present, competence outcomes are generally good, even in the context of chronic, severe stressors, and (d) maladaptive adolescents tend to be stress-reactive and have a history of adversity, low resources, and broad-based competence problems.

The outcome of the study indicated that better intellectual functioning and parenting resources were related to more favourable outcomes across competency domains. Additionally it is suggested that IQ and parenting scores are markers of fundamental adaptational systems which protect child development in the context of severe adversity (Masten, Hubbard, Gest, Tellegen, Garmezy, & Ramirez, 1999). This is explained by Masten, Hubbard, Gest, Tellegen, Garmezy and Ramirez (1999):

> Results from variable-oriented and person-oriented analyses consistently support the significance of intellectual functioning and parenting quality as markers of current and future adaption in children and adolescence, which is consistent with a broad literature on competence and its correlation. Good intellectual functioning and well-functioning parent-child relationships may signify that fundamental human adaptational systems, presumably the legacy of evolution, are operational and sufficient to sustain normal development under unfavourable conditions. The findings for IQ and parenting indicated both unique and shared linkages with specific domains of competence for academic achievement, though it also shared variance with parenting and SES (p.162).

An additional study by Driscoll (2006) investigated the support levels required for graduation success, for those learners from low SES backgrounds. The study found that students from low SES backgrounds benefitted most significantly from parental involvement in academic activities, enhancing the odds of academic success (Driscoll, 2006). The study also found that student-parent communication enhanced the likelihood of graduation success among those learners most at risk (Driscoll, 2006).

Based on the overview the following hypotheses are proposed:

Hypothesis 12: In the proposed learning potential structural model it is hypothesised that Parental Quality positively influence Learning Motivation

Hypothesis 13: In the proposed learning potential structural model it is hypothesised that Parental Quality positively moderated the relationship between Environmental Unfavourableness and Cognitive Engagement

2.4.9 Learning Performance

Learning Performance refers to the extent to which learners achieve academic success within the context of the learning environment and the measurement thereof through assessment of knowledge on the subject field or level of ability mastered (De Goede, 2007). Learning performance should be interpreted as the final criterion (η) which is not available at the time when the selection decision is made. Learning performance should be understood as crystallised learning potential in action. Learning potential can be described as the substitute predictor construct (ξ) of learning performance. When a selection decision is made, the selector attempts to predict the level of learning performance, given a training and development scenario (Taylor, 1994). De Goede (2007) writes:

> Learning performance can be interpreted as the extent to which an individual has acquired a specific skill, ability or knowledge or ability (job competency) and is the manifestation of that specific skill, ability or knowledge in action in a situation corresponding to the job for which the affirmative development is initiated. Learning potential, the individual's capacity to be modified and the capacity to acquire novel skills, is what needs to be assessed in disadvantaged individuals.

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It is learning potential that is crystallised through remedial intervention, and which allows an individual to demonstrate successful learning performance (p.33).

This presents a case for the current study, in that it is vital to understand the drivers that foster success, given the number of novel intellection demanding skills (job competence) attained among different individuals. In other words, it is the objective of the current research study to establish what learning competencies contribute to differences in learning performance on the job. Although the current study recognises the contribution made by De Goede (2007) as an extension of Taylors' (1989, 1994, 1997) work, in the following section the author will present additional competencies which is believed to influence successful learning performance.

2.5   THE PROPOSED EXPANDED LEARNING POTENTIAL STRUCTRUAL MODEL

If the research initiating question is considered, the current study is dedicated to understand why learning performance varies among those South Africans previously denied developmental opportunities. The current study specifically focuses on non-cognitive constructs driving learning performance of individuals engaging in affirmative developmental opportunities. The current study is dedicated to expand the De Goede (2007) learning potential structural model, in an attempt to get a closer approximation of the psychological processes influencing the level of learning performance. The proposed learning potential structural model will attempt to provide a more accurate answer to understanding the variance in learning performance achieved by those previously disadvantaged South African trainees.

In order to make convincing inferences about the research initiating question, the author has presented a thorough literature review. The resultant structural model depicted in the form of a path diagram can be regarded as a complete summary of the theoretical stance held by the author. The expanded learning potential structural model depicted in Figure 2.3 can be regarded as an overarching substantive research hypothesis.
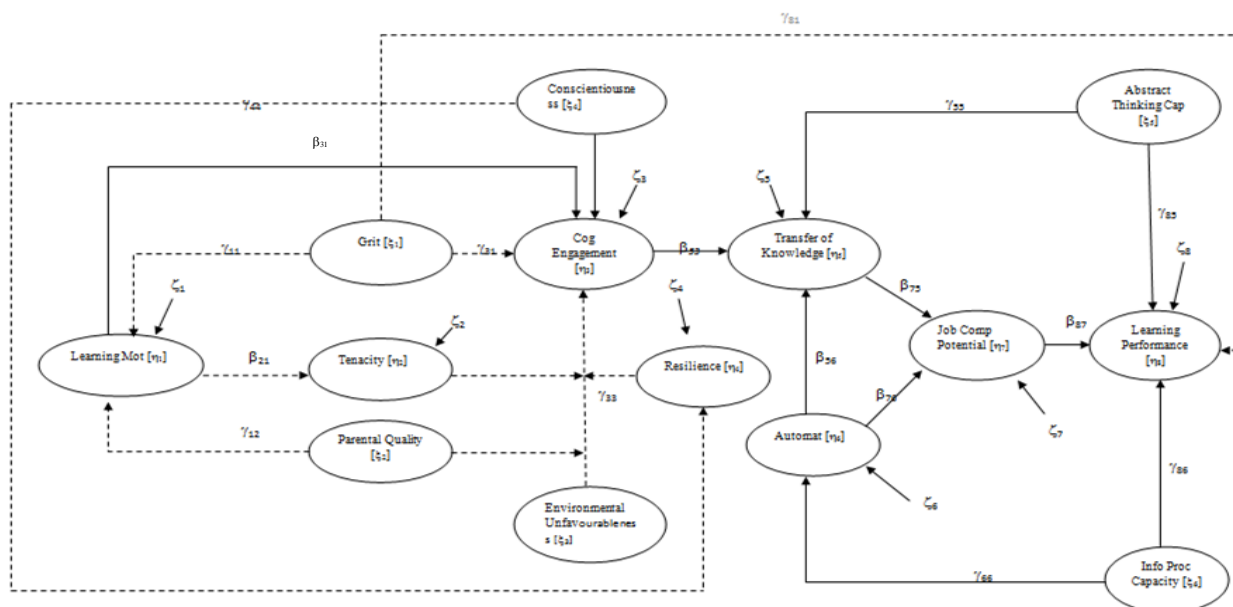
Figure 2.3 The hypothesised expanded learning potential structural model.

Existing Paths ——————> | Novel Paths - - - - - - >

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Equation 1 expresses the expanded learning potential structural model as a matrix equation.

$$
\begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \\ \eta_6 \\ \eta_7 \\ \eta_8 \end{bmatrix} =
\begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\beta_{21} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\beta_{31} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \beta_{53} & 0 & 0 & \beta_{56} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \beta_{75} & \beta_{76} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{87} & 0
\end{bmatrix}
\begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \\ \eta_6 \\ \eta_7 \\ \eta_8 \end{bmatrix} +
\begin{bmatrix}
\gamma_{11} & \gamma_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\gamma_{31} & 0 & \gamma_{33} & \gamma_{34} & 0 & 0 & \gamma_{37}^{13} & \gamma_{38} & \gamma_{39} \\
0 & 0 & 0 & \gamma_{44} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \gamma_{55} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \gamma_{66} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\gamma_{81} & 0 & 0 & 0 & \gamma_{85} & \gamma_{86} & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \\ \xi_8 \\ \xi_9 \end{bmatrix} +
\begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \\ \zeta_6 \\ \zeta_7 \\ \zeta_8 \end{bmatrix} \quad \dots 1
$$

In order for the first equation to comprehensively capture the theoretical position developed through theorising in response to the research initiating question the Ψ and ϕ matrices also need to be defined. The 9x9 variance-covariance matrix Ψ reflecting the variance in and covariance between the structural error terms (ζ_i) is assumed to be a diagonal matrix. The 9x9 variance-covariance matrix ϕ reflecting the variance in and covariance between the exogenous latent variables (ξ_i) is assumed to be a symmetrical matrix in which all off-diagonal covariance ϕ_{ij} terms are freed to be estimated. The exogenous latent variables are therefore assumed to be correlated. Assuming that the completely standardised solution will be most meaningful to interpret, the exogenous variance terms are fixed to 1 given the fact that the latent variables are standardised. Equation 1 can therefore be reduced to equation 2^{14}.

$$\eta = \beta\eta + \Gamma\xi + \zeta \dotfill 2$$

2.5.1 Reduced Learning Potential Structural Model

Due to practical time constraints it will not be possible to practically test the learning potential structural model developed through theorising in response to the research initiating questing as proposed in Figure 2.3. To maintain research efficiency in the current investigation, it will not be possible to subject the participants to the complete battery of instruments measuring all the variables as accounted for by the structural model and literature review. The most cost-effective strategy would be to subject participants to a subset of the learning potential structural model as proposed by the author in Figure 2.3. The reduced proposed learning potential structural model is presented in Figure 2.4, followed by the reduced model with the interaction effect defined in Figure 2.5 as the final model for testing.

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[13] $\gamma_{37}, \gamma_{38}, \gamma_{39}$ is the defined moderating variables interaction terms not graphically indicated in Figure 2.3, see Figure 2.5.

[14] Where, endogenous latent variables (latent variables that are effected by one or more latent variables in the irrespective of whether they exert a causal effect on other latent variables in the model) are indicated with the Greek letter Ŋ (eta). The Greek letter β (Beta) is used to represent the strength of the causal effect of the eta's. Γ (gamma) of regression coefficients describes the strength of the regression of eta on ksi. ξ (Ksi) represents the exogenous latent variables, which are the latent variables that only exert a casual effect on the other latent variables in the model but are themselves not affected by any latent variable in the model. ζ (zeta) is utilised to indicate a structural error term associated with the endogenous latent variable η.
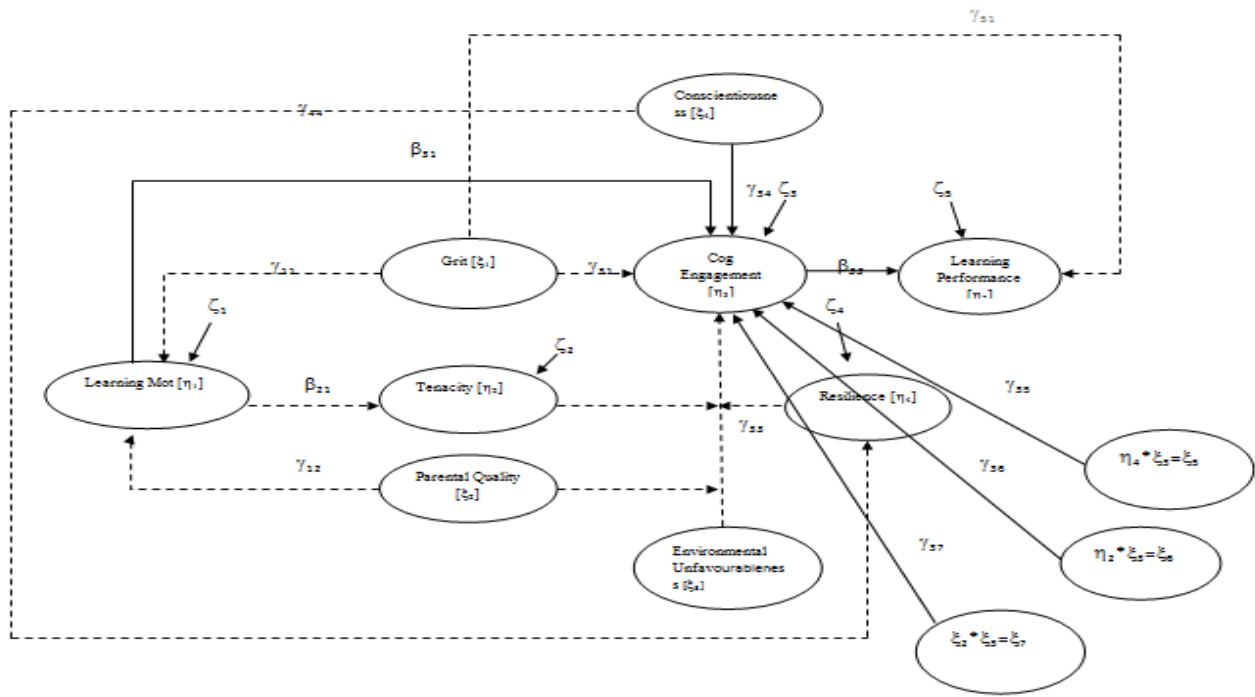
Figure 2.4. Reduced proposed learning potential structural model (with defined mediating paths)[15].
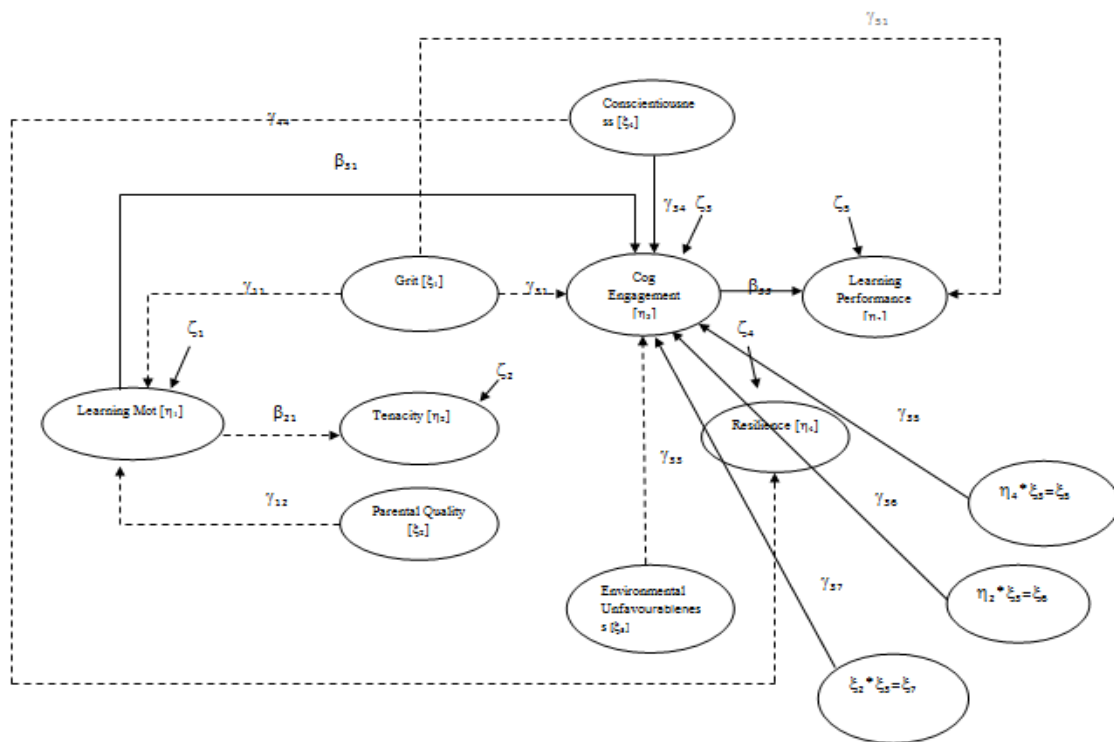
Figure 2.5 Hypothesised Reduced Learning Potential Structural Model with Defined Moderated Paths

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[15] Note: Figure 2.4 presents all three mediating paths, mediating the relationship between Environment Unfavourableness and Cognitive Engagement for demonstration purposes only.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

The methodology is meant to serve the epistemic ideal of science. To get to the most reliable verdict on the structural fit of the model depends on the methodology utilised to conclude a valued outcome, as well as the validity and reliability of the implicit claims of the investigation. It is critical that an optimal coverage of the methodology must be made explicit, as it is impossible to estimate the merits of the researcher's findings on a limited overview of the methodology, which means that it can only be accepted on face value[16]. According to Babbie and Mouton (2001), without an optimal coverage of the methodology, the rationale of science is compromised[17] and ultimately the epistemic ideal of science.

Considering the research proposed by some of the earlier pioneers like Cronbach (1949) and Bandura (1982), it is evident that non-cognitive factors have the potential to provide critical information on typical actions of individuals facing certain challenging environments. The current study has been undertaken by the author to investigate the non-cognitive predictors of academic/learning achievement in an attempt to clarify the driving elements of successful learning performance. The study is specifically focussing on learning performance against the backdrop of the daily adversities faced by South African society. In order to adhere to the latter, a representative sample of 395 grade 9 school learners, from previously disadvantage communities in the Cape Town area will be utilised for data capturing.

According to the extant body of research, Learning Potential can be regarded as a function of a myriad of cognitive and non-cognitive variables (Boeyens, 1989). If the earlier findings of Taylor's theory are considered, a very limited number of constructs have been identified as constructs that have a significant effect on learning potential and ultimately learning performance. This was the main rationale for De Goede's contributions. As stipulated in the introduction of this paper, it would seem insufficient to rely on the findings of a single explanatory research project to portray the comprehensive nomological network of latent variables that constitutes learning performance. The main rationale for this is the fact that Learning Performance is an extremely intricate phenomenon, which can only be partially explained in a single research model. Thus, although many others have made multiple attempts in explaining the construct of learning performance, the only way meaningful progress will be made is if multiple research studies are conducted with the necessary elaboration of the existing body of knowledge (Smuts, 2011). Although the main aim of this research study is to make an incremental contribution to the existing body of knowledge, partial overlap between models is possible, which is an inevitable outcome of the expansion of the existing knowledge base, as well as confirming earlier findings of previous studies through replication. These efforts will ultimately contribute in unveiling other latent variables in the nomological network on which learning performance rests. This can be regarded as the primary motivation by the author to contribute additional non-cognitive variables to the existing De Goede (2007) learning potential structural model. The author will attempt to test the present explanatory structural model presented in Figure 2.5. The methodology as well as the measurement instruments will be discussed in the current chapter. The author will first present an overview of the methodology, as well as the practical implications and rationale that accompanies the interaction terms as proposed in the current study.

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[16] While the verdict might be inappropriate due to an inappropriate procedure for investigating the merits of the structural model presented.

[17] A comprehensive description and thorough motivation of how the methodology was approached allows knowledgeable peers to identify methodological flaws and to point out the implications of these for the validity of the conclusion.

3.2 INTERACTION-EFFECTS

As proposed in the previous section the current study was set out to include interaction-effect terms with the additional challenge of attempting to fit three interaction terms to the structural model as proposed in Figure 2.5. It is evident from the research that the construct of learning performance is complex given the number of latent variables impacting on it. As the current study is set out to understand the non-cognitive elements impacting on the construct of learning performance, it was decided to investigate the complex nature of the latent variables interacting positively with the construct of environmental unfavourableness - impacting in conjunction on the learning performance of those individuals from deprived communities. This is proposed in an attempt to grasp the rich interconnectedness among the latent variables impacting on the overall learning performance of those individuals engaging in developmental opportunities.   The current investigation is attempting to understand how the relationship among Environmental Unfavourableness (EU) and Time Cognitively Engaged are interacting, being moderated by the constructs of Parental Quality (PQ), Tenacity (TENAC) and Resilience (PSYC). The interaction terms are constructed as PSYCEU (ξ_5), TENACEU (ξ_6) and PQEU (ξ_7).

3.2.1 Practical Implication

Given the utility of the interaction-term concept as investigated by the researcher, the structural model is defined in terms of main effects, as well as three proposed interaction effects, in an attempt to answer the research initiating question by developing an understanding of the variance in the endogenous latent variables (Theron, 2012). The challenge that this line of argument presents is captured in the operationalisation of the study in that testing the hypothesis in SEM (as the statistical analysis of choice) allows the direct testing of the overarching substantive research hypothesis as set out in the structural model presented in Figure 2.5 (Theron, 2012). However, with interaction-effects presented in the model, the utility found in SEM is somewhat flawed. If the theory is considered, multiple alternative processes are presented, all with their own level of technical challenges in operationalisation.

From the literature an alternative proposed by Little, Bovaird and Widemen (2006) is presented, based on the concept of residual centring, known as *othogonalising*. The process of residual centring in multiple regression involves the calculation of the product terms which are involved in the interaction effect, with regressing the interaction effect on the first-order effects involved in the product term (Theron, 2012). These residuals are calculated and utilised to represent the true interaction effect without first order main effects. The process of othogonalising in SEM involves calculating all possible product terms from the indicators of the latent variables which are involved in the interaction effect, regressing each product term on all the individual indictors of the latent variables involved and calculating the residuals for each regression model (Theron, 2012). The residuals are then used to represent the latent interaction effect/ power effect. The new orthogonalised interaction-term contains the unique variance which completely represents the interaction effect, separate from the first-order effect variance (Little, Bovaird, & Widaman, 2006). In the current study there are four residual values defined for each interaction-effect, with a total of twelve residuals values in the model.

If the fitting of the structural model is considered with the inclusion of the interaction-effects, such as in the current study, it is crucial that two elements of the model specification is considered, namely indicator correlation and main effect correlation. According to Theron (2013) it is crucial that the measurement error terms associated with the indicator variables of the interaction latent variable, $\xi_1*\xi_2$, that contains the same first order indicator should be allowed

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to correlate. Additionally it is also proposed by Theron (2013) that the latent interaction terms should not be allowed to correlate with the main effect latent variables involved in the interaction effects.

The current study with its inclusion of three interaction terms is somewhat ambitious, considering the stance of past researchers on the specific field, as testing the hypothesis may not succeed. However the researcher finds encouragement in the work of Little et al. (2006) and has developed the conviction that multiple interaction effects included in a single model is possible. In order to understand and grasp the vast complexities of the interaction among those latent variables impacting on learning performance it is crucial to attempt an execution based on the specific theory as presented above. The author's main belief and motivation to follow the current philosophy, as presented by the hypothesis on the interaction terms, stems from the belief that those elements impacting on learning performance does not exclusively take place or impact on learning performance in silo's. The current interest is to gain an understanding on how Environmental Unfavourableness in conjunction with additional latent variables impact on Time Cognitively Engaged.

3.2.2 Rationale

Utilising the process of *residual centring*, does have certain advantages, including the fact that the orthogonalised product and powered terms are stable when higher order terms are included. The second advantage is the fact that the product and power terms are unbiased in the process. Finally, full independence exists between the product and powered term and its constituent main effect (Little, Bovaird, & Widaman, 2006). These characteristics are convincing enough for the researcher to expect the specific operationalisation to be successful.

3.3 THE REDUCED PROPOSED LEARNING POTENTIAL STRUCTURAL MODEL

The reduced proposed learning potential structural model as presented in the path diagram in Figure 2.5 can also be expressed in matrix form as represented in equation 3 and reduce to a single matrix equation as expressed in equation 4.

$$
\begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 0 & 0 & 0 & 0 \\ \beta_{31} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_{53} & 0 & 0 \end{bmatrix} \begin{bmatrix} \eta_1 \\ \eta_2 \\ \eta_3 \\ \eta_4 \\ \eta_5 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \gamma_{31} & 0 & \gamma_{33} & \gamma_{34} & \gamma_{35} & \gamma_{36} & \gamma_{37} \\ 0 & 0 & 0 & \gamma_{44} & 0 & 0 & 0 \\ \gamma_{51} & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \end{bmatrix} + \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \end{bmatrix} \quad \ldots\ldots\ldots\ldots 3[18]
$$

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[18] From Equation 3: The 7 x 5 Γ matrix of path/ regression coefficients γ describe the strength of the regression of η_i on ξ_i | The 5 x 5 β matrix of regression/ path coefficients β describing the strength of η_i on η_i | The ϕ matrix of variance and covariance terms describing the variance in the covariance and covariance between the exogenous latent variables are correlated and thus all off diagonal elements in ϕ will be set free | 5 x 5 symmetrical Ψ matrix of variance and covariance terms describing the variance in and covariance between the structural error terms ζ_i and ζ_j it is assumed that the structural error terms are uncorrelated and thus that Ψ is diagonal| The 7 x 1 ξ column vector of exogenous latent variables| 5 x 1 column vector of endogenous latent variables| 5 x 1 ζ column vector of residual terms

Equation 3 representing the reduced learning potential structural model as stated above, can be reduced to equation 4:

$$\eta=\beta\eta+\Gamma\xi+\zeta\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.\ldots\ldots\ldots\ldots\ldots.4$$

3.3.1 Substantive Research Hypotheses

Multiple research designs exist to assist in providing answers to an empirical research problem. In order to understand the appropriate approach, it is important to consider the purpose of the study. The current study presented by the author is a second generation study aimed at elaborating the learning potential structural model proposed by De Goede (2007). The theoretical discussion presented earlier in the current study, resulted in adding additional learning competency latent variables to the existing De Goede (2007) model, as well as adding additional non-cognitive learning potential latent variables. The newly elaborated structural model can be viewed in Figure 2.3. Due to the practical implications of testing the fully elaborated model, only the adapted reduced structural model (as depicted in Figure 2.5) will be operationally tested.

Hypothesis 1:
If the overarching hypothesis is considered, the hypothesis represents the structural model as the author has depicted it in Figure 2.5. The figure provides a valid representation of the psychological processes that determine the level of learning achieved by learners/ trainees given affirmative developmental opportunities. The comprehensive overarching substantive research hypothesis can be broken down into the more specific and detailed individual substantive research hypotheses which will follow.

Hypothesis 2:
In the proposed learning potential structural model it is hypothesised that *Cognitive Engagement* will positively influence *Learning Performance.*

Hypothesis 3:
In the proposed learning potential structural model it is hypothesised that *Conscientiousness* will positively influence *Cognitive Engagement.*

Hypothesis 4:
In the proposed learning potential structural model it is hypothesised that *Conscientiousness* will positively influence *Resilience.*

Hypothesis 5:
In the proposed learning potential structural model it is hypothesised that *Learning Motivation* will positively influence *Tenacity.*

Hypothesis 6:
In the proposed learning potential structural model it is hypothesised that *Learning Motivation* will positively influence *Time Cognitively Engaged.*

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Hypothesis 7:

In the proposed learning potential structural model it is hypothesised that *Environmental Unfavourableness* negatively influences *Cognitive Engagement.*

Hypothesis 8:

In the proposed learning potential structural model it is hypothesised that *Tenacity* moderates the relationship between *Environmental Unfavourableness* and *Cognitive Engagement.*

Hypothesis 9:

In the proposed learning potential structural model it is hypothesised that *Grit* positively influences *Learning Motivation.*

Hypothesis 10:

In the proposed learning potential structural model it is hypothesised that *Grit* positively influence *Learning Performance* mediated through *Cognitive Engagement* (Time-on-Task).

Hypothesis 11:

In the proposed learning potential structural model it is hypothesised that *Resilience* positively moderates the relationship between *Environmental Unfavourableness* and *Cognitive Engagement*.

Hypothesis 12:

In the proposed learning potential structural model it is hypothesised that *Parental Quality* positively moderates the relationship between *Environmental Unfavourableness* and *Cognitive Engagement.*

Hypothesis 13:

In the proposed learning potential structural model it is hypothesised that *Parental Quality* positively influences *Learning Motivation*.

3.4 RESEARCH DESIGN

According to Kerlinger and Lee (2000), the capacity of the research design to maximise systematic variance and minimise error variance, while controlling extraneous variance, will ultimately decide the comprehensibility with which the empirical evidence is produced. In order to empirically investigate all the presented hypotheses, the author requires a strategy that will provide explicit empirical evidence in terms of evaluating the operationalised hypothesis. The first step is to consider a research design which will serve as a blueprint to procure answers to the research question and secondly to control variance (Kerlinger & Pedhazer, 1973).

The author has decided to utilise an *ex post facto* correlation design in the current study. Kerlinger and Lee (2000) describe an *ex post facto* correlation design as a systematic empirical inquiry by which the researcher does not own direct control of the independent variables. This is due to the fact that the independent variables' manifestations have already occurred or alternatively, they may not be inherently manipulable (Kerlinger & Lee, 2000). It should also be

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taken note of that an *ex post facto* research design does not allow experimental manipulation or random assignment. This is due to fact that through *ex post facto* research the researcher is interested in discovering the outcome in one variable when all the other variables changes. (Kerlinger & Pedhazer, 1973; Kerlinger & Lee, 2000). Inferences[19] about the hypothesized relations between the latent variables ξ_j and η_i are made from concomitant variation in independent variables (Kerlinger & Lee, 2000).

Utilising[20] the *ex post facto* correlation design, it is possible to obtain measures of the observed variables and calculate the observed covariance matrix. The specific research design refers to a systematic empirical inquiry where the researcher doing the investigation have no control of the independent variables, due to the fact that their manifestation has previously occurred or alternatively they don't allow any manipulation (Burger, 2012). The main focus in utilising the specific design is discovering what transpires to a specific variable as the others variables change. According to Diamantopoulos and Siguaw (2000) this enables the researcher to obtain estimates for the freed measurement and structural model parameters, in an iterative fashion, which enables the reproducing of the observed covariance matrix as closely as possible. According to Kerlinger and Lee (2000), the logic that underpins the specific design is captured in the manner this correlation design attains measures on the observed variables and estimates the observed n x p covariance matrix. From the work proposed by Diamantopoulos and Sigauw (2000), it is additionally indicated that estimates for freed structural and measurement model parameters are founded in an iterative manner, with the specific outcome of attempting to reproduce the observed covariance matrix as accurately as possible. Theron (2012) writes:

> The ex post facto correlation design in essence requires n units of analysis to be observed on indicator variables of the latent variables in the model while these observations/measures be correlated/ co-varied and that model parameter estimates be sought to reproduce the observed correlation/covariance matrix as accurate as possible (p.5).

Should fitting the model yield an absolute unsatisfactory model fit, the conclusion would inevitably follow that the comprehensive model does not provide an satisfactory explanation for the perceived covariance matrix and that the structural model as depicted in Figure 2.3 does not satisfactory explain variance in learning performance (Diamantopoulos & Siguaw, 2000; Kelloway, 1998; Byrne, 1989). The implication of such an outcome would entail that the current structural relationship hypothesised in the model do not provide an accurate reflection of those psychological processes moulding learning performance[21]. It should, however, be pointed out that the converse is not accurate. If the covariance matrix derived from the estimated structural and measurement model parameters closely agrees with the observed covariance matrix, it would not imply that the psychological dynamics postulated by the structural model necessarily produced the observed covariance. The implication of such an outcome means that it cannot be concluded that the psychological processes depicted in the model necessarily must have produced the levels of learning performance observed in the individuals sampled for the current proposed study. A high degree of fit between the observed and estimated covariance matrices would only imply that the psychological processes portrayed in the structural model provide one plausible explanation for the observed covariance matrix. According to Popper (1972), the structural model could, under such an outcome, be considered corroborated in the sense that it survived an opportunity to be refuted. Theron (2012) writes:

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[19] The *ex post facto* nature of the research design, however, prevents the drawing of casual inferences form significant path coefficients as correlations do not imply causation.

[20] The value of the of the ex post facto design lies in the fact that most research in the social sciences does not lend itself to experimentation. According to (Kerlinger & Lee, 2000) a certain degree of controlled inquiry may be possible, but experimentation is not.

[21] This outcome is only justified if the measurement model fits closely.

If the model parameter estimates cannot successfully reproduce the observed covariance/correlation matrix then the measurement/structural model has to be rejected. If the model parameter estimates can successfully reproduce the observed covariance/correlation matrix then the measurement/structural model has been corroborated (but not proven) (p.6).

The argument facilitated through the literature review, as represented by the hypotheses, presents a case for which dimensions of learning potential are expected to impact job performance. The drawing of causal inferences from significant correlation coefficients is prohibited, due to the nature of the research design.

3.5 STATISTICAL HYPOTHESES

The proposed structural model presents various endogenous latent variables with causal paths between the endogenous latent variables. The complex hypothesis presented by the proposed structural model (as presented in Figure 2.5) can be tested utilising structural equation modelling (SEM) (Jöreskog & Sörbom, 1993; Theron, 2013). Formulating the statistical hypothesis depends on the logic underlying the proposed research design as constructed and discussed earlier, taking into consideration the underlying logic of the statistical analyses. In order to maintain the integrity and meaning of the model, it will not be fruitful to consider other alternatives like multiple regression, as it would entail dissecting the model to test the paths as proposed by the structural model. The model should be tested as a complete entity, because the current study is attempting to establish why those individuals, given selective developmental opportunities, vary in the level of learning performance. This variance is not specifically located in a certain section of the structural model. The complete model as a complex network of relationships should be considered as the source of the variance found among the latent variables (Du Toit & Du Toit, 2001).

Through testing the current proposed structural model it is possible to obtain an estimation of the hypothesised model's fit to the extent to which the model is consistent with empirical data. This investigation of the fit of the proposed structural model will be executed through an exact fit null hypothesis and a close fit null hypothesis (Diamantopoulos & Siguaw, 2000).

Considering the overarching substantive research hypothesis, the proposed structural model is considered to be a valid account of the psychological process that determines the level of learning achieved by those individuals granted selected affirmative development opportunities. If the proposed overarching hypothesis would be interpreted to mean that the structural model provides a perfect account of the psychological processes underlying learning performance as defined by the literature study, the overarching hypothesis translates into and *exact fit null hypothesis* (which will also be tested) below:

$$H_{01} \text{ Exact Fit: RMSEA}=0$$
$$H_{a1} \text{ Exact Fit: RMSEA}>0$$

If the overarching substantive research hypothesis would be interpreted to mean that the structural model provides an approximate account of the psychological dynamics underlying learning performance, the substantive research hypothesis translates into a *close fit null hypothesis*:

$$H_{02} \text{ Close Fit: } RMSEA \leq 0.05$$
$$H_{a2} \text{ Close Fit: } RMSEA > 0.05$$

If reasonable fit is obtained for the paths proposed in the current model, the following path coefficient hypotheses should also be formulated and tested:

Hypothesis 2: In the proposed learning potential structural model it is hypothesised that Cognitive Engagement positively influences Learning Performance.

H_{03}: $\beta_{53} = 0$

H_{a3}: $\beta_{53} > 0$

Hypothesis 3: In the proposed learning potential structural model it is hypothesised that Conscientiousness will positively influence Cognitive Engagement.

H_{04}: $\gamma_{34} = 0$

H_{a4}: $\gamma_{34} > 0$

Hypothesis 4: In the proposed learning potential structural model it is hypothesised that Conscientiousness will positively influence Resilience.

H_{05}: $\gamma_{44} = 0$

H_{a5}: $\gamma_{44} > 0$

Hypothesis 5: In the proposed learning potential structural model it is hypothesised that Learning Motivation positively influences Tenacity.

H_{06}: $\beta_{21} = 0$

H_{a6}: $\beta_{21} > 0$

Hypothesis 6: In the proposed learning potential structural model it is hypothesised that Environmental Unfavourableness positively influences Cognitive Engagement.

H_{07}: $\gamma_{33} = 0$

H_{a7}: $\gamma_{33} > 0$

Hypothesis 7: In the proposed learning potential structural model it is hypothesised that Tenacity moderates the relationship between Environmental Unfavourableness and Cognitive Engagement.

H_{08}: No $\xi_3 * \eta_2$ interaction effect on η_3

H_{a8}: $\xi_3 * \eta_2$ interaction effect

Hypothesis 8: In the proposed learning potential structural model it is hypothesised that Grit positively influences Learning Motivation.

H_{09}: $\gamma_{11} = 0$

H_{a9}: $\gamma_{11} > 0$

Hypothesis 9: In the proposed learning potential structural model it is hypothesised that Grit positively influences Learning Performance mediated through Cognitive Engagement.

H_{010}: $\gamma_{51}=0$

H_{a10}: $\gamma_{51}>0$

Hypothesis 10: In the proposed learning potential structural model it is hypothesised that Grit positively influences Cognitive Engagement.

H_{011}: $\gamma_{31}=0$

H_{a11}: $\gamma_{31}>0$

Hypothesis 11: In the proposed learning potential structural model it is hypothesised that Resilience positively moderates the relationship between Environmental Unfavourableness and Cognitive Engagement.

H_{012}: No $\xi_3*\eta_4$ interaction effect on η_3

H_{a12}: $\xi_3*\eta_4$ interaction effect

Hypothesis 12: In the proposed learning potential structural model it is hypothesised that Parental Quality positively moderates the relationship between Environmental Unfavourableness and Cognitive Engagement.

H_{013}: No $\xi_3*\xi_2$ interaction effect on η_3

H_{a13}: $\xi_3*\xi_2$ interaction effect

Hypothesis 13: In the proposed learning potential structural model it is hypothesised that Parental Quality positively influences Learning Motivation.

H_{014}: $\gamma_{12}=0$

H_{a14}: $\gamma_{12}>0$

Hypothesis 14: In the proposed learning potential structural model it is hypothesised that Learning Motivation positively influences Cognitive Engagement.

H_{015}: $\beta_{31}=0$

H_{a15}: $\beta_{31}>0$

3.6 MEASURING INSTRUMENTS AND OPERATIONALISATION

In the current study, multiple hypotheses have been presented, given the twelve variables included in the current investigation, as described in Figure 2.5. In order to acquire observed evidence that the relationships as presented by the current learning potential structural model offer a credible vindication for the variances observed in learning performance, measures of the various latent variables compromising the model are required from the designated sample population of grade 9 learners. According to Diamantopoulos and Siguaw (2000) it is vital for the researcher to be able to trust the quality of the research measurements otherwise any assessment of the substantive relations of interest will pose challenges. Thus in order to come to a valid and reliable conclusion about the ability of the proposed learning potential structural model that can explain variance in the job competency potential, qualifying proof is needed that the

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manifest indicators are indeed valid and reliable measures of the latent variables they are related to, in accordance with the proposed measurement model. Therefore an evaluation of the measurement part of the model should precede the detailed evaluation of the structural section of the model (Diamantopoulos & Siguaw, 2000).

In order to establish the psychometric veracity of the indicator variables of the proposed learning potential structural model utilised to operationalise the latent variables, the author has discussed the operationalisation of each measuring instrument utilised in the study, with the specific focus on the reliability and validity of the measurement instruments. The latent variables operationalised included Learning Motivation, Environmental Unfavourableness, Conscientiousness, Resilience, Time Cognitively Engaged, Tenacity and Grit. The measure for Learning Performance was directly obtained from the participating institutions with the voluntary consent of each participant. The fit of the individual measurement models will additionally imitate the success with which the indicator variables represent the latent variables to which they are linked. This will be done empirically through item analysis[22], exploratory factor analysis[23] (EFA) and confirmatory factor analysis[24] (CFA). It should be noted that where self-constructed[25] instruments are utilised in this study the psychometric evidence will be the exclusive evidence available.

3.6.1 Learning Motivation

Nunes (2003) constructed a collective questionnaire to measure learner motivation and intention to learn. The omnibus questionnaire known as the Motivation to Learn Questionnaire [MLQ] was constructed with three sections. In the current study the author will utilise Section B, known as Motivation to Learn, assessing motivation to learn of the specific programme material presented. The motivation to learn scale consists out of 20 items. The questionnaire has proven to be reliable in that Nunes (2003) obtained a Cronbach alpha[26] of .941 with a sample size of 114. From the convincing evidence presented the MLQ will be utilised in the current study. The scale can be consulted in Appendix D.

3.6.2 Environmental Unfavourableness

The author developed a self-compiled 10-item scale in conjunction with a knowledgeable reference group establishing the content validity. The Environmental Unfavourableness subscale was designed to establish learner's home background, including caregiver occupational background, degree of physical space at home and general level of materialistic wealth. The questionnaire utilises a five point Likert scale. An example question includes: "I have my own bed and bedroom at home". The scale can be obtained in Appendix D.

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[22] Item analysis will be performed to determine to what extent the items all reflect a common underlying latent variable and all sensitively differentiate between different states of the latent variable. Poor items will be considered for deletion or revised.

[23] EFA will be conducted to examine the unidimentionality assumption.

[24] CFA will be utilised in an attempt to evaluate the degree to which the design intention succeeded.

[25] Parental Quality, Environmental Unfavourableness, Tenacity

[26] Burger's (2012) study revealed a Cronbach Alpha of .899. No extreme means or small standard deviations were reported, presenting a case for a finding of no poor items; hence all items of the specific scale were retained. In the current study two item parcels were calculated, utilising the even- and uneven means, forming two composite indicator variables for the Learning Motivation latent variable.[This should be retained for the section on the analysis of the data]

3.6.3 Conscientiousness

In order to measure the level of conscientiousness, the Alphabetical Index of 204 labels for 269 IPIP will be utilised (Prinsloo, 2012). The instrument is based on the revised version of NEO Personality Inventory [NEO-PI-R], which includes 20-items of the original 240-items. For the purposes of the current study the author adapted the instrument, however, the definition as cited in the current research project will be honoured. Conscientiousness is associated with the degree of organisation, persistence, control, and motivation in goal-directed behaviour. According to Burger (2012) the NEO Five-Factor Inventory [NEO-FFI] is mostly utilised in field based research and clinical studies as the design intention was to measure the same personality dimension as the longer NEO Personality Inventory in a shorter time frame. The shorter scale seems to be highly correlated with the NEO-PI-R factor score and internal consistency estimates are all acceptable (Burger, 2012). From the work presented by Burger (2012), a Cronbach Alpha of .90 is indicated in the literature on conscientiousness, whilst the Cronbach Alpha for the Conscientiousness Scale,[27] given Burger's item analysis, was reported as .890. Burger (2012) reported item C3 as a problematic item, and after deletion the Cronbach Alpha was reported as .927. Although the inter-item correlation matrix revealed that some items had a correlation less than .50, the item-total statistics indicated that no item increased the Cronbach Alpha after the deletion of C3 was executed. In the current study the author will calculate two item parcels, by utilising the means from the even and uneven numbered items of the scale to form two composite indicator variables for the Conscientiousness latent variable of the structural model. The scale can be consulted in Appendix D.

3.6.4 Resilience

In order to measure the construct of resilience the author utilised the PsyCap Questionnaire (PCQ). The PCQ was developed from multiple measurement sources of efficacy, hope, optimism and resilience (Luthans, Youssef, & Avolio, 2007). Different scales are utilised to measure the four facets of the PCQ. Two of the main criteria that were used in constructing the PCQ were: considering equal weights for each of the facets by selecting six items from each measure, and secondly, all of the measures should have face and content validity, reflecting their state-like nature and being relevant to the workplace. The items include the following sample items: "When I have a setback at work, I have trouble recovering from it, moving on" and "I usually take stressful things at work in my stride" Prinsloo (2012).

Through extensive psychometric analysis the PCQ has gained much support since it was developed. The PCQ is supported among multiple sector samples including, service, manufacturing, education, and military. If the Cronbach Alpha for resilience is considered for the six-item subscales and the overall PsyCap measures for the four samples, it is reported as follows: .71, .71, .66, and .72. Although the third sample (education) poses challenging results (.66) in the case of resilience, the internal consistency and reliability of the PsyCap measures proved to be consistently above conventional standards (Luthans et al., as cited in Prinsloo, 2012). For the current study two item parcels will be created for the Psychological Capital-variable of resilience which is included in the proposed model. This will be calculated by utilising the means of the even and uneven numbered items of the sub scale, which will form two composite indicator variables per for the Psychological Capital variable of resilience in the proposed structural model. The Resilience sub scale can be consulted in Appendix D.

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[27] Consisting of 12-items. After Deletion of C3 only 11-items remained.

3.6.5 Cognitive Engagement

It is critical that those learners who find themselves in a learning situation would expend extra effort in concentrating on the work at hand. Linnenbrink, Pintrich and Arbor (2003) write, that learners should think critically and creatively about the content presented to them. Once learners are engaged with the material at higher levels of concentration, understanding would be more easily obtained rather than using memory as a mechanism to retrieve uninternalised content (Burger, 2012).

Engagement is the extent of time a learner invests in his learning material. To measure Cognitive Engagement the Academic Engagement Scale for Grade School Students (AES-GS) can be utilised. The AES-GS consists of three subscales, which includes the Behavioural, Emotional and Cognitive subscales. In the current study the author will adapt the latter and only extract the Cognitive Engagement section. Burger (2012) obtained good reliability statistics with a Cronbach Alpha of .936. Two items were identified as poor items[28] and deleted, which resulted in an increased Cronbach Alpha score of .940.

In the current study two item parcels will be calculated by taking the mean of the even and uneven numbered items of the above mentioned scale, to form two composite indicator variables which will represent the Cognitive Engagement latent variable in the learning potential structural model. The scale can be consulted in Appendix D.

3.6.6 Tenacity

The author developed a self-compiled 8-item scale in conjunction with a knowledgeable reference group establishing the content validity. The Tenacity subscale was designed to measure academic tenacity among school learners. Academic tenacity, as operationalised in the current study can be defined as working hard and smart over a long period of time. An example question includes: "If I get stuck with a problem I continue to look for a solution". The questionnaire utilises a five point Likert scale. The subscale can be consulted in Appendix D.

3.6.7 Grit

Duckworth, Paterson, Matthews and Kelly (2007) introduced the construct of grit, defined as trait level perseverance and passion for long terms goals and showed that grit predicted achievement in challenging domains over and beyond measures of talent. Originally Duckworth et al. (2007) developed a 12-item grit scale known as the grit-o scale, however, examination of the Grit scale's model rendered a CFI of .83; a Root Means Square Error of Approximation of .11 suggested room for improvement. As a result of this Duckworth et al. (2007) constructed the Grit-S, a shortened Grit scale consisting of 8 items only. The Grit-S has proven to possess a more than adequate internal consistency, with alphas ranging from .73 to .79. Overall the 8-item Grit-S is both shorter and psychometrically stronger than the Grit-O. A CFA indicated that the Grit-S fitted the data better than the Grit-O. Shortening the Grit-O didn't influence the predictive validity compared to that of the original Grit-O (Duckworth et al., 2007). On the basis of the psychometric evidence provided, the author utilised the 8 item Grit-S scale to measure the learner's perseverance and passion for long-term goals. The scale can be consulted in Appendix D.

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[28] CE11 and CE14. After deletion only 15 items remained.

3.6.8 Learning Performance

The author obtained the permission of the learners and their parents to get access to the learner's academic marks. These marks were to be used as indicators of the learners learning performance during evaluation. These marks included the marks from the learners' four main subjects, Afrikaans, English, Mathematics and Geography/ History/Natural Science. This decision was based on the fact that the learning performance during evaluation of a learner should be measured by subjects were insight and transfer is required to perform successfully in the evaluation situation. It is not sufficient to include subjects were learners are able to pass the subject based on their memory, as this is not an accurate measure to provide an indication learners learning performance during evaluation, as the successful transfer of knowledge does not play such a deciding role in the level of learning performance achieved (Prinsloo, 2012). Transfer of knowledge can be regarded as the principal learning competency. To obtain a valid operationalisation of this construct requires that only the subjects where insight plays a deciding role and where transfer of knowledge is needed for the learner to achieve a certain level of learning performance should be included (Prinsloo, 2012).

In the current study the author has decided to utilise the first and the second terms' subject marks of the learner's grade 9 academic year, which will serve as a criterion measure for this particular study. These would form composite indicator variables for learning performance during the assessment of the evaluation latent variable, as presented in the current structural model (Prinsloo, 2012).

3.6.9 Parental Quality

The author has defined parental quality as the extent to which caregiver support is available for learner's educational success. The literature indicates that learners from low SES backgrounds benefits most significantly from caregiver involvement in academic activities. The Parental Quality subscale was designed to measure the extent to which the learner's caregivers have the capacity to check school homework, to assist with homework, present motivational incentives while having a goal for their child to complete school successfully. The author created a self-compiled 10 item scale set out on 5 point Likert scale, in conjunction with a knowledgeable reference group establishing the content validity. An example item included: "My caregiver(s) can help me with my school homework after school". The scale can be consulted in Appendix D.

3.7 RESEARCH PARTICIPANTS

The target sample unit that will be utilised testing the Learning Potential Structural Model consists of 395 grade 9 learners from numerous high schools in the Western Cape, resorting under the Western Cape Department of Education (DOE). The schools utilised in the study were geographically located in Bonteheuwel, Mannenberg and Goodwood. Permission from the DOE was granted for conducting the research. All the schools included in the study consisted of learners from disadvantaged backgrounds. Geographically the school is situated in Cape Town's lower socio-economic neighbourhoods. In order to adhere to the principle of ethics in research utilising minors, the author received full assent from the learners and consent from the parents.

3.7.1 Sample

Practically it is not always possible to reach every subject for measurement in a targeted population (N), alternatively it is possible to use a sample population (n) as presented in the current study. Generalising the observations to the target population is a function of the number of subjects in the selected sample and the handpicked individual representatives of the sample, while the sample size has a direct effect on the inferential statistics (De Goede & Theron, 2010; Elmes, Kantowitz, & Roediger, 1999; SIP, 1998). In order to estimate the sample size SEM can be utilised as an acceptable calculator. According to Kelloway (1998) a sample size at least 200 observations is sufficient for most SEM applications. Determining an accurate sample size is vital for the purpose of power analysis, including Type 1 and Type 2 errors (De Goede, 2007). In the current study non-probability convenience sampling was utilised.

If SEM is considered for calculating the acceptable sample size for a study, three issues should be considered. The first consideration that should be taken note of is the ratio of the sample size considered against the number of parameters to be estimated. It is not acceptable to have more freed model parameters than the number of observations in the sample (Prinsloo, 2012). It is proposed by Burger (2012) that elaborated models which contain more variables should result in a larger sample size. From the work presented by Bentler and Chou, it is recommended that the ratio of sample size to the number of parameters estimated should fall between 5:1 and 10:1 (Kelloway, 1998). If the current study is considered, the parameter calculation estimated 79 as the total number of parameters (see Figure 3.1). If the Bentler and Chou guideline is considered the current study sample size required will range between 395-790 observations for a credible test outcome.

$$\text{Df} \quad = (\tfrac{1}{2}[(p+q)(p+q+1)]-t) = 384$$

MODEL/HYPOTHESIS	# LAMBDA's	# TAU's	# Qδ/Qε's	#ALPA's	#GAMMA's	#BETA's	#PSI's	# PHI's	TOTAL # OF PARAMETERS TO BE ESTIMATED	# INDICATOR VARIABLES	# GROUPS	# UNIQUE INFORMATION PIECES	DF
SINGLE GROUP STRUCTURAL MODEL	25	0	30	0	10	3	5	6	79	30	1	465	384

Figure 3.1 Excel Macro Computing Degrees of Freedom for Single Group Structural Model

Compute Sample Size for RMSEA

Alpha	0.05
Degrees of Freedom	384
Desired Power	0.80
Null RMSEA	0.05
Alt. RMSEA	0.05

Figure 3.2 Preachers and Coffman Sample Size Estimation

The second main consideration with regard to the appropriate sample size, is the power statistics utilised in testing the hypothesis of close fit (H_0: RMSEA≤0.05) against the alternative hypothesis fit (H_a: RMSEA>0.05). If the above Figure 3.2 is considered, the Preacher and Coffman calculation[29] suggest that a sample size of 57 observations is required to ensure a .80 probability of correctly rejecting an incorrect model with 384 degrees of freedom. Burger (2012) writes that the statistical power in the context of SEM refers to a probability of rejecting the null hypothesis of close fit when in fact it should be rejected, because the model fit is mediocre. It should however be taken note of that excessively high statistical power would mean that any attempt to formally empirically corroborate the validity of the model would be futile. Even a small deviation from close fit would result in a rejection of the close fit null hypothesis. On the other hand excessively low power means that even if the model fails to fit closely, the close fit null hypothesis would still not be rejected. By not rejecting the close fit under circumstances of limited power will therefore not provide very convincing evidence on the validity of the model (Burger, 2012).

The final aspect that should be regarded; when deciding on the appropriate sample size, is practical and logistical considerations like cost, availability of appropriate respondents and the willingness of the institution targeted for research purposes (Burger, 2012).

Considering all the prerequisites[30] as mentioned above, a sample size of 395 research respondents were included in the current study for the purpose of testing the proposed learning potential structural model. These 395 respondents consisted of grade nine learners (which have completed term 1 and term 2 of grade 9) from four Western Cape Schools from the Bonteheuwel, Mannenberg and Goodwood areas.

3.8 MISSING VALUES

According to Mels (2003) multivariate data sets are prone to having missing values due to factors like non-responses or absenteeism. Imputing missing values depend on the amount of missing values and the nature of the data, specifically whether it follows multivariate normality. The most popular way of dealing with these missing is to utilise list-wise deletion to generate a data set that exclusively contains the complete data cases. If the issue of missing values is not dealt with, calculating the composite indicator variables may result in deficient indicator variables. However, this may pose a challenge to the researcher in that he may be left with only a small data set (Mels, 2003).

Alternatively to list wise deletion, there exist four additional options in dealing with missing values, namely pair-wise deletion, imputation by matching, multiple imputation and full information maximum likelihood imputation.

List-wise deletion requires the deletion of complete cases where missing values for any of the variables exist. This however, may lead to major reductions of the sample size, whereas pair-wise deletion only focuses on deleting cases for analysing of variables where values are missing. There is, however, also a flaw in pair-wise deletion in that it can produce calculation challenges of the observed covariance matrix, should the appropriate sample size for the calculation of the various covariance terms differ markedly (Dunbar-Isaacson, 2006).

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[29] Please view Appendix E for the complete calculation.
[30] Informed assent and consent documentation are included in Addendum C & D.

Being left with a small data set requires alternative methods of dealing with data containing missing values, however two such methods include Multiple Imputation (MI) and Full Information Maximum Likelihood (FIML). Multiple imputation performs several imputations for each missing value, creating a complete data set through each imputation. According to Davey, Shanan, & Schafer (2001), Raghunatha (2004), Schafer (1998, 1999) the imputations can be analysed individually, in order to obtain multiple estimates of the parameters of the model. When LISREL is considered, missing values for each case are subtitled with the average of the missing values imputed on each of the data sets (Du Toit & Du Toit, 2001). This means that the researcher is able to obtain credible values, while at the same time obtaining an indication of the uncertainty of the estimates. Du Toit and Du Toit (2001) writes that the multiple imputation technique makes the arduous assumption that the data is missing at random and that the observed data follows an underlying multivariate normal distribution. On the other hand Full Information Maximum Likelihood uses a more repetitive approach namely, an Expectation-Maximisation algorithm, which computes a case likelihood function, utilising only the variables that are observed for specific cases (Mels, 2003; Enders & Bandalos, 2001). Estimates of missing values are obtained on the basis of incomplete observed data to maximise the observed data likelihood (Enders & Bandalos, 2001). There is however a disadvantage, in that FIML directly returns a covariance matrix calculated for the imputed data. This makes the calculation of item parcels impossible, as well as item and dimensionality analysis (Du Toit & Du Toit, 2001). According to Du Toit and Du Toit (2001) the FILM also makes the strenuous assumption that data is missing at random and that the observed data follows an underlying multivariate normal distribution.

Finally, imputation by matching solves the missing value problem if the assumption of multivariate normality is not met. This process imputes values from other cases with a similar pattern of observed values on a set of matching variables. Thus, the procedure is substituting real values for missing values. The process involves a minimisation criterion application on a set of matching variables (Jöreskog & Sörbom, 1996). The ideal is to utilise matching variables that will not be utilised in the confirmatory factor analysis. However, it should be noted that imputation does not take place for a case if the minimisation criterion is not satisfied or if no observation exists with complete data on the set of matching variables (Enders & Bandalos, 2001). The items least plagued by missing values will be identified to serve as matching variables; cases with missing values after imputation will be deleted (Enders & Bandalos, 2001).

In the current study a decision will be taken on the most appropriate approach to treat the matter of missing values once the data has been collected and the extent of missing values is established.

3.9 DATA ANALYSIS

In the current study 395 grade 9 subjects will participate in completing the 77 item Learning Potential Questionnaire (LPQ) developed by the author (see Addendum D). The proposed expanded learning potential structural model's data, collected by means of the various instruments, will be analysed using Item Analysis, Exploratory Factor Analysis (EFA) and Structural Equation Modelling (SEM), with specific reference to the accommodation of the interaction effects. The process will allow the researcher to test if the assumed outcome holds true as proposed in Figure 5.2.

3.9.1 Item- and Dimensionality Analysis

Item analysis is a technique which is traditionally utilised to identify and estimate items from a measure that does not necessarily contribute to an internally consistent description of the sub-scale in question. Various scales exist that are intended to measure a specific latent variable or dimension of a latent variable carrying a specific constitutive definition. According to Anastasi and Urbina (1997) it is possible to install high validity and reliability into the measuring instruments in advance through item analysis, and through the selection, substitution, or revision of items. Items in the measuring instruments have specifically been created to indicate the standing of respondents on a specific latent variable. They are serving as stimuli to which respondents react with observable behaviour that is a relatively uncontaminated expression primarily of the specific underlying latent variable being assessed. The outcome on these latent variables is displayed and reflected through a number of item statistics, as a reaction to the design success (Burger, 2012).

In the current study item analysis[31] will be executed to determine the internal consistency of the items of the selected measuring instruments assessing the proposed learning potential structural model. Poor items are defined as items that fail to discriminate between different levels of the latent variables they were designed to reflect and those they were not intended to reflect. Considering all the available psychometric evidence[32] presented will assist in the decision to delete poor items from the scale or not.

3.9.2 Exploratory Factor Analysis

Considering the structure of the scale and subscales that are proposed in the current study as measures of the latent variables in the expanded learning potential structural model, allows the researcher to evaluate the intention to construct fundamentally one-dimensional sets of items (Theron, 2012). The implication being that test takers would respond to the items with observable behaviour which can be regarded as an outcome of a specific uni-dimensional latent variable, as the items are meant to function as homogenous stimulus sets to which raters respond with behaviour that is primarily an relatively uncontaminated expression of a specific underlying latent variable (Theron, 2012). The question that should be asked is whether this intention succeeded. According to Guion (1998) the behavioural response that is found in reaction to the items is not an exclusive reflection of the latent variables of interest, it is also a reflection of the influence by a number of additional latent variables and random error influences which were not intended in the specific measurement objective. Burger (2012, p107) writes:

> "The non-relevant latent variables that influence respondent's reaction to item i do not, however, operate to affect respondent's reaction to item j. The assumption is that only the relevant latent variable is a common source of variance across the items compromising a subscale."

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[31] Item analysis will be performed on the data before and after the treatment of missing values to assess the impact of the chosen procedure on the quality of item level measurement. This will be performed using SPSS| PASW version 20 (2013).

[32] In order to make a plausible changes to the included items the author will consider the outcome on, the total-item correlation, the squared multiple correlation, the change in the subscales reliability when the is deleted, the change in the subscale variance if the item is deleted, the inter-item correlations, the item mean and the item standard deviation.

According to Hulin, Drasgow and Parson (1993), if the latent variable of interest is statistically controlled then the partial correlation between items would approach zero. The most desirable outcome would be to obtain the most pure, uncontaminated findings on the specific underlying latent variable through the scale items (Theron, 2012).

In the current study a uni-dimensionality assumption is proposed in conjunction with the assumption that the latent variable explains a significant part of the observed variance in each of the items. Exploratory Factor Analyses would be executed[33] on each of the subscales. For extraction, Principle Axis Factor analysis would be utilised and, where factor fission is present, oblique rotation (Tebachnik & Fidell, 1989). Principle axis factor analyses with oblique (oblimin) rotation should be performed on each of the subscales, individually representing a facet of the multidimensional construct, to further evaluate the success with which each item accomplishes its intended function of reflecting primarily the intended latent dimension (Theron, 2012).The objective of these analyses is to confirm the uni-dimensionality of each subscale and to remove items with inadequate factor loadings and/or split heterogeneous subscales into two or more homogeneous subsets of items if necessary. According to Tebachnik and Fidell (as cited in Burger, 2012, p107) "principle axis factoring (PAF) is preferred over principal component factor analysis (PCA) as the former only analyses common variance shared between the items comprising a subscale whereas PCA analyses all the variance".

On the other hand the outcome of oblique rotation is to some extent, more challenging to interpret than the orthogonal rotation solution; however, oblique rotation is more realistic as it provides the analyst the possibility; if factor fission should occur, the option to correlate the extracted factors (Burger, 2012). If the factor loadings are considered; factor loading can be regarded as acceptable if $\lambda_{ij} > 0.05$. It is however, recommended that in the context of confirmatory factor analysis that factor loadings should be considered satisfactory if $\lambda_{ij} > 0.71$ (Hair, Black, Babin, Anderson, & Tatham, 2006). The literature however points out that the cut-off value, as suggested by Hair, Black, Babin, Anderson and Tatham (2006), is to strict when individual items are considered, but acceptable when interpreting the factor loadings of the item parcels in the measurement model fitted before the evaluation of the fit of the structural model (Burger, 2012).

Theron (2012) writes, that the uni-dimensionality assumption would be supported if the eigenvalue-greater-than-unity rule would result in the extraction of a single factor, the magnitude of the factor loadings are reasonably high and a small percentage (at least less than 50%) of the reproduced correlations are greater than 0,05. If the eigenvalue-greater-than unity rule would result in the extraction of more than one factor, the question becomes whether a sufficient number of items load on each factor, whether a meaningful interpretation of the factor fission is possible, and whether the magnitude of the factor loadings are reasonably high. If the fission is meaningful the decision needs to be taken on whether to adapt the current model and to do so.

The author however wants to point out that neither the item analyses nor the exploratory factor analyses of the various scales can however, provide sufficient evidence to permit a conclusive verdict with respect to the success with which the specific latent variable, as constitutively defined, is measured. To obtain more conclusive evidence on the construct validity of the various scales, the measurement models mapping the items on the latent variables will have to be

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[33] Dimensionality analyses will be executed through utilising PASW version 20 (PASW, 2013).

elaborated into fully fledged structural models that also map the latent variables onto outcome variables in accordance with the directives of the constitutive definitions of the latent variables (Theron, 2012).

3.9.3 Structural Equation Modelling

In the current study Structural Equation Modelling (SEM) will be used as a statistical analysis technique, to test the proposed learning potential structural model's absolute fit. Three different statistical techniques are discussed below.

3.9.3.1 Variable Type

In the current study two or more linear composites of the individual items will be constructed from each subscale, as representatives of each latent variable, when investigating the accurateness of the structural model. This will be executed by calculating the unweighted average of the odd numbered items and the even number items (Theron, 2012). This is known as parcelling[34]. According to Nunnally (1978), although the number of freed model parameters that have to be estimated are reduced by this technique, the sample size also becomes more manageable, which has the added benefit of creating more reliable indicator variables. It should however be pointed out that by reducing the sample size, the outcome of the confirmatory factor analysis can be influenced negatively (Marsh, Hau, Balla, & Grayson, 1998). A comment of caution is proposed by Theron (2012), which points out that should individual items be utilised as indicator variables, an extremely complex comprehensive LISREL model would result, thus he argues for parcelling as the better alternative. Should the parcelling alternative not be followed, a large sample size would be required, for the parameter estimates in the study to be considered credible.

For the purposes of the current study the choice fell on the utilisation of composite indicator variables, as this would ensure continuous indicator variables, measured on an interval level (Jöreskog & Sörbom, 1996; Mels, 2003) . In the current study the assumption is that multivariate normality will be met, thus the covariance matrix will therefore be analysed with maximum likelihood estimation (Du Toit & Du Toit, 2001).

3.9.3.2 Multivariate Normality

According to Kelloway (1998) and Theron (2012) LISREL by default uses maximum likelihood, assuming the indicator variables follow a multivariate normal distribution, to obtain estimates for the freed model parameters. Additionally PRELIS will be used to test whether the null hypothesis assumption is satisfactory, given the supposition that the indicator variables follow a multivariate normal distribution. Should the null hypothesis of a multivariate normal distribution be rejected, Jöreskog and Sörbom (1996) suggests that normalisation should be executed. This can be executed via PRELIS. According to Mels (2003), should the null hypothesis of a multivariate normal distribution still be rejected, Robust Maximum Likelihood can alternatively be executed. In the case of fitting a structural model to non-normal data, Weighted Least Square (WLS), Diagonally Weighted Least Squares (DWLS) and Robust Maximum Likelihood (RML) can be utilised to fit the model. The latter should, however, be considered with caution as failure to use the appropriate estimation technique, if the assumption of a multivariate normal distribution does not hold, can have

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[34] Parcelling refers to the act of taking the mean of the even and uneven numbered items of all the mentioned scales, to create two composite indicator variables for each latent variable represented in the structural model.

a significant negative effect on the fit of the resultant model, the parameter estimates and especially the standard error estimates (Theron, 2012).

3.9.3.3 Confirmatory Factor Analysis

Before the structural model can be fitted, the fit of the measurement model used to operationalise the structural model should be inspected first. According to Diamantopoulos and Siguaw (2000) the fit of the structural model indices can only be interpreted unequivocally for or against the fitted structural model if evidence exists that confirms that the indictor variables utilised to operationalise the latent variables successfully do so. Thus, successful operationalisation can only be confirmed if the measurement model fits closely. Additionally, the estimated factor loadings should all be statistically significant (p<0.05), while completely standardised factors loadings should be large and the measurement error variance small, but statistically significant (p<0.05) (Burger, 2012).

When the measurement model is fitted, the covariance matrix would be analysed, with maximum likelihood estimation, should the multivariate normality assumption be met[35]. Should the normalisation process fail to achieve the multivariate normality within the indicator variable distribution, the author will make use of robust maximum likelihood (RML) estimation, as an alternative method of determining the freed measurement model parameters. Performing the Confirmatory Factor Analysis will be done utilising LISREL

3.9.3.4 Measurement Model

The measurement model describes the way in which the latent variables express themselves as indicator variables, taken into consideration the operationalised choice of the latent variables in the structural model. In the current study a single measurement model will be fitted to examine the success of the operationalisation of the latent variables in which all latent variables are treated as exogenous latent variables. Equation 5 expresses the full measurement model:

---

[35] Before or after the normalization process.

$$
\begin{bmatrix}
X_1 \\ X_2 \\ X_3 \\ X_4 \\ X_5 \\ X_6 \\ X_7 \\ X_8 \\ X_9 \\ X_{10} \\ X_{11} \\ X_{12} \\ X_{13} \\ X_{14} \\ X_{15} \\ X_{16} \\ X_{17} \\ X_{18} \\ X_{19} \\ X_{20} \\ X_{21} \\ X_{22} \\ X_{23} \\ X_{24}
\end{bmatrix}
=
\begin{bmatrix}
\lambda_{11} & & & & & & & & & & & \\
\lambda_{21} & & & & & & & & & & & \\
& \lambda_{32} & & & & & & & & & & \\
& \lambda_{42} & & & & & & & & & & \\
& & \lambda_{53} & & & & & & & & & \\
& & \lambda_{63} & & & & & & & & & \\
& & & \lambda_{74} & & & & & & & & \\
& & & \lambda_{84} & & & & & & & & \\
& & & & \lambda_{95} & & & & & & & \\
& & & & \lambda_{105} & & & & & & & \\
& & & & & \lambda_{116} & & & & & & \\
& & & & & \lambda_{126} & & & & & & \\
& & & & & & \lambda_{137} & & & & & \\
& & & & & & \lambda_{147} & & & & & \\
& & & & & & & \lambda_{158} & & & & \\
& & & & & & & \lambda_{168} & & & & \\
& & & & & & & & \lambda_{179} & & & \\
& & & & & & & & \lambda_{189} & & & \\
& & & & & & & & & \lambda_{1910} & & \\
& & & & & & & & & \lambda_{2010} & & \\
& & & & & & & & & & \lambda_{2111} & \\
& & & & & & & & & & \lambda_{2211} & \\
& & & & & & & & & & & \lambda_{2312} \\
& & & & & & & & & & & \lambda_{2412}
\end{bmatrix}
\begin{bmatrix}
\xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \\ \xi_6 \\ \xi_7 \\ \xi_8 \\ \xi_9 \\ \xi_{10} \\ \xi_{11} \\ \xi_{12}
\end{bmatrix}
+
\begin{bmatrix}
\delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ \delta_6 \\ \delta_7 \\ \delta_8 \\ \delta_9 \\ \delta_{10} \\ \delta_{11} \\ \delta_{12} \\ \delta_{13} \\ \delta_{14} \\ \delta_{15} \\ \delta_{16} \\ \delta_{17} \\ \delta_{18} \\ \delta_{19} \\ \delta_{20} \\ \delta_{21} \\ \delta_{22} \\ \delta_{23} \\ \delta_{24}
\end{bmatrix}
\qquad \ldots\ldots 5
$$

Equation 5 can be reduced to equation 6:

$$X = \Lambda^x + \delta \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

According to Theron (2012), should the above measurement hypothesis be construed to mean that the measurement model exclusively provides an estimated account of the dynamics that produced the observed covariance matrix; the following *exact fit* null hypothesis would be true:

60

$$H_{01a}:RMSEA = 0$$
$$H_{a1a}:RMSEA > 0$$

Alternatively, should the measurement hypothesis be interpreted to mean that the, measurement model exclusively presents an estimated account of the dynamics that produce the observed covariance matrix, the following *close fit* null hypothesis would be true:

$$H_{01b}:RMSEA \leq 0.05$$
$$H_{a1b}:RMSEA > 0.05$$

3.9.3.5 Interpretation of Measurement Model Fit and Parameter Estimates

The ability of the fitted model to reproduce the observed covariance matrix can be regarded as the model fit and the fit is acceptable if the reproduced covariance matrix approximate the observed covariance matrix. Through utilising LISREL the fit can be analysed by interpreting the goodness of fit statistics. Additionally the quality of the model can be assessed through considering the magnitude and distribution of the standardised residuals, as well as calculating the model modification indices for Λ_x, Θ_δ and Θ_ϵ (Diamantopoulos & Siguaw, 2000). The fit[36] of the measurement model would improve through the freeing of large modification index values. It should however be pointed out that, a large number of significant modification index values will have an adverse impact on the fit of the model (Burger, 2012).

3.9.3.6 Fitting the structural model

The complete LISREL model will be fitted by analysing the covariance matrix. The analysis will be executed through Maximum Likelihood estimation, if the multivariate normality assumption is satisfied. Should the normalisation process fail to accomplish multivariate normality in the indicator variables distribution, alternatively robust maximum likelihood estimation will be utilised as an alternative to obtain estimate for the freed model parameters (Kelloway, 1998; Du Toit & Du Toit, 2001; Jöreskog & Sörbom, 1993; Jöreskog & Sörbom, 2003). Structural Equation Analysis will be executed using LISREL.

3.9.3.7 Interpretation of structural model fit and parameter estimates

The success of the proposed structural model would be considered successful and satisfactory if the comprehensive model fits the data seamlessly, the measurement model fits the data well, the path coefficients for the hypothesised structural relations are significant and the model explains a substantial part of the variance in each of the endogenous latent variables. The success of the outcome depends on the model fit as produced by LISREL with all indices provided. Additionally consideration would be focused on the modification indices and standardised residuals as calculated for Ψ, β and Γ. Inspection of the model modification indices for the aforementioned matrices here will primarily serve the

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[36] If the magnitude of the factor loadings is considered, according to (Hair, Black, Babin, Anderson, & Tatham, 2006) acceptability of the estimates will only be granted if the completely standardised factor loadings estimates are equal or greater than 0.71. If the criterion is deemed acceptable, it would imply that at least 50% of the indicator variable's variance is a reflection of what the latent variable is designed to represent.

purpose of remarking on the model fit as hypothesised. Inspection of the model modification calculation for the Γ and β matrices will, however, also be utilised exploring the possible modifications to the current structural model given the theoretical rationale accompanying the change. Should close fit be obtained, or at least reasonable fit for the comprehensive model, all the hypotheses will be tested as proposed in the current study. The completely standardised path coefficients will be interpreted for all the significant path coefficients, as well as the magnitude of the indirect and total effects with the variance explained by each of the endogenous latent variables.

3.9.3.8 Considering possible structural model modifications

In order to judge whether any adjustment should be made to the current paths as presented or additional paths to be added to the existing model, the author will consider the modification indices and the completely standardised expected change values calculated for the Γ and β matrices. Alterations will however only be accepted should the premise of the theory support such changes (Diamantopoulos & Siguaw, 2000).

3.10 SUMMARY

The current chapter presented the collection of hypotheses which will be investigated during empirical operationalization, as well as the research methodology to test the proposed hypotheses. In addition, the selected research design, measuring instruments and statistical analysis techniques were presented.

CHAPTER 4
RESEARCH RESULTS

4.1 INTRODUCTION

In the following section the author will present an overview and in-depth discussion of the statistical outcomes and the multiplicity of analyses performed. In determining the psychometric integrity of the indicator variables representing a range of latent dimensions, item analyses will be performed. The item analyses will be followed by an assessment to understand the level and extent to which the data is satisfactory in terms of the statistical data assumptions and techniques executed. Subsequently the measurement models fit will be assessed. It should be noted that no distinction has been made between the exogenous and endogenous measurement model, considering the success with which the latent variables had been operationalised. Accepting the measurement model fit to be satisfactory, the author continued to consider the structural model.

4.2 MISSING VALUES

The researcher initially attempted imputing the missing values utilising *Imputation by Matching*; however this proved to be a fruitless exercise as the execution of the process failed. It was then decided to utilise *Multiple Imputation*. The outcome of the latter process indicated the operational data gathered had only a very limited number of missing values. Most respondents were eager to answer all the questions presented. In Table 4.1 the distribution of missing values can be viewed among the items of the subscales.

Table 4.1

Distribution of Missing Values Across Items

TCE 1	TCE2	TCE3	TCE4	TCE5	TCE6	TCE7	TCE8	TCE9	TCE10
0	5	9	6	7	4	2	3	5	4
TCE11	TCE12	TCE13	TCE14	TCE15	TCE16	TCE17	CONS1	CONS2	CONS3
4	4	4	4	5	2	0	2	1	1
CONS4	CONS5	CONS6	CONS7	CONS8	CONS9	CONS10	CONS11	CONS12	LM1
2	4	0	3	2	2	1	1	1	2
LM2	LM3	LM4	LM5	LM6	PSYCAP1	PSYCAP2	PSYCAP3	PSYCAP4	PSYCAP5
2	2	1	1	0	0	1	0	0	3
PSYCAP6	GRIT1	GRIT2	GRIT3	GRIT4	GRIT5	GRIT6	GRIT7	GRIT8	PQ1
0	2	1	3	2	1	5	2	2	1
PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	EU1
1	0	4	0	2	2	2	1	0	0
EU2	EU3	EU4	EU5	EU6	EU7	EU8	EU9	EU10	TENAC1
0	1	1	3	0	2	1	0	0	4
TENAC2	TENAC3	TENAC4	TENAC5	TENAC6	TENAC7	TENAC8	ENGAVE	AFRAVE	MATHAVE
1	4	1	5	3	2	3	0	0	0
NSAVE									
0									

TCE= Time Cognitively Engaged; CONS= Conscientiousness; LM=Learning Motivation; PSYCAP= Resilience; GRIT; PQ= Parental Quality; EU=Environmental Unfavourableness; TENAC= Tenacity; ENGAVE= English Average Mark; AFRAVE= Afrikaans Average Mark; MATHAVE= Math Average Mark; NSAVE= Natural Science Average Mark

It should be noted however, that when attempting to calculate the composite indicator variables in the absence of treating the problem of missing values, one risks to end up with deficient indicator variables. Imputing the missing values depends on the number of missing values, as well as taking into consideration the nature of the data and whether the multivariate normality assumption is met (Du Toit & Du Toit, 2001). The data indicated that there were a small number of missing values. It was essential that these missing values were considered before Item Analyses was executed, which will be discussed in the following section.

4.3 ITEM ANALYSES

In order to detect those items in the subscale that are less representative of the latent construct being measured, item analysis via the SPSS reliability procedure can be utilised. The SPSS reliability procedure allows the researcher to remove any of the items not contributing to a valid and reliable delineation of the latent dimension being measured (Theron, 2012). The outcome gives a clear indication of the level of unreliability of a specific scale or of the lack of adequate levels of validity. This allows the researcher to adjust the scale and improve its credibility, by removing unsatisfactory and non-representative items (Theron, 2012). The rationale for removing of the bad items is that not only are they misrepresentative of the dimension measured, they are also insensitive to small discrepancies in the latent construct, as well as being non-unison responsive.

In the current study, item analysis was executed on the individual subscales of the learning potential questionnaire, utilised to gather the necessary data from the sample of 399 responders. The rationale for executing item analyses included screening items prior to final construction of the subscale item parcels, investigating the homogeneity of each sub-scale, as well as investigating the reliability of each of the latent variables. In the current study the author performed the item analyses on the imputed data set, utilising the reliability procedure as per SPSS 20.

4.3.1 Item Analysis Findings

After inspecting the item analyses as presented by the reliability procedure (via SPSS), the results of the considered latent variable scales are presented in Table 4.2. The internal consistency (Cronbach alpha) of the different subscales, after five items were removed from the subscales in total, revealed that three of the subscales were found to be >.80, indicating a very satisfactory outcome, and three of the subscales were >.70, indicating a moderately satisfactory outcome. The internal consistency of the PSYCAP subscales of Resilience (.675) and Grit (.478) were, unfortunately, unsatisfactory.

Table 4.2

Reliability results of learning potential latent variable scales

Scale	Sample Size	Number of Items	Mean	Variance	Standard Deviation	Cronbach Alpha
TCE	399	16	66.11	201.782	14.205	.895
CONS	399	11	43.21	139.434	11.808	.861
LM	399	6	34.42	25.339	5.034	.764
RES	399	5	22.14	20.272	4.502	.675
GRIT	399	7	21.64	25.942	5.093	.478
PQ	399	10	41.72	46.807	6.842	.818
EU	399	9	40.60	32.612	5.711	.791
TENAC	399	8	32.49	32.240	5.678	.744

TCE= Time Cognitively Engaged, CONS= Conscientiousness, LM= Learning Motivation, RES=Resilience, GRIT, PQ= Parental Quality, EU= Environmental Unfavourableness, TENAC= Tenacity

4.3.1.1 Time Cognitively Engaged

The *Time Cognitively Engaged* scale comprised of 17 items (see Addendum D). The results for the item analysis for the Time Cognitively Engaged scale are depicted in Table. 4.3. The Time Cognitive Engaged scale obtained a Cronbach's alpha of .893. The absence of extreme means and small standard deviations indicates the absence of poor items. When looking at the item statistics the means fell in a range from 3.52 to 4.53 (on a 7-point Likert scale) and the standard deviation ranged from 1.218 to 1.728.

Table 4.3

Item analysis results for the Time Cognitively Engaged scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.893	.899	17

Item Statistics			
	Mean	Std. Deviation	N
TCE1	3.52	1.366	356
TCE2	3.98	1.364	356
TCE3	4.35	1.294	356
TCE4	4.22	1.493	356
TCE5	3.92	1.537	356
TCE6	4.13	1.675	356
TCE7	3.90	1.728	356
TCE8	4.53	1.168	356
TCE9	4.35	1.218	356
TCE10	3.54	1.710	356
TCE11	3.88	1.465	356
TCE12	4.25	1.481	356
TCE13	4.00	1.532	356
TCE14	4.04	1.231	356
TCE15	4.32	1.463	356
TCE16	4.37	1.354	356
TCE17	4.39	1.339	356

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TCE1	66.17	194.670	.681	.526	.882
TCE2	65.71	199.757	.542	.377	.887
TCE3	65.34	198.879	.601	.419	.885
TCE4	65.47	198.762	.511	.301	.888
TCE5	65.77	195.597	.571	.401	.886
TCE6	65.56	201.289	.387	.217	.893
TCE7	65.79	198.298	.436	.316	.892
TCE8	65.15	200.458	.625	.582	.885
TCE9	65.34	198.214	.665	.560	.883
TCE10	66.15	202.503	.351	.261	.895
TCE11	65.81	195.456	.608	.432	.885
TCE12	65.44	203.537	.397	.227	.892
TCE13	65.69	194.661	.597	.463	.885
TCE14	65.65	201.531	.557	.360	.887
TCE15	65.37	193.208	.668	.511	.882
TCE16	65.32	198.630	.578	.392	.886
TCE17	65.30	197.697	.611	.460	.885

Inter-item correlations below .50 were obtained for items TCE6, TCE7, TCE10, and TCE12. All the items, however, obtained a correlation larger than .30. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that item TCE6, TCE10 and TCE12 were the only items with a squared multiple correlation smaller than .30. It is additionally indicated in the item statistics that the Cronbach's alpha would increase to .895 if item TCE 10 were to be deleted. Furthermore it is indicated that the deletion of any of the other items will have no

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increasing effect on the Cronbach alpha. With the significant evidence presented the researcher decided that item TCE 10, qualifying as a poor item, should be deleted.

With the deletion of item TCE 10 complete, the analysis was re-run and a Cronbach alpha of .895 was obtained. The item statistics indicated a mean ranging from 3.52 to 4.53 and standard deviation ranging from 1.168 to 1.727. The item-total statistics further indicated few items with correlations lower than 0.50, with the lowest being .383 for TCE6. Should item TCE6 be deleted it would further indicate an increase in Cronbach alpha to .896. The increase is not substantial enough for a deletion of item TCE6.

4.3.1.2 Conscientiousness

The Conscientiousness scale comprises of 12 items (see Appendix D). The results for the item analysis for the Conscientiousness are depicted in Table 4.4.

Table 4.4

Item analysis results for the Conscientiousness scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.832	.836	12

Item Statistics			
	Mean	Std. Deviation	N
CONS1	4.22	1.309	386
CONS2	4.26	1.261	386
CONS3	1 .85	1.974	386
CONS4	4.75	1.277	386
CONS5	4.40	1.541	386
CONS6	3.64	1.854	386
CONS7	3.75	1.309	386
CONS8	4.42	1.339	386
CONS9	3.16	2.083	386
CONS10	3.39	2.107	386
CONS11	3.41	2.090	386
CONS12	3.80	1.682	386

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CONS1	40.84	127.100	.502	.375	.819
CONS2	40.80	128.229	.483	.396	.821
CONS3	43.21	139.783	-.001	.067	.862
CONS4	40.31	133.402	.292	.270	.832
CONS5	40.66	125.804	.447	.330	.822
CONS6	41.42	113.907	.664	.501	.804
CONS7	41.31	126.478	.524	.390	.818
CONS8	40.64	126.793	.499	.414	.820
CONS9	41.90	109.101	.694	.673	.800
CONS10	41.67	109.358	.677	.647	.801
CONS11	41.65	108.691	.702	.697	.799
CONS12	41.26	121.781	.512	.309	.817

The Conscientiousness scale obtained a Cronbach's Alpha of .832. The item statistics showed the mean ranging from 1.85 to 4.75 (on a 7-point scale) and the standard deviation ranging from 1.261 to 2.107. In the inter-item correlation matrix item CONS3 stood out dramatically with all its correlations below .50, with a fair number of negative correlations as expected. Furthermore, the corrected item-total correlations flagged item CONS3 as a poor item as it obtained a correlation of -.001, compared to the other item correlations which ranged from .292 to .667. The squared multiple correlations also suggested that CONS3 was a poor item as it obtained a value of .067 compared to the rest of the items which turned values ranging from .270 to .697. Additionally the data indicates that should item CONS3 be

deleted the Cronbach's alpha will increase from .832 to .862, whilst none of the other items if deleted, would result in an increase in the Cronbach's alpha. With the above mentioned evidence it was decided to delete item CONS3 and the analysis was re-run.

The results of the re-run analysis after item CONS3 was deleted indicated an increase in the Cronbach alpha from .832 to a value of .861. The item statistics indicated a mean ranging from 3.16 to 4.75 and standard deviation ranging from 1.263 to 2.111. The item-total statistics further indicated few items with a correlations lower 0.50 with the lowest being .324 for CONS4. Should item CONS4 be deleted it would further indicate an increase in Cronbach alpha to .864. This increase is not substantial enough for a deletion of item CONS4, thus the only item which were deleted is CONS3.

4.3.1.3 Learning Motivation

The *Learning Motivation* subscale was constructed as a 7-point Likert scale (see Appendix D). The results for the item analysis for the Learning Motivation scale are depicted in Table 4.5. The Learning Motivation scale obtained a Cronbach's alpha of .764. The absence of extreme means and small standard deviations indicates the absence of poor items. When looking at the item statistics the means fell in range from 5.43 to 6.04 and the standard deviation ranged from 1.164 to 1.337.

Table 4.5

Item Analysis results for the Learning Motivation scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.764	.766	6

Item Statistics			
	Mean	Std. Deviation	N
LM1	5.78	1.164	394
LM2	5.63	1.308	394
LM3	5.43	1.171	394
LM4	5.95	1.225	394
LM5	5.60	1.337	394
LM6	6.04	1.219	394

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
LM1	28.64	18.516	.546	.324	.720
LM2	28.80	19.312	.376	.153	.764
LM3	28.99	18.656	.525	.292	.725
LM4	28.48	18.250	.534	.305	.722
LM5	28.82	17.509	.540	.317	.720
LM6	28.39	18.324	.529	.298	.723

Inter-item correlations below .50 were obtained for item LM2. All the items obtained a correlation larger than .30. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that item LM2, LM3 and LM6 were the only items with a squared multiple correlation of smaller than .30. It is additionally indicated in the item statistics that the Cronbach's alpha would increase to .764 if item LM2 were to be deleted. This deletion does not pose a significant effect on the increase of the Cronbach alpha and will thus not be considered for deletion.

4.3.1.4 Resilience

The resilience scale comprised of 6 items (see Appendix D). The result for the item analysis for the resilience scale is depicted in Table 4.6. The resilience scale obtained a Cronbach's alpha of .436. The absence of extreme means and small standard deviations indicates the absence of poor items. When looking at the item statistics the means fell in range from 3.00 to 5.14 and the standard deviation ranged from 1.103 to 1.576.

Table 4.6

Item analysis results for the Resilience scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.436	.470	6

Item Statistics			
	Mean	Std. Deviation	N
RES1	3.00	1.576	396
RES2	4.09	1.409	396
RES3	5.14	1.103	396
RES4	4.01	1.488	396
RES5	4.48	1.452	396
RES6	4.42	1.345	396

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
RES1	22.14	20.272	-.295	.104	.674
RES2	21.05	12.962	.357	.268	.302
RES3	20.01	15.114	.261	.089	.373
RES4	21.13	12.076	.414	.325	.256
RES5	20.66	13.025	.328	.160	.318
RES6	20.72	12.659	.429	.256	.262

Inter-item correlations below .50 were obtained for item RES1, RES2, RES3 and RES4. All the items obtained a correlation larger than .20. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that RES4 were the only item with a squared multiple correlation larger than .30. It is additionally indicated in the item statistics that the Cronbach's alpha would increase to .674 if item RES1 were to be deleted. Furthermore it is indicated that the deletion of any of the other items will have no increasing effect on the Cronbach alpha. With the significant evidence presented the researcher decided that item RES1, qualifying as a poor item, should be deleted.

With the deletion of item RES1 complete, the analysis was re-run and a Cronbach alpha of .674 was obtained. The item statistics indicated a mean ranging from 4.01 to 5.14 and standard deviation ranging from 1.103 to 1.488. The item-total statistics further indicated few items with a correlations lower than .50 with the lowest being .281 for RES3. Should item RES3 be deleted it would further indicate an increase in Cronbach alpha to .679. The increase was not considered as substantial enough for the deletion of item RES3.

4.3.1.5 Grit

The Grit scale comprised of 6 items (see Addendum D). The results of the item analysis of the Grit scale are depicted in Table 4.7. The Grit scale obtained a Cronbach's alpha of .471. A Cronbach alpha shows a satisfactory coefficient of internal consistency if it is >.80. The Grit scale is therefore not satisfactory, as only a very limited amount of variance is explained. The absence of extreme means and small standard deviations indicates the absence of poor items. When looking at the item statistics the means fell in range from 2.20 to 3.81 and the standard deviation ranged from 1.164 to 1.653.

Table 4.7

Item analysis results for the Grit scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.471	.483	8

Item Statistics			
	Mean	Std. Deviation	N
GRIT1	3.39	1.480	388
GRIT2	2.93	1.561	388
GRIT3	3.63	1.535	388
GRIT4	2.25	1.164	388
GRIT5	3.36	1.653	388
GRIT6	3.81	1.648	388
GRIT7	2.20	1.373	388
GRIT8	2.29	1.227	388

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
GRIT1	20.48	24.095	.201	.117	.441
GRIT2	20.93	23.241	.235	.101	.427
GRIT3	20.23	22.534	.297	.200	.399
GRIT4	21.61	24.729	.270	.509	.420
GRIT5	20.51	22.762	.236	.163	.426
GRIT6	20.05	24.266	.137	.233	.471
GRIT7	21.66	25.815	.108	.223	.475
GRIT8	21.57	25.021	.219	.548	.436

Inter-item correlations below .50 were obtained for all the items. All the items obtained a correlation larger than .10. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is clear that only GRIT4 and GRIT8 had squared multiple correlations larger than .30. Good items share a reasonable proportion of variance with the other items since they are meant to measure the same underlying factor. It is additionally indicated in the item statistics that the Cronbach's alpha would increase to .475 if item GRIT7 were to be deleted. It is furthermore indicated that the deletion of any of the other items will have no increasing effect on the Cronbach alpha. With the significant evidence presented the researcher decided that item GRIT7, qualifying as a poor item, should be deleted.

With the deletion of item GRIT7 complete, the analysis was re-run and a Cronbach alpha of .478 was obtained. The item statistics indicated a mean ranging from 2.25 to 3.80 and standard deviation ranging from 1.156 to 1.655. The item-total statistics further indicated few items with correlations lower 0.50 with the lowest being .110 for GRIT8.

Should item GRIT8 be deleted it would further indicate an increase in Cronbach alpha to .484. The increase is not substantial enough for a deletion of item GRIT8.

4.3.1.6 Parental Quality

The *Parental Quality* scale comprises of 10 items (see Addendum D). The results of the item analysis for the Parental Quality scale are depicted in Table 4.8. The Parental Quality scale obtained a Cronbach's alpha of .818. The absence of extreme means and small standard deviations indicates the absence of poor items. When looking at the item statistics the means fell in a range from 3.12 to 4.73 and the standard deviation ranged from .772 to 1.354.

Table 4.8

Item analysis results for the Parental Quality scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.818	.837	10

Item Statistics			
	Mean	Std. Deviation	N
PQ1	3.81	1.348	391
PQ2	4.71	.817	391
PQ3	4.08	1.180	391
PQ4	4.15	1.182	391
PQ5	4.67	.829	391
PQ6	3.89	1.354	391
PQ7	3.84	1.241	391
PQ8	3.12	1.338	391
PQ9	4.72	.799	391
PQ10	4.73	.772	391

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
PQ1	37.91	36.726	.506	.344	.802
PQ2	37.01	40.220	.571	.500	.798
PQ3	37.64	36.211	.648	.472	.784
PQ4	37.58	37.701	.531	.375	.798
PQ5	37.05	40.128	.570	.444	.798
PQ6	37.83	37.821	.429	.205	.812
PQ7	37.88	38.171	.463	.332	.806
PQ8	38.60	38.179	.414	.305	.814
PQ9	37.00	40.485	.559	.536	.799
PQ10	36.99	41.172	.509	.540	.804

Inter-item correlations below .50 were obtained for items PQ6, PQ7, and PQ8. All the items obtained a correlation larger than .40. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that item PQ6 were the only item with a squared multiple correlation of smaller than .30. Furthermore it is indicated that the deletion of any of the other items will have no increasing effect on the Cronbach alpha. With the significant evidence presented the researcher decided that no item qualifies as a poor item and thus, no items will be additionally deleted.

4.3.1.7 Environmental Unfavourableness

The *Environmental Unfavourableness* scale comprises of 10 items (see Addendum D). The results of the item analysis for the Environmental Unfavourableness scale are depicted in Table 4.9. The Environmental Unfavourableness scale

obtained a Cronbach's alpha of .687. The presence of extreme means and small standard deviations indicated in item EU5 is an immediate consideration for deletion. When looking at the item statistics the means fell in range from 3.17 to 4.89 and the standard deviation ranged from .608 to 1.786.

Table 4.9

Item Analysis results for the Environmental Unfavourableness scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.687	.799	10

Item Statistics			
	Mean	Std. Deviation	N
EU1	4.85	.666	391
EU2	4.25	1.273	391
EU3	4.89	.608	391
EU4	4.84	.740	391
EU5	3.17	1.786	391
EU6	4.85	.638	391
EU7	4.23	1.282	391
EU8	3.66	1.509	391
EU9	4.61	.864	391
EU10	4.43	1.287	391

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EU1	38.92	29.257	.570	.572	.646
EU2	39.52	26.681	.418	.288	.649
EU3	38.87	29.353	.619	.667	.645
EU4	38.93	29.259	.499	.508	.650
EU5	40.59	32.833	-.108	.058	.792
EU6	38.92	29.185	.611	.599	.643
EU7	39.53	26.998	.387	.279	.656
EU8	40.10	25.441	.400	.264	.655
EU9	39.15	27.761	.582	.534	.632
EU10	39.34	26.552	.422	.264	.649

Inter-item correlations below .50 were obtained for item EU2, EU4, EU5, EU7, EU8 and EU10. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that items EU1, EU3, EU4, EU6 and EU9 were the only items with a squared multiple correlation larger than .50. Good items share a reasonable proportion of variance with the other items since they are meant to measure the same underlying factor. It is additionally indicated in the item statistics that the Cronbach's alpha would increase to .792 if item EU5 were to be deleted. Furthermore it is indicated that the deletion of any of the other items will have no increasing effect on the Cronbach alpha. With the significant evidence presented the researcher decided that item EU5, qualifying as a poor item, should be deleted.

With the deletion of item EU5 complete, the analysis was re-run and a Cronbach alpha of .791 was obtained. The item statistics indicated a mean ranging from 3.65 to 4.89 and standard deviation ranging from .606 to 1.283. The item-total statistics further indicated few items with correlations lower than .50, with the lowest being .434 for EU7. The deletion of any additional items will not succeed in increasing the current Cronbach alpha.

4.3.1.8 Tenacity

The *Tenacity* scale comprises of 8 items (see Addendum D). The results of the item analysis for the Tenacity scale are depicted in Table 4.10. The Tenacity scale obtained a Cronbach's alpha of .744. The presence of extreme means and small standard deviations were found to be fairly absent. When looking at the item statistics the means fell in range from 3.54 to 4.48 and the standard deviation ranged from .876 to 1.392.

Table 4.10

Item Analysis Results for the Tenacity Scale

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.744	.746	8

Item Statistics			
	Mean	Std. Deviation	N
TENAC1	4.25	1.037	384
TENAC2	4.48	.876	384
TENAC3	4.19	1.020	384
TENAC4	3.54	1.200	384
TENAC5	3.73	1.392	384
TENAC6	4.21	1.287	384
TENAC7	3.83	1.355	384
TENAC8	4.27	1.219	384

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
TENAC1	28.24	27.298	.357	.155	.732
TENAC2	28.01	27.352	.450	.238	.720
TENAC3	28.30	27.272	.369	.204	.730
TENAC4	28.95	26.026	.390	.215	.727
TENAC5	28.77	23.428	.510	.275	.703
TENAC6	28.28	24.384	.488	.322	.708
TENAC7	28.67	23.998	.482	.290	.710
TENAC8	28.22	24.921	.479	.313	.710

An inter-item correlations above .50 was obtained only for item TENAC5. The squared multiple correlation indicates the multiple correlation when regressing each item on a weighted linear composite of the remaining variables. If the squared multiple correlations are considered it is indicated that only TENAC 6 and TENAC8 were the only items with a squared multiple correlation larger than .30. Good items share a reasonable proportion of variance with the other items since they are meant to measure the same underlying factor. Furthermore it is indicated that the deletion of any item will have no increasing effect on the Cronbach alpha.

4.4 DIMENSIONALITY ANALYSIS

In the current study the researcher performed Unrestricted Principal Axis Factoring with Varimax rotation (which maximises the factor loading variance) on each of the subscales of the Learning Potential Questionnaire. The rationale for performing this was to establish the uni-dimensionality of each of the subscales and to remove the items with insufficient factor loadings, as well as, where necessary, to split heterogeneous subscales into two of more homogenous subsets of item. To establish the number of factors to be extracted, the eigenvalues-greater-than-unity (>1.00) (Norusis, 1988) rule of thumb was used. Factor loadings were considered satisfactory if they were greater than .50. For this specific analysis the researcher utilised SPSS 20 [2013]. By evaluating the item-analyses it was decided to delete (given the outcome on the calculation of the percentage of large residual correlations) specific items before commencing with the dimensionality analysis. The items that qualified for deletion were excluded from the exploratory factor analysis.

Most of the current subscales expressed non uni-dimensionality subscales including Time Cognitively Engaged, Conscientiousness, Grit, Parental Quality, Environmental Unfavourableness and Tenacity. The application of the eigen-value-greater-than-unity rule indicated that no single factor adequately explained the latter observed correlation matrixes. These items were meant to operate as stimuli sets to which test takers respond with behaviour that is primarily an expression of that specific one-dimension underlying latent variable. The intention in the current study was to obtain a relatively uncontaminated measure of the specific latent variable, which in the current study were not the case in the majority of the cases.

Factor analysis seeks to condense a large amount of observed variables into highly correlated groups that measure a single underlying construct. Thus, the observed variables are the extent of agreement with specific behavioural statements. According to Byrne (2001), factor analytic models are primarily focussed on how, and the extent to which, values on the observed variables are generated by underlying latent variables or factors. In the current analysis the primary interest includes the factor loading patterns and the parameters characterising the regression paths from the factors to the observed variables. It should be realised that a factor loading is described as the slope of the regression of an observed variable on the underlying factor that it represents (Allen & Yen, 1979).

In Table 4.11 the author presents a summary of the findings and results of the factor analysis of the complete scale. The findings are further elaborated on in the following section.

Table 4.11

Factor analysis results for the Learning Potential Questionnaire (LPQ) scale

Scale	(KMO)	Bartlett's Test	Maximum Loading	Minimum Loading	Proportion of variance accounted for by a single factor	Percentage Non-Redundant residuals	Number of Factors Extracted
TCE	.934	2152.176	0.725	0.394	37.037%	40.0%	2
CONS	.874	1798.444	.745	.356	37.156%	76.0%	2
LM	.827	494.711	.649	.429	35.986%	20.0%	1
RES	.734	281.509	.696	.341	30.816%	30.0%	1
GRIT	.620	479.060	.888	-.308	22.124%	85.0%	2
PQ	.838	1325.156	.699	.391	35.042%	66.0%	3
EU	.819	1377.056	.772	.427	38.572%	77.0%	2
TENAC	.803	549.137	.602	.417	27.282%	60.0%	2

TCE=Time Cognitively Engaged, CONS=Conscientiousness, LM=Learning Motivation, RES= Resilience, GRIT, PQ= Parental Quality, EU= Environmental Unfavourableness, TENAC= Tenacity

4.4.1 Time Cognitively Engaged

If the scale of Time Cognitively Engaged is considered, item TCE 10 was found to be a poor item in the item analysis and was therefore not included in the dimensionality analysis of the Time Cognitively Engaged scale. The correlation matrix should contain correlations that are bigger than .30 and significant ($p < .05$) for the correlation matrix to factor analysable. The correlation matrix indicated that the matrix was factor analysable as a large number of the correlations were bigger than .30 and significant ($p < .05$). The Kaiser-Meyer-Olkin (KMO) is a measure of sampling adequacy and reflects the ratio of the sum of the squared inter-item correlations to the sum of the squared inter-item correlations, plus the sum of the squared partial inter-item correlations, summed across all correlations. In the current study the KMO is indicated as .934, providing sufficient evidence that the Time Cognitively Engaged scale was factor analysable ($>.60$). When the KMO approaches unity, or at least achieves a value bigger than .60, the correlation matrix is deemed factor analysable (Tebachnik & Fidell, 1989). The Bartlett's Test of Sphericity[37] tests the null hypothesis that the correlation matrix is an identity matrix in the population. The Bartlett's Test of Sphericity indicated that H_0 could be rejected ($p < .05$) providing further support that the matrix was factor analysable.

In contrast to the researcher's expectations two factors had to be extracted to adequately explain the observed correlation matrix, since two factors obtained eigenvalues greater than 1. The evaluation of this statement can be viewed in the pattern matrix in Table 4.12, which reflects the unique correlation between factors (Tebachnik & Fidell, 1989). Tebachnik and Fidell (1989) views the interpretation of the pattern matrix as superior to the structure matrix, as the differences among high and low loadings is more apparent.

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[37] Indicating that the diagonal contains 1's and all off-diagonal elements are zero (Tebachnik & Fidell, 1989).

Table 4.12

Rotated factor structure for the Time Cognitively Engaged scale

	Pattern Matrix	
	Factor	
	1	2
TCE1	**.673**	-.109
TCE2	-.051	**-.677**
TCE3	.157	**-.537**
TCE4	.344	-.247
TCE5	**.682**	.027
TCE6	.491	.069
TCE7	.254	-.191
TCE8	-.162	**-.938**
TCE9	.109	**-.683**
TCE11	**.689**	.018
TCE12	.119	-.341
TCE13	**.668**	-.025
TCE14	.217	-.414
TCE15	**.656**	-.115
TCE16	**.510**	-.158
TCE17	.165	**-.558**

The five items loading (.>50) on the second factor all appeared to refer to a specific underlying theme, while the 6 items (.>50) in the first factor seem to reflect a more general theme of Time Cognitively Engaged, thus improvement is necessary. It should be noted, however, that the proposed structural model of Time Cognitively Engaged was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Time Cognitively Engaged scale reflects the single underlying latent variable, the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.13. Not all items loaded onto the one factor with factor loadings larger than .50. Only variable items with a loading larger than .50 were selected as satisfactory enough to represent the specific underlying factor.

Table 4.13

Factor matrix when forcing the extraction of a single factor (Time Cognitively Engaged)

	Factor Matrix
	Factor
	1
TCE1	.725
TCE2	.568
TCE3	.640
TCE4	.551
TCE5	.607
TCE6	**.394**
TCE7	**.415**
TCE8	.689
TCE9	.724
TCE11	.622
TCE12	**.426**
TCE13	.643
TCE14	.585
TCE15	.716
TCE16	.623
TCE17	.667

The results indicated that all the items loaded >.50, besides items TCE6, TCE7 and TCE12, which are considered unsatisfactory. It was consequently decided to delete those values <.50. The residual correlations were computed for both 2-factor and the 1-factor solution. For the 2-factor solution only 15% of the non-redundant residuals had absolute values greater than .05, thus suggesting that the rotated factor solution provides a very credible explanation for the

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observed inter-item correlation matrix. The 1-factor solution, however failed to provide a credible explanation as 40% of the residual correlations were greater than .05.

4.4.2 Conscientiousness

If the scale of Conscientiousness is considered, item CONS 3 was found to be a poor item in the item analysis and was therefore not included in the dimensionality analysis of the Conscientiousness scale. In the current study the KMO is indicated as .874 providing sufficient evidence that the Time Cognitively Engaged scale was factor analysable (>.60). The Bartlett's Test of Sphericity indicated that H_0 could be rejected (p< .05) providing further support that the matrix was factor analysable.

In contrast to the intention of the researcher two factors had to be extracted to adequately explain the observed correlation matrix, since two factors obtained eigenvalues greater than 1. The evaluation of this statement can be viewed in the pattern matrix as depicted in Table 4.14.

Table 4.14

Rotated factor structure for the Conscientiousness scale

Pattern Matrix		
	Factor	
	1	2
CONS1	**.556**	-.098
CONS2	**.672**	.014
CONS4	**.586**	.149
CONS5	**.604**	.002
CONS6	.225	**-.593**
CONS7	**.576**	-.120
CONS8	**.610**	-.075
CONS9	.007	**-.860**
CONS10	-.028	**-.862**
CONS11	-.011	**-.896**
CONS12	.470	-.182

The four items loading (.>50) on the second factor all appeared to refer to a specific underlying theme, while the 6 items (.>50) in the first factor seem to reflect a more general theme of Conscientiousness, suggesting improvement is necessary. It should be noted however, that the proposed structural model of Conscientiousness was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Conscientiousness scale reflect a single underlying latent variable the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.15.

Table 4.15

Factor matrix when forcing the extraction of a single factor *(Conscientiousness)*

Factor Matrix	
	Factor 1
CONS1	.554
CONS2	.544
CONS4	**.356**
CONS5	.502
CONS6	.718
CONS7	.592
CONS8	.577
CONS9	.734
CONS10	.705
CONS11	.745
CONS12	.562

The results indicated that all the items, besides item, CONS4 loaded <.50 which is unsatisfactory. It was consequently decided to delete those values <.50. The residual correlations were computed for both 2-factor and the 1-factor solution. For the 2-factor solution only 16% of the non-redundant residuals had absolute values greater than .05, thus suggesting that the rotated factor solution provides a very credible explanation for the observed inter-item correlation matrix. The 1-factor solution, however failed to provide a credible explanation in that 76% of the residuals correlations were greater than .05.

4.4.3 Learning Motivation

If the scale of Learning Motivation is considered, no items was found to be poor items in the item analysis and all the original items were included in the dimensionality analysis of the Learning Motivation scale. In the current study the KMO is indicated as .827 providing sufficient evidence that the Learning Motivation scale was factor analysable (>.60). The Bartlett's Test of Sphericity indicated that H_0 could be rejected (p< .05) providing further support that the matrix was factor analysable.

One factor was extracted, since only one factor obtained an eigenvalue greater than 1. The scree plot also suggested that a single factor should be extracted. The factor matrix indicated that all the items loaded on one factor satisfactorily as all factor loading were larger than .50, accept LM2 (.429). The resultant factor structure is shown in Table 4.16.

Table 4.16

Rotated factor structure for the Learning Motivation scale

Factor Matrix	
	Factor 1
LM1	.649
LM2	**.429**
LM3	.608
LM4	.625
LM5	.634
LM6	.626

In the current scale only 20% of the reproduced correlations were larger than .05, suggesting that the rotated factor solution provides a credible explanation for the observed inter-item correlation matrix. The uni-dimensionality assumption was thus corroborated.

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4.4.4 Resilience

The item analysis indicated that item RES1 was a poor item and it was subsequently deleted from the scale. The dimensionality analysis performed on the Resilience scale was, therefore, performed without item RES1. Only a limited number of the items in the correlation matrix obtained correlations exceeding the .30 cut-off value. However all the correlations in the correlation matrix were significant (p<.05). The Resilience scale obtained a KMO of .734 and it was deduced from the results that H_0 could be rejected, meaning that the correlation matrix was factor analysable. From the results it is indicated that only a single factor could be extracted since one factor obtained an eigenvalue greater than 1. The resultant factor structure is shown in Table 4.17.

From the scree plot it is also indicated that only a single factor are to be extracted. Additionally it can be said that all the other items could be considered satisfactory in terms of the proportion of item variance that could be explained by the first factor, as they were all larger than .50 accept RES3 (.341). It can thus be confirmed that the uni-dimensionality assumption is met.

Table 4.17

Rotated factor structure for the Resilience scale

Factor Matrix	
	Factor 1
RES2	.590
RES3	**.341**
RES4	.696
RES5	.458
RES6	.619

Only 30% of non-redundant residuals obtained absolute values greater than .05, suggesting that the rotated factor solution provides a credible explanation for the observed inter-item correlation matrix.

4.4.5. Grit

If the scale of Grit is considered, item GRIT 7 was found to be a poor item in the initial item analysis and was therefore not included in the dimensionality analysis of the Grit scale. The correlation matrix should contain correlations that are bigger than .30 and significant (p< .50) for the correlation matrix to factor analysable. In the current study the KMO is indicated as .620, providing sufficient evidence that the Grit scale was factor analysable (>.60). The Bartlett's Test of Sphericity indicated that H_0 could be rejected (p< .05) providing further support that the matrix was factor analysable.

In contrast to the intention of the researcher two factors had to be extracted to adequately explain the observed correlation matrix, since two factors obtained eigenvalues greater than 1. The evaluation of this statement can be viewed in the pattern matrix as depicted in Table 4.18.

Table 4.18

Rotated factor structure for the Grit scale

Pattern Matrix		
	Factor	
	1	2
GRIT1	-.001	.437
GRIT2	.299	.092
GRIT3	.063	**.606**
GRIT4	**.774**	-.077
GRIT5	.032	**.518**
GRIT6	-.119	**.584**
GRIT8	**.891**	-.161

   The three items loading (>.50) on the second factor all appeared to refer to a specific underlying theme, while the two items (>.50) in the first factor seem to reflect a more general theme of Grit, although improvement is necessary. It should be noted, however, that the proposed structural model of Grit was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Grit scale reflect a single underlying latent variable, the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.19. Not all items loaded onto the one factor with factor loadings larger than .50 which can be considered satisfactory.

Table 4.19

Factor matrix when forcing the extraction of a single factor (Grit)

Pattern Matrix
Factor
1
GRIT1	**-.169**
GRIT2	**.238**
GRIT3	**-.162**
GRIT4	.726
GRIT5	**-.164**
GRIT6	**-.308**
GRIT8	.888

The results indicated that all the items, besides items GRIT4 and GRIT8 loaded <.50, which is unsatisfactory. It was consequently decided to re-investigate the theory on the particular latent variable and the construct items measuring it. In the current outcome, the residual correlations were computed for both 2-factor and the 1-factor solution. For the 2-factor solution only 4% of the non-redundant residuals had absolute values greater than .05, thus suggesting that the rotated factor solution provides a very credible explanation for the observed inter-item correlation matrix. The 1-factor solution, however failed to provide a credible explanation in that 85% of the residuals correlations were greater than .05.

After the re-investigation of the theory on the Grit scale, the researcher decided, after meticulous investigation into the sub-dimensions of the construct of Grit, that the only option yielding a satisfactory outcome was to divide the items constituting Grit. The research indicated that the items can be separated into the sub-dimensions of (a) *Consistency of Interest*[38] and (b) *Perseverance of Effort*[39] (Duckworth & Quinn, 2009). The sub-division of the items yielded a

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[38] GRIT 1, GRIT3, GRIT5, GRIT6

[39] GRIT2, GRIT4, GRIT7,GRIT8

moderately positive outcome, with a significant increase in the Cronbach alphas as indicated by the recalculated Item Analysis. The first sub-dimension, namely Consistency of Interest, yielded a Cronbach alpha of .616. The scale statistics indicated a mean of 14.16; variance of 18,588 and a standard deviation of 4.311. Unfortunately the deletion of any addition items did not yield a positive change to the Cronbach alpha. The second sub-dimension, namely Perseverance of Effort, yielded a Cronbach alpha of .673. In this case the scale statistics indicated a mean of 9.72; variance of 14.716 and a standard deviation of 3.836. Fortunately the item-total statistics indicated that, with the deletion of item GRIT2, the Cronbach alpha increased to a satisfying value of .741. The analysis was re-run and the Cronbach alpha yielded a value of .741. It was therefore established that the shortened Grit scale does measure two distinctive underlying factors.

As a result of the favourable outcome of the restructured item analysis the researcher decided to re-run the dimensionality analysis. The result of the re-run dimensionality analysis indicated that the correlation matrix factor was analysable with respect to both sub-dimensions, as all the correlations exceeded .30 and all were significant (p< .05). Furthermore, the KMO was.704 for sub-dimension Consistency of Interest, and .665 for sub dimension Perseverance of Effort. In the case of both sub dimensions the Bartlett's Test of Sphericity indicated that H_0 could be rejected. Table 4.19 (a) and Table 4.19 (b) presents the rotated factors structure for the sub-dimensions of the Grit scale.

Table 4.19 (a)

Rotated Factor Structure for the Consistency of Interest sub dimension

Factor Matrix	
	Factor 1
GRIT1	**.437**
GRIT3	.597
GRIT5	.533
GRIT6	.577

Only a single factor was extracted in terms of the observed correlation matrix, since only one factor obtained an eigenvalue greater than 1. As expected, the factor matrix indicted that all the items loaded on to one factor satisfactorily. All the obtained factor loadings were bigger than .50, except for item GRIT1 (.437), while the reproduced correlations were larger than .50, suggesting that the rotated factor solution provides a credible explanation for the observed inter-item correlation matrix. GRIT1 was removed from the sub-dimension of *Consistency of Interest*.

Table 4.19 (b)

Rotated Factor Structure for the Perseverance of Effort sub dimension

Factor Matrix	
	Factor 1
GRIT2	**.308**
GRIT4	.783
GRIT7	.499
GRIT8	.869

Only a single factor was extracted in terms of the observed correlation matrix, since only one factor obtained an eigenvalue greater than 1. As expected, the factor matrix indicated that all the items loaded on to one factor

satisfactory. All the obtained factor loadings were bigger than .50, except for item GRIT2 (.308), while the reproduced correlations were larger than .50, suggesting that the rotated factor solution provides a credible explanation for the observed inter-item correlation matrix. GRIT2 was removed from the sub dimension of *Perseverance of Effort*.

4.4.6 Parental Quality

 For this scale the item analysis indicated that the deletion of any of the items will not increase the Cronbach alpha. Subsequently no items have been deleted, and thus all items were included in the item analysis for the Parental Quality scale. However, even with all the items the correlation matrix indicated a fair amount of correlations larger than .30, although all the correlation were significant (p<.05).

If the KMO is considered, a figure of .838 is indicated, which is larger than .60 and the Bartlett's Test of Sphericity indicated that H_o could be rejected, indicating that the correlation matrix was factor analysable. The Parental Quality scale was hypothesised to have a single dimension. It was however found that, contrary to what was hypothesised, three factors were extracted in terms of the observed correlation matrix, since three factors obtained eigenvalues greater than 1. The resultant pattern matrix is indicated in Table 4.20. From the scree plot it is also indicated that more than a single factor should be extracted.

Table 4.20

Rotated factor structure for the Parental Quality scale

	Pattern Matrix		
	Factor		
	1	2	3
PQ1	-.035	.018	**-.708**
PQ2	**.659**	.030	-.104
PQ3	.169	.303	-.412
PQ4	.053	-.063	**-.730**
PQ5	**.629**	.069	-.085
PQ6	.180	.117	-.271
PQ7	.119	**.744**	.110
PQ8	-.113	**.648**	-.112
PQ9	**.779**	.005	.000
PQ10	**.873**	-.068	.073

The four items loading (>.50) on the first factor all appeared to refer to a specific underlying theme, while the two items (>.50) in the second factor, and two items in the third factor seem to reflect a limited scope if Parental Quality thus, improvement is necessary. It should be noted however, that the proposed structural model of Parental Quality was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Parental Quality scale reflects a single underlying latent variable, the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.21.

Table 4.21

Factor matrix when forcing the extraction of a single factor (Parental Quality)

Factor Matrix	
	Factor 1
PQ1	.522
PQ2	.699
PQ3	.682
PQ4	.563
PQ5	.685
PQ6	**.463**
PQ7	**.478**
PQ8	**.391**
PQ9	.689
PQ10	.648

The results indicated that all the items loaded successfully, besides items PQ6, PQ7 and PQ8 loading <.50, which is unsatisfactory. It was consequently decided to delete those values <.50. The residual correlations were computed for both 2-factor and the 1-factor solution. For the 2-factor solution only 6% of the non-redundant residuals had absolute values greater than .05 thus suggesting that the rotated factor solution provides a very credible explanation for the observed inter-item correlation matrix. The 1-factor solution, however failed to provide a credible explanation in that 66% of the residuals correlations were greater than .05.

4.4.7 Environmental Unfavourableness

If the scale of Environmental Unfavourableness is considered, item EU5 was found to be a poor item in the item analysis and was therefore not included in the dimensionality analysis of the Environmental Unfavourableness scale. In the current study the KMO is indicated as .819, providing sufficient evidence that the Environmental Unfavourableness scale was factor analysable (>.60). The Bartlett's Test of Sphericity tests the null hypothesis that the correlation matrix is an identity matrix in the population. The Bartlett's Test of Sphericity indicated that H_0 could be rejected (p< .05), providing further support that the matrix was factor analysable.

In contrast to the intention of the researcher two factors had to be extracted to adequately explain the observed correlation matrix, since two factors obtained eigenvalues greater than 1. The evaluation of this statement can be viewed in the pattern matrix as depicted in Table 4.22.

Table 4.22

Rotated factor structure for the Environmental Unfavourableness scale

Pattern Matrix		
	Factor	
	1	2
EU1	**.722**	.081
EU2	-.017	**.577**
EU3	**.937**	-.054
EU4	**.789**	-.075
EU6	**.603**	.242
EU7	-.026	**.557**
EU8	-.043	**.591**
EU9	.102	**.712**
EU10	.211	.375

The four items loading (.>50) on the second factor and four items (.>50) on the first factor seem to reflect a limited theme of Environmental Unfavourableness and thus improvement is necessary. It should be noted however, that the proposed structural model of Environmental Unfavourableness was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Environmental Unfavourableness scale reflect a single underlying latent variable the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.23.

Table 4.23

Factor matrix when forcing the extraction of a single factor (Environmental Unfavourableness)

Factor Matrix	
	Factor 1
EU1	.736
EU2	**.450**
EU3	.793
EU4	.655
EU6	.772
EU7	**.427**
EU8	**.437**
EU9	.662
EU10	.511

The results indicated that all the items loaded sufficiently, besides items EU2, EU7 and EU8 loading <.50, which is unsatisfactory. It was consequently decided to delete those values <.50. The residual correlations were computed for both the 2-factor and the 1-factor solution. For the 2-factor solution only 25% of the non-redundant residuals had absolute values greater than .05, thus suggesting that the rotated factor solution provides a very credible explanation for the observed inter-item correlation matrix. The 1-factor solution, however, failed to provide a credible explanation, as 77% of the residuals correlations were greater than .05.

4.4.8 Tenacity

In the Tenacity scale no items were found to be poor items in the item analysis and all items were included in the dimensionality analysis of the Tenacity scale. The correlation matrix should contain correlations that are bigger than .30 and significant ($p < .05$) for the correlation matrix to factor analysable. The correlation matrix indicated that the matrix was factor analysable as a number of the correlations were bigger than .30 and significant ($p < .05$). In the current study the KMO is indicated as .803 providing sufficient evidence that the Tenacity scale was factor analysable (>.60). The Bartlett's Test of Sphericity indicated that H_0 could be rejected ($p < .05$) providing further support that the matrix was factor analysable.

In contrast to the intention of the researcher two factors had to be extracted to adequately explain the observed correlation matrix, since two factors obtained eigenvalues greater than 1. The evaluation of this statement can be viewed in the pattern matrix depicted in Table 4.24.

Table 4.24

Rotated factor structure for the Tenacity scale

Pattern Matrix		
	Factor	
	1	2
TENAC1	.375	-.104
TENAC2	**.553**	-.061
TENAC3	**.628**	.099
TENAC4	**.580**	.029
TENAC5	.379	-.296
TENAC6	-.022	**-.700**
TENAC7	.043	**-.617**
TENAC8	-.008	**-.675**

The three items loading (.>50) on the first factor and three items (.>50) on the second factor seem to reflect a limited theme of Tenacity and thus improvement is necessary. It should be noted, however, that the proposed structural model of Tenacity was treated as a single, undifferentiated latent variable. In order to determine how well the items of the Tenacity scale reflect a single underlying latent variable, the analysis were re-run, by forcing the extraction of a single factor. The resultant single-factor factor structure is shown in Table 4.25.

Table 4.25

Factor matrix when forcing the extraction of a single factor (Tenacity)

Factor Matrix	
	Factor
	1
TENAC1	**.417**
TENAC2	.521
TENAC3	**.429**
TENAC4	**.459**
TENAC5	.602
TENAC6	.574
TENAC7	.573
TENAC8	.568

The results indicated that all the items loaded successfully, besides items TENAC1, TENAC3 and TENAC4 which loaded <.50, which is unsatisfactory. It was consequently decided to delete those values <.50. The residual correlations were computed for both the 2-factor and the 1-factor solution. For the 2-factor solution only 7% of the non-redundant residuals had absolute values greater than .05, thus suggesting that the rotated factor solution provides a very credible explanation for the observed inter-item correlation matrix. The 1-factor solution, however failed to provide a credible explanation as 60% of the residual correlations were greater than .05.

4.5 CONCLUSION DERIVED FROM THE ITEM AND DIMENSIONALITY ANALYSIS

The analyses empowered the researcher to confidently combine the remaining items into complete item parcels (two parcels per latent variable) representing their specific underlying latent variables. Through the item analysis the researcher established moderately adequate internal consistency for the latent variable scales, thus Cronbach alpha's >.80. However, not all the subscales had a Cronbach alpha that was >.80, despite this the obtained alpha was, however, convincing. This was the case with Learning Motivation (.764), Resilience (.674), Grit: Consistency of Interest= .616, Grit: Perseverance of Effort=.741, Environmental Unfavourableness (.792) and Tenacity (.744). Through deeper

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investigation, the item analysis identified some poor items which were deleted if the evidence supported such action. In total the researcher deleted six items which had a substantial positive effect on the Cronbach alpha's of the specific subscales.

The dimensionality analysis was performed after the item analysis was completed and poor items were removed. In the current analysis only four of the subscales passed the unidimentionality assumption, while four subscales did not. Finally, all the subscales were successfully forced onto a single factor. Those items which didn't load adequately were removed. From this outcome the researcher gained some insights, which are discussed in the following section, prior to the fitting of the structural model.

4.6 DATA SCREENING PRIOR TO CONFIRMATORY FACTOR ANALYSIS AND THE FITTING OF THE STRUCTURAL MODEL

According to the theory, before the researcher is to analyse the data of multivariate statistics and structural equation modelling, it remains essential to consider all the necessary assumptions and the degree to which the data are aligned with the critical assumptions. Should the data not comply with the underlying assumptions, the integrity of the outcome may be at stake (Tebachnik & Fidell, 1989). By utilising LISREL in estimating the fit of the measurement and/or structural model, maximum likelihood is by default executed (Theron, 2012). The process of maximum likelihood demands that the independent variables, including item parcels, should follow a multivariate normal distribution. If the latter is to be undermined, large variation in the chi-square test may occur, undermining all utility (Du Toit & Du Toit, 2001). Should there be a general lack of multivariate normality, an inflated chi-square statistic will exist, and bias in the overall chi-square fit statistics for the complete model may occur towards a Type 1 error, thus rejecting a model which should not have been rejected. This error will extend to the parameter estimates, which have the ability to yield too many significant results (Garson, as cited in De Goede, 2004;Theron, 2012).

From the outcome of the item and exploratory factor analysis, item parcels were constructed for each latent variable considered in the measurement model. The researcher decided to assemble the item parcels, also known as the composite variables through grouping the even and uneven numbered items together, through utilization of SPSS. The item parcels of the underlying latent variable include LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NSAVE=NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6, RES7,RES8= TENACEU; RES9, RES10, RES11, RES12= PQEU. This data was then imported into PRELIS. The researcher treated all the newly constructed item parcels as continuous variables. In operationalising the latent variables as per structural model, the most effective solution is to simply execute the operationalisation through using the individual items set out per subscale. However, to sidestep the challenge of being stuck with a large number of model parameters to be estimated, one can simply calculate and construct a minimum of two item parcels of indicator variables from the number of items comprising the sub scales measuring the latent variables. Through utilising PRELIS, it is possible to evaluate the multivariate normality of the

composite item parcels. It should be noted that due to fact that the covariance matrix is not positive definitely[40], PRELIS was unable to execute the test for multivariate normality for the learning potential latent variables before normalisation. In Table 4.26 the results of testing the univariate normality of the learning potential indicators variable distribution are captured.

Table 4.26

Test for univariate normality for learning potential variables before normalisation

	Skewness		Kurtosis		Skewness and Kurtosis	
Variable	**Z-Score**	**P-Value**	**Z-Score**	**P-Value**	**Chi-Square**	**P-Value**
P_ENGAVE	1.667	0.095	-3.313	0.001	13.759	0.001
P_AFRAVE	-0.780	0.436	-1.357	0.175	2.448	0.294
P_MATHAVE	2.228	0.026	-2.190	0.029	9.756	0.008
P_NSAVE	1.751	0.080	-1.425	0.154	5.096	0.078
P_TCE1	-2.858	0.004	-1.120	0.263	9.424	0.009
P_TCE2	-3.232	0.001	0.564	0.573	10.766	0.005
P_CONS1	-2.450	0.014	-3.854	0.000	20.859	0.000
P_CONS2	-2.937	0.003	-3.066	0.002	18.025	0.000
P_LM1	-7.071	0.000	3.344	0.001	61.185	0.000
P_LM2	-8.544	0.000	4.223	0.000	90.840	0.000
P_PSYC1	-3.710	0.000	-1.212	0.226	15.236	0.000
P_PSYC2	-4.084	0.000	-4.387	0.000	35.925	0.000
P_GRIT1	-0.485	0.628	-3.117	0.002	9.948	0.007
P_GRIT2	6.064	0.000	2.104	0.035	41.201	0.000
P_PQ1	-10.471	0.000	6.423	0.000	150.907	0.000
P_PQ2	-11.991	0.000	7.728	0.000	203.513	0.000
P_EU1	-16.232	0.000	10.823	0.000	380.613	0.000
P_EU2	-14.076	0.000	9.357	0.000	285.696	0.000
P_TENAC1	-5.319	0.000	-1.194	0.233	29.722	0.000
P_TENAC2	-8.342	0.000	2.987	0.003	78.506	0.000
RES_1	9.308	0.000	11.901	0.000	228.275	0.000
RES_2	5.996	0.000	10.544	0.000	147.136	0.000
RES_3	-1.174	0.094	11.355	0.000	131.732	0.000
RES_4	-1.674	0.094	11.355	0.000	131.732	0.000
RES_5	4.153	0.000	11.560	0.000	150.876	0.000
RES_6	3.129	0.002	10.257	0.000	115.004	0.000
RES_7	12.339	0.000	11.664	0.000	288.296	0.000
RES_8	14.199	0.000	12.272	0.000	352.215	0.000
RES_9	11.918	0.000	11.785	0.000	280.916	0.000
RES_10	11.657	0.000	11.448	0.000	267.875	0.000
RES_11	14.264	0.000	11.872	0.000	344.410	0.000
RES_12	15.571	0.000	12.457	0.000	397.636	0.000

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

Test of multivariate normality for the learning potential latent variables before normalisation

> ### PRELIS
>
> Output
>
> Covariance Matrix not Pos.Def. Tests of Multivariate Normality Can Not be Performed.

From the obtained data feedback it was decided to normalise the data through PRELIS, as the quality of the solution obtained in SEM is heavily dependent on the multivariate normality. In Table 4.27 the outcome of the test for univariate- and multivariate normality on the normalised indicator variables are presented.

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[40] This may occur if one (or more) of the variables is a linear combination of other variables, or the sample size is smaller than the number of variables (Jöreskog & Sörbom, 1996).

Table 4.27

Test for Univariate Normality for the Learning Potential Variables after normalisation

	Skewness		Kurtosis		Skewness and Kurtosis	
Variable	Z-Score	P-Value	Z-Score	P-Value	Chi-Square	P-Value
P_ENGAVE	-0.001	0.999	0.058	0.954	0.003	0.998
P_AFRAVE	-0.019	0.985	0.021	0.983	0.001	1.000
P_MATHAVE	0.031	0.975	0.011	0.991	0.001	0.999
P_NSAVE	0.015	0.988	0.028	0.978	0.001	1.000
P_TCE1	-0.053	0.958	-0.018	0.986	0.003	0.998
P_TCE2	-0.097	0.923	-0.129	0.897	0.026	0.987
P_CONS1	-0.093	0.926	-0.131	0.896	0.026	0.987
P_CONS2	-0.095	0.925	-0.110	0.912	0.021	0.989
P_LM1	-0.472	0.637	-0.605	0.545	0.588	0.745
P_LM2	-2.374	0.018	-2.617	0.009	12.486	0.002
P_PSYC1	-0.654	0.513	-1.142	0.253	1.732	0.421
P_PSYC2	-0.927	0.354	-3.662	0.000	14.272	0.001
P_GRIT1	-0.042	0.966	-0.688	0.491	0.475	0.789
P_GRIT2	1.610	0.107	-2.581	0.010	9.251	0.010
P_PQ1	-2.629	0.009	-3.453	0.001	18.832	0.000
P_PQ2	-5.138	0.000	-2.814	0.005	34.313	0.000
P_EU1	-9.552	0.000	3.288	0.001	102.050	0.000
P_EU2	-9.740	0.000	3.503	0.000	107.139	0.000
P_TENAC1	-2.316	0.021	-4.713	0.000	27.572	0.000
P_TENAC2	-4.271	0.000	-3.513	0.000	30.585	0.000
RES_1	0.006	0.995	0.030	0.976	0.001	1.000
RES_2	0.005	0.996	0.030	0.976	0.001	1.000
RES_3	0.010	0.992	0.035	0.972	0.001	0.999
RES_4	0.010	0.992	0.035	0.972	0.001	0.999
RES_5	-0.291	0.771	-0.153	0.878	0.108	0.947
RES_6	-0.220	0.826	-0.071	0.944	0.053	0.974
RES_7	-0.045	0.964	0.089	0.929	0.010	0.995
RES_8	-0.066	0.947	0.066	0.947	0.009	0.996
RES_9	-0.594	0.553	-0.466	0.641	0.570	0.752
RES_10	-0.399	0.690	-0.193	0.847	0.196	0.907
RES_11	-0.546	0.585	-0.390	0.696	0.451	0.798
RES_12	-0.662	0.508	-0.568	0.570	0.761	0.683

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

Test of multivariate normality for continuous variables after normalization

> **PRELIS**
>
> Output
>
> Covariance Matrix not Pos.Def. Tests of Multivariate Normality Can Not be Performed.

If the test of univariate normality for continuous variables after the normaliszation is considered in Table 4.27, there is a definite indication that the normalisation procedure made a positive contribution as it rectified the univariate normality challenge among the indicator variables. From the data it is evident that the p-values of all the sub-scales increased dramatically as set out in Table 4.27. Additionally the normalisation also contributed positively to the symmetry and kurtosis if the indicator variables distribution. It seems, however, that the normalisation of the data did not contribute to the challenge of obtaining multivariate normality given the outcome presented in the PRELIS output.

When fitting the measurement model and structural model to continuous data; maximum likelihood estimation is the default method, unfortunately it requires the multivariate normality assumption to be met (Mels, 2003). Should a researcher continue with the improper analysis of non-normal variables which is continuous, the SEM model has the ability to produce incorrect standard errors and chi-square estimate outcomes (Theron, 2012). In the current study normalisation had less than a satisfactory outcome which means that an alternative method of estimation should thus be considered, which is more aligned with data not following a multivariate normal distribution. Given the non-normalised

data the author decided on Robust Maximum Likelihood (RML) to fit the data. The procedure of RML is appropriate to be utilised when fitting the structural equation models to non-normal data (Du Toit & Du Toit, 2001). The process demands the computation of an asymptotic covariance matrix via PRELIS to enable the calculation of more appropriate fit indices in LISREL. In the current study the researcher utilised the original non-normalised data. The non-normalised data was selected out of choice due to the uncooperative and disappointing outcome that the normalisation produced yielded.

4.7 EVALUATING THE FIT OF THE MEASURMENT MODEL VIA CONFIRMATORY FACTOR ANALYSIS IN LISREL

Through utilising LISREL, a confirmatory factor analysis was performed on the Learning Potential measurement model in order to establish the fit of the model. An admissible final solution of parameter estimates was obtained once 87 iterations were performed. The relationship among the learning potential latent variables and their manifest indicators, as displayed in measurement model, can be expressed as an equation, such as presented in equation 7 below.

$$X = \Lambda_x \xi + \delta \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 7^{[41]}$$

If the measurement model, as specified in equation 7, can reproduce the observed covariance matrix and the parameter estimates of the measurement model indicates that the most of the variance in the indicator variables are explainable through the latent variables, then the measurement model operationalisation can be considered successful. In the following section the estimated learning potential measurement model is discussed and a decision is made regarding the overall credibility of the measurement model parameter estimates, as well as the estimates of the fitted model. The measurement model standardised output as presented by LISREL is presented in Figure 4.1. In addition the researcher has also presented the overall fit statistics in Table 4.28.

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[41] If the symbols is considered, Λ_x represents the matrix equation of lambda coefficient (λ), indicating the loading of the indicators on their designated latent variables, while the vectors of the latent variables is represented by ksi (ξ) and the delta symbol (δ) indicates a vector of measurement error terms. The X represents a vector of composite indicator variables. The reason why confirmatory factor analysis is useful, is that it can assist in determining if the operationalization of the latent variables comprising the structural model in terms of item parcels was successful or not.

Chi-Square=341.09, df=390, P-value=0.96455, RMSEA=0.000
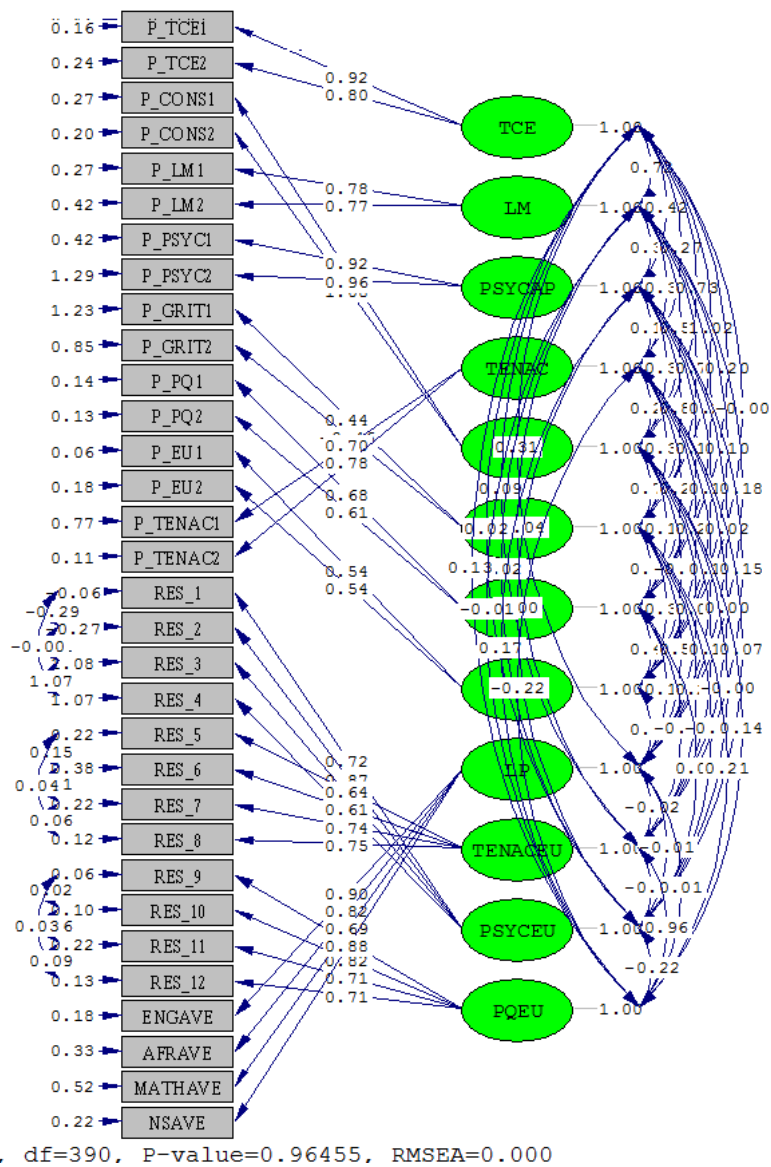
Figure 4.1 **Representation of the Fitted Learning Potential Measurement Model**

4.7.1 Measurement Model Fit Indices

The output spectrum on the goodness of fit statistics for the Learning Potential Measurement Model is depicted in Table 4.28.

Table 4.28

Goodness of Fit Statistics for the Learning Potential Measurement Model

---

Goodness of Fit Statistics

Degrees of Freedom = 390
Minimum Fit Function Chi-Square = 652.094 (P = 0.00)
Normal Theory Weighted Least Squares Chi-Square = 631.570 (P = 0.00)
Satorra-Bentler Scaled Chi-Square = 341.091 (P = 0.965)
Estimated Non-centrality Parameter (NCP) = 0.0
90 Percent Confidence Interval for NCP = (0.0 ; 0.0)
Minimum Fit Function Value = 1.638
Population Discrepancy Function Value (F0) = 0.0
90 Percent Confidence Interval for F0 = (0.0 ; 0.0)
Root Mean Square Error of Approximation (RMSEA) = 0.0
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.0)
P-Value for Test of Close Fit (RMSEA < 0.05) = 1.000
Expected Cross-Validation Index (ECVI) = 1.673
90 Percent Confidence Interval for ECVI = (1.673 ; 1.673)
ECVI for Saturated Model = 2.653
ECVI for Independence Model = 35.460
Chi-Square for Independence Model with 496 Degrees of Freedom = 14049.234
Independence AIC = 14113.234
Model AIC = 617.091
Saturated AIC = 1056.000
Independence CAIC = 14272.881
Model CAIC = 1305.567
Saturated CAIC = 3690.172
Normed Fit Index (NFI) = 0.976
Non-Normed Fit Index (NNFI) = 1.005
Parsimony Normed Fit Index (PNFI) = 0.767
Comparative Fit Index (CFI) = 1.000
Incremental Fit Index (IFI) = 1.004
Relative Fit Index (RFI) = 0.969
Critical N (CN) = 535.296
Root Mean Square Residual (RMR) = 0.0342
Standardized RMR = 0.0353
Goodness of Fit Index (GFI) = 0.910
Adjusted Goodness of Fit Index (AGFI) = 0.878
Parsimony Goodness of Fit Index (PGFI) = 0.672

In the current study the researcher tested the following hypotheses:

[a] Exact fit null hypothesis:

$$H_{01}: RMSEA = 0$$

$$H_{a1}: RMSEA > 0$$

[b] Close fit null hypothesis:

$$H_{02}: RMSEA \leq .05$$

$$H_{a2}: RMSEA > .05$$

91

4.7.1.1 Goodness of Fit

Absolute fit statistics: The Satorra-Bentler chi-square statistics is the most common measure for evaluating the overall model fit in covariance structures and supplies an indication of perfect fit in which the null hypothesis states that the model fits the gathered population data perfectly. If the chi-square is statistically significant, a rejection of the null hypothesis is possible, which implies that the model does not fit the data perfectly and the model thus, will be rejected. It should be noted that the main aim is not to reject the null hypothesis. In the current study, with a sample size of between 200 to 500, the Satorra-Bentler Chi-Square statistic appears to have the most effective properties for testing the null hypothesis of exact fit (Diamantopoulos & Siguaw, 2000). If the current study's outcome is considered, the Satorra-Bentler Scaled Chi-square value comes to 341.09 with 390 degrees of freedom, and a p-value equalling .965 (>.05), implying that the hypothesis for exact fit cannot be rejected. If the CFI and IFI values are considered, it is suggested that values which approach 1 represents good fit (Diamantopoulos & Siguaw, 2000).

The Root Mean Square Residual (RMR): is the square root of the mean of the squared discrepancies between the implied and observed sample covariance matrices. In the current study, the RMR is indicated as .0342 which is below the required ≤0.05 value, indicating a model that fits well. If the current index is considered, the value which is less than 0.05 is interpreted as indicating a good fit to the data (Diamantopoulos & Siguaw, 2000).

The Root Mean Square Error of Approximation (RMSEA): The RMSEA provides an indication of how well the model, with unknown but optimally chosen parameter values will fit the population covariance matrix if it were available (De Goede, 2004; Diamantopoulos & Siguaw, 2000). The RMSEA thus provides a measure representing the closeness of fit. If the RMSEA value falls below ,10 a reasonable to good fit has been obtained while values below .05 indicates a very good fit to the data, as in this case (Kelloway, 1998). In the current study the researcher obtained a RMSEA of .00 which indicates exact fit. If the confidence interval is considered, the null hypothesis of close fit is not rejected. From the output it is suggested that H_0: RMSEA ≤ 0.05 cannot be rejected at a 5% significance level (p>.05).

According to Kelloway (1998), *The Goodness of Fit Index (GFI)* and the *Adjusted GFI (AGFI)* values should be ranging between zero for poor fit and unity for perfect fit, where a value over 0,9 shows good fit to the captured data (Kelloway, 1998). In the current study the researcher obtained a value for the GFI result of ,91 which can be interpreted as a good fit to the data. If the AGFI is considered, it adjusts the GFI degrees of freedom in the model and also ranges from 0 to 1. A value as presented in the current study of above .878 indicates a good fit to the data (Diamantopoulos & Siguaw, 2000).

4.7.1.2 Comparative fit Statistics

The *Normal Fit Index (NFI)* is an indication of the proportion of total covariance among observed variables explained by a target model if one is utilising the null model as a baseline model (Hoyle, as cited in De Goede, 2004). Because the index is *normed* it has a 0 to 1 range, should a value exceed .878 it is an indication of good fit. In the current study the NFI is .976 which indicates that the model is 97.6% better fitting than the null model (Diamantopoulos & Siguaw, 2000).

The *Non-Normed Fit Index (NNFI)* makes adjustments to the NFI for the number of degrees of freedom in the model (df=390). The outcome of any adjustment may result in a number larger than 0 to 1, however in the current model the NNFI=1.005, which indicates a good fit (Kelloway, 1998).

According to De Goede (2004), the *Incremental Fit Index (IFI)* contains a scaling factor, enabling the IFI to range between 0 to 1. The *Comparative Fit Index (CFI)* is defined on the non-central x^2, also ranging from 0 to 1. In the current study both these scores ranged within these limits which indicates good fit. The IFI is indicated as 1.004, and the CFI is indicated as 1.00.

4.7.1.3 Parsimonious fit Statistics:

The *Parsimonious goodness-of-fit index (PGFI)* adjusts the GFI for the degrees of freedom in the model. On the other hand, *Parsimonious Normed Fit Index (PNFI)* adjusts the NFI for model parsimony (Diamantopoulos & Siguaw, 2000). The indices are both limited to a range of 0 to 1. There is, however, no clear cut indication of how strong the value has to be to take a decision on the parsimonious fit. According to Kelloway (1995), it is highly unlikely that the PSFI and the PNF values will reach the "cut off" point of .90, known for the other indices. The parsimonious score is valued, when a decision should be taken on two alternative models.

It is concluded from the body of evidence presented in the Fit Statistics that the null hypothesis for exact fit is not rejected for the Learning Potential Model. The researcher has thus obtained exact fit; whereby the null hypothesis for close fit is rejected. The covariance matrix is thus producing the observed covariance matrix perfectly to the extent of accurateness explained in terms of sampling error exclusively. This indicates that variance can be explained in terms of individual differences which exist among the different subjects that were drawn from the population.

4.7.2 Examining the Measurement Model Residuals

According to Jöreskog and Sörbom (1993), residual values are the difference between corresponding cells in the fitted and observed covariance/ correlation matrices. The standardised residuals refer specifically to a residual that is divided by its estimated standard error and can be considered to be large should its value fall outside +2.58 or -2.58. If the distribution is considered, residual values should be arranged and distributed more or less symmetrically around zero. The residual values in general, with special reference to the positive residuals, signify diagnostic information on sources of lack of model fit, thus underestimation (Theron, 2012). This underestimation implies that the researcher should be exploring additional exploratory paths (Theron, 2012; Jöreskog & Sörbom, 1993). Should the residuals be negative, a suggestion is made that the researcher has overestimated certain paths and should consider removing certain paths (Theron, 2012; Jöreskog & Sörbom, 1993). A summary of the standardised residuals obtained for this analysis is presented in Table 4.29 below.

Table 4.29

Summary Statistics for Learning Potential Measurement Model Standardised Residuals

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Summary Statistics for Standardized Residuals

Smallest Standardized Residual =   -3.579
Median Standardized Residual =   0.000
Largest Standardized Residual =   3.178

Largest Negative Standardized Residuals
Residual for   RES_10 and   P_LM2   -2.796
Residual for   RES_11 and   P_LM2   -3.431
Residual for   AFRAVE and   P_TCE1   -2.782
Residual for   AFRAVE and   P_PQ1   -2.977
Residual for   MATHAVE and   AFRAVE   -3.579

Largest Positive Standardized Residuals
Residual for P_GRIT2 and   P_TCE2   2.697
Residual for P_GRIT2 and   P_LM1   3.178
Residual for   P_PQ1 and P_CONS1   2.705
Residual for   P_EU1 and P_CONS1   2.620
Residual for P_TENAC1 and   P_TCE1   2.956
Residual for P_TENAC1 and   P_TCE2   2.918
Residual for P_TENAC1 and   P_LM1   2.675

Viewing Table 4.29 it is evident that only a limited number of large positive residual values exist, which in this case means that the researcher has estimated a very small percentage of unique variance-covariance value terms unsuccessful, indicating a poor estimate captured by the fitted model. However, this limited percentage of large residual values confirms the good fit of the model. If the large residual values are investigated, it is indicated that large values are most evidently associated with the latent variables of Grit, Tenacity, Conscientiousness and Time Cognitively Engaged. According to Byrne (2001) residual values represent the discrepancy between elements in the sample and those in the restricted variance and covariance matrices. A single residual represents each pair of observed variables. Given a well-fitting model, these values will be close to zero and evenly distributed among all observed variables. Byrne (2001) points out that, large residuals associated with particular parameters indicate their misspecification in the model, thereby affecting overall model fit. Thus a possible explanation for these specific large positive values may be the fact that the model underestimates the co-variance associated between the manifest variables, which are evident regarding the significant paths found in the structural model. Overall the model show exact fit, thus the large positive and negative residuals has an almost insignificant effect on the model fit.

If the output is further considered, the stem-and-leaf plot and Q-plot can also be analysed. The characteristics of a good stem-and-leaf plot is one where, the residual values are distributed as close as possible to symmetry around zero. Looking at the stem-and-leaf plot surplus positive and negative values on both sides of the stem-and-leaf plot indicates that the covariance terms are over- and under-estimated. The over- and under-estimation can be observed in Figure 4.2 below.

Stem and Leaf Plot

```
 – 3|6
 – 3|40
 – 2|88655
 – 2|32222211111000
 – 1|99999887777766666666666655555555555
 – 1|44444443333333222222222111111100000
 – 0|99999999998888888888877777666666555555555555
 – 0|4444444444444443333333333333333333322222222222222222222211111111111111+14
   0|1111111111111111111122222222222222233333333333333334444444444444444
   0|55555555555555555555556666666666666677777777777777777778888888888889999
   1|000000011111122222222233333344444444444
   1|5567788899
   2|001124
   2|55567779
   3|02
```

Figure 4.2 **Stem-and-Leaf Plot of Learning Potential Measurement Model Standardised Residuals**

If the stem-and-leaf plot is viewed in Figure 4.2, it is evident that the distribution of the standardised residual values appears to be symmetrical, although negatively skewed, if the amount of value to the negative side is considered. This outcome according to Jöreskog and Sörbom (2003) is an indication that the model in the particular case is rather overestimating the observed co variances in the matrix.

If the outcome of the Q-Plot is considered of the specific measurement model, an additional depiction is presented on the goodness of fit. A Q-Plot distribution which is displayed running close to the 45-degree angled line indicates a very good fit. In this case the latter desired outcome is clearly achieved. The Q-Plot distribution is displayed in Figure 4.3 below.

Q-plot of Standardized Residuals
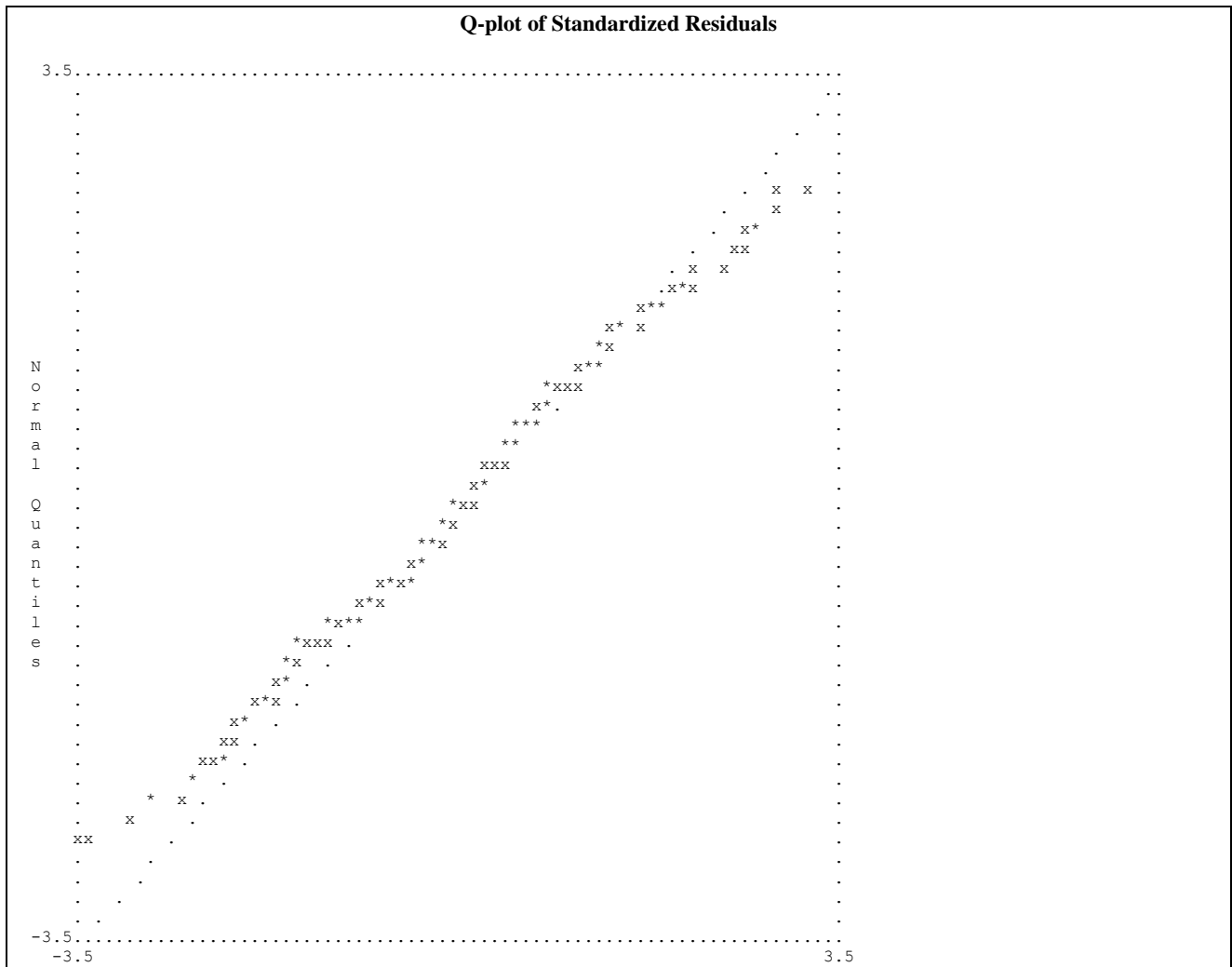
Figure 4.3 **Q-plot of the Learning Potential Measurement Model with Standardised Residual values**

If the 45-degree reference line is considered in this case, the distribution in the particular model is satisfactorily distributed, as the data only narrowly parts with the 45-degree angle. The swivel of the satisfactory distribution of standardised residuals of pairs of observed variables is displayed in the lower and upper x-axis value distribution. The outcome however, is to be expected given the small number of large positive and negative standardised residuals which were discussed in the previous section. The outcome of the Q-plot is an indication that the researcher should also consider the modification indices in detail (Jöreskog & Sörbom, 1993). In the following section the researcher will discuss an overview of the modification indices.

4.7.3 Learning Potential Measurement Model Modification Indices

If the accurate fit of the model is considered, the modification indices can be a resource in determining whether the freeing of any specific fixed parameter would have a considerable positive effect on the model fit. According to Jöreskog and Sörbom (1993), the modification indices display the extent to which the X^2 fit statistics decreases, should a parameter which is fixed be freed, and the model fit re-estimated. Diamantopoulos and Siguaw (2000) writes a modification index which is >6.6349 can be considered large. The large modification indices are values, which if set free can result in an improvement of the model fit (p< .01). In the current study there appears to be a very limited

number of large values, which if set free will improve the model fit. In Table 4.30 the Modification Indices of the Learning Potential Measurement Model for Lambda-X is considered below.

Table 4.30

Modification Indices of the Learning Potential Measurement Model for LAMBDA-X

Variable	TCE	LM	PSYCAP	TENAC	CONS	GRIT	PQ	EU	LP	TENACEU	PSYCEU	PQEU
P_TCE1												
P_TCE2												
P_CONS1												
P_CONS2												
P_LM1												
P_LM2						10.816				7.445		10.245
P_PSYC1										8.075		10.922
P_PSYC2												
P_GRIT1												
P_GRIT2												
P_PQ1												
P_PQ2												
P_EU1												
P_EU2												
P_TENAC1	13.522	10.193			9.187	10.475						
P_TENAC2	16.268	15.930			11.802	50.442						
RES_1										14.851		14.279
RES_2												
RES_3												
RES_4												
RES_5												
RES_6												
RES_7												
RES_8		8.477										
RES_9											39.124	
RES_10												
RES_11												
RES_12											12.777	
P_ENGAVE												
P_AFRAVE												
P_MATHAVE												
P_NSAVE												

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

If the displayed modification index values are considered as calculated for the Λ_x matrix, it is evident that certain values load significantly high on each other. From Table 4.30 it is indicated that Time Cognitively Engaged, Learning Motivation, Conscientiousness and Grit loads on Tenacity and Learning Motivation, while the interaction terms of TENACEU and PQEU loads onto Learning Motivation. This outcome indicates that considering these additional paths will increase the fit of the model, however, these loadings are only 18 out of the possible 341 ways of modifying the factor loadings pattern for an improved model fit. The limited 5.3% indicate that the current model fit is more than adequate. Thus, only 5.3% of the ways in which the factor loading patterns can be modified will result in an enhanced model fit. In order to establish whether this statement is convincing the researcher will additionally consider the modification index values calculated for the Θ_δ matrix next as set out in Table 4.31 below.

Table 4.31

Modification Index Values Calculated for the Θ_δ Matrix

Variable	P_TCE1	P_TCE2	P_CONS1	P_CONS2	P_LM1	P_LM2	P_PSYC1	P_PSYC2	P_GRIT1	P_GRIT2	P_PQ1	P_PQ2	P_EU1	P_EU2	P_TENAC1	P_TENAC2	RES_1	RES_2	RES_3	RES_4	RES_5	RES_6	RES_7	RES_8	RES_9	RES_10	RES_11	RES_12	P_ENGAVE	P_AFRAVE	P_MATHAVE	P_NSAVE
P_TCE1																																
P_TCE2																																
P_CONS1																																
P_CONS2																																
P_LM1																																
P_LM2		7.478																														
P_PSYC1																																
P_PSYC2																																
P_GRIT1																																
P_GRIT2					13.036	10.609																										
P_PQ1																																
P_PQ2																																
P_EU1																																
P_EU2																																
P_TENAC1																																
P_TENAC2	7.871								9.611																							
RES_1										8.037																						
RES_2																																
RES_3																																
RES_4																																
RES_5																																
RES_6																																
RES_7																																
RES_8				8.330																												
RES_9																																
RES_10							8.178																									
RES_11																	11.735						30.196	39.766								
RES_12																		13.367			19.480		40.298									
P_ENGAVE																																
P_AFRAVE										7.832																						
P_MATHAVE																																
P_NSAVE																																

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQE

From the modification index values as calculated for the Theta-delta matrix only a very limited number (1.19% alternative options to adapt the factor loading pattern) of values are again > 6,6349 which indicate that the freeing of any parameters would not significantly improve the measurement model fit. This is again a confirmation that should those qualifying values currently set to zero be set free, no significant improvement would arise, which is an additional sign that no fit improvement would arise.

4.7.4 Decision on the Fit of the Measurement Model

Without considering the small number of large residual values, the data indicates that the data fits the measurement model well. In both the Lambda-X and Theta-Delta modification indexes a significant but limited number of large modification indices exist. This means that the measurement model parameter estimates therefore can be considered plausible in reproducing the observed covariance. The researcher accordingly believes that the model parameter estimates is truly convincing.

4.8 INTERPRETATION OF THE PROPOSED LEARNING POTENTIAL MEASURMENT MODEL PARAMETER ESTIMATES

If the validity of the measurement model is considered, an indication is achieved through the evaluation of the statistical significance, given the slope of the regression of the observed variable loadings on their particular latent variables. In order for any measure to validly reflect the specific latent variable it was design for, it is critical that the slope of the regression of X_i on ξ_j in the model should be significant. In Table 4.32 the learning potential measurement model unstandardised lambda-X matrix is displayed, showing the regression coefficients of the regression of the manifest variables on the latent variables they are connected to. According to Diamantopoulos and Siguaw (2000) significant indicator loadings grant valid proof in support of the indicators. If the regression coefficients are considered, the variable loadings reach significance if $p < .05$ and t-values $> 1,96$.

Table 4.32

Learning Potential Measurement Model Unstandardised Lambda-X Matrix

Variable	TCE	LM	PSYCAP	TENAC	CONS	GRIT	PQ	EU	LP	PSYCEU	TENACEU	PQEU
P_TCE1	0.923 (0.040) 22.857											
P_TCE2	0.799 (0.039) 20.611											
P_CONS1					1.073 (0.050) 21.481							
P_CONS2					1.082 (0.045) 23.955							
P_LM1		0.779 (0.045) 17.457										
P_LM2		0.769 (0.050) 15.487										
P_PSYC1			0.920 (0.073) 12.555									
P_PSYC2			0.960 (0.087) 11.029									
P_GRIT1						0.438 (0.079) 5.527						
P_GRIT2						-0.459 (0.075) -6.122						
P_PQ1							0.678 (0.036) 19.000					
P_PQ2							0.614 (0.040) 15.530					
P_EU1								0.544 (0.044) 12.497				
P_EU2								0.541 (0.050) 10.895				
P_TENAC1				0.702 (0.066) 10.565								
P_TENAC2				0.777 (0.053) 14.721								
RES_1										0.718 (0.209) 3.445		
RES_2										0.872 (0.249) 3.500		
RES_3										0.567 (0.168) 3.383		
RES_4										0.573 (0.165) 3.463		
RES_5											0.645 (0.040) 16.203	
RES_6											0.613 (0.043) 14.157	
RES_7											0.744 (0.035) 21.119	
RES_8											0.748 (0.028) 26.804	
RES_9												0.806 (0.039) 20.927
RES_10												0.825 (0.044) 18.723
RES_11												0.707 (0.041) 17.275
RES_12												0.709 (0.037) 19.398
P_ENGAVE									0.899 (0.040) 22.558			
P_AFRAVE									0.815 (0.038) 21.289			
P_MATHAVE									0.688 (0.046) 14.885			
P_NSAVE									0.878 (0.039) 22.592			

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

From Table 4.32 it is clear that only a single factor (P_GRIT2) is not significant given the cut-off value t > |1.96| in the Lambda-X matrix. Given this outcome concern arises that relying solely on the unstandardised loadings may prove to be insufficient, thus it is advised that the standardised lambda-X should also be investigated (Diamantopoulos & Siguaw, 2000). In the following table the researcher has also presented the outcome on the Learning Potential Measurement Model Completely Standardised Solution Lambda-X.

Table 4.33

Learning Potential Measurement Model Completely Standardised Solution Lambda-X

Variable	TCE	LM	PSYCAP	TENAC	CONS	GRIT	PQ	EU	LP	PSYCEU	TENACEU	PQEU
P_TCE1	0.923											
P_TCE2	0.799											
P_CONS1					1.073							
P_CONS2					1.082							
P_LM1		0.779										
P_LM2		0.769										
P_PSYC1			0.920									
P_PSYC2			0.960									
P_GRIT1						0.438						
P_GRIT2						-0.459						
P_PQ1							0.678					
P_PQ2							0.614					
P_EU1								0.544				
P_EU2								0.541				
P_TENAC1				0.702								
P_TENAC2				0.777								
RES_1										0.718		
RES_2										0.872		
RES_3										0.567		
RES_4										0.573		
RES_5											0.645	
RES_6											0.613	
RES_7											0.744	
RES_8											0.748	
RES_9												0.806
RES_10												0.825
RES_11												0.707
RES_12												0.709
P_ENGAVE									0.899			
P_AFRAVE									0.815			
P_MATHAVE									0.688			
P_NSAVE									0.878			

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

If the completely standardised solution is considered in which the latent and manifest variables is standardised, the values could be interpreted as the regression slope of the regression of the standardised indicator variables on the standardised latent variables (Diamantopoulos & Siguaw, 2000). The values in the completely standardised matrix displays the average change expressed in the standard deviation units in the indicator variables associated with one standard deviation change in the latent variable (Diamantopoulos & Siguaw, 2000). If the square of the completely standardised factor loadings is considered, an indication is given on the proportion of indicator variance explained in terms of the latent variable which it is supposed to reflect.

In order to rely on the measurement model, the R^2 value is also to be considered. The squared multiple correlation (R^2) value reflects the amount or portion of variance explained by the indicator representing a specific underlying latent variable. Should the R^2 be high, it reflects a situation where the specific indicator variance reflects a high degree of the variance in the latent variable it represents. The amount of the variance not displayed in the specific R^2 value can be regarded as variance accounted for by random and systematic measurement error (Diamantopoulos & Siguaw, 2000) (Du Toit & Du Toit, 2001). Table 4.34 display the learning potential measurement model squared multiple correlations for X-variables.

Table 4.34

Learning Potential Measurement Model Squared Multiple Correlation for X-Variables

P_TCE1	P_TCE2	P_CONS1	P_CONS2	P_LM1	P_LM2	P_PSYC1	P_PSYC2	P_GRIT1	P_GRIT2	P_PQ1	P_PQ2	P_EU1	P_EU2	P_TENAC1	P_TENAC2
0.843	0.729	0.812	0.851	0.695	0.582	0.670	0.416	0.135	0.200	0.767	0.740	0.842	0.614	0.391	0.847

RES_1	RES_2	RES_3	RES_4	RES_5	RES_6	RES_7	RES_8	RES_9	RES_10	RES_11	RES_12	P_ENGAVE	P_AFRAVE	P_MATHAVE	P_NSAVE
1.120	1.538	0.229	0.234	0.659	0.495	0.714	0.830	0.912	0.872	0.696	0.800	0.816	0.670	0.478	0.777

The above x variables can be regarded as indicator variable validity coefficients, $\rho\,(X_i, \xi_j)$. If the random error and systematic non-relevant variance is considered, the completely standardised error variance of the ith indicator variable $(\theta_{\delta ii})$ can be seen in the completely standardised theta-delta matrix as set out in Table 4.35 below. From the literature it is proposed that since $(\lambda_{ij}^2 + \theta_{\delta ii})$ are equal to unity in the completely standardised solution, the validity coefficient, $\rho\,(X_i, \xi_j)$ can be expressed as:

$$\rho\,(X_i, \xi_j) = \delta^2{}_{\text{systematic-relevance}} / (\delta^2{}_{\text{systematic-relevant}} + \delta^2{}_{\text{non-relevant}})$$
$$= \lambda_{ij}^2 / [\lambda_{ij}^2 + \theta_{\delta ii}]$$
$$= 1 - (\theta_{\delta i} / [\lambda_{ij}^2 + \theta_{\delta ii}])$$
$$= 1 - \theta_{\delta ii}$$
$$= \lambda_{ij}^2$$

Table 4.35

Learning Potential Measurement Model Completely Standardised Theta-Delta Matrix

Variable	P_TCE1	P_TCE2	P_CONS1	P_CONS2	P_LM1	P_LM2	P_PSYC1	P_PSYC2	P_GRIT1	P_GRIT2	P_PQ1	P_PQ2	P_EU1	P_EU2	P_TENAC1	P_TENAC2	RES_1	RES_2	RES_3	RES_4	RES_5	RES_6	RES_7	RES_8	RES_9	RES_10	RES_11	RES_12	P_ENGAVE	P_AFRAVE	P_MATHAVE	P_NSAVE
P_TCE1	0.157																															
P_TCE2		0.271																														
P_CONS1			0.188																													
P_CONS2				0.149																												
P_LM1					0.305																											
P_LM2						0.418																										
P_PSYC1							0.330																									
P_PSYC2								0.584																								
P_GRIT1									0.865																							
P_GRIT2										0.800																						
P_PQ1											0.233																					
P_PQ2												0.260																				
P_EU1													0.158																			
P_EU2														0.386																		
P_TENAC1															0.609																	
P_TENAC2																0.153																
RES_1																	-0.120															
RES_2																	-0.609	-0.538														
RES_3																		0.006	0.771													
RES_4																	-0.006		0.767	0.766												
RES_5																					0.341											
RES_6																					0.210	0.505										
RES_7																						0.148	0.286									
RES_8																					0.060		0.087	0.170								
RES_9																									0.088							
RES_10																									0.033	0.128						
RES_11																										0.076	0.304					
RES_12																									0.039		0.127	0.200				
P_ENGAVE																													0.184			
P_AFRAVE																														0.330		
P_MATHAVE																															0.522	
P_NSAVE																																0.223

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

According to Diamantopoulos & Siguaw (2000), reliability can be interpreted as the degree to which variance in indicator variables can be ascribed to systematic sources, irrespective of whether the source of variance is relevant to the measurement model intention or not. The squared multiple correlations for x-variables can thus be interpreted, according to Diamantopoulos and Siguaw (2000) as lower bound estimates of the item reliabilities ρ_{ii}. Diamantopoulos and Siguaw (2000) writes, that the extent to which the true item reliabilities would be under-estimated would be determined by the degree to which δ_{ii} contains the effect of the systematic non-relevant latent influences. Table 4.35 contains the values of the squared multiple correlations for the indicator variables, which appears to be less than satisfactory in some cases, indicating that some of the indicators are not truly reflecting variance in the latent variables they are supposed to reflect.

4.8.1 Decision on the Success of the Operationalisation

From the outcome of the statistical fit, the measurement model overall showed a very satisfactory fit. However, with a closer inspection it was found that not all the indicator variables loaded statistically significantly (p<.05) on those latent variables they were supposed to reproduce. From the evidence of the correlation matrix it is clear that the indicator values of the latent variable Grit and the residual values of the interaction term PSYCEU raises concern. Overall the operationalisation of the measurement model was, however, successful. The researcher is convinced that an unequivocal judgement is possible on the structural model given that the challenges, as pointed out, are handled appropriately. In the following section the researcher will be discussing the goodness of fit of the learning potential structural model.

4.9 THE OVERALL GOODNESS-OF-FIT OF THE STRUCTURAL MODEL

From the exact fit obtained by the measurement model with the indicator variables showing an overall satisfactory reflection (with the exception of the interaction term PSYCEU and Grit) of the specific latent variables they are assigned to, the structural relationships among all the latent variables as hypothesised by the proposed model and depicted earlier in Figure 4.2[42] were thoroughly tested utilising SEM via LISREL. The structural paths of the specific model depicted in Figure 4.2 can be expressed through Equation 9 depicted below:

$$\eta = \beta\eta + \Gamma\xi + \zeta \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots9^{43}$$

Attempting to fit the hypothesised model to the data proved to be a fruitless exercise, as the solution failed to converge. This outcome was expected by the researcher as no attempt has been made in the past to force three interaction terms on a single latent variable in SEM in the current domain of structural equation modelling known to the researcher. From the output implication of the squared multiple correlations for the X-Variables and the Completely Standardised Theta-Delta Matrix, given the readings presented on Res_1, Res_2, Res_3 and Res_4, it was decided by the researcher to remove these values and re-run the syntax without the path PSYCEU on TCE. With this second attempt, the model did

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[42] Figure 4.2: Pretorius (2013) Reduced Learning Potential Structural Model with defined Moderated Paths

[43] If the symbols is considered in the equation, β (beta) parameters, describing the slope of the regression of the η_I on η_j. Γ is a matrix containing the Y (gamma) parameters, depicting the slope of the regression of η_I on ξ_j, while ζ (psi) represents a vector of structural error terms linked to the endogenous (η;eta) variables (Diamantopoulos & Siguaw, 2000).

converge successfully, however the fit of the model was only reasonable *[Degrees of Freedom=318, Satorra-Bentler Scaled Chi-Square=767.297 (P=0.0), RMSEA=.06]*. The finding forced the researcher to revise the hypothesised outcome. After investigating the output further, the Learning Performance indicator values (ENGAVE, AFRAVE, MATHAVE and NSAVE) raised a concern, given the extreme values presented it was decided to standardise the particular indicator values. The standardisation proved to have a very fruitful effect on the model fit, as good fit was obtained with the re-run of the syntax. The revised outcome proved an admissible final solution of parameter estimates for which a successful outcome was reached after 103 iterations. In Table 4.36 the Goodness of Fit Statistics for the Learning Potential Structural Model is displayed reflecting the fit as estimated by LISREL.

Table 4.36

Goodness of Fit Statistics for the Learning Potential Structural Model

Goodness of Fit Statistics
Degrees of Freedom = 318
Minimum Fit Function Chi-Square = 693.052 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 639.332 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 321.332
90 Percent Confidence Interval for NCP = (253.087 ; 397.353)
Minimum Fit Function Value = 1.741
Population Discrepancy Function Value (F0) = 0.807
90 Percent Confidence Interval for F0 = (0.636 ; 0.998)
Root Mean Square Error of Approximation (RMSEA) = 0.0504
90 Percent Confidence Interval for RMSEA = (0.0447 ; 0.0560)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.447
Expected Cross-Validation Index (ECVI) = 2.049
90 Percent Confidence Interval for ECVI = (1.877 ; 2.240)
ECVI for Saturated Model = 2.040
ECVI for Independence Model = 31.611
Chi-Square for Independence Model with 378 Degrees of Freedom = 12525.274
Independence AIC = 12581.274
Model AIC = 815.332
Saturated AIC = 812.000
Independence CAIC = 12720.965
Model CAIC = 1254.361
Saturated CAIC = 2837.518
Normed Fit Index (NFI) = 0.945
Non-Normed Fit Index (NNFI) = 0.963
Parsimony Normed Fit Index (PNFI) = 0.795
Comparative Fit Index (CFI) = 0.969
Incremental Fit Index (IFI) = 0.969
Relative Fit Index (RFI) = 0.934
Critical N (CN) = 218.990
Root Mean Square Residual (RMR) = 0.0514
Standardized RMR = 0.0550
Goodness of Fit Index (GFI) = 0.897
Adjusted Goodness of Fit Index (AGFI) = 0.869
Parsimony Goodness of Fit Index (PGFI) = 0.703

If the Goodness of Fit Statistics for the Learning Potential Structural Model is considered, it is evident from the p-value associated with the Satorra-Bentler X^2 value in Table 4.36 that a significant outcome was obtained. According to Kelloway (1998), should the X^2 be non-significant, the model fit is questionable, as the observed covariance matrix's

accuracy can only be explained in terms of sampling error. If the current model is considered, there is an inability to reproduce the observed covariance matrix in an accurate and sufficient way, allowing for incongruity and discrepancy attributable to sampling error exclusively. From this outcome it is evident that H_{02a}: RMSEA = 0 is rejected in favour of the alternative H_{a2a}: RMSEA>0. With an obtained RMSEA value of .05, good fit is indicated, which is satisfactory given the unexplored interaction effects in the structural model. This is also evident in the 90% confidence interval for RMSEA (0.0447; 0.0560) which includes the critical value of .05, additionally supporting reasonable good fit as argued.

If the level of significance is considered of the obtained outcome, estimation through LISREL is executed by testing H_{02b}: RMSEA<.05 against H_{a2b}: RMSEA > .05. From Table 4.36 it is indicated by the RMSEA value of .0504 that it meets the required targeted value of .05, thus H_{a2b}: RMSEA> .05 is not rejected. This outcome strengthens a close fit conclusion, as the targeted value is included in the critical confidence interval.

If the current paths are investigated, additional evidence for the model support can be obtained. The decision to delete or add specific paths in order to improve the fit of the learning potential structural model can be executed by considering the Beta and Gamma matrices. The Beta matrix is shown below in Table 4.37, reflecting all the estimates of the β_{ij} being statistically significant or not.

Table 4.37

Learning Potential Structural Model Unstandardised Beta Matrix

	TCE	LM	PSYCAP	TENAC	LP
TCE		0.042			
		(0.043)			
		0.962			
LM					
RES					
TENAC		0.431			
		(0.072)			
		6.029			
LP	-9.567				
	(10.682)				
	-0.896				

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

It is evident from the Beta Matrix in Table 4.37 that the convincingly hypothesised path of Learning Motivation on Time-Cognitively-Engage was not supported (0.962), as well as Time-Cognitively-Engaged on Learning Performance (-0.896). These t-values smaller than 1.96 indicates that the Beta estimates as stated are not statistically significant (p<.05), meaning that H_{03} and H_{015} cannot be rejected. From the evidence presented it is evident that no support was obtained to confirm that a statistical significant relationship exists between Learning Motivation and Time-Cognitively-Engaged, as well as between Time-Cognitively-Engaged and Learning Performance. The only path that could be corroborated was the path of Learning Motivation on Tenacity as originally hypothesised, given its statistical significance (6.029). In the defence of the path between Time-Cognitively-Engaged and Learning Performance, given the original model, it reaffirms the fact that Time-Cognitively-Engaged will only have an effect on Learning Performance once Transfer takes place. Operationally measuring the effect of Time-Cognitively-Engaged on Transfer and Transfer's effect on Learning Performance is a complex process and poses a challenge which is beyond the scope of the current study. The fact that the path between Learning Motivation and Time Cognitively Engaged proved to be statistically insignificant, presents a situation where Time Cognitively Engaged comes rather as an act of perseverance (passion towards a long term goal) rather than motivation, given the statistically significant effect of Grit on Time Cognitively Engaged. It is unlikely that the subjects in the particular study will be motivated regarding Learning

Performance, given their dire circumstances, those that do perform well are those subjects that have the ability to look beyond the "short-term" circumstance and persevere and perform optimally in spite of their current situation. The sign associated with the path between Time-Cognitively-Engaged and Learning Performance is in disagreement with the proposed direction of the effect as hypothesised. The researcher has decided that the paths should be removed as H_{03} and H_{015} has not been corroborated. In order to establish the statistical significance of the gamma paths, the author will consider the Gamma Matrix next as set out in Table 4.38 below.

Table 4.38

Learning Potential Structural Model Unstandardised Gamma Matrix

	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE	0.073	0.909		-0.017	0.024	-0.021
	(0.073)	(0.101)		(0.018)	(0.033)	(0.031)
	1.005	8.980		-0.945	0.719	-0.672
LM		0.691	0.119			
		(0.056)	(0.049)			
		12.277	2.415			
RES	0.401					
	(0.058)					
	6.976					
TENAC						
LP		9.981				
		(10.712)				
		0.932				

TCE= TIME COGNITIVELY ENGAGED; LM= LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; TENACEU= TENACITY*ENVIRONMENTAL UNFAVOURABLENES; PQEU= PARENTAL QUALITY* ENVIRONMENTAL UNFAVOURABLENESS

If the unstandardised Gamma matrix is considered as shown in Table 4.38, the outcome is dramatically out of line regarding the proposed hypothesis which has been made. If the t-values are considered in the unstandardised Gamma matrix, we find that five of the nine proposed paths is < 1.96 and thus insignificant (p<.05). The only four paths that had a statistical significant outcome included the positive loadings of Grit on Time Cognitively Engaged and Learning Motivation, Parental Quality on Learning Motivation, as well as Conscientiousness on Resilience. The insignificant paths include the proposed hypotheses of the interaction terms TENACEU and PQEU on Time-Cognitively-Engaged, as well as Environmental Unfavourableness, and the positive effect of Conscientiousness on Time-Cognitively-Engaged. Given the outcome of the proposed Gamma matrix it is concluded that H_{04}, H_{07}, H_{08}, H_{010}, H_{012} and H_{013} cannot be rejected as the specific paths could not be corroborated. Given this outcome it is also important to consider if any addition paths may improve the fit of the measurement model, therefore the researcher will also consider the modification indices for Γ and β.

If the modification index values calculated for Beta are considered, it is indicated in Table 4.39 that two paths, which are fixed, if freed may contribute to a significant (p< .01) improvement to the fit of the proposed structural model. It should however be noted that when considering to free certain paths that the theory should be convincing in such a case. This point is also supported in the argument proposed by Jöreskog and Sörbom (1993) on the evaluation of the model and modification indices.

Table 4.39

Learning Potential Structural Model Modification Indices for Beta

	TCE	LM	PSYCAP	TENAC	LP
TCE			3.954	0.320	1.811
LM	0.001		3.608	3.305	0.062
RES	10.691	9.793		0.013	0.263
TENAC	0.969		0.298		0.933
LP		0.045	4.022	0.273	

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

In Table 4.39, the modification indices for Beta represent the amount of reduction which can be expected in the value of the Satorra-Bentler Chi Square should those qualifying paths found in the Beta matrix be set free. If the modification indices of Beta are considered, it was found that two values are > 6.64, with qualifying paths to be set free and improve the model fit significantly (p <.01). The first path which is to be added is the path between Time Cognitively Engaged and Resilience (MI= 10.691; EC=0.293) and the second path which can be added is the path between Learning Motivation and Resilience (MI=9.793; EC=0.223). Should both these paths be added to the existing model, the possibility presents itself that the model fit may improve. The critical question should be asked if, however, these additional paths make substantive theoretical sense. Should the proposed paths not be convincing, no alterations should be made to the existing structural model. Additionally, in order to establish if freeing the paths will have a practical positive effect on the model, the Standardised Expected Change for Beta should be evaluated as set out in Table 4.40 below.

In Table 4.40 the index values calculated for Gamma (Γ) is reported. If the t-value > 6.64 rule is considered it is indicated that five values qualify for being considered to be set free.

Table 4.40

Learning Potential Structural Model Modification Indices for Gamma

	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE			0.017			
LM	0.444			1.743	4.233	5.181
RES		5.944	2.337	3.771	2.765	3.606
TENAC	2.654	1.258	8.807	13.633	6.000	7.726
LP	7.386		0.173	11.329	0.264	1.084

TCE= TIME COGNITIVELY ENGAGED; LM= LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; TENACEU= TENACITY*ENVIRONMENTAL

UNFAVOURABLENES; PQEU= PARENTAL QUALITY* ENVIRONMENTAL UNFAVOURABLENESS

From the proposed index values for Gamma five new paths are proposed. The proposed loadings include Conscientiousness on Learning Performance (MI=7.386; EC=-5.329), Parental Quality on Tenacity (MI=8.807; EC=0.186), Environmental Unfavourableness on Tenacity (MI=13.633; EC=0.219), Environmental Unfavourableness on Learning Performance (MI=11.329; EC=-2.069), as well as between the interaction term Parental Quality*Environmental Unfavourableness and Tenacity (MI=7.726; EC=-0.158). Again the question should be asked whether these proposed paths make sense. Although the proposed five paths are significant, as presented in the

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Modification Indices for Γ, the Standardised Expected Change for Gamma should be reviewed in order to establish whether these proposed paths is practically going to have a positive impact if freed.

Table 4.41

Learning Potential Structural Model Standardised Expected Change for Beta (β)

	TCE	LM	PSYCAP	TENAC	LP
TCE			0.012	-0.004	-0.802
LM	-0.062		0.099	-0.136	0.054
RES	0.293	0.223		0.007	0.028
TENAC	0.099		-0.035		0.058
LP		-0.260	-0.119	0.034	

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

In Table 4.41 the Standardised Expected Change for Beta is presented with respect to the suggested path alterations as set out in the Modification Indices for Beta. From the Standardised Expected Change for Beta it is evident that the expected change is < .30 and thus no practical significant benefit is indicated from freeing any of the currently fixed parameters for Beta.

Table 4.42

Learning Potential Structural Model Standardised Expected Change for Gamma (Γ)

	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE			-0.007			
LM	0.092			0.073	-0.098	-0.105
RES		0.193	0.088	0.110	0.091	0.104
TENAC	0.117	0.102	0.186	0.219	-0.140	-0.158
LP	-5.329		0.111	-2.069	0.274	0.544

TCE= TIME COGNITIVELY ENGAGED; LM= LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; TENACEU= TENACITY*ENVIRONMENTAL UNFAVOURABLENES; PQEU= PARENTAL QUALITY* ENVIRONMENTAL UNFAVOURABLENESS

In Table 4.42 the Standardised Expected Change for Gamma is presented with respect to the suggested path alterations as reported in the Modification Indices for Gamma. From the Standardised Expected Change for Gamma it is evident that the expected change is < .30 and thus no practical significant benefit for the model is indicated from freeing any of the currently fixed parameters for Gamma.

From the results of the Modification Indices no convincing evidence has been established to add any of the suggested paths. In the following section the final modified fit assessment is presented.

4.10 ASSESSING THE OVERALL GOODNESS-OF-FIT OF THE LEARNING POTENTIAL STRUCTURAL MODEL

Figure 4.4 presents the completely standardised Learning Potential Structural Model which was obtained from LISREL once the interaction term PSYCEU was removed.

4.10.1 Overall fit assessment

The overall fit as presented in Figure 4.4 indicates the degree to which the model as a whole is consistent with the empirical data at hand.

Chi-Square=639.33, df=318, P-value=0.00000, RMSEA=0.050
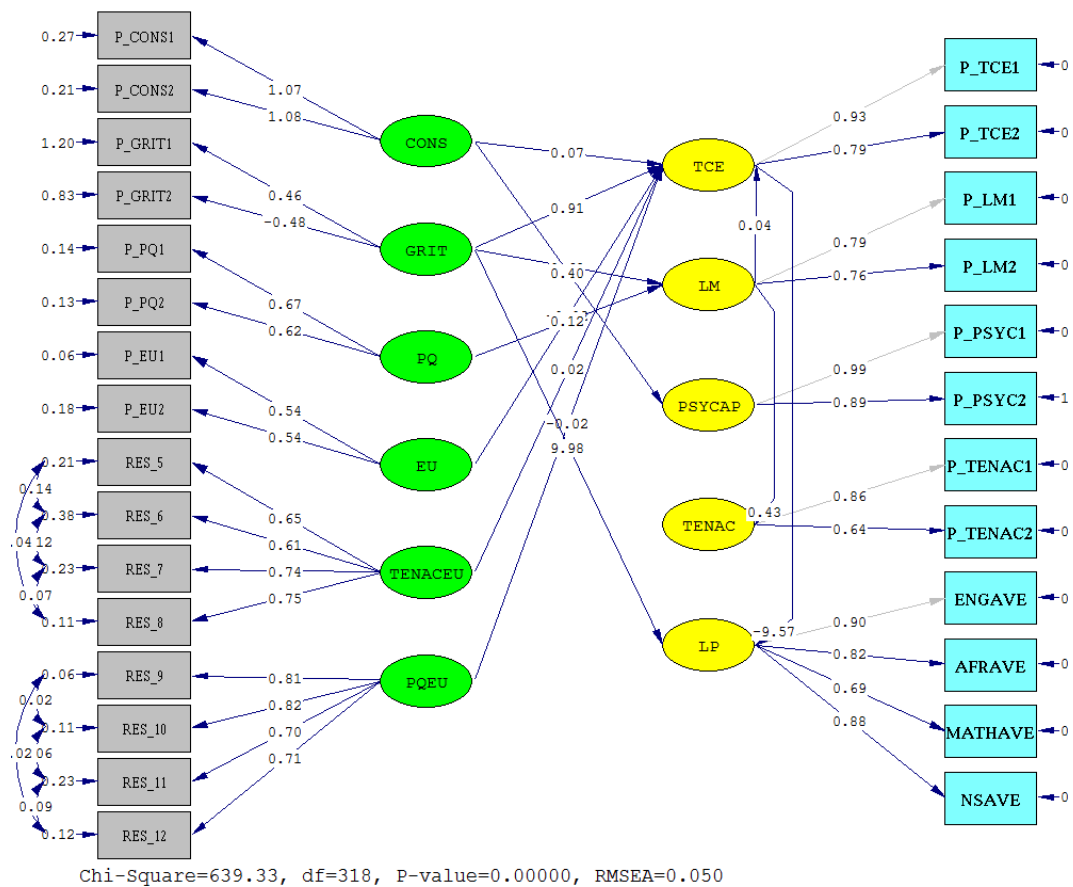
Figure 4.4 **Representation of the Learning Potential Structural Model**

4.10.2 Examination of the Learning Potential Structural Model Residuals

In Table 4.43 the Learning Potential Structural Model Standardised Residuals is displayed, which resulted from the covariance estimates derived from the estimated structural model parameters obtained. The standardised residuals can be seen as large if they exceed the values of +2,58 or -2,58. It is also desirable to have the values symmetrically distributed around the value of 0. Positive residuals presents underestimation and imply a need for more additional paths, while negative values presents overestimation implying need for certain paths to be deleted (Theron, 2012).

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Table 4.43

Learning Potential Structural Model Standardised Residuals

Variable	P_TCE1	P_TCE2	P_CONS1	P_CONS2	P_LM1	P_LM2	P_PSYC1	P_PSYC2	P_GRIT1	P_GRIT2	P_PQ1	P_PQ2	P_EU1	P_EU2	P_TENAC1	P_TENAC2	RES_1	RES_2	RES_3	RES_4	RES_5	RES_6	RES_7	RES_8	RES_9	RES_10	RES_11	RES_12	P_ENGAVE	P_AFRAVE	P_MATHAVE	P_NSAVE
P_TCE1																																
P_TCE2																																
P_CONS1																																
P_CONS2																																
P_LM1																																
P_LM2																																
P_PSYC1	2.644																															
P_PSYC2																																
P_GRIT1																																
P_GRIT2																																
P_PQ1																3.490														-2.681		
P_PQ2																3.258																
P_EU1								2.653							2.596	3.174																
P_EU2															2.608	3.156																
P_TENAC1																																
P_TENAC2																																
RES_1																																
RES_2																																
RES_3																																
RES_4																																
RES_5																																
RES_6																																
RES_7						-3.310																										
RES_8						-2.786																										
RES_9						-3.231			-2.650							-4.354																
RES_10						-3.931									-2.780	-4.701																
RES_11						-4.374									-2.609	-4.660					-3.084		4.089									
RES_12						-3.298										-4.271					-2.870	-3.643										
P_ENGAVE																																
P_AFRAVE																																
P_MATHAVE																														-2.840		
P_NSAVE																															4.433	

LP (Learning Performance): P_ENGAVE= ENGLISH AVERAGE MARK; P_AFRAVE=AFRIKAANS AVERAGE MARK; P_MATH AVERAGE MARK; P_NATURAL SCIENCE AVERAGE MARK; P_TCE1 AND P_TCE2= TIME COGNITIVELY ENGAGED; P_CONS1 AND P_CONS2= CONSCIENTIOUSNESS; P_LM1 AND P_LM2= LEARNING PERFORMANCE; P_PSYC1 AND P_PSYC2= RESILIENCE; P_GRIT1 AND P_GRIT2= GRIT; P_PQ1 AND PQ2= PARENTAL QUALITY; P_EU1 AND P_EU2= ENVIRONMENTAL UNFAVOURABLENESS; P_TENAC1 AND P_TENAC2= TENACITY; RES1, RES2, RES3, RES4= PSYCEU; RES5, RES6,RES7,RES8= TENACEU; RES9,RES10,RES11, RES12= PQEU

If the values in Table 4.43 are considered is it is clear that only 28 values (as depicted in Table 4.44 below) can be considered large. No clear specific finding has arisen regarding alteration to the model from the inspection of the variables associated with these standard residuals. It is however important to note the concentration on the indicator variables associated with P_LM2 and P_TENAC2, thus the only conclusion will be to investigate these specific latent variables of the underlying indicators in order to establish an improvement to the current model fit. In Figure 4.5 the Stem-and-Leaf plot is depicted, complementing the goodness of fit indices. A Stem-and-Leaf plot which is characterised by a symmetrical distribution around the value zero is good. In the current case the values are very much symmetrically distributed around zero. If closely observed there is a very slight negative distribution. A negative distribution means that the model parameters are more likely to overestimate rather than underestimate the observed covariance. The distribution of the Q-plot is also considered to be judged on the model fit, as depicted in Figure 4.6.

```
 – 4|775
 – 4|4443
 – 3|96
 – 3|3321
 – 2|998887776
 – 2|4443332221000
 – 1|9988888887666655555
 – 1|444443333333222222221111000000000
 – 0|99999887777666666655555
 – 0|444444444433332222222222222222222222222111111111111111111111110000000000+42
   0|111111111111111122222223333333444444444
   0|555555556666666666666667777777788888889999999999
   1|00000000011111222222233333333334444444
   1|5555555556666666677777788888999
   2|000011222233344
   2|556667
   3|223
   3|589
   4|14
```

Figure 4.5 **Learning Potential Structural Model Stem-and-Leaf Plot of the Standardised Residuals**

Table 4.44

Extreme Negative and Positive Residuals for Structural Models

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Largest Negative Standardized Residuals

Residual for MATHAVE and AFRAVE	-2.840
Residual for P_GRIT2 and P_PSYC1	-4.503
Residual for P_GRIT2 and P_PSYC2	-4.372
Residual for P_PQ1 and AFRAVE	-2.681
Residual for P_EU2 and P_TCE2	-2.689
Residual for RES_5 and P_GRIT2	-2.911
Residual for RES_7 and P_LM2	-3.310
Residual for RES_8 and P_LM2	-2.786
Residual for RES_8 and P_GRIT2	-2.650
Residual for RES_9 and P_LM2	-3.231
Residual for RES_9 and P_TENAC2	-4.354
Residual for RES_10 and P_LM2	-3.931
Residual for RES_10 and P_TENAC1	-2.780
Residual for RES_10 and P_TENAC2	-4.701
Residual for RES_11 and P_LM2	-4.374
Residual for RES_11 and P_TENAC1	-2.609
Residual for RES_11 and P_TENAC2	-4.660
Residual for RES_11 and RES_5	-3.084
Residual for RES_12 and P_LM2	-3.298
Residual for RES_12 and P_TENAC2	-4.271
Residual for RES_12 and RES_5	-2.870
Residual for RES_12 and RES_6	-3.643

Largest Positive Standardized Residuals

Residual for P_PSYC1 and P_TCE1	2.644
Residual for AFRAVE and ENGAVE	3.932
Residual for NSAVE and MATHAVE	4.433
Residual for P_PQ1 and P_TENAC2	3.490
Residual for P_PQ2 and P_TENAC2	3.258
Residual for P_EU1 and P_PSYC2	2.653
Residual for P_EU1 and P_TENAC1	2.596
Residual for P_EU1 and P_TENAC2	3.174
Residual for P_EU1 and P_GRIT1	3.793
Residual for P_EU2 and P_TENAC1	2.608
Residual for P_EU2 and P_TENAC2	3.156
Residual for RES_11 and RES_7	4.089

In Figure 4.6 the Q-Plot is depicted showing that the data is not perfectly distributed around the desired 45-degree reference line which in the current case reflects negatively, as well as positively on the fit of the model. If the Q-Plot is considered it is indicated that it is only at the lower end and slightly on the upper end were the data point swivel from the desired 45-degree reference line.

Q-plot of Standardized Residuals

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 3.5..........................................................................
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 N  .                                           .    *      x    .
 o  .                                        .      *  *      .
 r  .                                      *  *           .
 m  .                                  . x  x*          .
 a  .                              . xxx              .
 l  .                            ***               .
    .                      .  xxx              .
 Q  .                   .  xxx             .
 u  .                 . xxxx            .
 a  .                . ***           .
 n  .             .xx*x           .
 t  .             xxx            .
 i  .          **x*            .
 l  .         xx              .
 e  .         **             .
 s  .       .*x             .
    .      . *x            .
    .      *xxx           .
    .    x**x**          .
    .    ***.           .
    .   xxx  .          .
    .  *x**  .          .
    . *xx**              .
    .* xxx     .          .
    . *xx     .           .
    .xxx x    .           .
    * x      .            .
    *        .            .
    *       .             .
    *      .              .
    x      .              .
    .    .                .
    .  .                  .
    . .                   .
    ..                    .
-3.5..........................................................................
 -3.5                                                                      3.5
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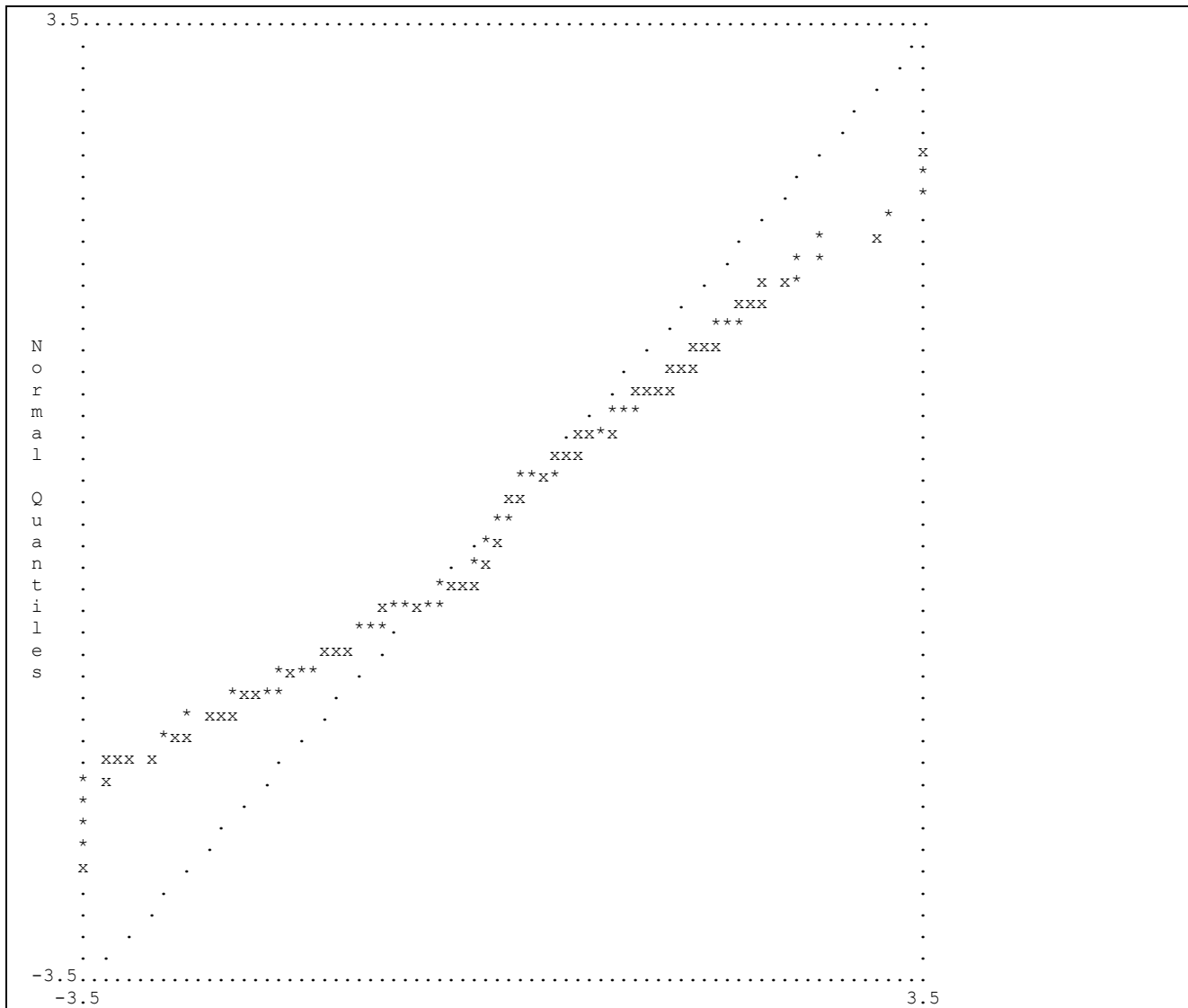
Figure 4.6 **Learning Potential Structural Model Q-Plot of Standardised Residuals**

4.10.3 Direct Effect in the Learning Potential Structural Model

If the goodness of fit statistics, measures and distribution of standardised residuals are considered on the basis of the evidence gathered, the structural model and the data fits well. In order to assess the fit of the structural model in a thorough manner Diamantopoulos and Siguaw (2000) suggests four issues which should be considered in order to determine if the relationships as hypothesised are supported by the data. The first issue is to establish whether the paths between the latent variables are correctly represented by the signs of the parameters, as well as the nature of the causal effects hypothesised between the latent variables. The second issue is to clarify if the parameter estimates are significant. If the parameter estimates are assumed to be significant, the third issue to consider is the magnitude of the parameter estimates indicating the strength of the relationships as hypothesised. Finally, the squared multiple correlations should be considered, which reflects the amount of variance in each endogenous latent variable, explained by the latent variable linked to it as hypothesised.

The parameters which should be considered are reported in the unstandardised Gamma and Beta matrices. In Table 4.45 the freed elements are reported in the Gamma (Γ) matrix which will be considered first.

Table 4.45

Learning Potential Structural Model Unstandardised Gamma Matrix

	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE	0.073	0.909		-0.017	0.024	-0.021
	(0.073)	(0.101)		(0.018)	(0.033)	(0.031)
	1.005	8.980		-0.945	0.719	-0.672
LM		0.691	0.119			
		(0.056)	(0.049)			
		12.277	2.415			
RES	0.401					
	(0.058)					
	6.976					
TENAC						
LP		9.981				
		(10.712)				
		0.932				

TCE= TIME COGNITIVELY ENGAGED; LM= LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; TENACEU= TENACITY*ENVIRONMENTAL UNFAVOURABLENES; PQEU= PARENTAL QUALITY* ENVIRONMENTAL UNFAVOURABLENESS

If the unstandardised Gamma matrix is considered as reported in Table 4.44, the main objective is to assess the level of significance regarding the estimated path coefficients γ_{ij}, which reflects the strength Ksi (ξ_i) to Eta (η_i). If the t-value as stated is $>|1,96|$, then the parameter of interest is significant ($p<.05$). This outcome would mean that the corresponding null hypothesis (H_0) will be rejected in favour of its alternative (H_a) (Diamantopoulos & Siguaw, 2000). In Table 4.45 it is indicated that only four out of the nine t-values are bigger than 1,96, while two of the values are negative, which are in contrast to the nature of the hypothesised effect. The hypotheses which are affected [t-value $<|1,96|$] in the Gamma Matrix include H_{04}, H_{07}, H_{08}, H_{010} and H_{013}, which will be discussed next.

The first hypothesis considered, namely H_{04}, indicates that Conscientiousness (ξ_4) has no statistically significant effect on Time Cognitively Engaged (η_3), thus H_{04}: $\gamma_{34}=0$ cannot be rejected in favour of the alternative H_{a4}: $\gamma_{34}> 0$. The outcome suggests that the relationship between ξ_4 and η_4 in the structural model is not corroborated. The second hypothesis considered, namely H_{07}, indicates that Environmental Unfavourableness (ξ_3) has no statistically significant effect on Time Cognitively Engaged (η_3), thus H_{07}: $\gamma_{33}=0$ cannot be rejected in favour of the alternative H_{a7}: $\gamma_{33}>0$. The outcome suggests that the relationship between ξ_3 and $\eta3$ in the structural model is not corroborated. The third hypothesis considered, namely H_{08}, indicates that the interaction term Tenacity*Environmental Unfavourableness[44] (ξ_6) has no statistically significant effect on Time Cognitively Engaged (η_3), thus H_{08}: $\gamma_{36}=0$ cannot be rejected in favour of the alternative H_{a8}: $\gamma_{36}>0$. The outcome suggests that the relationship between ξ_6 and η_3 in the structural model is not corroborated. The fourth hypothesis H_{010}, indicated that the Grit (ξ_1) has no statistically significant effect on Learning Performance (η_5), thus H_{010}: $\gamma_{51} = 0$ cannot be rejected in favour of the alternative H_{a10}: $\gamma_{51} > 0$. The final hypothesis to

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[44] Interaction Effect

be considered H_{013}, indicates that the interaction term Parental Quality*Environmental Unfavourableness (ξ_7) has no statistically significant effect in Time Cognitively Engaged (η_3), thus H_{013}: $\gamma_{37}=0$ cannot be rejected in favour of the alternative H_{a13}: $\gamma_{37}>0$.

Furthermore, Table 4.45 indicates four values which are > |1,96|, involving H_{05}, H_{09}, H_{011} and H_{014}. If H_{05} is considered, it is indicated that Conscientiousness (ξ_4) has a statistically significant effect on Resilience (η_4). H_{05}: $\gamma_{44} =0$ can thus be rejected in favour of the alternative H_{a5}: $\gamma_{44} > 0$. The relationship between ξ_4 and η_4 can be corroborated. If H_{09} is considered, the outcome indicates that Grit (ξ_1) has a statistically significant effect on Learning Motivation (η_1). H_{09}:$\gamma_{11}=0$ can be rejected in favour of H_{a9}: $\gamma_{11}>0$. Thus, the relationship as postulated between ξ_1 and η_1 can be corroborated. If H_{011} is considered, the outcome indicates that Grit (ξ_1) has a statistically significant effect on Time Cognitively Engaged (η_3). H_{011}: $\gamma_{011}= 0$ can be rejected in favour of $H_{a11}>0$. It is evident that the relationship as postulated between ξ_1 and η_1 can confidently be corroborated. If H_{014} is considered, the outcome indicates that Parental Quality (ξ_2) has a statistically significant effect on Time Cognitively Engaged (η_3). H_{014}: $\gamma_{31}>0$ can be rejected in favour of $H_{a14}>0$. The outcome presents a convincing relationship between ξ_2 and η_3 and can thus be corroborated.

In the following section the unstandardised Beta (β) matrix will be considered, as reported below in Table 4.46, which provides evidence regarding the significance of the estimated path coefficients β_{ij}, considering the degree of strength of η_j on η_i.

Table 4.46

Learning Potential Structural Model unstandardised Beta Matrix

	TCE	LM	PSYCAP	TENAC	LP
TCE		0.042			
		(0.043)			
		0.962			
LM					
RES					
TENAC		0.431			
		(0.072)			
		6.029			
LP	-9.567				
	(10.682)				
	-0.896				

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

In the Beta Matrix two of the three t-values are smaller than the rule of thumb, namely 1,96, including one value which is negative and not in the hypothesised direction. The three hypotheses affected in the Beta matrix are H_{03}, H_{06} and H_{015}. The first hypothesis to be considered is H_{03}. The output indicates a t-value (-0.896) which means that Time Cognitively Engaged (η_3) does not have a statistically significant effect on Learning Performance (η_5), thus H_{03}: $\beta_{53} =0$ cannot be rejected in favour of H_{a3}: $\beta_{53} > 0$. It should also be noted that the sign associated with the path is incorrect as it was originally hypothesised that Time Cognitively Engaged is supposed to increase Learning Performance. Hypotheses H_{03}

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is therefore clearly not supported. If H_{06} is considered, it is indicated that Learning Motivation (η_1) has a statistically significant effect on Tenacity (η_2) and thus H_{06}: $\beta_{21} = 0$ can therefore be rejected in favour of H_{a6}: $\beta_{21} > 0$. The relationship as postulated between η_1 and η_2 is thus corroborated. The final value to consider in the Beta matrix is related to H_{015}, which refers to the relationship between Learning Motivation (η_1) and Time Cognitively Engaged (η_3). The evidence indicated that η_1 does not have a statistically significant effect on η_3, thus H_{015}: $\beta_{31} = 0$ cannot be rejected in favour of H_{a15}: $\beta_{31} > 0$. Thus, the relationship between η_1 and η_3 cannot be corroborated, concluding that Learning Motivation has no direct positive relationship on Time Cognitively Engaged in the current population of subjects.

4.10.4 Completely Standardised Solution

If the LISREL output is considered, it is vital to obtain the maximum amount of evidence and insight provided by the Gamma (Γ) and Beta (β) matrices and thus the completely standardised solution should also be taken into account (Diamantopoulos & Siguaw, 2000). The major advantage of the completely standardised solution is that the parameter estimates for Gamma and Beta are not influenced by variance in the unit of measurement of the latent variables, allowing comparison with any equation (Diamantopoulos & Siguaw, 2000). In Table 4.47 and Table 4.48 the completely standardised parameter estimates of Gamma and Beta are shown below.

Table 4.47

Learning Potential Structural Model Completely Standardised Beta (β) Estimates

	TCE	LM	RES	TENAC	LP
TCE		0.042			
LM					
RES					
TENAC		0.431			
LP	-9.567				

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

Table 4.48

Learning Potential Structural Model Completely Standardised Gamma (Γ) Estimates

	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE	0.073	0.909		-0.017	0.024	-0.021
LM		0.691	0.119			
RES	0.401					
TENAC		9.981				
LP						

TCE= TIME COGNITIVELY ENGAGED; LM= LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; TENACEU= TENACITY*ENVIRONMENTAL UNFAVOURABLENES; PQEU= PARENTAL QUALITY* ENVIRONMENTAL UNFAVOURABLENESS

Table 4.47 and 4.48 display the average change, which is expressed in standard units, reflected by the endogenous latent variables which are the outcome of one standard deviation change in an endogenous and the exogenous latent variable linked to it, holding constant any additional variables (Diamantopoulos & Siguaw, 2000). It is evident from the Γ and β

matrix tables above that certain values exceeding unity is worrisome. According to Mels (2000) completely standardised Γ and β values cannot exceed unity, as they are regression coefficients. In linear regression models like the one in the current study the dependent and independent variables are standardised with a standard deviation of one and a mean of zero, while the regression slope is equal to the correlation between the dependent and independent variable, thus the correlation cannot be bigger than the value of unity.

Although the latter is the common stance regarding unity, Jöreskog (1999) argues differently stating that it is possible for the structural coefficients to exceed unity in the case were endogenous variables have multiple determinants. The reason for this is, if the factors are correlated (oblique), the factor loadings are regression coefficients and not correlations, and thus can exceed unity. A warning is however stated in that if unity is exceeded, there may exist a high degree of multi-co-linearity in the data. In the current study, only a small degree of strong relatedness is found given the inter-latent variable correlation matrix as displayed in Table 4.49 below.

Table 4.49

Inter-Latent Variable Correlation Matrix for the Learning Potential Structural Model

	TCE	LM	RES	TENAC	LP	CONS	GRIT	PQ	EU	TENACEU	PQEU
TCE	1.000										
LM	0.727	1.000									
RES	0.295	0.203	1.000								
TENAC	0.313	0.431	0.088	1.000							
LP	0.304	0.190	0.001	0.082	1.000						
CONS	0.735	0.506	0.401	0.218	0.004	1.000					
GRIT	0.989	0.716	0.283	0.309	0.519	0.705	1.000				
PQ	0.201	0.264	0.064	0.114	0.173	0.159	0.210	1.000			
EU	0.015	0.072	-0.007	0.031	0.192	-0.017	0.033	0.413	1.000		
TENACEU	0.098	0.037	0.055	0.016	-0.033	0.138	0.091	-0.218		1.000	
PQEU	0.124	0.082	0.058	0.035	-0.001	0.145	0.118			0.955	1.000

TCE=TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES=RESILIENCE; TENAC= TENACITY; LP= LEARNING PERFORMANCE; CONS=CONSCIENTIOUSNESS; GRIT; PQ=PARENTAL QUALITY; EU= ENVIRONMENTAL UNFAVOURABLENESS; TENACEU= TENACITY*ENVIRONMENTAL UNFAVOURABLENESS; PQEU= PARENTAL QUALITY*ENVIRONMENTAL UNFAVOURABLENESS

4.10.5 Variance Explained in the Endogenous Latent Variables

If the R^2 is considered regarding the endogenous latent variables; the R^2 value as displayed in Table 4.50 shows the proportional amount of variance each of the endogenous latent variables explains that can be accounted for in the learning potential structural model.

Table 4.50

R^2 values for the Five Endogenous Latent Variables Included in the Learning Potential Structural Model

TCE	LM	RES	TENAC	LP
0.981	0.526	0.161	0.098	0.554

TCE= TIME COGNITIVELY ENGAGED; LM=LEARNING MOTIVATION; RES= RESILIENCE; TENAC= TENACITY; LP=LEARNING PERFORMANCE

If R^2 values, as reported in Table 4.50, are considered, not all the endogenous latent variables account for a significant amount of variance. Three variables can be regarded as sufficiently explaining an adequate amount of variance, namely Time Cognitively Engaged (.981), Learning Motivation (.526) and Learning Performance (.554). The R^2 values associated with Resilience (.161) and Tenacity (.098) indicate that these variables do not explain much variance in the structural model. If the variance is considered in the particular study it should be taken into account that the sample consisted of 399 subjects from a particular area, and the reason for the lower variance levels may be accounted by the low level of variation in the subject's circumstances.

4.11 POWER ASSESSMENT

If the overall findings of the model fit is considered it is crucial to additionally pay attention to the statistical power, which refers the outcome of rejecting H_0 given that it is false, thus rejecting an incorrect model successfully (Diamantopoulos & Siguaw, 2000). Caution should be taken, when SEM is utilised, about wrongly rejecting a correct model. In SEM the two types of errors are commonly known as Type 1 and Type 2 errors. Diamantopoulos and Siguaw (2000) explain Type 1 error as rejecting a correct model, and write:

> The probability is captured by the significance level, α, which is usually set at .05. A significant chi-square result indicates that if the H_0 is true (i.e. the model is correct in the population), then the probability of incorrectly rejecting it is low (i.e. less than five times out of a 100 if α= .05) (p.93).

Diamantopoulos and Siguaw (2000) go on to explain the Type 2 error, as not rejecting an incorrect model and write:

> Type 2 error and the probability associated with it is denoted as β. The probability of avoiding a Type 2 error is, therefore, 1-β and it is this probability that indicates the power of our test, thus the power of the test tells us how likely it is that a false null hypothesis (i.e. incorrect model) will be rejected (p.93).

In the current study the author performed two types of power calculation, the first is known as *power associated with a test of exact* fit and secondly, the *power associated with a test of close fit*. The power associated with a test of exact fit stems from testing the null hypothesis that the model fits perfectly in the population, as executed by the Satorra-Bentler chi-square test. The exact fit, to some degree, is over ambitious as models rarely fit perfectly with its associated target population, as the model is an approximation of reality. To take a more realistic approach the test of close fit was additionally also performed, where the null hypothesis states that the model is associated with a close fit, however, not completely perfect within the given population. Diamantopoulos and Siguaw (2000) write that the null hypothesis, as stated, takes the error of approximation into account. In the case of both exact and close fit, the Root Mean Square Error of Approximation (RMSEA) statistic is utilised. In the case where the model fits perfectly within the targeted

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population, the error due to approximation is set to zero, while the null hypothesis, previously formulated as $H_{01a,}$ is consequently tested against the alternative H_{a1a} (Diamantopoulos &Siguaw, 2000).

If the test for the exact fit is considered, determining the power of the fit should be assigned to a specific value for the parameter assumed under H_a. This is necessary as there are an equal amount of power estimates as possible values, for the parameter under H_a. A RMSEA equal to .05 is logical to use as an RMSEA<.05 indicates good model fit. Close fit is achieved, given the specific population, once the RMSEA is set equal or smaller than .05, as in the case of the current model fit (RMSEA=.05). Should a model only indicate approximate fit, given the specific population, the error due to approximation is set at .05, while H_0 (indicated in the current study as H_{01b}) is consequently tested against the alternative H_{a1b}. In order to establish the power of a test of close fit, a particular value should be assigned to the parameter. In the case of close fit, a reasonable value for the RMSEA equals .08[45] (Diamantopoulos & Siguaw, 2000). Given this background information, the statistical power associated with exact and close fit will be determined for the current learning potential structural model next.

4.11.1 Statistical Power of the Test of Exact and Close Fit for the Learning Potential Structural Model

The statistical power associated with the test of exact and close fit can be determined and derived by utilising the Preacher and Coffman calculation syntax for determining statistical power (Preacher & Coffman, 2006). The statistical power of fit is a function of the effect size, the significance level, the sample size (N) and the degrees of freedom (v) in the model and can be given as v=½[(p)(p+1)3t), were t represents the amount of parameters to be established in the fitted model, given the total number of γ's, β's, Ψ's, λ's and θ_δ's. In Figure 5.7 the Degree of Freedom is calculated below, as a prerequisite for determining the statistical significance.

MODEL/HYPOTHESIS	# LAMBDA's	# TAU's	# Q_δ/Q_ϵ's	#ALPA's	#GAMMA's	#BETA's	#PSI's	# PHI's	TOTAL # OF PARAMETERS TO BE ESTIMATED	# INDICATOR VARIABLES	# GROUPS	# UNIQUE INFORMATION PIECES	DF
SINGLE GROUP STRUCTURAL MODEL	20	0	26	0	9	3	4	6	68	26	1	377	309

Figure 4.7 **Excel Macro Calculation of Structural Model Degrees of Freedom**

In Figure 4.7 the calculation for the current model presents a total of 377 unique variance and covariance terms in the observed covariance matrix. In Table 4.51 the power analysis is displayed below as per Preacher and Coffman (2006).

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[45] .08 is the upper limit for reasonable fit

Table 4.51

Statistical Power of the Test of Exact and Close Fit for the Adapted Structural Model

H_0	H_a	N	A	Df	Power
H_0:RMSEA=0	H_a:RMSEA=.05	399	.05	318	1.00
H_0:RMSEA≤0.05	H_a:RMSEA=.08	399	.05	318	1.00

The outcome indicated in Table 4.51 was found testing the exact and close fit, with a significance level of .05 for α and an estimated sample size of 399. From the outcome it is evident that the chance of rejecting the exact fit H_0 is high, although the model fits moderately well in the population. It could be declared without a doubt that the null hypothesis of close fit could not be rejected. Not rejecting the close fit null hypothesis is thus evident, with the reassurance that the outcome cannot be attributed to the lack of statistical power given the calculation outcome as per Preacher and Coffman (2006).

4.12 SUMMARY

The current chapter presented a collection of evidence which was obtained from the data analyses procedures implemented. Following the current chapter an in-depth discussion on the results and conclusions of this study will take place as well as the methodological limitations, practical implications and general recommendations for future research.

CHAPTER 5

DISCUSSION, RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

5.1 INTRODUCTION

The current study set out to explore non cognitive elements which may have a significant negative or positive influence on the learning performance of those individuals most affected by the injustices of South Africa's past. The study is unique in its endeavour to understand the consequences and complexities that should be taken into consideration when attempting to understand why certain individuals engaging in learning activities are failing. Conducting the study among the specific sample of Grade 9 learners proved to be more challenging than expected, however it opened up a perspective on life which is far removed from the prospering inclusive post-apartheid South Africa anticipated by the "born-free[46]" youth. It was evident to see that so much more will have to be done in order to reach the dream of equality, not only in the education sector and the level of education presented, but also on the grounds of social development and overall welfare management. It was interesting to listen to and experience the thoughts and beliefs of the learners volunteering to participate in the study, although it was at times frustrating to see a democracy on its knees through the eyes of a child. The lack of vision and the absence of the general ability to strive for excellence was notable, not only in the lives of the learners, but also amongst some of their educated seniors as well. The main question that should be asked is; whose responsibility is it to make sure that upcoming generations are self-sufficient and encouraged to stand on their own two feet, rather than being reliant on a social welfare grant system supplied by government. If the solution is the adequate development of knowledge, skills and abilities through affirmative development, then this stance should be honoured at all cost, given its promise of equality to those previously disadvantaged. In order to reach prosperity through affirmative development practices the forces that inhibit, threaten and impact on its success should be understood, not only to avoid failures, but also to approach it with the level of integrity it deserves.

In order to answer the question of whose responsibility is it to see that self-sustainability is reached by those most affected by the wrongs from the past; it is the author's belief that those who can should do something about it, in order to change things for the better. Government is failing in its attempt to handle affirmative development with the necessary integrity it deserves. Failure in governmental practices is evident given the array of "unsustainable-quick-fix-empowerment" solutions. A cognitive leap and paradigm shift should be made by those previously disadvantaged and now participating in affirmative development opportunities - excellent learning performance does not come without effort, despite meeting the cognitive prerequisites impacting on learning ability. The presenters of affirmative development opportunities should also realise that learning performance is not a random event, it is dependent on (but not limited to) a complex nomological network of person-related and environmental latent variables as researched in the current study.

In order for development through training to succeed it is important to understand the learning performance of those being developed. In order to understand the push and pull forces that constitute successful learning, Taylor (1989) developed the APIL test battery (Taylor, 1994). From the work produced by Taylor (1989, 1994, 1997), De Goede (2004) developed a learning potential structural model, attempting to explain the cognitive latent variables collectively constituting learning potential (De Goede, 2007). The current researcher developed an elabotated Learning Potential

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[46] Born-free is the term used to describe the generation of South African's which were born in post-apartheid South Africa.

Structural Model which is based upon the original De Goede Learning Potential Structural Model. The current model is, however, not solely focussing on cognitive elements influencing learning performance, but rather on the non-cognitive latent variables impacting on learning performance. The current Non-Cognitive Learning Potential Structural Model was empirically tested and the results are discussed in the following section.

5.2 DISCUSSION OF RESULTS

5.2.1 Evaluation of the Measurement Model

By utilising SEM, the fit indices of the measurement model proved to be very satisfying given the exact fit that was obtained. If the indices of the measurement model are analysed, the data does fit the model well, except for the latent variables of Psychological Resilience*Environmental Unfavourableness (PSYCEU) and Grit (GRIT). In the case of the latter, the indicator variables does not seem to reflect the specific latent variable well, thus not all the items successfully reflect their individual latent variable. If the R^2 values are considered, most of the values were larger than .70, indicating adequate variance. The distribution of the stem-and-leaf plot seemed to be fairly well distributed, with only a limited number of large values displayed as indicated by the standardised residuals. The Q-plot also reproduced a very accurate distribution of values among the 45-degree reference line. The fact that the indicator values did not successfully reflect the underlying interaction latent variable of PSYCEU made the researcher remove the interaction term, thus only two interaction terms were included in structural model.

5.2.2 Evaluation of the Structural Model

The structural model failed to converge with all three interaction terms, when the most unsuccessful and suspicious latent variable, being the interaction term PSYCEU was removed; the model converged successfully showing good fit.

In evaluating the fit of the structural model, the researcher investigated the output through analysing the unstandardised and standardised Beta and Gamma matrices, residual tables, stem-and-leaf plot, the Q-plot, as well as the correlation matrices and the statistical significance of the structural model. From the Beta matrix it was indicated that only one out of the three paths were corroborated in the study, no support was established for the hypothesised significant positive influence (<1.96) of Learning Motivation on Time Cognitively Engaged (β_{31}), as well as for Time Cognitively Engaged on Learning Performance (β_{53}). It was, however, suggested that two additional Beta paths should be considered in the model, in that Time Cognitively Engaged positively influenced RES (β_{43}), as well as that Learning Motivation positively influenced RES (β_{41}). With the inspection of the Standardised Expected Change for Beta it was found that only a very limited change (<.30) will be obtained in both cases and it was decided to abort the mission of adding these two additional paths due to their statistical insignificance.

If the outcome of the Beta matrix is considered with respect to the supported paths, it was established that Learning Motivation does have a statistically significant effect on Academic Tenacity. This outcome is supported in the work of Bandura. Bandura (1997) states that those people who have a tenacious belief in their capabilities will persevere in their efforts despite innumerable difficulties and obstacles they may face. These specific people, are also not easily overwhelmed by the adversities they may incur.

In the current study it can be said that learning motivation does have a significant impact as a motivational catalyst that ignites the tenacious effort towards goal achievement. This supports Theron's (2013) argument that the construct of tenacity in isolation is scalar and without direction. In the current study, given the specific sample and context, despite the learners being highly tenacious, their obstinate effort will have no purpose if it is not expended in a specific direction which is governed by a motivational component.

If the Gamma matrix is considered it was found that only four out of the nine hypothesised paths could be corroborated, while the positive influence of Conscientiousness (γ_{34}), Environmental Unfavourableness (γ_{33}), Tenacity*Environmental Unfavourableness [TENACEU (γ_{36})] and Parental Quality* Environmental Unfavourableness [PQEU (γ_{37})] on Time Cognitively Engaged could not be corroborated, as well as the effect of Grit on Learning Performance (γ_{51}). If the modification indices are considered, four additional paths were suggested including, Parental Quality *(γ_{22})* and Environmental Unfavourableness *(γ_{32})* positively influencing Tenacity, as well as Conscientiousness *(γ_{54})* and Environmental Unfavourableness *(γ_{53})* positively influencing Learning Performance. However given the Standardised Expected Change for Gamma with reference to the suggested paths, no practically significant benefit will arise from freeing these additional paths as the expected change for all the paths were <.30. The researcher decided not to free any of the suggested paths given the limited expected change.

If the outcome of the Gamma Matrix is considered regarding the supported paths, it was established as hypothesised that Conscientiousness does have a statistically positive effect on Resilience. This supports the finding by Fayombo (2010) that, among other Big Five personality traits, conscientiousness does account for variance in psychological resilience. This means that those subjects in the context of the current study which were more conscientious, were likely to be more resilient in their overall response to stressors. From the research obtained it was also established that Parental Quality had a significant positive influence on Learning Motivation. This outcome supports the finding of Driscoll (2006) that students from low socio economic status backgrounds benefit most significantly from parental involvement in academic activities. If the context of the current study is considered, it can be said that the higher the level of Parental Quality that exists, the higher the level of Learning Motivation on the part of the subjects exist. Finally the construct of Grit proved to have a significant positive effect on Cognitive Engagement, as well as Learning Motivation as hypothesised. If the relationship between Grit and Learning Motivation is considered, the current study supports the fact that the more Gritty a subject is, the higher the level of learning motivation. This means that those subjects with a passion and perseverance for long-term goals will have a higher level of learning motivation over a longer period of time towards their goal accomplishment. Secondly the study supported the fact that the Grittier a subject is the higher the level of Cognitive Engagement that exists. This again supports the research by Duckworth et al. (2007) in that Gritty individuals work harder and longer than their less gritty peers. The fact that the study supported the motivational (*perseverance of effort*) and engaged (*consistency of interest*) aspects of Grit, reinforces the statement presented by Duckworth et al (2007) that Gritty individuals are individuals who work actively and constantly at challenges, maintaining effort over a long period of time while not quitting, despite many adversities.

If the fit is investigated through analysing the stem-and-leaf plot it is evident that a very satisfying distribution is present, however it is indicated that a very slight negatively skewed distribution was observed, expressing the concern that overestimation through the parameters is likely in the model fit. From the distribution of values on the Q-plot it was observed that many values showed a slight deviation from the 45-degree reference line.

From the evidence obtained in this study it is evident that the more motivated a learner is towards studying, the more tenacious the learner will become in his or her learning efforts. This means they will persevere in their effort even if the work is difficult and they face personal adversities. Thus, increasing school learner's motivation to study will enhance their tenacious effort and drive to succeed in their academic efforts. Secondly, the research findings suggest that the more involved caregivers are involved in learner's school and learning activities, the more motivated learners are to study. The findings also suggest that learning motivation and cognitive engagement is enhanced by Grit. Thus the more "Gritty" a learner becomes the more motivated he will be toward the activity of study and the more engaged with the work, for a longer period of time, he will be. Finally, the research findings indicate that those learners who measure higher on the trait of conscientiousness will be more resilient in their effort of learning success.

5.3 LIMITATIONS TO THE RESEARCH METHODOLOGY

The current study attempted to explain the impact of non-cognitive factors[47] on the learning performance of Grade 9 school-going individuals from previously disadvantaged communities in the Cape Town area, Western Cape, South Africa. The main aim was to make out a case for the fact that these non-cognitive variables do have a significant impact on the lives of those individuals attempting to obtain an education. The survey utilised in the current study was specifically designed, developed and validated for grade 9 school learners. This brings about the first practical implication of the study; although a relatively good model fit was achieved, it does not imply generalisability. Thus, the significant path coefficients were not convincing enough evidence to support the causal hypotheses as defined. It is therefore premature to argue that the specific hypotheses were fully validated.

If the data capturing is considered, the data for the current study was sampled from a very specific non-probability group of grade 9 learners from the suburbs of Cape Town resorting under the Western Cape Education Department. This convenience sample is not representative of all those being granted developmental opportunities and as a result it is suggested to further investigate the construct of learning potential in a broader arena, including the private sector. The duplication of the findings will enable generalisations.

When considering the measurement instruments utilised, all the instruments in the current research study was self-reporting instruments. There are several implications when using self-reporting measuring instruments which include the risk of social desirability, inaccurate self-perception, method bias and lack of discriminant validity. The risk of social desirability is noticeable in respondents that manipulate their answers to appear more or less favourable. This can have dire consequences for the reported results of each construct being measured (Elmes, Kantowits & Roediger, 1999). Secondly, self-perception can have less than a desirable outcome, given the nature of the respondents' actual experiences and their inaccurate perceptions. According to Van Heerden (2013), respondents' perceptions may differ in relation to their actual state of being, which have implications for personal ratings on a specific construct. This issue is particularly of concern when working with school learners, given that their perception of themselves and their actual state is not yet fully developed. Thirdly, method bias may result from using a self-reporting measuring instrument only. In the current study the researcher did include objective academic results for the measure of learning performance,

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[47] Time Cognitively Engaged, Learning Motivation, Resilience, Tenacity, Grit, Parental Quality, Learning Performance and Environmental Unfavourableness

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which minimized the issue of method bias overall. Finally, the issue of discriminant validity become apparent when the constructs being measured is closely related (Diamantopoulos & Siguaw, 2000).

5.4 PRACTICAL IMPLICATIONS

The current Learning Potential Structural Model presents a novel approach to learning potential assessment, as it not only included non-cognitive latent variables in the study, but additionally attempted to include three interaction terms. The inclusion of interaction terms is a promising start to understand how different latent variables together and in conjunction can have a statistically significant positive effect on a dependent variable. The researcher's main aim with the inclusion of the interaction terms in the specific study was the conviction that elements impacting on learning performance do not take place in "individual silos". The South African scenario has proven time-and-again that many different kinds of adversities are affecting those affiliated with it. It should be noted, however, that, almost all the latent variables which were included and tested in the study were malleable variables and thus change is possible regarding those variables most profoundly impacting on Learning Performance.

The current study focussed on scholastic success of Grade 9 learners. If the utility of the study is considered, evidence was found that certain variables may have a significant impact on the learning performance of those individuals that are granted affirmative developmental opportunities or any training for that matter. These variables should be taken into consideration by trainers and organisations conducting developmental programmes. It is evident that successful learning performance will translate to the actual task that is to be executed by the trainees, thus if learning takes place in a successful manner, higher return-on-investment (ROI) can be expected. It was however outside the scope of the specific study to establish the matter of transfer of knowledge; this is a matter that should be researched as it makes theoretical sense.

The utility is extended by the confirmation that learning potential assessment can play a leading role in identifying those individuals that have the highest learning competency potential to succeed in a given training opportunity. This will enable organisations already constrained with respect to training expenses to have a lower fall-out rate among those in training. In South Africa many individuals are annually identified for training but fail due to non-cognitive elements which were not anticipated by the trainer. This issue will get worse in the near future with the newly suggested implementation of the "*youth wage subsidy*". Many of those young individuals applying for positions under the new act will need to be trained with respect to the processes and practices of their organisations. The matter of employers taking in youths, given the financial governmental aid they will receive, will pose a challenge in the near future regarding how to select "inexperienced youth" with very limited work-related experience. Having a tool that has the ability to identify the youth's "learning potential", or as some may see it, "potential to learn", makes the burden of selecting young inexperienced employees much less strenuous. Employers will be able to choose those subjects with the highest capacity to learn and succeed, given the training success they can anticipate. This process is however not limited to youth employment, as the same process will be useful for any group of employees.

An additional consideration that should be taken into consideration regarding the utility of the research is the role of affirmative development programme developers, facilitators and trainers. Understanding the push and pull forces of their trainees/learners' learning success, could be utilised in training material which optimise the learning experience and performance. If the trainers understand the malleableness of those constructs and elements impacting on their

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trainees' experience, they can make provision for it. For example, if parental quality does play an active part in learning success, then caregivers should be made aware of the significant benefits of the elements that constitute this construct (e.g. I have enough food to eat every day). The mastery experience will only be successful if the external influences inhibiting learning success are managed appropriately.

Some of the constructs that can be addressed include Learning Motivation, Time Cognitively Engaged, Grit, Tenacity, Resilience and Conscientiousness. The variables that are not under the control of trainers, but should be taken into consideration, include Parental Quality and Environmental Unfavourableness, and how these constructs alone or in concert with other constructs inhibit learning performance.

In order to increase Learning Motivation, a trainer can utilise the concept of Vroom's Expectancy Theory, focussing on outcomes that trainees want and redefining it as a desirability that drive their learning motivation and ultimately their learning performance. This means that trainees should understand that adequate learning performance is instrumental in reaching higher and more desirable rewards. This concept can be implemented through presenting those subjects that obtain the highest level of learning performance with a financial incentive. If there is an expectation among trainees that their effort will translate into successful learning performance, and if this learning performance has valence and present access to valued alternatives, they will be more motivated to learn.

Because transfer of novel knowledge only takes place once enough time has been spent on actually studying the material presented and internalising the message which is conveyed through the written and oral presentation, it is crucial that Time Cognitively Engaged is spent on the material. Although Time Cognitively Engaged is the responsibility of each trainee; the process can be facilitated by trainers through instructional time by providing opportunities for trainees to be engaged in their learning material.

If Conscientiousness is considered, it was found to have a profoundly significant positive effect on Resilience, which means that trainers have the ability to influence and enhance trainees' levels of Resilience during engagement with difficult tasks. According to Goff and Ackerman (1992) conscientiousness has been proven to be a valuable predictor of academic success beyond cognitive ability. If trainees' level of resilience can be enhanced, more individuals will be completing training programmes, resulting in a decrease in drop-out rates.

In the study Grit proved to have a statistically significant effect on Time Cognitively Engaged, as well as on Learning Motivation. According to Duckworth (2007) Grit is defined as passion and perseverance for long-term goals. The main question that should be asked is whether Grit can be taught and the answer is "yes". Rather than praising your trainee for his/her good or bad grades or for being smart, praise the trainee for being tenacious and determined to succeed in his/her effort. Focusing on those qualities of "stick-to-it-ness" may help trainees to succeed more than praise for particular achievements would do. This is a strategy that can assist those trainees involved in long term courses (i.e. school) to persevere over many years to reach their end goal (i.e. obtaining a senior certificate/ grade 12 matric).

Finally the outcome of the current study proved that Parental Quality has a significant effect on Learning Motivation. This is an element of the study which is not so much under the control of the trainee's trainer, but rather a supportive element with respect to training success. In the training context, like schools, where parental guidance is necessary for learning performance to succeed, the role that parental involvement plays should be enhanced. The practical challenge

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that exists is that in most cases were this type of support is most needed it is also the most absent. In order to enhance the Learning Motivation of younger subjects, parents should be informed about their role to make the learning experience optimal. In the current study Parental Quality was defined as a term describing parental support for their children's educational development, through activities such as checking school homework, assisting with school homework and presenting motivational incentives for good grades. It is evident from the outcomes of the current study that these mentioned activities do have a significant effect on the degree of learning motivation that learners have towards their learning material. Parents should be made aware of these findings and the value adequate learning motivation holds for successful learning performance.

5.5 RECOMMENDATIONS WITH RESPECT TO FUTURE RESEARCH

In order to promote the generalisability of the current study, it is recommended that the current learning potential structural model be empirically tested on a wider scale. This can be executed by including a more representative sample (outside the school realm) of those individuals being granted developmental learning opportunities. The outcome of further representative studies will greatly contribute to the body of knowledge utilised by the industrial psychological. This will enable the industry to understand the complex interplay taking place in the learning environment and the challenges that some trainees/learners face when attempting to stay cognitively engaged in the learning material presented. This empowering knowledge could assist in determining the resources required by those who are at risk of failing developmental opportunities presented. If the interplay of resources is understood by those presenting learning opportunities, they will be in a position to attempt to compensate for the lack of resources in the case of those learners/trainees without the critical resources. This realisation of required resources and there interrelationships may be the key to adding more variables to the current learning potential structural model.

It is recommended that the aspects of the current model that were empirically supported be integrated with the learning potential structural model of De Goede (2007). This elaborated model will shed light on the complex relationships that exist between the cognitive and the non-cognitive variables that promote learning performance success. This elaborated model will assist stakeholders in understanding the complex psychological processes that determine the success or the lack thereof of learning performance in South Africa.

If elaborations to the current model is considered the author is convinced that language proficiency plays a critical role in the learning process. The issue of language should be a primary priority for future researchers, as, without a proper proficiency in the language of instruction, the transfer and storage of novel information will be severely hampered. The matter of not understanding questions well enough, and not being able to respond appropriately in many cases, is due to the poor language development in the preferred language of the trainer or educator, which in many cases is not the official home language of those receiving developmental opportunities.

Finally, the author recommends that longitudinal models of learning potential be developed and tested in such a manner that latent variables are modelled at different time intervals, which will result in a more realistic recording of the structural feedback loops which exist between the investigated latent variables.

5.6 CONCLUDING REMARKS

The current study was rolled out as a proposed solution to the challenges South Africa faces with regard to affirmative development. The study presents an answer to the challenges faced by those presenting affirmative development opportunities, with specific reference to the level of learning success being achieved by those on the receiving side. The author's stance remains that learner performance is not a random event, but rather a systematically determined process consisting of a complex nomological network of latent variables. These latent variables reflect learners' abilities and the dispositional stance they adopt within their environment. This study highlights the importance of optimally utilising scarce resources fostering development, and offers a solution to those who are aiming to ensure the best possible learning performance success to those granted a selective developmental opportunity. The current learning potential structural model has identified a combination of latent variables which should be considered for learning performance success. This structural model sensitises those in the position of presenting learning in a training institution to take into consideration the malleable "state like constructs" that interact with the outcome of learning performance and compensate for them. Compensation can take place through reinforcement and modelling by those in key positions of the training institution. The current study was presented as an attempt to find insight into what constitutes learning performance success in selective developmental learning programmes in South Africa - as a nudge in the direction of equality through affirmative development by means of selective developmental opportunities.

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APPENDIX A

DOE WESTERNCAPE RESPONSE ON DATA CAPTURING REQUEST

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NAVORSINGSVOORSTEL: DIE EVALUASIE VAN BEROEPSVOORLIGTING OP KINDERS

U aansoek om bogenoemde navorsing in skole in die Wes-Kaap te onderneem, is toegestaan onderhewig aan die volgende voorwaardes:
1. Prinsipale, opvoeders en leerders is onder geen verpligting om u in u ondersoek by te staan nie.
2. Prinsipale, opvoeders, leerders en skole mag nie op enige manier herkenbaar wees uit die uitslag van die ondersoek nie.
3. U moet al die reëlings met betrekking tot u ondersoek self tref.
4. Opvoeders se programme mag nie onderbreek word nie.
5. Die ondersoek moet onderneem word vanaf **21 Mei 2012 tot 22 Junie 2012**.
6. Geen navorsing mag gedurende die vierde kwartaal onderneem word nie omdat skole leerders op die eksamen (Oktober tot Desember) voorberei.
7. Indien u die tydperk van u ondersoek wil verleng, moet u asb met **Dr A.T. Wyngaard** in verbinding tree by die nommer soos hierbo aangedui, en die verwysingsnommer aanhaal.
8. 'n Fotostaat van hierdie brief sal oorhandig word aan die prinsipaal van die inrigting waar die beoogde navorsing sal plaasvind.
9. U navorsing sal beperk wees tot die lys van skole soos wat by die Wes-Kaap Onderwysdepartement ingedien is.
10. 'n Kort opsomming van die inhoud, bevindinge en aanbevelings van u navorsing moet voorsien word aan die Direkteur: Onderwysnavorsing.
11. 'n Afskrif van die voltooide navorsingsdokument moet ingedien word by:
    Die Direkteur: Navorsingsdienste
    Wes-Kaap Onderwysdepartement
    Privaatsak X9114
    KAAPSTAD
    8000
Ons wens u sukses toe met u navorsing.
Die uwe

Geteken: Dr Audrey T Wyngaard
vir: **HOOF: ONDERWYS**
DATUM: 07 Mei 2012

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APPENDIX B

PERMISSION LETTER TO HEADMASTER

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Permission Letter

Department of Industrial Psychology
University of Stellenbosch
Stellenbosch
7600

Malibu High School
Malibu Village,
Cape Town
 7100

27 August 2013

Dear Mr Esterhuizen

This letter is addressed to you, for the purpose of asking you to partake in a research study conducted by Dirk J Pretorius, a Master's (MComm) student of the Department of Industrial Psychology at the University of Stellenbosch (US).

The study aims to elaborate on previous research, by considering the effect of non-cognitive variables in the learning process of a learner. This study will specifically consider the effect of the following variables on a learners learning performance: *Time Cognitively Engaged, Learning Motivation, Conscientiousness, Resilience, Tenacity, Grit, Parental Quality and Environmental Unfavourableness*. For a more thorough description of the proposed study, please consult the attached research proposal. By participating in the proposed study, the following will be required of you:

1. This study needs the participation of Grade 9 learners who have the following three subjects: English First Language, Afrikaans Second Language, Mathematics and Science.

2. Two hours with the learners, as this will be enough time for them to complete the fill-in questionnaire.

3. The term 1 and term 2 academic marks of the participating Grade 9 learners for the four subjects. Their academic marks will fulfil a crucial part in this study, as it will serve as measures of the level of *Learning Performance* achieved by learners.

The study will require each leaner to provide their name on the questionnaire they need to complete. However, this will only be done to link academic marks with the results obtained on the questionnaire. Research participants will otherwise remain confidential. The information will only be disclosed when permission from the learner and their parent/guardian is obtained. It is also important to take note of the fact Malibu High identity will not be revealed in my Master's Thesis, and will also remain confidential. This study will not be invasive, and will avoid disrupting day-to-day practices at Malibu High. I will aim to visit the participating school as the third term commences (first week in August), but will come at a time that will suit you best. This study has the potential to make an immeasurable difference in how any learning environment approaches the process of learning and succeeds in achieving great learning performance. Consequently, I would encourage you to partake in this study, as it will assist in the improvement of interventions aimed at facilitating successful learning, and therefore, the result of this study will be extremely valuable to your school, your community and future of our country.

Additionally, a feedback session with the school will be arranged to report on the findings, and outcome of the study, with some solutions presented to the critical non-cognitive challenges the learners face impacting on their learning performance.

If you have any questions or concerns about the proposed study, please feel free to contact Dirk J Pretorius (0720202816 or 15112438@sun.ac.za) or my study supervisor Mrs Michelle Visser (021 808 3001 or mvis@sun.ac.za).

Yours Sincerely,

Mr Dirk J Pretorius

APPENDIX C

INFORMED CONSENT FROM CAREGIVER

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CONSENT TO PARTICIPATE IN RESEARCH

You are asked to give permission to allow your child to participate in a research study conducted by Dirk J Pretorius (master's student, MComm), from the Department of Industrial Psychology at Stellenbosch University. The results of this study will contribute to the thesis of Dirk J Pretorius. Your child is selected as a possible participant in this study because he/she is a Grade 9 learner.

1. PURPOSE OF THE STUDY

The objective of the research study is aimed at explaining differences in the *Learning Performance* of grade 9 learners.

2. PROCEDURES

If you give permission for your child to participate in this study, we would ask of them to complete a short questionnaire that would take ± 45 minutes to complete. They would be asked to provide their name, as this would allow us to link your child's academic results (for term 1 and term 2) and their questionnaire results. We will come to your child's school, and provide them with the questionnaire. Completion of the questionnaire will not interfere with the normal school activities of your child.

3. POTENTIAL RISKS AND DISCOMFORTS

The Department of Education has approved the research study. There exist no foreseeable risks, discomforts or inconveniences for your child or their school.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR SOCIETY

There exist no direct benefits for you or your child. However, the development of this learning potential structural model will assist in the development of interventions aimed at promoting successful learning. Thus, this research will be very valuable to your child's school, your community, and society as a whole.

5. PAYMENT FOR PARTICIPATION

Not you, your child, nor their school will receive any payment for participating in the research study.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with your child, will remain confidential, and will only be disclosed with your and your child's permission or as required by law. Confidentiality will be maintained by storing the data on a password-protected computer, and by only reporting aggregate statistics of the sample. No publication will reveal the identity of any research participant (learner), or the academic marks of any learner. The identity of your child's school will also remain confidential.

7. PARTICIPATION AND WITHDRAWAL

You as parent/guardian/caregiver can choose whether to allow your child to participate in this study. If you allow your child to participate in the study, you may at any time withdraw your child from the study without suffering any consequences. Your child may refuse to answer any questions that he/she does not want to answer, and still remain in the study. Your child will also give personal permission to partake in the study, by signing an informed assent letter.

8. IDENTIFICATION OF INVESTIGATORS

If you as parent/guardian/caregiver have any questions or concerns about the particular research study, please feel free to contact Dirk J Pretorius (072 0202816 or 15112438@sun.ac.za) or Ms M Visser (021 808 3001 or mvis@sun.ac.za).

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and your child will discontinue participation without any penalty. You are not waving any legal claims, rights or remedies by allowing your child to participate in this study.

10. SIGNATURE OF PARENT/GUARDIAN/CAREGIVER OF RESEARCH PARTICIPANT

I hereby give consent voluntarily that my Grade 9 child may participate in the research study.

Name of parent/guardian/caregiver_____

Name of Grade 9 learner_____

Parent/Guardian/Caregiver Signature_____   **Date**_____

APPENDIX D

LEARNING POTENTIAL QUESTIONNAIRE [LPQ]

Date (dd/mm/yyyy):

| | | /0 | 8 | /2 | 0 | 1 | 3 |

Initials and Surname of Student:

Name of School:

Learning Potential

QUESTIONNAIRE

[Self Assessment Form]

_____

Leer Potensiaal

Vraelys

[Self Assesseerings Vorm]

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PARTICIPANT ASSENT FORM

You are asked to participate in a research study that will be lead by Dirk J Pretorius, a Master's student from the Department of Industrial Psychology at the University of Stellenbosch.

1. What is the Research project about?
The Research project aims to explain differences in grade 9 student's Learning Performance.

2. Why have I been invited to participate in this project?
You were selected because you are a Grade 9 learner who has completed the first half (term 1 and term 2) of their Grade 9 course, with the following 3 subjects: English First language, Afrikaans Second language, Mathematics and Science
.

3. Who is doing the research?
Dirk J Pretorius, a Master's student from the Department of Industrial Psychology at the University of Stellenbosch, conducts this specific Research Project you are asked to participate in. The results obtained from this study, will contribute to my Master's thesis.

4. What will happen to me in this study?
If you volunteer to participate in this study, you will be asked to fill in a short questionnaire of ±45 minutes. You will be asked to fill in your name and surname.

5. Can anything bad happen to me?
There are no expected risks connected with your participation in this study. The results of this study will be treated as confidential.

6. Can anything good happen to me?
If you participate in this study, you will NOT receive any direct benefits. However, the results of this study have the potential to help your school, your community and South Africa as a country.

7. Will anyone know I am in the study?
Any information obtained in this study, and any information that can be linked to you, will remain confidential. A summary of the results will be presented to the teachers and principle of your school. In none of these cases will your information be revealed, and your academic marks will not be reported. The name of your school will also remain confidential, so no one will know that your school took part in this study.

8. Who can I talk to about the study?
If you have any questions or concerns about this study, you are more than welcome to contact Dirk J Pretorius (072 0202816 or 15112438@sun.ac.za) or Ms M Visser (021 808 3001 or mvis@sun.ac.za), both from the department of Industrial Psychology of the University of Stellenbosch.

9. What if I do not want to do this?
You are not forced to take part in this study, so you may refuse, even if your parents/guardians have given permission for you to participate. You may also stop participating at any time during the study without getting into trouble. You are also not forced to answer questions that you don't want to answer. You are not waving any legal claims, rights or remedies because you are participating. If you want to talk to anyone about your rights as a research participant, please contact Ms Maléne Fouché (021 808 4622 or mfouche@sun.ac.za) at the Division of Research Development.

Yes I, the undersigned understand, and want to participate in the study: **Yes** ☐   **NO** ☐

Name and Surname:_____   **Grade :9**

Signature of Grade 9 learner: _____   **Date:** _____

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Instructions

[1] Please make sure that your initials and surname is filled in correctly on the front page.

[2] Please make sure that your school's name is filled in correctly.

[3] Please read the following general instructions carefully:

- This questionnaire is not a test.

- There is no right or wrong answers.

- All the questions should be answered. Please don't leave out any questions.

- There is no time limit to complete the questionnaire. You should however try to complete the questionnaire within ± 45 minutes.

- Please do not talk to other students when completing the questionnaire.

- Answer all questions as truthfully and honestly as possible.

- When you are finished please hand in the questionnaire.

[4] Please read the definitions of each section before starting.

Please do not turn the page until you are instructed to.

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[1] TIME COGNITIVELY ENGAGED

This section of the questionnaire is to provide an assessment of cognitive engagement. **Definition:** Cognitive (mental) engagement refers to the amount of time you spent on your school work as well as how hard you try.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e., term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate how often you did the following behaviours described in the statements by crossing the number (from 0 to 6) that best describes how often you performed the following behaviours in the first half of grade 9.

Example Statement: I take a lot of breaks when I study.

For example: If you never performed the behaviour described in the statement, cross the box with the number 0.

0 (crossed out)	1	2	3	4	5	6
Never	Almost Always	Rarely	Sometimes	Often	Very Often	Always

Read each statement carefully and choose only ONE answer.
Please respond to all questions.

Statement	Never	Almost Never	Rarely	Sometimes	Often	Very Often	Always
1. I spent enough time on my school work in the first half of grade 9 to reach the school marks I wanted.	0	1	2	3	4	5	6
2. In my grade 9 class I actively listened and communicated with my teachers.	0	1	2	3	4	5	6
3. In my grade 9 class I showed effort to concentrate and understand what my teacher was saying.	0	1	2	3	4	5	6
4. I was concentrating, when I did my grade 9 homework.	0	1	2	3	4	5	6
5. I would make sure that when I had set time aside to study, I used effort to learn my work.	0	1	2	3	4	5	6
6. I forced myself to focus if my mind drifted off while I was studying.	0	1	2	3	4	5	6
7. I was an active member of my grade 9 class and during group activities.	0	1	2	3	4	5	6
8. I paid attention in my grade 9 classes.	0	1	2	3	4	5	6
9. I concentrated in my grade 9 classes.	0	1	2	3	4	5	6
10. I actively participated in grade 9 academic group activities.	0	1	2	3	4	5	6
11. When I was studying in the first half of grade 9 I really engaged with my grade 9 study material.	0	1	2	3	4	5	6
12. I tried not to get distracted in class.	0	1	2	3	4	5	6
13. I worked hard enough on my grade 9 school work to reach my goals.	0	1	2	3	4	5	6
14. I was intellectually/mentally engaged with what my teacher was saying in my grade 9 class.	0	1	2	3	4	5	6
15. When I got down to work with regards to the first half of grade 9, I worked hard.	0	1	2	3	4	5	6
16. I kept myself focussed when I studied for my grade 9 tests.	0	1	2	3	4	5	6
17. I listened well enough in my grade 9 classes.	0	1	2	3	4	5	6

Please turn over to the next page.

[2] CONSCIENTIOUSNESS

This section of the questionnaire is to provide an assessment of conscientiousness. **Definition:** Conscientiousness refers to the trait of being meticulous self-disciplined, careful, thorough, organized, and deliberating carefully before acting.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e., term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate how often you did the following behaviours described in the statements by crossing the number (from 0 to 6) that best describes how often you performed the following behaviours in the first half of grade 9.

Example Statement: I am always aware of my available study time.

For example: If you always perform the behaviour described in the statement, cross the box with the number 6.

0	1	2	3	4	5	6
Never	Almost Always	Rarely	Sometimes	Often	Very Often	Always

Read each statement carefully and choose only ONE answer.
Please respond to all questions.

Statement	Never	Almost Never	Rarely	Sometimes	Often	Very Often	Always
1. I was always prepared in grade 9.	0	1	2	3	4	5	6
2. I paid attention to detail in my schoolwork.	0	1	2	3	4	5	6
3. My parents and/or teachers needed to check up on me, in order for me to get started with my work in the first half of grade 9.	0	1	2	3	4	5	6
4. I got my grade 9 tasks done efficiently and effectively.	0	1	2	3	4	5	6
5. I successfully completed the first half of my grade 9 tasks in the manner I planned to.	0	1	2	3	4	5	6
6. I planned my study time.	0	1	2	3	4	5	6
7. I was thorough in my academic work.	0	1	2	3	4	5	6
8. I got my academic work completed on time.	0	1	2	3	4	5	6
9. I developed a study timetable to guide my studying.	0	1	2	3	4	5	6
10. I followed my study timetable.	0	1	2	3	4	5	6
11. The study timetable I set up was well organised.	0	1	2	3	4	5	6
12. When I made plans with regards to the first half of grade 9 I stuck to them.	0	1	2	3	4	5	6

Please turn over to the next page.

[3] LEARNING MOTIVATION

This section of the questionnaire is to provide an assessment of learning motivation. **Definition:** Learning motivation refers to the specific desire to learn the content of the curriculum relevant to grade 9.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e., term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate the extent to which you agree or disagree with the following statements by crossing the number (from 1 to 7) that best describes your behaviours in the first half of grade 9.

Example Statement: I am never motivated to study.

For example: If you strongly agree with the behaviour described in the statement, cross the box with the number 7.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree

Read each statement carefully and choose only ONE answer.
Please respond to all questions.

Statement	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Agree	Strongly Agree
1. I intended to increase my knowledge during the first half of grade 9.	1	2	3	4	5	6	7
2. When I did not understand some part of the first half of grade 9 course, I tried harder, for example, by asking questions.	1	2	3	4	5	6	7
3. I was willing to use considerable effort in order to enhance my knowledge and understanding during the first half of grade 9.	1	2	3	4	5	6	7
4. I wanted to learn as much as I could during the first half of grade 9.	1	2	3	4	5	6	7
5. I was motivated to learn the work covered in the first half of grade 9.	1	2	3	4	5	6	7
6. I intended to do my best in the first half of grade 9.	1	2	3	4	5	6	7

Please turn over to the next page.

[4] PSYCHOLOGICAL CAPITAL
(RESILIENCE)

This section of the questionnaire provides an assessment of Psychological Capital (Hope, Optimism, Resilience and Self-efficacy). **Definition: Resilience** is your capacity to "bounce back" from uncertainty, stress, conflict, failure and even positive change.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e. term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate your level of agreement to the following behaviours described in the statements by crossing the number (from 1 to 6) that best describes how often you performed the following behaviours in the first half of grade 9.

Example Statement: I cannot work properly in times of difficulty.

For example: If you strongly disagree with the behaviour described in the statement, cross the box with the number 1.

1	2	3	4	5	6
Strongly Disagree	**Disagree**	**Somewhat Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**

Read each statement carefully and choose only ONE answer.

Please respond to all questions.

Statement	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
1. When I have a setback at school, I have trouble recovering from it.	1	2	3	4	5	6
2. I usually manage difficulties easily.	1	2	3	4	5	6
3. I can work on my own.	1	2	3	4	5	6
4. I manage well during stressful times.	1	2	3	4	5	6
5. I can get through difficult times at school because I've experienced difficulty before.	1	2	3	4	5	6
6. I feel I can handle many things at a time at school.	1	2	3	4	5	6

Please turn over to the next page.

[5] GRIT

This section of the questionnaire provides an assessment of Grit. **Definition:** Grit refers to a person's capacity to work actively and constantly at challenges, maintaining effort over a long period of time while not quitting despite facing many adversities, independent of positive feedback. Individuals who own Grit not only complete their current task at hand, they also have the ability to pursue a particular aim over many years.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e. term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate your response to the following behaviours described in the statements by crossing the number (from 1 to 6) that best describes your behaviour in the first half of grade 9.

Example Statement: I never finish what I started.

For example: If the behaviour described in the statement is mostly like you, cross the box with the number 2.

1	2	3	4	5	6
Very much like me	**Mostly like me**	**Somewhat like me**	**Not quite like me**	**Mostly not like me**	**Not like me at all**

Read each statement carefully and choose only ONE answer.
Please respond to all questions.

Statement	Very much like me	Mostly like Me	Somewhat like me	Not quite like me	Mostly not like me	Not like me at all
1. New ideas and projects sometimes distract me from previous ones.	1	2	3	4	5	6
2. Setbacks do not get me down.	1	2	3	4	5	6
3. I have been obsessed with a certain idea or project for a short time but later lost interest.	1	2	3	4	5	6
4. I am a hard worker.	1	2	3	4	5	6
5. I often set a goal but later choose to pursue a different one.	1	2	3	4	5	6
6. I have difficulty maintaining my focus on projects that take more than a few months to complete.	1	2	3	4	5	6
7. I finish whatever I begin.	1	2	3	4	5	6
8. I am diligent (hard-working).	1	2	3	4	5	6

Please turn over to the next page.

[6] PARENTAL QUALITY

This section of the questionnaire provides an assessment of Parental Quality. **Definition:** Parental Quality refers to the extent to which parental support is available for scholar's educational development. Please note that the terms "Parent" also refers to caregiver, foster parent or guardian.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e. term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

IMPORTANT: If you <u>do not</u> have a caregiver which is an <u>adult</u>, please mark all the following questions as 1 (Strongly Disagree).

Indicate your level of agreement to following behaviours described in the statements by crossing the number (from 1 to 5) if you have a caregiver.

Example Statement: My caregiver(s) help me with my homework.

For example: If you strongly disagree with the behaviour described in the statement, cross the box with the number 1.

1 ✗	2	3	4	5
Strongly Disagree	**Disagree**	**To an extent**	**Somewhat agree**	**Agree**

Read each statement carefully and choose only ONE answer.

Please respond to all questions.

Statement	Strongly Disagree	Disagree	To an extent	Somewhat agree	Agree
1. My caregiver(s) can help me with my school homework; after school.	1	2	3	4	5
2. My caregiver(s) make sure I attend school every school day.	1	2	3	4	5
3. My caregiver(s) make sure I do my homework.	1	2	3	4	5
4. My caregiver(s) assists me in difficult school assignments.	1	2	3	4	5
5. My caregiver(s) encourage me to work hard in school.	1	2	3	4	5
6. My caregiver(s) provide incentives (e.g. money) for good grades.	1	2	3	4	5
7. My caregiver(s) attends all school meetings.	1	2	3	4	5
8. My caregiver(s) have regular contact with my teacher to discuss my academic performance.	1	2	3	4	5
9. My caregiver(s) encourage me to matriculate.	1	2	3	4	5
10. My caregiver(s) encourage me to further my studies when I matriculate.	1	2	3	4	5

[7] ENVIRONMENTAL UNFAVOURABLENESS

This section of the questionnaire provides an assessment of Environmental Unfavourableness. **Definition:** Environmental Unfavourableness refers to Socio-Economic Status [SES]. SES is a multifaceted construct which refers to three main dimensions including: Occupation, Education and Wealth.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e. term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate your level of agreement to the following statements described below by crossing the number (from 1 to 5), that best describes your experience in the first half of grade 9.

Example Statement: I study by candle light.

For example: If you agree with the behaviour described in the statement, cross the box with the number 5.

1	2	3	4	5
Strongly Disagree	Disagree	To an extent	Somewhat agree	Agree

Read each statement carefully and choose only ONE answer.

Please respond to all questions.

Statement	Strongly Disagree	Disagree	To an extent	Somewhat agree	Agree
1. I am currently living in a house.	1	2	3	4	5
2. I have my own bed and bedroom at home.	1	2	3	4	5
3. I have electricity at home.	1	2	3	4	5
4. I have running water at home.	1	2	3	4	5
5. I have to walk to school.	1	2	3	4	5
6. I get enough food to eat every day.	1	2	3	4	5
7. My caregiver(s) have fulltime jobs.	1	2	3	4	5
8. I have my own table/desk to study at, at home.	1	2	3	4	5
9. My caregiver(s) has enough money to care for me.	1	2	3	4	5
10. I have a cellular phone.	1	2	3	4	5

Please turn over to the next page.

[8] TENACITY

This section of the questionnaire provides an assessment of Tenacity. **Definition**: Tenacity refers to a person's ability to persist against all odds, when faced with difficult challenges.

Directions: Listed below is a set of statements about your first half of grade 9 (i.e. term 1 and 2). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

Indicate your level of agreement to the following behaviours described in the statements by crossing the number (from 1 to 5), that best describes your experience in the first half of grade 9.

Example Statement: If I cannot do a certain task, I leave it.

For example: If you agree with the behaviour described in the statement, cross the box with the number 5.

1	2	3	4	5
Strongly Disagree	Disagree	To an extent	Somewhat agree	Agree

Read each statement carefully and choose only ONE answer.

Please respond to all questions.

Statement	Strongly Disagree	Disagree	To an extent	Somewhat agree	Agree
1. If I get stuck solving a problem, I continue to look for a solution.	1	2	3	4	5
2. I always complete school assignments, even if it is difficult.	1	2	3	4	5
3. If I do not understand something, I will ask my teacher to explain it until I understand.	1	2	3	4	5
4. I never leave my school homework unfinished, even if I get very tired.	1	2	3	4	5
5. I always do my homework, although there is violence at home.	1	2	3	4	5
6. I always attend school, although I have to walk very far to school.	1	2	3	4	5
7. I always concentrate in class, although I come to school hungry.	1	2	3	4	5
8. I come to school every day, although it is dangerous sometimes.	1	2	3	4	5

End of Questionnaire: Please hand in to your study leader.

Thank you for participating in the current research study.

APPENDIX E

PREACHER AND COFFMAN SYNTAX

Results from Rweb

You are using Rweb1.03 on the server at rweb.quant.ku.edu

```
R version 2.13.0 (2011-04-13)
Copyright (C) 2011 The R Foundation for Statistical Computing
ISBN 3-900051-07-0
Platform: x86_64-redhat-linux-gnu (64-bit)

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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

Rweb:> png(file= "/tmp/Rout.30183-15450%03d.png",bg="white",height=800,width=800)
Rweb:>
Rweb:> #Computation of minimum sample size for test of fit
Rweb:>
Rweb:> rmsea0 <- 0.05 #null hypothesised RMSEA
Rweb:> rmseaa <- 0.08 #alternative hypothesised RMSEA
Rweb:> d <- 384 #degrees of freedom
Rweb:> alpha <- 0.05 #alpha level
Rweb:> desired <- 0.8 #desired power
Rweb:>
Rweb:> #Code below need not be changed by user
Rweb:> #initialize values
Rweb:> pow <- 0.0
Rweb:> n <- 0
Rweb:> #begin loop for finding initial level of n
Rweb:> while (pow<="" n+100="" ncp0="" (n-1)*d*rmsea0^2="" ncpa="" (n-1)*d*rmseaa^2=""
#compute="" power="" if(rmsea0
Rweb:> #begin loop for interval halving
Rweb:> foo <- -1
Rweb:> newn <- n
Rweb:> interval <- 200
Rweb:> powdiff <- pow - desired
Rweb:> while (powdiff>.001) {
+    interval <- interval*.5
+    newn <- newn + foo*interval*.5
+    ncp0 <- (newn-1)*d*rmsea0^2
+    ncpa <- (newn-1)*d*rmseaa^2
+    #compute power
+    if(rmsea0<="" qchisq(alpha,d,ncp="ncp0,lower.tail=F)" pow=""
pchisq(cval,d,ncp="ncpa,lower.tail=F)" }="" else="" qchisq(1-
alpha,d,ncp="ncp0,lower.tail=F)" 1-pchisq(cval,d,ncp="ncpa,lower.tail=F)" powdiff=""
abs(pow-desired)="" if="" (powdesired) {
+      foo <- -1
+    }
+ }
Rweb:>
Rweb:> minn <- newn
Rweb:> print(minn)
[1] 56.83594
Rweb:>
Rweb:> dev.off()
null device
          1
Rweb:>
```