# THE MODIFICATION, ELABORATION AND EMPIRICAL EVALUATION OF THE DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL THROUGH THE INCORPORATION OF NON-COGNITIVE LEARNING COMPETENCY POTENTIAL LATENT VARIABLES

Berné du Toit

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**SUPERVISOR: PROF C.C. THERON**

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# OPSOMMING

In die konteks van Menslike Hulpbronontwikkeling word daar vele kere na mense verwys as die organisasie se belangrikste hulpbron uit erkenning vir die belangrike kennis en leer wat hulle na die organisasie bring (Bierema & Eraut, 2004). Suid-Afrikaanse organisasies ervaar 'n tekort aan die waardevolle en belangrike hulpbron weens die land se verlede onder leiding van die Apartheidsisteem. Suid-Afrika ly vandag steeds onder die gevolge van die geskiedenis van rassediskriminasie onder leiding van die Apartheidstelsel. Hierdie stelsel is gebaseer op wetlike rasseskeiding, afgedwing deur die Nasionale Party regering in Suid-afrika tussen 1948 en 1993. Hierdie sisteem het die meeste Suid-Afrikaners die geleentheid op toegang tot ontwikkelingsgeleenthede ontneem. Suid-Afrika se verlede het die lede van die voorheen benadeelde groepe gelaat met onderontwikkelde bevoegdheidspotensiaal, in teenstelling met lede van bevoorregte groepe. Dit het daartoe aanleiding gegee dat geldige en regverdige (in die Cleary sin van die begrip) streng bo-tot-onder keuring 'n nadelige impak teen voorheen benadeelde individue tot gevolg het. Die onderontwikkelde bevoegdheidspotensiaal verhoed die voorheen benadeelde groepe om suksesvol in die werksplek te wees. Weens die belangrikheid van arbeid is dit noodsaaklik dat die Suid-Afrikaanse arbeidsmag ontwikkel word om sy volle potensiaal te bereik.

Nadelige impak in personeelkeuring verwys na die situasie waar 'n keuringstrategie lede van 'n spesifieke groep 'n laer waarskynlikheid van keuring bied in vergelyking met lede van 'n ander groep (Boeyens, 1989). Daar bestaan dus 'n reuse onontginde reservoir van menslike potensiaal in hierdie land en 'n metode om hierdie individue te identifiseer word benodig. Die feit dat 'n nadelige impak geskep word tydens personeelkeuring beteken nie noodwendig dat die keuringsprosedures verantwoordelik is vir die nadelige impak nie. Die aanvaarding van 'n probleemoriëntasie vereis die gebruik van 'n versigtige analise om die grondoorsake van 'n problem te identifiseer (Bierema & Eraut, 2004). In Suid-Afrika sal dit 'n intellektueel eerlike oplossing ten opsigte van die probleem van nadelige impak bied om ontwikkelingsgeleenthede te voorsien aan daardie lede wat geleenthede misgun is in die verlede, om vaardighede, vermoëns en hanteringstrategieë wat benodig word vir werksprestasie te ontwikkel, eerder as om 'n ander keuringsinstrument te soek. Daar word glad nie hiermee geïmpliseer dat regstellende aksie tot niet gemaak moet word nie. Daar word slegs voorgestel dat die fokus van regstellende aksie meer ontwikkelingsgerig

moet wees. Groter klem moet dus daarop geplaas word om lede van voorheen benadeelde groepe die geleenthede te gee om die nodige bevoegdheidspotensiaal te ontwikkel om suksesvol in the werksplek te wees. Regstellende ontwikkelingsgeleenthede sal voorheen benadeelde individue toegang gee tot opleidings en ontwikkelingsgeleenthede wat daarop afgestem is om hulle van die nodige vaardighede en kennis te voorsien wat hulle kortkom.

'n Behoefte bestaan om daardie indiwidue te identifieer wat die grootste voordeel uit hierdie ontwikkelingsgeleenthede sal trek en wat die hoogste vlak van leerpotensiaal het, aangesien hulpbronne vir die doel baie skaars is. Pogings tot versnelde regstellende ontwikkeling sal net suksesvol wees tot die mate wat daar 'n omvattende begrip is van die faktore wat onderliggend is aan leerprestasie en die wyse waarop hulle kombineer om leerprestasie te bepaal (De Goede & Theron, 2010). De Goede (2007) het reeds so 'n leerpotensiaalnavorsingstudie gedoen. Keuring alleen, alhoewel belangrik en noodsaaklik, is nie voldoende om suksesvolle regstellende ontwikkelingsingrypings te verseker nie. Verdere addisionele ingrypings word na keuring benodig om sukses te verseker.

Die primêre doelstellings van hierdie studie is gevolglik om op De Goede (2007) se fondasies te bou. De Goede (2007) se model is beskryf, sy onderliggende argument is verduidelik, verslag is gedoen oor die pasgehalte van die voorgestelde strukturele model en ook oor sy bevindinge aangaande die spesifieke, oorsaaklike verwantskappe wat hy voorgestel het.

De Goede (2007) se bestaande leerpotensiaal strukturele model is gewysig en uitgebrei deur die toevoeging van addisionele nie-kognitiewe veranderlikes om 'n meer indringende begrip van die kompleksiteit onderliggend aan leer en die determinante van leerprestasie te verkry. Die strukturele model is empiries getoets en geëvalueer en die model het 'n goeie passing getoon. Modifikasie-indekse bereken as deel van die strukturele vergelykingsmodellering het 'n spesifieke baan uitgewys wat die passing van die model sou verbeter indien dit bygevoeg word tot die bestaande model. Die strukturele model is dus aangepas deur die addisionele baan by te voeg tot die bestaande model na die oorweging van die volle spektrum pasgehaltemaatstawwe, gestandaardiseerde residue, modifikasie-indekse and parameterskattings. Geen bane is verwyder nie. Die besluit is geneem omdat die baan-spesifieke hipoteses wat getoets is,

verwys het na spesifieke bane toe hulle ingesluit is in die spesifieke model. Verwydering van bane wat nie statisties beduidend was nie, sou dus die oorspronklike hipoteses verander. Die bevinding was dat die finaal-gewysigde strukturele model die data goed gepas het.

Die beperkinge van die navorsingsmetodiek, die praktiese implikasies van die studie en aanbevelinge vir toekomstige navorsing word ook bespreek.

# ABSTRACT

People are often referred to in a Human Resource Development context as the organisation's most important resource in recognition of the important knowledge and learning they bring to the organisation (Bierema & Eraut, 2004). South African organisations experience a shortage of this valuable and important resource due to the country's social political past which was led by the Apartheid system. South Africa today still suffers from the consequences of the history of racial discrimination which was lead by the Apartheid system. This system was one of legal racial segregation enforced by the National Party government of South Africa between 1948 and 1993 and it deprived the majority of South Africans of the opportunity to develop and accumulate human capital. South Africa's past has thus left the previously disadvantaged group members with underdeveloped competency potential, as opposed to the not previously disadvantaged group members, and this has subsequently led to adverse impact in valid, fair (in the Cleary sense of the term) strict-top-down selection. This underdeveloped competency potential prohibits these individuals from succeeding in the world of work. Because of the importance of labour it is crucial that the South African labour force be developed to reach its full potential.

Adverse impact in personnel selection refers to the situation where a selection strategy affords members of a specific group a lower probability of being selected compared to members of another group (Boeyens, 1989). There thus lies a vast reservoir of untapped human potential in this country, and a method to identify these individuals is required. The fact that adverse impact is created during personnel selection does not necessarily mean that selection procedures are responsible for the adverse impact. Adopting a problem orientation involves using careful analysis to identify the root causes of a problem (Bierema & Eraut, 2004). In South Africa an intellectually honest solution to the problem of adverse impact would be to provide development opportunities, rather than searching for an alternative selection instrument, to those individuals who have been denied opportunities in the past in order to develop skills, abilities and coping strategies necessary for job performance. This does not imply that affirmative action should be abolished; it rather suggests that the focus of this corrective policy should shift towards a more developmental approach. More emphasis should be placed on providing the previously disadvantaged with the necessary training and development to foster the necessary competency potential to succeed in the world of work. Affirmative developmental opportunities will entail giving previously disadvantaged individuals access to skills development and educational opportunities aimed at equipping them with the currently deficit skills and knowledge. A need exists to identify individuals who will gain maximum benefit from these developmental opportunities and who display the highest potential to learn, as resources for such developmental programmes are scarce. Attempts at accelerated affirmative development will be effective to the extent to which there exists a comprehensive understanding of the factors underlying training performance and the manner in which they combine to determine learning performance (De Goede & Theron, 2010). De Goede (2007) has already conducted a study to identify such individuals. Selection alone, although important and necessary, is not sufficient to ensure successful affirmative development interventions. Additional interventions are required, post-selection, to ensure success.

The primary objectives of this study are consequently to build onto De Goede's (2007) foundations and it is therefore necessary to describe De Goede's (2007) model, explain its underlying argument, report on the fit of his proposed structural model and also to report on the findings regarding the specific causal relationships which he proposed. De Goede's (2007) existing learning potential structural model was expanded with the inclusion of additional non-cognitive variables in order to gain a deeper understanding of the complexity underlying learning and the determinants of learning performance. The hypothesised learning potential structural model was empirically tested and evaluated and achieved good close fit. Modification indices calculated as part of the structural equation modelling suggested a specific addition to the existing model that would improve the fit. One modification was subsequently made to the model after the consideration of the full range of fit indices, standardised residuals, modification indices and parameter estimates. No paths were removed. This decision was taken because the path-specific hypotheses that were tested referred to the specific paths when they were included in the specific model. Deleting insignificant paths from the model would therefore change the original hypotheses. The final revised structural model achieved good fit.

The limitations of the research methodology, the practical implications of this study, and recommendations for future research are also discussed.

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# INTRODUCTION

## 1.1 THE IMPORTANCE OF LABOUR

Labour is arguably the most important asset of the South African economy (Van Jaarsveld & Van Eck, 2006). Organisations are managed, operated and run by people. Labour is the life giving production factor with which the other factors of production are mobilised and thus represents the factor which determines the effectiveness and efficiency with which the other factors of production are utilised. The competitive difference of consistent high economic growth in organisations thus lies within the humans who are the carriers of the production factor labour. People are often referred to in a human resource development context as the organisation's most important resource in recognition of the important knowledge and learning they bring to the organisation (Bierema & Eraut, 2004). Human capital can thus be viewed as a vital and indispensable resource for an organisation's effectiveness.

Because of the importance of labour it is crucial that the organisation optimises the quality of its labour force. The quality of the human resources the organisation has at its disposal will determine the efficiency with which it produces products or services. To ensure that an organisation has a valuable resource of human capital, it needs to select the best employees, invest in their training and development and create and maintain a performance driven working environment. Sound selection practices can thus be seen as an important function of the human resource practitioner and industrial/organisational psychologist. Through human resource interventions these individuals can control who enters the organisation and how the organisation will further train or develop its employees. In order for them to attain and maintain a competent workforce, they need to empirically identify the complex nomological network of influencing variables characterising the employee and the working environment that determines an employee's level of competence. Credible and valid theoretical explanations for the different facets of the behaviour of working man constitute a fundamental and indispensable, though not sufficient, prerequisite for efficient and equitable human resource management (De Goede & Theron, 2010). This form of management will contribute to the organisation's goals through the attainment and maintenance of a competent and motivated workforce.

## 1.2 PROBLEM WITH SOUTH AFRICAN LABOUR

South Africa's socio-political past unavoidably influenced the research on the behaviour of the working man and the subsequent interventions to try and positively influence these behaviours. South Africa's socio-political past has affected the standing of those who were disadvantaged by the previous political dispensation on many of the competency potential latent variables required to succeed in the world of work. This brings unique theoretical and practical challenges to the human resource practitioner and industrial psychologist.

South Africa has a history of racial discrimination which was lead by the Apartheid system. This system was one of legal racial segregation enforced by the National Party government of South Africa between 1948 and 1993. Apartheid was designed to benefit Whites and disadvantage Blacks. Apartheid not only denied many people in South Africa access to quality education over a prolonged period of time but also relentlessly attacked their self-esteem and self-image via innumerable negative socio-political cues (De Goede & Theron, 2010). The disadvantaged group were thus deprived of opportunities to accumulate human capital which can be defined as the productive investments in humans, including their skills and health, which are the outcomes of education, healthcare and on-the-job training (Burger, 2011). In other words the disadvantaged group generally lacks the knowledge, skills, abilities and behaviour, which allow employees to perform important work tasks and functions. South Africa subsequently became one of the most unequal societies in the world with an immense gap between rich and poor. This lead to further social instability, which negatively affected economic growth. The effects of Apartheid have left the previously disadvantaged group members with underdeveloped competency potential, as opposed to the not previously disadvantaged group members, and this has subsequently led to adverse impact in valid fair (in the Clearly sense of the term) strict-top-down selection.

Valid selection procedures, used in a fair, non-discriminatory manner that optimise utility, very often result in adverse impact against members of previously disadvantaged groups and it thereby aggravates the effect of socio-political discrimination. Adverse impact in personnel selection refers to the situation where a selection strategy affords members of a specific group a lower probability of being selected compared to members of another group (Boeyens, 1989). Adverse impact thus occurs when a decision, practice, or policy has a disproportionately negative effect on a specific group. It will thus create the situation where there will be a substantially different rate of selection in hiring, promotion or other employment decisions which work to the disadvantage of members of a race, sex or ethnic group (Ployhart & Holtz, 2008). Adverse impact refers to a situation where a seemingly neutral practice has greater but unintended negative consequences for members of a specific group. An example of unintentional adverse impact would be an employment policy that requires all applicants to have a Grade 12 certificate or a university degree but where the proportion of individuals satisfying the requirement differs appreciably across groups. A demonstration of adverse impact shifts the burden of persuasion to the defendant to demonstrate that what *prima facie* seems like unfair discrimination is in fact not. Chapter II of the Employment Equity Act (Republic of South Africa, 1998, p. 16), under the heading "Burden of proof", paragraph 11 states that:

> Whenever unfair discrimination is alleged in terms of this Act, the employer against whom the allegation is made must establish that it is fair.

In a similar vein the Constitution (Republic of South Africa, 1996, p. 7) states:

> When prima facie evidence of unfair discrimination is shown the defendant must establish that it is fair.

If such a degree or certificate is not necessary to successfully perform the job, then the adverse impact would constitute unfair indirect discrimination and the policy would have to be changed. There is thus a reduced likelihood for a member of a previously disadvantaged group to be selected for a job because of lower performance on an invalid predictor. Demonstrating the job-relatedness of the predictor is, however, not sufficient to demonstrate that what *prima facie* seems like unfair discrimination is in fact not. What additionally needs to be demonstrated is that the criterion inferences derived from the predictor do not contain systematic group-related bias[1].

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[1] This position implies the Cleary (1968) interpretation of selection fairness that is favoured by most technical guidelines on personnel selection.

The important point here, however, is that although adverse impact constitutes important *prima facie* evidence of unfair discrimination it does not equate to unfair discrimination. In addition, given the socio-political history of South Africa, valid, fair, strict top-down selection is expected to create adverse impact. Although formal scientific proof is not available this study would therefore want to claim that logically adverse impact is generally present in valid, fair, strict top-down South African personnel selection. Previously disadvantaged South Africans experience this adverse impact when they get turned down in strict top-down performance maximising selection decisions. The (questionable) response of the South African legislature to this dilemma was to implement a system of affirmative action to combat the adverse impact of top down selection systems.

The fact that adverse impact is created during personnel selection does not necessarily mean that selection procedures are responsible for the adverse impact. An extremely popular stance supported by Murphy (2002) is that cognitive ability tests represent the best single predictor of job performance, but also represent the predictor most likely to have substantial adverse impact on employment opportunities for members of several racial and ethnic groups. Cognitive ability tests measure crystallised abilities which are strongly affected by education. Cattell (1971) developed a higher-order theory which distinguished two forms of intelligence, namely fluid intelligence and crystallised intelligence. According to Taylor (1994) fluid intelligence is a basic inherited capacity, whereas crystallised intelligence refers to specialised skills and knowledge promoted by and required in a given culture. Horn and Hofer (1992, p. 88) define fluid intelligence as 'reasoning abilities consisting of strategies, heuristics, and automatised systems that must be used in dealing with novel problems, reducing relations, and solving inductive, deductive, and conjunctive reasoning tasks'. Taylor (1994) mentions that this type of ability is considered basically innate or unlearned and therefore less susceptible to extensive acculturation or education and the effects of environmental deprivation. Crystallised intelligence refers to specialised skills and knowledge promoted by and required in a given culture and develops as a result of investing fluid ability in particular learning experiences (Taylor, 1994).

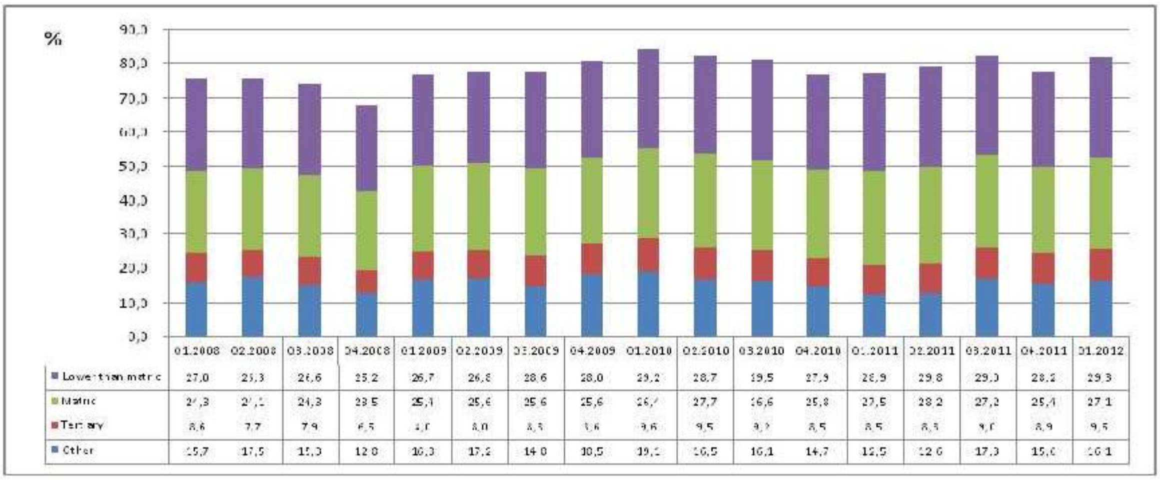
Murphy (2002) further states that massive societal changes will be necessary to significantly affect the discriminatory effects of cognitive ability tests and that racial difference in cognitive ability tests have an unduly large adverse effect on employment opportunities for members of several racial and ethnic minority groups. In one way Murphy (2002) is correct when he argues in favour of large-scale societal changes to bring about improvements in the level of crystalised ability amongst currently disadvantaged communities. It is however incorrect to claim that it is the cognitive test *per se* that is causing the adverse impact.

To appreciate the error in the rather prevalent view that adverse impact is due to the unwise selection of predictor instruments the logic underlying personnel selection should be considered. Selection is a human resource intervention aimed at improving employee work performance by regulating the quality of employees that flow into the organisation, and up the organisational hierarchy. Ideally one would therefore want to base selection decisions on measures of work performance. Logically this is, however, not possible since the level of performance that any given applicant will demonstrate will only materialise once the candidate has been appointed. The solution is to predict the work (or criterion) performance that can be expected from applicants. At the point of making selection decisions, actual performance is unknown and the best that the selectors can do is to rely on predictors with well-established records of validity and utility which brings us back to cognitive ability tests. It can be analytically shown (Theron, 2009) that if the work (or criterion) performance predictions are valid (and in the Cleary sense of the term fair) strict top-down selection will invariably result in adverse impact if the actual levels at which different (gender, cultural, language, racial) groups perform on the criterion differ across groups. If valid predictors, like cognitive tests, are used during selection without predictive bias to infer/estimate the criterion then it is the difference in the estimated criterion distributions that cause adverse impact. Predicted criterion performance distributions will differ across groups if the actual criterion distributions differ. The fundamental cause of adverse impact therefore does not lie in the predictors used to make the predictions but rather in the fact that the criterion (or work performance) distributions of different groups do not coincide. According to De Goede and Theron (2010) the fundamental cause of the adverse impact created by performance-maximising fair use of valid predictors in selection in South Africa is the difference in the means of the criterion distributions of previously disadvantaged and not previously disadvantaged groups. If members of different groups do not perform the job equally well valid and fair criterion predictions (or inferences) will mirror this fact. If decisions are then based on the valid and fairly derived criterion inferences top-down selection must necessarily result in adverse impact against members of the groups that perform less well on the criterion.

The solution to adverse impact therefore should also not be sought in the selection procedure itself but rather in the reasons why the criterion (or work performance) distributions of different groups do not coincide. The previous political dispensation in South Africa, mentioned earlier, should be considered rather than the predictors used in selection procedures when human resource practitioners and industrial psychologists attempt to address under-representation and finding a constructive solution to adverse impact (De Goede & Theron, 2010).

Since 1994, the government has attempted to address the imbalances that Apartheid created, but some challenges still remain and the effects are still clearly visible as will be discovered in the section that follows.

Large scale unemployment has become the prime social and economic issue in South Africa. Large scale unemployment in South Africa constitutes a waste of human potential and national product, it is responsible for poverty and inequality, it erodes human capital and it creates social and economic tension (Snower & De La Dehesa, 1997). Unemployment refers to the condition of being unemployed. A person is defined as being unemployed if he or she is looking for work, but is unable to find to find a job. From the definitions it can thus be seen that a person cannot be classified as being unemployed merely by not having a job. The requirement of wanting the job must be present (Layard & Nickell, 2005). Pensioners and students for example will not be classified as unemployed. Unemployment is the cause of many serious economic and social problems and it affects everyone. In general, lower unemployment rates are associated with higher levels of education. From the first quarter of 2008 the unemployment rate for persons without matric was higher than for those with matric or a higher education level as can be seen from Figure 1.1 below.

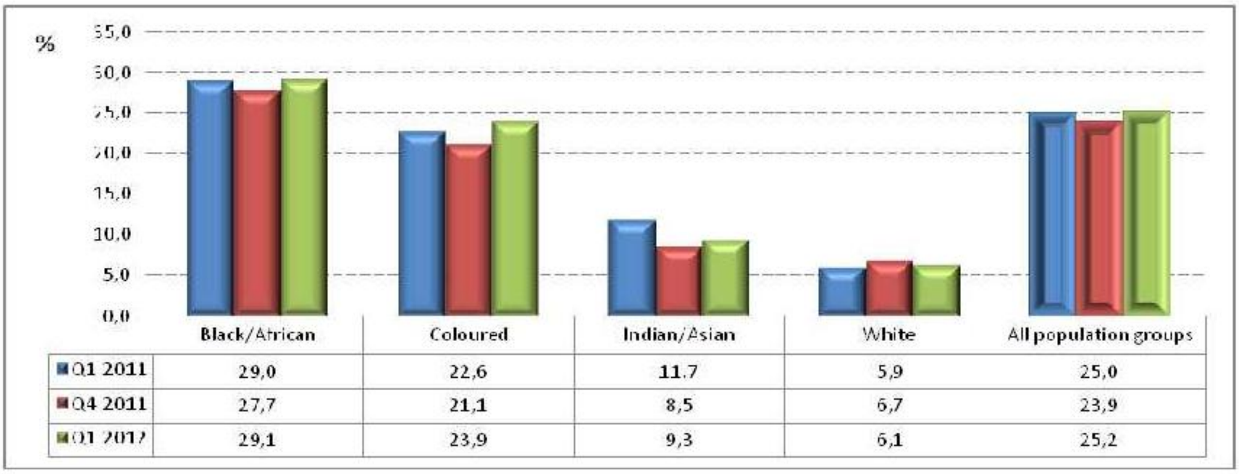


| | Q1.2008 | Q2.2008 | Q3.2008 | Q4.2008 | Q1.2009 | Q2.2009 | Q3.2009 | Q4.2009 | Q1.2010 | Q2.2010 | Q3.2010 | Q4.2010 | Q1.2011 | Q2.2011 | Q3.2011 | Q4.2011 | Q1.2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ■ Lower than matric | 27,0 | 25,3 | 26,6 | 25,2 | 26,7 | 26,8 | 28,6 | 28,0 | 29,2 | 28,7 | 19,5 | 27,9 | 28,9 | 29,8 | 29,0 | 28,2 | 29,3 |
| ■ Matric | 24,3 | 24,1 | 24,3 | 23,5 | 25,1 | 25,6 | 25,6 | 25,6 | 26,4 | 27,7 | 16,6 | 25,8 | 27,5 | 28,2 | 27,2 | 25,4 | 27,1 |
| ■ Tertiary | 8,6 | 7,7 | 7,9 | 6,5 | 8,0 | 8,0 | 8,5 | 8,6 | 9,6 | 9,5 | 9,2 | 8,5 | 8,5 | 8,5 | 9,0 | 8,9 | 9,5 |
| ■ Other | 15,7 | 17,5 | 15,3 | 12,8 | 16,3 | 17,2 | 14,0 | 18,5 | 19,1 | 16,5 | 16,1 | 14,7 | 12,5 | 12,6 | 17,3 | 15,6 | 16,1 |

***Figure 1.1*** Unemployment rate by education level. Adapted from "Quarterly Labour Force Survey" by Statistics South Africa, 2012.

According to Statistics South Africa (STATS SA, 2012) the official unemployment rate was 25.2% at the end of the 1st Quarter 2012.

Figure 1.2 below also shows that between the fourth quarter in 2011 and the first quarter in 2012, the unemployment rate increased among the Coloured (2.8 percentage points), Black African (1.4 percentage points) and Indian/Asian population (0.8 of a percentage point), while it decreased among the White population (.6 of a percentage point).



| | Black/African | Coloured | Indian/Asian | White | All population groups |
|---|---|---|---|---|---|
| ■ Q1 2011 | 29,0 | 22,6 | 11.7 | 5,9 | 25,0 |
| ■ Q4 2011 | 27,7 | 21,1 | 8,5 | 6,7 | 23,9 |
| ■ Q1 2012 | 29,1 | 23,9 | 9,3 | 6,1 | 25,2 |

***Figure 1.2*** Unemployment rate by population group. Adapted from "Quarterly Labour Force Survey" by Statistics South Africa, 2012.

The above statistics seem to be the results of previous injustices that took place in South Africa. The problem in South Africa is even more complex. Certain groups are more likely to be unemployed than others which could be due to a skills mismatch. In the third quarter of 2010, 29.8% of Blacks were unemployed compared with 22.3% of Coloureds and 5.1% of Whites (STATS SA, 2010).

The skills mismatch has its origins in the Apartheid era during which the education system for the non-white population, particularly blacks, constrained the acquisition of skills among the majority of the population. Several factors, such as the strong unionisation and the participation of labour groups in the struggle for freedom, as well as the effect of trade sanctions on import substitution (as in the energy sector), pushed firms to rather invest in capital-intensive than labour-intensive activities which all related to apartheid. The creation of townships and homelands also isolated blacks in geographic zones with little or no work, thus creating a large pool of unskilled and unemployed labour. The skills mismatch did not ease up after the end of the apartheid. Despite improvements in the education system, higher education is still limited, as around 70 percent of the population aged over 20 years has not completed secondary schooling, which constrains the supply of skills. Some studies discuss the possibility that trade liberalisation has led to a skill-biased technological change and increase in skill-intensive exports, thus increasing the skills mismatch (Poswell, 2002; Bhorat, 2001; and Nattrass, 2000).

The fundamental cause of Black under-representation in higher level jobs is due to the legacy of racial discrimination. The root problem is that South Africa's intellectual capital is not, and has not been, uniformly developed and distributed across races. There thus lies a vast reservoir of untapped human potential in this country. South Africa thus has a large number of people who could potentially contribute to the economy far beyond their current capacity, but the reality is that their talent has never been discovered or developed.

It is thus clear that labour development is not just important for employers to increase their profit, but it is also their social responsibility, which will be beneficial for the country as a whole. The effects of the past wrongdoings must be dealt with effectively and proactively. There is thus a responsibility and an opportunity for human resource managers in the private and public sector to identify and develop those individuals from the previously disadvantaged groups that have the potential to learn (Burger, 2011). The mining of this untapped reservoir of potential, moreover, needs to proceed with a real sense of urgency. Adverse impact in personnel selection aggravates the effect of socio-political discrimination. There are several considerations, over and above the fact that there are a large number of people in this country who could potentially contribute to the economy far beyond their current capacity, that contribute to the urgent need for HR in the public and private sector to address this problem of adverse impact in South Africa in an intellectually honest way:

The 2011-2012 annual report of the Commission of Employment Equity (Commission of Employment Equity, 2012), shows that very little progress has been made in transforming the upper echelons of organisations in the private sector as White men still occupy the majority of top management positions in this sector, yet they are in the minority. This is exacerbated by the fact that the majority of recruitment and promotions into these levels are of White males. This picture on training and development is no different, where White males continue to benefit the most. This report is discouraging because it indicates a very slow progress on transformation and potential to erode the insignificant achievement made since 1994 to date.

South Africa is also the most unequal society and has the widest gap between rich and poor worldwide (Machivenyik, 2012; Manual, 2009; Republic of South Africa, 2009). Social instability is not conducive to economic growth and this emphasises the need to empower those individuals excluded from the formal economy to participate productively in the economy.

Affirmative action can be defined as action aimed at achieving a diverse workforce broadly representative of the population in all occupational categories and levels through the appointment of suitably qualified people from the designated groups (Finnmore, 2006). Aggressive affirmative action as it is traditionally interpreted benefits an already privileged few, but ultimately hurts the people it is meant to help through gradual systematic implosion of organisations due to the lack of motivated and competent personnel and a loss of institutional memory. This is an insincere solution to the problem of adverse impact and the under-representation of previously disadvantaged groups as it denies the fundamental cause and severity of the problem. The conclusion that can be drawn is that the impact of affirmative action in promoting equality, as is required in the

Constitution, has signally failed to promote the achievement of equality, now 17 years later (Hoffman, 2007).

## 1.3 OVERCOMING ADVERSE IMPACT

Adopting a problem orientation involves using careful analysis to identify root causes (Bierema & Eraut, 2004). In South Africa an intellectually honest solution to the problem of adverse impact would be to provide development opportunities, rather than searching for an alternative selection instrument, to those individuals who have been denied opportunities in the past in order to develop skills, abilities and coping strategies necessary for job performance. The problem occurs during selection but not due to a problem or fault with the selection itself. The problem lies in the fact that specific people do not currently have the crystallised ability to do the job properly. Many of these individuals lack this ability, not because they inherently do not have talent but because they never were given the opportunity to develop their talent. When viewed optimistically past social injustices have negatively impacted on the attributes (i.e., job competency potential) required to perform successfully in a job but not on the psychological processes and structures which influence the development of the attributes required to succeed on the job. In this context it does not seem unreasonable to ascribe the systematic differences in criterion distributions to an environment where past injustices have had a negative impact on the development and acquisitions of the skills, knowledge and abilities of certain groups required to succeed. The solution to adverse impact would thus be to now give them that opportunity to develop their talent. In terms of this line of reasoning affirmative action should entail giving the opportunity now, to those disadvantaged individuals with the requisite psychological processes and structures that would have allowed them to develop the attributes required to succeed on the job if they would have been given the opportunity.

When viewed pessimistically past social injustices have negatively impacted not only on the attributes (i.e., job competency potential) required to perform successfully in a job but also on the psychological processes and structures which influence the development of the attributes required to succeed on the job. The prognosis for undoing the wrongs of the past under this low road scenario seems significantly less promising.

Affirmative development is proposed as an alternative interpretation of affirmative action to the current quota interpretation of the term., Affirmative action as it is currently interpreted and implemented in South Africa is criticised and rejected in this study. Affirmative action *per se* is thereby, however, not rejected. To the contrary. Affirmative action is a necessary action that should be enthusiastically endorsed as being in the best interest of our nation. If affirmative action is to function well in a diverse society with inequitable opportunities to learn, attention must be given to the deliberate development of competence in those populations least likely to develop it under usual circumstances. Affirmative development places emphasis on the creation and enhancement of competence in targeted populations, in addition to the more traditional emphasis in affirmative action on the equitable reward of competence across the social divisions by which persons are classified. Attempts at accelerated affirmative development will only be effective to the extent to which there exists a comprehensive understanding of the factors underlying affirmative development performance success and the manner in which they combine to determine learning performance in addition to clarity on the fundamental nature of the key performance areas comprising the learning task.

The solution to overcome adverse impact is, however, more complex. All individuals that currently do not have the crystallised abilities to do the job will not necessarily be able to develop these if given the chance. An additional selection problem thus arises to determine which candidates will be successful in the development of these abilities. Limited resources should be invested wisely in those that would benefit most from further developmental opportunities. A suitable method will have to be established which would place emphasis on the ability to benefit from cognitively challenging development opportunities. It is therefore proposed here that a critical challenge facing human resource practitioners and industrial psychologists in South Africa is to validly identify the previously disadvantaged individuals with the potential to benefit from cognitive challenging affirmative development opportunities (assuming that social injustices did not directly impact on psychological processes and structures which play a role in the development of the attributes required to perform successfully). As resources are scarce only those previously disadvantaged individuals who would subsequently derive maximum benefit from development opportunities should be identified and invested in. human resource practitioners and industrial psychologists should ensure that those individuals, who are given the opportunity, do succeed in the programme and in the job/role they will fulfil. The challenge is therefore to determine the learning potential of previously disadvantaged South Africans. A sobering thought, though, is that all the competency potential latent variables relevant to job performance that were negatively affected by the lack of opportunity are not all necessarily malleable through development interventions.

If the latent variables comprising learning potential would be clear, as well as the manner in which they could be measured, the question would still exist how these measures ought to be used. If measures of learning potential would be used for job selection, but nothing would be done to develop individuals with the requisite psychological processes and structures that would have allowed them to develop the attributes required to succeed on the job the problem of adverse impact will not be solved. One possibility is to use measures of learning potential to predict post-development job performance (Theron, personal communication, June, 2013). Such a procedure would reduce adverse impact but it would imply a single stage selection procedure in which selection errors are compounded. Burger (2012) rather suggests that a two-stage selection procedure should be followed. Stage one would be to select previously disadvantaged individuals who should maximally benefit from developmental opportunities. This would ensure that individuals with learning potential are identified and selected for affirmative development programmes and then developed off-the-job. This would attempt to ensure that disadvantaged applicants are on an equal footing with non-disadvantaged applicants when moving to stage two. During stage two of the selection process, those with the highest expected job performance should be selected. This stage would be based on a battery of predictors that could include an evaluation of the performance during the affirmative development programme. Burger (2012) also mentions that due to the less than-perfect predictive validity of selection procedures, this option would be more cautious than a one-stage selection process. This selection process will allow for the manipulation of the level of learning performance that those individuals who participated in affirmative development programmes achieve. This manipulation will be possible through regulating the flow of those that enter the affirmative development program by filtering out candidates whose expected learning performance is too low according to their non-malleable learning potential competency latent variables.

The idea behind learning potential is that if an individual is given the opportunity to learn how to solve a problem through systematic instruction, some proportion of educateable individuals will show improvement in performance beyond what which would be predicted by their crystalised intelligence test score (i.e., current crystalised and accessible knowledge) (Elliot & Lauchlan, 1997). The level of learning performance that those who participated in the affirmative development programme achieve is not a random event. The level of learning performance is an expression of the systematic working of a complex nomological network of person-centred and situational/environmental latent variable, some of which are difficult to modify whilst others are more malleable. Selection of individuals with high learning potential is therefore not enough to ensure high learning performance. Selection along with attempts to optimise learner and learning context characteristics are required. All of the variables characterising the learner and the learning environment (irrespective of whether they are malleable or not) constitute learning potential In South Africa a valid understanding of the complex nomological network of latent variables characterising the learner and his/her learning environment as well as the measurement of these learning potential variables, is important to ensure that the previously disadvantaged aren't denied any more development opportunities.

In order to differentiate between candidates in terms of their training or development prospects and to optimise training conditions, it is imperative to determine why differences in learning performance exist. The level of learning performance that learners achieve in a development programme is complexly determined by a nomological network of latent variables characterising the learners, and their perception of the learning and work environment as mentioned earlier. De Goede's (2007) developed a basic performance@learning competency model with a close fit ($p>.05$) which is based on the work of Taylor's APIL-B test battery, a learning potential measure (1989, 1992, 1994).

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 learning performance. It is highly unlikely that a second or third explanatory research study that attempts to expand on the first study will fully reveal the cunning logic and elegant design (Ehrenreich, 1991) that determines the phenomenon of learning performance. The likelihood of meaningful progress towards a more expansive and more penetrating understanding of the psychological process underlying the phenomenon of learning performance increases if explicit attempts are made to formally model the structural relations governing this phenomenon and if successive research studies attempt to expand and elaborate the latest version of the explanatory structural model. Gorden, Kleiman and Hanie (1978, p. 119) argued the importance of cumulative research studies in which researchers expand and elaborate on the research of their predecessors.

> The short-lived interest that industrial-organisational psychologists display in their work promotes severe intellectual disarray. Lack of commitment to thorough exploration of a subject is inimical to the creation of viable psychological theory. By continuing to ignore the integrative role of theory, industrial-organisational psychologists are likely to share a fate that Ring (1967) forecast for social psychologists: We approach our work with a kind of restless pioneer spirit: a new or seemingly new territory is discovered, explored for a while, and then usually abandoned when the going gets rough or uninteresting. We are a field of many frontiersmen, but few settlers. And, to the degree that this remains true, the history of social psychology will be written in terms not of flourishing interlocking communities, but of ghost towns, (pp. 119, 120).

Rather than abandoning the De Goede (2010) model and starting afresh with the development of a new model, the foregoing argument suggests that a more prudent option would be to modify and elaborate the existing model. This model however exclusively focused on cognitive ability as a determinant of learning performance. It is argued in the study that the De Goede learning potential structural model should be expanded by expanding the number of learning competencies that constitute learning and by adding non-cognitive determinants of learning performance.

Affirmative development is proposed to equal the playing field between economic efficiency and economic development. Affirmative development places emphasis on the creation and enhancement of competence in targeted populations. Attention must thus be given to the deliberate development of competence in those populations least likely to develop it under the circumstances that used to exist but that morally/ethically ought not to have existed. An approach would thus be to use a learning potential instrument designed to identify candidates with the greatest potential to learn new skills and knowledge, particularly those skills which are crucial to success in the workplace and training or educational programs. Affirmative development as a solution to adverse impact will allow/offer the possibility of combining/simultaneously serving economic efficiency and social policy. If all assumptions implicit in the preceding arguments would be true, then the goal of equal representation of all groups in all jobs while still maintaining economic efficiency would be met (Schmidt, 2002).

The aim is thus be to expand the discipline's understanding of learning potential and the role it plays in addressing the negative effects of South Africa's past by modifying and elaborating De Goede's (2007) proposed performance@learning competency model which he based on the work of Taylor's APIL-B test battery, a learning potential measure (1989, 1992, 1994).

## 1.4 RESEARCH OBJECTIVE

The current De Goede model focuses exclusively on cognitive ability as a determinant of learning performance. It is unlikely that cognitive ability would be the sole determinant of learning performance and therefore a need exists to expand this learning potential structural model.

The objective of this study consequently is to modify and elaborate De Goede's (2007) proposed learning potential model by elaborating the network of learning competency potential latent variables that affect the learning competencies comprising *classroom learning performance* and that in turn affect the *learning performance during evaluation* latent variable and to empirically test the elaborated model.

In order to build onto De Goede's (2007) foundations it is necessary to describe De Goede's (2007) model, explain its underlying argument, report on the fit of the proposed structural model and also to report on the findings regarding the specific causal relationships which he proposed.

De Goede and Theron (2010) suggested that the De Goede model should be elaborated by adding non-cognitive determinants of learning performance but to successfully do so the number of learning competencies that constitute learning also has to be expanded. De Goede and Theron (2010) argued that it seemed unlikely that non-cognitive determinants of learning performance would directly affect *transfer* and *automatisation*. De

Goede and Theron (2010) more specifically suggested that metacognition, and specifically knowledge about cognition, can in addition be an important learning potential latent variable that affects the ability of learners to plan, sequence and monitor their classroom learning in a way that directly improves classroom learning performance. They also suggested that possible additional learning competencies to consider could be time devoted to the learning task, organising and planning, self-motivation and self management of cognition.

If this study would succeed in its objective to refine and elaborate De Goede's (2007) model, the learning potential structural model would hold promise to identify individuals who will gain maximum benefit from affirmative developmental opportunities, especially cognitive demanding developmental opportunities in South Africa. The learning potential structural model would in addition suggest additional steps that should be taken to optimise the probability that those individuals that are admitted onto an affirmative development programme do in fact successfully realise their potential.

More specifically, the objectives of the study are to elaborate the De Goede (2007) learning potential structural model by:

1. Explicating additional competencies that also constitute learning other than *transfer* and *automatisation*.
2. Explicating additional learning competency potential latent variables, other than *fluid intelligence* and *information processing ability* that also determine the level of competence on the learning competencies.
3. Developing a theoretical structural model that explicates the nature of the causal relationships that exist between the learning competency potential latent variables, between the learning competencies and between the learning competency potential latent variables and the learning competencies.
4. Empirically testing the proposed structural model by first testing the separate measurement models and thereafter the structural model.

## 1.5 OVERVIEW OF THE STUDY

The literature review follows in which the De Goede (2007) learning potential structural model is discussed and explained. Extensions to the De Goede (2007) learning potential structural model are subsequently proposed and motivated based on a review of the literature on learning performance. Thereafter a section will follow, focusing on the research methodology and includes the research design, the statistical hypotheses, the development of the measurement instruments, selection of the sample as well as the statistical analyses which will be performed.

# CHAPTER 2
# LITERATURE STUDY

## 2.1 INTRODUCTION

The objective of this study is to modify and elaborate De Goede's (2007) proposed learning potential model and to empirically test the elaborated model. It is important to fully understand learning potential as it plays a vital role in addressing the negative effects of the past in South Africa. Attempts at accelerated development will be effective to the extent to which there exists a comprehensive understanding of the factors underlying training performance success and the manner in which they combine to determine learning performance (De Goede & Theron, 2010). In order to more fully understand learning potential and the underlying nomological network of push and pull forces, further research is needed.

To build on De Goede's (2010) foundations it is necessary to describe De Goede's (2007) model, explain its underlying argument, report on the fit of the proposed structural model and also to report on the findings regarding the specific causal relationships which he proposed.

## 2.2 EXPLICATING THE DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL

De Goede (2007) proposed a learning potential structural model based on the pioneering research of Taylor (1992) aimed at the development of a learning potential selection battery. Taylor (1992) proposed four predictor variables with learning performance as the primary outcome/criterion variable. Taylor (1992) defines learning potential as the underlying, (currently existing) fundamental aptitude or capacity to acquire and master novel intellectual or cognitive demanding skills, which is demonstrated through the improvements in performance in response to cognitive mediation, teaching, feedback, or repeated exposure to the stimulus material. Whereas ability refers to that which is available on demand, potential is concerned with what could be accomplished through currently existing characteristics and thus refers to the possibility of change (Taylor, 1992, 1994; Zaaiman, Van der Flier &Thijs, 2001). Learning potential refers to the extent to which individuals currently possess the characteristics that will allow them to develop into more than they currently are if they would be granted a development opportunity. Taylor (1992; 1994) interpreted learning potential overly narrow as referring only to the overall cognitive capacity. For Taylor (1992; 1994) overall cognitive capacity includes both present and projected future performance. De Beer (2006) makes the assumption that crystallised intelligence which is measured with psychometric tests is changeable, as indicated by improvement in scores obtained with standard tests when a relevant learning opportunity or some form of help can be provided. Learning potential is the underlying fundamental aptitude or capacity to acquire and master novel intellectual or cognitive demanding skills demonstrated through the improvements in performance after a cognitive intervention such as teaching, feedback or repeated exposure to the stimulus material (Taylor, 1992).

The De Goede (2007) model can be described as an attempt to explain the internal structure of the learning potential construct. The objective of his study was to formally establish whether the causal linkages that Taylor (1992; 1994) suggested should exist between the learning competency potential latent variables, the learning competencies comprising *classroom learning performance* and *learning performance during evaluation* hold under empirical evaluation. The De Goede (2007) model is schematically depicted in Figure 2.1.

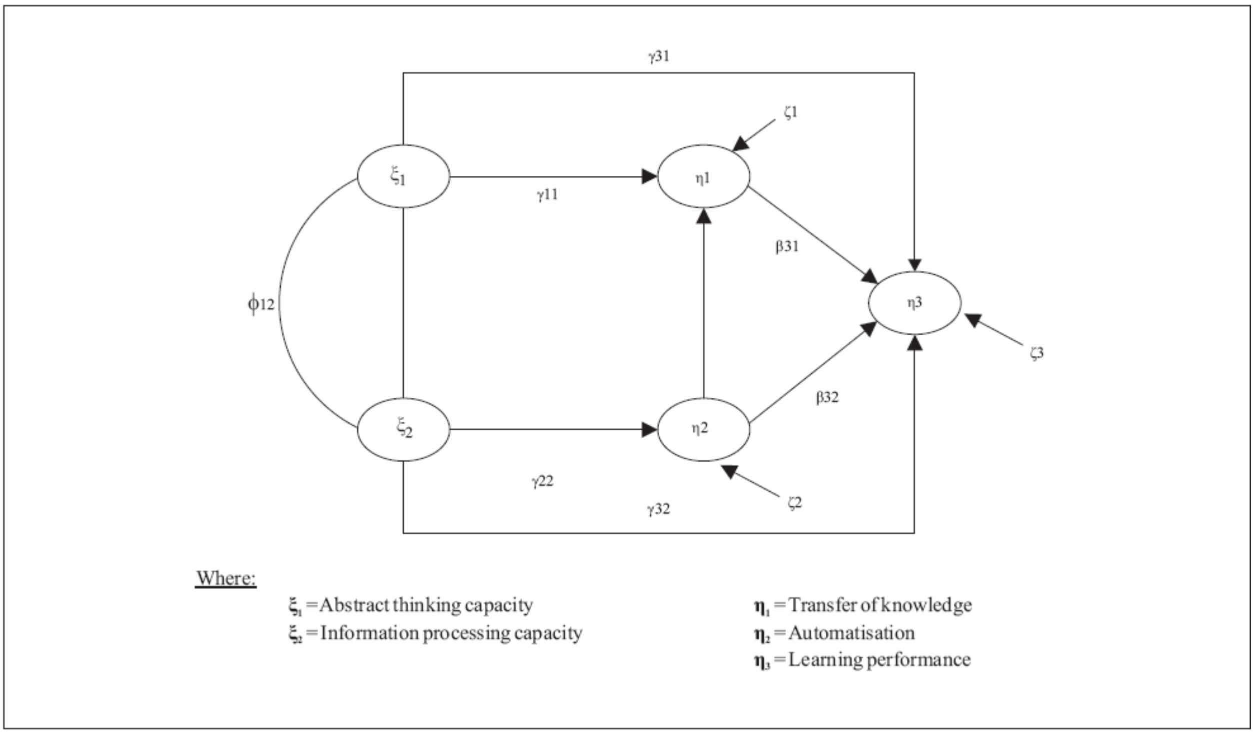


***Figure 2.1*** Graphical portrayal of the De Goede (2007) Learning Potential Structural Model. Adapted from "An investigation into the learning potential construct as measured by the APIL test battery." by J de Goede, 2007, unpublished master's thesis. Copyright 2007 by the University of Stellenbosch, Stellenboch.

Where:

$\xi_1$=Abstract thinking capacity

$\xi_2$=Information processing capacity

η1=Transfer of knowledge

$\eta_2$=Automatisation

$\eta_3$=Learning Performance

## 2.3 DEFINING THE CONSTRUCTS OF THE MODEL

### 2.3.1 LEARNING COMPETENCY POTENTIAL

A person's learning competency potential is made up of a nomological network of person-centred characteristics and situational/contextual characteristics[2] which determine

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[2] Situational/contextual characteristics are generally underappreciated explanatory latent variables which can also be expected to affect classroom learning performance, as well as learning performance during evaluation as main effects and in interaction with learner-centered characteristics. The identity of situational latent variables and the manner in

the success of transferring existing knowledge onto novel problems in order to successfully automate the derived insight. Taylor (1992) concluded that the *capacity to form abstract concepts* and *information processing capacity* (speed, accuracy, flexibility) constitute the nucleus of the learning competency potential that drives the two learning competencies that constitute learning (*transfer* and *automatisation*).

### 2.3.1.1 Abstract thinking capacity

Taylor (1997) assumes that conceptual thinking plays an important part in work activities which require additional effort above simple routine duties. The capacity to think abstractly develops as *fluid intelligence* and consists of a set of general cognitive tools and strategies to solve novel problems (Cattell, 1971; Taylor, 1994). These abilities are considered basically innate or unlearned and therefore are less susceptible to extensive accultural, education and the effects of environmental deprivation (Taylor, 1994). Fluid intelligence can be thought of as *abstract thinking capacity*. *Abstract thinking capacity* can therefore be seen as a person's fluid intelligence which comprises the fundamental abstract reasoning and concept formation capacity that an individual applies to novel problems. De Goede (2007) stated that *abstract reasoning capacity* plays an important role in dealing both with novel problems and learning and it will either contribute or inhibit an individual's capacity to make sense of the learning task.

### 2.3.1.2 Information processing capacity

Information processing can be termed as the processing of bits of information through executive and non-executive cognitive processes, which are activated in an uncertain situation in order to reduce the amount of uncertainty. Both Taylor (1994) and Ackerman (1988) believe that *information processing capacity* makes up one of the constituent parts of cognitive ability and regard it a key term in cognitive psychology.

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which they combine with learner characteristics to affect learning performance should eventually be captured in an elaborated learning potential structural model. Latent variables characterising the instructor and his teaching behaviour as well as latent variables characterising the learning favourableness of the learner's home environment seem contextual latent variables worthy of consideration.

Jensen (1998, p. 205) describes information processes as follows:

> Information processes are essentially hypothetical constructs used by cognitive theorists to describe how persons apprehend, discriminate, select, and attend to certain aspects of the vast welter of stimuli that impinge on the sensorium to form internal representations that can be mentally manipulated, transformed, stored in memory (short-term or long term), and later retrieved from storage to govern the person's decisions and behaviour in a particular situation.

Information processing is genetically endowed, meaning that an individual's capacity to process information is generally uninfluenced by education and opportunities (Taylor, 1994). Information processing is used to denote what happens mentally between stimulus and response including perception, memory, thinking, problem-solving and decision-making

Information processing is used to reduce the amount of uncertainty as mentioned in previous paragraphs. Individuals are often faced with novel, intellectually challenging tasks which cause them to experience uncertainty. Sternberg (1984) suggests that in order to reduce the uncertainty, the individual first has to make use of executive processes to process the bits of information or stimuli and select a strategy to follow. The individual then has to make use of non-executive processes to carry out the strategy (Sternberg, 1984). This processing of bits of information through cognitive processes (executive and non-executive), in an uncertain situation aiming to reduce the amount of uncertainty, could be referred to as information processing (Sternberg, 1984).

High information processing capacity enables an individual to process information more quickly, accurately and flexibly. Such individuals will be able to acquire more, learn faster and perform better than individuals with lower information processing capacity. Individual differences in *information processing capacity* thus relate to individual differences in learning, or more precisely, the speed of learning (Jensen, 1998).

### 2.3.2 LEARNING COMPETENCIES

Learning competencies are the behavioural actions that allow one individual to be more successful than another in acquiring novel intellectually demanding skills. These learning competencies thus constitute learning performance. A distinction should be made between *classroom-learning performance* and subsequent *learning performance during evaluation*. In the classroom learners are confronted with novel, initially essentially meaningless, learning material in which they have to create meaningful structure and where they have to commit the resultant insight to memory in a manner that it can be retrieved for further problem-solving. The competencies comprising *classroom learning performance* include all learning behaviours that directly or indirectly facilitate these outcomes.

Meaningful structure is created via *transfer* by adapting existing crystalised ability developed through prior learning. Insights (or crystalised ability) developed via transfer in the classroom are integrated into the existing knowledge structure and in turn form the basis from which novel problems encountered outside the classroom are solved through *transfer* in action learning. There exists no sharp division between classroom learning and subsequent action learning. The same learning competencies that comprise *classroom learning performance* also constitute *learning performance during evaluation*.

The aim of the evaluation of the extent to which classroom learning took place should therefore be to determine whether learners can successfully transfer the acquired crystalised ability onto novel problems that could realistically be encountered in the real world. During the evaluation of the learning that took place in the classroom the insights developed via *transfer* are again transferred onto novel problems presented in the test/examination paper. Successful *learning performance during evaluation* therefore depends on the level of competence achieved on the learning competencies comprising *classroom learning performance* and therefore also on the same learning competency potential latent variables that affected the level of competence achieved on the classroom learning competencies.

#### 2.3.2.1 Transfer of knowledge

*Transfer* is the process through which crystallised abilities develop from the confrontation between fluid intelligence (Cattell, 1971) and novel stimuli (Taylor, 1994). *Fluid intelligenc*e allows for the development of the first specific ability (crystallised ability), which through a process of transfer of skills, lead to the emergence of more specific skills. Crystallised abilities are developed through repeated practise (*automatisation*) of something which was initially unfamiliar to an individual.

*Transfer* is the application of that which an individual already knows to novel problems and can be described as the effect previously learned behaviour has on the performance of new learning tasks. *Transfer* thus allows for an already learned task to make the learning of a new task or solving of an intellectually more challenging novel problem, easier and achievable.

*Transfer* can thus be seen as change in performance of one task, resulting from practise in another task (Taylor, 1994).

#### 2.3.2.2 Automatisation

*Automatisation* takes place when an individual uses learned responses to deal with new problems that are similar to old problems in a manner that is similar to the original response without solving the problem afresh via *transfer*. *Automatisation* can be described as an efficient cognitive algorithm which gets written and stored for later retrieval in a manner that captures the insight or problem-solving derived through *transfer*.

*Transfer* has to do with learning tasks which are different, whilst *automatisation* on the other hand has to do with tasks which do not change dramatically over time and thus enables an individual to become more efficient at what he or she is doing (Taylor, 1992). Learning is not concluded once sense has been made out of novel stimuli via *transfer* as the stimulus will remain a novel problem to be solved through transfer every time it is encountered, unless an efficient algorithm can be written and stored via *automatisation* for later retrieval for subsequent *transfer* (Taylor, 1994). Individuals who automate many of the operations involved in performing a task, can become more efficient and effective in the execution of the task (De Goede, 2007). Sternberg (1984) also mentions that the *automatisation* of a substantial proportion of an operation required to perform a complex task, enables an individual to perform the task with minimum mental effort.

De Goede (2007) also explored Ferguson's theory (1954) which states that when an individual is faced with a novel learning task he or she will first attempt to find a way of coping with the problem by 'scanning' existing knowledge, skills and abilities for a way of coping with a similar problem. If a way of coping is found, which was automated before, the individual will use a learned response to deal with the current novel problem he or she is facing. In the case where no way of coping with the new novel problem is found, *fluid intelligence* or *abstract reasoning capacity* will be used to deal with the task by transferring existing relevant, but not directly applicable skills, knowledge and abilities to a solution of the novel problem. The individual can then add the task mastered, through the novel problem they encountered, to their existing pool of skills, knowledge and abilities. The individual's pool of skills, knowledge and abilities is thus elaborated which will enable him or her to apply knowledge from a more elaborate pool when next faced with a novel problem (De Goede, 2007).

### 2.3.3 LEARNING OUTCOMES

A learning outcome constitutes that what an individual knows, understands and is able to do as the result of a process of learning. A learning outcome is thus the actual result of the learning activity designed to achieve a specific intended result or objective. The learning outcome in affirmative development interventions is therefore the level that learners achieved on the malleable job competency potential latent variables that the intervention targeted.

### 2.3.4 LEARNING PERFORMANCE

Learning performance refers to the creative use of acquired knowledge rather than the level to which job relevant knowledge and abilities have been developed. Within the context of learning measures (i.e. tests), learning performance refers to the extent to which learners successfully cope with the learning material they are confronted with in the development intervention as well as the extent to which learners achieve academic success. A distinction is therefore made between *classroom learning performance* and *learning performance during evaluation*. *Classroom learning performance* refers to the creative use of previously acquired knowledge by adapting and transferring it on novel learning problems encountered in the development intervention. *Learning performance during evaluation* refers to the creative use of the newly acquired knowledge by adapting and transferring it on novel learning problems encountered in the academic evaluation[3]. Subsequent *on-the-job action learning performance* refers to the creative use of the integrated old and new knowledge by adapting and transferring it on novel learning problems encountered on the job in real life.

## 2.4 DISCUSSION OF THE MODEL

The model depicted in Figure 2.1 essentially argues that the differences in learning performance between individuals can be described in terms of two constructs, namely *transfer of knowledge* and *automatisation* and those differences in learning performance can be explained in terms of two constructs, namely: *abstract reasoning capacity* and *information processing capacity* (speed, accuracy, and flexibility).

This learning potential structural model, based on Taylor's (1994; 1992) research and his APIL-B test battery, depicts the way in which cognitive ability (*fluid intelligence* and *information processing capacity*) affects the learning competencies (*transfer* and *automatisation*) that constitute learning performance. The learning outcomes are not formally modelled in the De Goede (2007) model.

*Information processing capacity* and *automatisation* are causally linked, because Taylor (1994; 1992) and De Goede (2007) argue that an individual's ability to store what has been learned from global processing of a novel experience into a given local processing system (*automatisation*) depends on the speed, accuracy and flexibility with which information can be processed.

The model also displays a direct causal link between *abstract thinking capacity* and *transfer of knowledge*. The ability to adapt and transform previously learned insights and thereby create meaningful structure in new learning material (*transfer of knowledge*) depend on a person's capacity to deal with both novel kinds of problems and learning (*abstract thinking*

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[3] Ideally one would want tests/examinations that evaluate the extent to which classroom learning successfully took place in affirmative development intervention to validly simulate the target job for which learners are being groomed and thereby confront learners with novel but job-relevant (learning) problems that they need to find solutions to by transferring their newly acquired onto the problems.

*capacity*), which will either contribute or inhibit a person's capacity to make sense of a learning task.

The two learning competencies, *transfer of knowledge* and *automatisation* comprising classroom learning performance are causally linked to learning performance during evaluation[4]. Specific learning competencies are instrumental in attaining desired learning outcomes via successful *classroom learning performance*. Taylor (1994) argued that *transfer of knowledge* and *automatisation* of information processes are the two learning competencies to which successful learning performance can be attributed. The application of existing knowledge and the use of learned responses to new novel problems underpin *classroom learning performance* as well as *learning performance during evaluation*.

De Goede (2007) also hypothesised direct causal paths in terms of which *abstract thinking capacity* and *information processing capacity* directly affect learning performance during evaluation. The application of newly acquired knowledge in solving new work related problems is again transfer at work and thus dependent on (a) *abstract thinking capacity* and, since abstract thinking capacity cannot operate in a vacuum, (b) the extent to which previous relevant learning (transfer) has been successfully internalised (automated). By the same token De Goede (2007) argued that *information processing capacity* should also affect the ability to apply newly derived knowledge to novel stimuli.

The question should however be asked whether the interaction between *abstract thinking capacity* and the *post-training knowledge* or crystalised ability developed through transfer during classroom learning, affects *learning performance during evaluation*? De Goede (2007) and De Goede and Theron's (2010) hypothesis that *information processing capacity* should also affect the ability to apply newly derived knowledge to novel stimuli should be questioned. *Information processing capacity* probably affects the *post-training knowledge* or crystalised ability that learners bring to the test or examination. The effect of *post-training knowledge* or crystalised ability on *learning performance during evaluation* is moderated by *abstract thinking capacity* or fluid intelligence.

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[4] Neither Taylor (1992; 1994), De Goede (2007) or De Goede and Theron (2010) explicitly make the distinction between *classroom learning performance* and *learning performance during evaluation*.

The model also displays a causal linkage between *automatisation* and *transfer of knowledge*. *Automatisation* of operations required to perform complex tasks allow an individual to perform the tasks with minimal mental effort, thus freeing cognitive capacity, specifically fluid intelligence (Gf), for novel problem solving (i.e., *transfer*).

## 2.5 FITTING THE DE GOEDE LEARNING POTENTIAL STRUTURAL MODEL

### 2.5.1 STRUCTURAL MODEL FIT

The structural model hypothesises[5] specific structural hypothesis on the psychological process that underpins *classroom learning performance* and *learning performance during evaluation*. The structural model provides an explanation as to why the indicators of the latent variables included in the model are correlated in the observed covariance matrix in the manner that they are. Diamantopoulos and Sigauw (2000) suggest that the aim of testing structural model fit is to ascertain whether the data supports the theoretical relationships proposed in the model. In the case where estimates for the freed structural model parameters can be found (given that the measurement model fits closely) which can reproduce the observed covariance matrix with reasonable accuracy, the hypothesised structural model can be said to fit the data (Hair et al., 2006). Close structural model fit does not suggest that all the structural relationships proposed by the model are in fact correct. Close fit of the structural model, suggests that the model presents one plausible account for the process that underlies learning potential (Diamantopoulos & Siguaw, 2000).

The fit statistics obtained by de Goede (2007) for the learning potential structural model depicted in Figure 2.1 are shown in Table 2.1. It was found that the structural model fitted the data reasonably well as judged by the overall goodness-of-fit measures. The fit statistics indicated that the null hypothesis of exact fit has to be rejected ($p<.05$) but the close fit null hypothesis was not rejected ($p>.05$) (De Goede, 2007). This suggests that there is a significant discrepancy between the sample covariance matrix implied by the

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[5] Again it needs to be reiterated that neither Taylor (1992; 1994), De Goede (2007) or De Goede and Theron (2010) explicitly made this distinction between *classroom learning performance* and *learning performance during evaluation*. It is a distinction superimposed by the researcher.

comprehensive LISREL model and the observed covariance matrix (Kelloway, 1998). The estimates derived for the freed model parameters thus reproduce the observed covariance matrix approximately, but not perfectly.

### 2.5.2 STRUCTURAL MODEL PARAMETER ESTIMATES

The gamma and beta estimates for the freed structural parameters are shown in Table 2.2 and Table 2.3. The relationship hypothesised between *information processing capacity* ($\xi_2$) and *automatisation* ($\eta_2$) was corroborated and *information processing capacity* thus has a statistically significant effect on *automatisation* ($\eta_2$). The direct paths that were hypothesised between *information processing capacity* ($\xi_2$) and *learning performance (during evaluation)* ($\eta_3$) and between *automatisation* ($\eta_2$) and *transfer of knowledge* ($\eta_1$) were also supported. The gamma estimates also indicates that *information processing capacity* ($\xi_2$) has quite a pronounced effect on *automatisation* ($\eta_2$) and *learning performance (during evaluation)*. Support was thus found for the indirect effect of *information processing capacity* ($\xi_2$) on *learning performance (during evaluation)* ($\eta_3$) mediated by *automatisation* ($\eta_2$) (De Goede, 2007). *Information processing capacity* ($\xi_2$) has no statistically significant ($p>.05$) effect on *learning performance (during evaluation)* ($\eta_3$). The hypothesised effect of *abstract thinking capacity* on *transfer of knowledge* ($\eta_1$) and *learning performance (during evaluartion)* ($\eta_3$) was also not corroborated. The relationship between *transfer of knowledge* ($\eta_1$) and *automatisation* ($\eta_2$) was corroborated and can be seen as a modest effect. The causal relationships between *transfer of knowledge* ($\eta_1$) and *learning performance (during evaluation)* ($\eta_3$) and between *automatisation* ($\eta_2$) and *learning performance (during evaluation)* ($\eta_3$) were not corroborated.

Table 2.1

*Goodness-of-fit statistics for the structural model*

| Degrees of Freedom | 57 |
|---|---|
| Minimum Fit Function Chi-Square | 96.23 (P=0.00090) |
| Normal Theory Weighted Least Squares Chi-Square | 92.89 (P=0.0019) |
| Estimated Non-centrality Parameter (NCP) | 5.89 |
| 90 Percent Confidence Interval for NCP | 13.37 ; 66.32 |
| Minimum Fit Function Value | 0.82 |
| Population Discrepancy Function Value (F0) | 0.30 |
| 90 Percent Confidence Interval for F0 | 0.11 ; 0.56 |
| Root Mean Square Error of Approximation (RMSEA) | 0.073 |
| 90 Percent Confidence Interval for RMSEA | 0.045 ; 0.099 |
| P-Value for Test of Close Fit (RMSEA<0.05) | 0.085 |
| Expected Cross-Validation Index (ECVI) | 1.36 |
| 90 Percent Confidence Interval for ECVI | 1.17 ; 1.62 |
| ECVI for Saturated Model | 1.54 |
| ECVI for Independence Model | 12.97 |
| Chi-Square for Independence Model with 78 Degrees of Freedom | 1505.02 |
| Independence AIC | 1531.02 |
| Model AIC | 160.89 |
| Saturated AIC | 182.00 |
| Independence CAIC | 1580.15 |
| Model CAIC | 289.38 |
| Saturated CAIC | 525.90 |
| Normed Fit Index (NFI) | 0.94 |
| Non-Normed Fit Index (NNFI) | 0.96 |
| Parsimony Normed Fit Index (PNFI) | 0.68 |
| Comparative Fit Index (CFI) | 0.97 |
| Incremental Fit Index (IFI) | 0.97 |
| Relative Fit Index (RFI) | 0.91 |
| Critical N (CN) | 104.90 |
| Root Mean Square Residual (RMR) | 0.055 |
| Standardised RMR | 0.055 |
| Goodness of Fit Index (GFI) | 0.89 |
| Adjusted Goodness of Fit Index (AGFI) | 0.83 |
| Parsimony Goodness of Fit Index (PGFI) | 0.56 |

Table 2.2

*Completely standardised gamma (γ) matrix*

| | ABSTRACT | INFOPRO |
|---|---|---|
| **TRANSFER** | **0.28**<br>**(0.15)**<br>**1.85** | |
| **AUTOMAT** | | **0.87***<br>**(0.10)**<br>**8.52** |
| **LEARNPER** | **-0.21**<br>**(0.24)**<br>**-0.87** | **0.84***<br>**(0.43)**<br>**1.97** |

*p<0.05

Table 2.3

*Completely standardised beta (β) matrix*

| | TRANSFER | AUTOMAT | LEARNPER |
|---|---|---|---|
| **TRANSFER** | **0.28**<br>**(0.15)**<br>**1.85** | **0.53***<br>**(0.16)**<br>**3.30** | |
| **AUTOMAT** | | | |
| **LEARNPER** | **0.31**<br>**(0.20)**<br>**1.54** | **-0.35**<br>**(0.38)**<br>**-0.92** | |

*p<0.05

## 2.6 ELABORATION OF THE DE GOEDE MODEL

### 2.6.1 INTRODUCTION

When reviewing the learning potential structural model proposed by De Goede (2007) with the objective of extending the research he initiated, the question should firstly be asked whether the existing model should be structurally adapted by deleting any of the existing paths or by adding additional paths. A decision on the deletion of existing paths will be taken by taking into consideration his findings on the significance of the path coefficients estimates and the persuasiveness of the argument and theory presented in support of the existing structural hypothesis. The majority of structural paths/hypotheses suggested by De Goede (2007) were not corroborated as mentioned earlier.

When contemplating ways in which the De Goede (2007) structural model should be modified and elaborated the soundness of the fundamental argument underlying this model as depicted in Figure 2.1 should moreover be reconsidered. The question should therefore be asked whether the learning competencies and learning competency potential latent variables identified by Taylor (1992; 1994) and the manner in which De Goede (2007) structured the relationship between the latent variables validly depicts the psychological dynamics that allows one individual to be more successful than another in acquiring novel intellectually demanding skills or job competencies. Individuals are assigned to affirmative development treatments with the aim of achieving specific learning objectives through specific learning outcomes.

Learning performance is the final criterion in the case of an educational or training and development selection procedure. As it was argued earlier it is important to distinguish between *classroom learning performance* and *learning performance during evaluation*. The former comprises *transfer*, *automatisation* and probably other additional learning competencies. The underlying principles of *learning performance during evaluation* are as follows: learners have to be confronted with novel problems, during a test or exam, of which the solution is dependent on the knowledge obtained through prior training; learners should be able to transfer acquired knowledge to novel problems; learning during evaluation is known as action learning which is reliant on the ability to transfer acquired knowledge onto novel problems. Learning performance during evaluation should therefore be equated to *transfer*. At the same time, however, the other learning competencies constituting *classroom learning performance* also remain relevant to *learning performance during evaluation*. No sharp division exists between classroom learning and application. In the interest of continuous learning it is therefore as desirable that the insights unlocked through *transfer* in action learning should be available for subsequent transfer. *Automatisation* should therefore also be considered an integral learning competency constituting *learning performance during evaluation*.

Specific learning competencies, which in turn depend on and are expressions of a complex nomological network of person-centred characteristics (learning competency potential), some of which are relatively malleable (attainments) and some if which are less easily altered (dispositions) are instrumental in attaining desired learning outcomes. A performance@learning competency model can therefore be assumed, analogous to the performance@work model originally proposed by Saville and Holdsworth (2001). The challenge is to explicate the latent variables and structural relations comprising the performance@learning competency model and to sequentially link this model to the performance@work competency model. This will provide a model that will explicate the structural relationship between the characteristics of the learner required to exhibit the learning behaviours that are instrumental in achieving the outcomes that would permit a level of competence on the job competencies that would allow the achievement of the job outcomes for which the job in question has been created (De Goede & Theron, 2010).

Learning should thus be conceptualised in terms of that which constitutes successful learning in a training and development or educational programme, the person-centred determinants of the level of competence that is achieved on the learning competencies, the situational characteristics that facilitate or inhibit successful learning (possibly in interaction with the characteristics of the learner) and the outcomes of successful learning. A learning performance structural model that explains variance in learning performance will form the theoretical foundation for a generally applicable learning potential selection battery. A learning performance structural model that explains variance in learning performance will moreover suggest additional interventions aimed at affecting malleable learning competency potential latent variables and situational variables to increase the probability of successful learning.

It seems extremely unlikely that the learning behaviour domain only comprises the two learning competencies, *transfer* and *automatisation*, in terms of which successful learning performance (in the classroom) can be described as proposed by Taylor (1994). If non-cognitive determinants are to affect learning performance (in the classroom) they most likely do so through other learning competencies than *transfer* and *automatisation*. De Goede and Theron (2010) suggested that his model should be elaborated by expanding the number of learning competencies that constitute learning and also by adding non-cognitive determinants of learning performance. De Goede and Theron (2010) suggested that the learning behaviour domain should be elaborated through possible additional learning competencies like time devoted to the learning task, cognitive engagement, organising and planning, self-motivation and regulation of cognition (a dimension of metacognition) in addition to the two learning competencies in his model. According to

De Goede and Theron (2010) metacognition, and specifically knowledge about cognition, should be considered an additional important learning competency potential latent variable that will affect the ability of learners to plan, sequence and monitor their learning in a way that directly improves performance.

The main objective of the subsequent discussion is to identify additional learning competencies that constitute classroom learning performance and the learning competency potential latent variables that determine the level of competence that is achieved on these learning competencies.

The causal paths hypothesised by De Goede (De Goede and Theron, 2010) will be retained in the expanded du Toit-De Goede[6]-learning potential structural model (Figure 2.3). When an individual' engages with learning material, it seems reasonable to hypothesise that *information processing capacity* directly positively influences *automatisation* and indirectly through this *transfer*. As was originally hypothesised in the De Goede model (Figure 2.1) the current model also hypothesises that *abstract reasoning ability* positively influences *transfer*. *Transfer* and *automatisation* both directly positively influences learning performance (during evaluation). The follow five path-specific substantive hypotheses are therefore retained in the du Toit-De Goede learning potential structural model.

**Hypothesis 1a: In the proposed learning potential structural model it is hypothesised that *Abstract reasoning ability* positively influences *transfer of knowledge*.**

**Hypothesis 1b: *Information processing capacity* positively influences *automatisation*.**

**Hypothesis 1c: The extent to which *transfer of knowledge* occurs is positively determined by the extent to which *automatisation* occurs.**

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[6] It is acknowledged that the convention of attaching the current researchers name to a proposed model is to some degree contentious. The practice is nonetheless utilised in the larger learning potential series of studies in an attempt to clearly distinguish between the different learning potential structural models that originate from the various studies.

**Hypothesis 1d:** ***Transfer of knowledge*** **affects** ***learning performance during evaluation.***

**Hypothesis 1e:** ***Automatisation*** **affects** ***learning performance during evaluation.***

### 2.6.2 ADDITIONAL LEARNING COMPETENCIES PROPOSED FOR INCLUSION IN THE EXPANDED DU TOIT-DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL

#### 2.6.2.1 Time at task

Early studies often made use of time-based indices like time-on-task in assessing an individual's engagement rates. Time-on-task has long been recognised as an important contributor to academic success because learning is partly a function of time spent engaged in a task (Carini, Kuh & Klein, 2004). Gest and Gest (2005) also suggest that time at task has relatively direct implications for learning. The argument is simple and self-evident: The more students study or practise a subject, the more they tend to learn about it (Carini et al., 2004). Individual differences in the time spent engaged on a task contribute to individual differences in academic skills (Bloom, 1974). Individuals from previously disadvantaged groups may have lower levels of crystallised abilities and therefore they would be required to exert more effort and spend more time cognitively engaged on a specific task at hand. The results of Carini et al.'s (2004) study suggests that low ability students benefit more from engagement than their high ability counterparts. Individuals with high levels of crystallised intelligence may simply require less time and effort to achieve similar academic results or to do well. The foregoing argument suggests that individuals who exert more effort and persist longer at tasks are more likely to learn more and achieve higher levels of academic achievement (Pintrich & Schunk, 2002).

Various operationalisations of student engagement have appeared in published evaluations. Early studies often made use of time-based indices like time-on-task in assessing student engagement rates (e.g., Brophy, 1983; Fisher et al., 1980; McIntyre et al., 1983). Individual differences in the time spent engaged on the learning task contribute to individual differences in skills and abilities required to (Bloom, 1974). *Transfer of knowledge*, as defined earlier, refers to the adaptation of knowledge and skill to address novel, cognitively demanding problems different from those already encountered. In order for *transfer* to occur the individual must engage with the learning material cognitively.

The foregoing argument suggests that individuals who exert more effort and persist longer at tasks are more likely to learn more and achieve higher levels of academic achievement (Pintrich & Schunk, 2002) as they are more likely to transfer their knowledge in order to create meaningful structure in the novel learning material and to automate that insight.

It is therefore proposed that *time at task* positively influences *transfer of knowledge*.

**Hypothesis 2a: In the proposed learning potential structural model it is hypothesised that *time at task* positively influences *transfer of knowledge*.**

**Hypothesis 2b: In the proposed learning potential structural model it is hypothesised that *time at task* positively influences *automatisation*.**

#### 2.6.2.2 Metacognitive regulation

Metacognition is a person's knowledge about the cognitive processes necessary for understanding and learning and a person's ability to regulate and influence these cognitive processes (Flavell, 1976).

> …if somebody knows something, then he knows that he knows it, and at the same time he knows that he knows that he knows.
>
> *Spinoza 1632-1677*

The demands of the twenty-first century require students to know more than content knowledge; they must know how to learn. Learning is an active process that requires students to think about their thinking, or be metacognitive (Wilson & Bai, 2010). The inclusion of the underlying dimensions of metacognition as an additional important learning competency potential latent variable, as well as additional learning competency which will affect the ability of learners to plan, sequence and monitor their learning in a way that directly improves performance according to De Goede and Theron (2010). The inclusion of this latent variable in the learning potential structural model can be justified by defining this construct and looking at the outcomes, dimensions and antecedents of this latent variable. Metacognition will first be discussed in general and then as an additional learning competency potential, given the current focus. The meaningful discussion of metacognitive regulation requires the prior discussion of metacognition. Metacognitive knowledge as an additional learning competency potential latent variable will be discussed when the focus shifts from the learning competencies to the learning competency potential latent variables.

The term 'metacognition' was introduced by John Flavell in the early 1970s based on the term 'metamemory' previously conceived by him. Flavell viewed metacognition as learners' knowledge of their own cognition, defining it as 'knowledge and cognition about cognitive phenomena'. Metacognition is often referred to in the literature as 'thinking about one's own thinking', or as 'cognitions about cognitions'. It is usually related to learners' knowledge, awareness and control of the processes by which they learn, and the metacognitive learner is thought to be characterised by ability to recognise, evaluate and, where needed, reconstruct existing ideas.

Although the use of the term is relatively recent, the view of the learner as one who reflects upon, monitors, and is able to influence his or her own learning has a long history (Forrest-Pressley, MacKinnon & Waller, 1985).

Flavell's definition was followed by numerous others, often portraying different emphases on (or different understanding of) mechanisms and processes associated with metacognition (Georghiades, 2004:365). As researchers began to study the learner's linking processes and problem solving skills, they began to view metacognition as an important performance-based mental activity that expert learners complete, as they "plan, monitor, and evaluate their thinking processes more often and more efficiently than poor or novice learners". Most recently, metacognition has emerged into the mainstream of cognitive psychology (Smith, 2008).

Three of the cognitive processes mentioned by Smith (2008) include:

- intentionality (setting a goal or intention)
- self-monitoring (monitoring one's behaviour in relation to that intention)
- self-regulation (Choosing a response that moves towards fulfilling one's intentions. A process of deliberate control of one's thoughts and actions) (Bulkeley, 2005; Vermunt & Vermetten, 2004).

Metacognition is our capacity to monitor our own thoughts. In metacognition, we analyse what we know and how well we know it. According to this approach, language and thought emerge as integrated processes monitored by metacognition (Bergh & Theron, 2003). The simplest definition of metacognition is that it is 'thinking about thinking' (Downing et al., 2008).

Metacognition consists of three types of thinking:

- Metacognitive knowledge: What one knows about knowledge
- Metacognitive skill: What one is currently doing
- Metacognitive experience: One's current cognitive or affective state (Downing et al., 2009).

The most common distinction in metacognition separates metacognitive knowledge from skills. The former refers to a person's declarative knowledge about the interactions between person, task, and strategy characteristics, whilst the latter refers to a person's procedural knowledge for regulating one's problem solving and learning activities. Metacognitive knowledge about our learning processes can be correct or incorrect, and self-knowledge may be quite resistant to change. For instance, an employee may incorrectly think that he/she invested enough time in preparation for a monthly product assessment at work, despite repeated failure ("but the questions were so unreasonable"). Such misattributions prevent employees from amending their self-knowledge. Metacognitive skills, on the other hand, have a feedback mechanism built-in. You are either capable of planning your actions ahead and task performance progresses smoothly, or you don't and actions go astray. Or, you may be unsure of task performance status as metacogntive skills are developing. Failing metacognitive skills may be rendered by new metacogntive knowledge, but the process of skill acquisition takes time (Veenman et al., 2006).

Metacognition is associated with a collection of activities and skills related to planning, monitoring, evaluating, and repairing performance. The basic idea is that teaching metacognitive skills must be one of the goals of instruction, so that the employees have a bundle of strategies that will encourage significant learning. This is a process during which employees put new information in relation with existing knowledge (Esnault & Lyon, 2008). A metacognitive framework defined as a template that can be included in every learning resource to transform it, along with some additional information, in a learning object follows in Figure 2.2.

The basic metacognitive strategies are connecting new information to existing knowledge, selecting thinking strategies intentionally and planning, monitoring and evaluating thinking processes (Jackson, 2004).

Directed attention, selective attention and self-reinforcement also play a big role in metacognitive strategies. These are strategies about learning rather than learning strategies themselves (Jackson, 2004).

There appear to be two key dimensions or components associated with metacognition. In conceptions of metacognition, a distinction is often made between knowledge of cognition and regulation of cognition (Brown, 1987; Schraw & Dennison, 1994; Schraw & Moshman, 1995; Schraw, 2001).

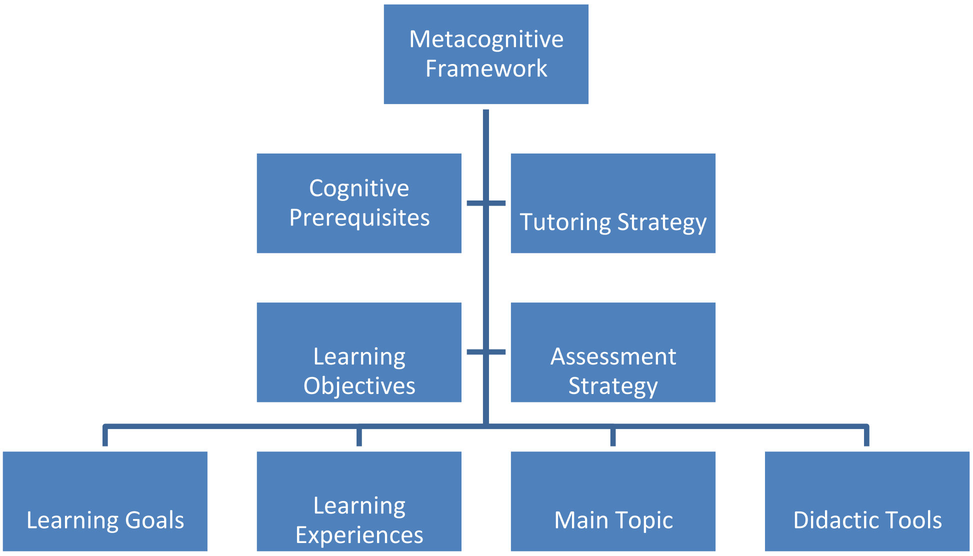

***Figure 2.2*** The structure of the metacognitive framework. Reshaping the structure of learning objects in the light of metacognition by Falsetti, C., Leo, T., Ramazotti, S., & Valenti, S., 2006. *International Journal of Web-Based Learning and teaching Technologies*, 1(1), 36. Copyright 2006 by Idea Group Inc.

According to Schraw (2001) metacognition consists of knowledge and regulatory skills that are used to control one's cognition. The most common distinction in metacognition separates metacognitive knowledge from skills. The former refers to a person's declarative knowledge about the interactions between person, task, and strategy characteristics, whilst the latter refers to a person's procedural knowledge for regulating one's problem solving and learning activities (Veenman et al., 2006).

The first component (knowledge of cognition) includes knowledge of oneself and possible implementation strategies (Shraw & Dennison, 1994; Shraw, 2001). Knowledge about cognition includes three sub processes that facilitate the reflective aspect of metacogntion:

1. Declarative metacognitive knowledge refers to knowing "about" things.
2. Procedural knowledge refers to knowing "how" to do things.
3. Conditional knowledge refers to knowing the "why" and "when" aspects of cognition (Shraw & Dennison, 1994; Shraw, 1998; Smith, 2008).

The second component (regulation of cognition) refers to a set of sub processes that facilitate the control aspect of learning. Five component skills of regulation have been previously discussed extensively, including planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation.

Metacognition draws on cognition. If metacognition is conceived as (knowledge of) a set of self-instructions for regulating task performance, then cognition is the vehicle of those self-instructions. These cognitive activities in turn are subject to metacognition e.g. ongoing monitoring and evaluation processes. It is very hard to have adequate metacognitive knowledge of one's competencies in a domain without substantial (cognitive) domain-specific knowledge, such as knowledge about relevant concepts and theories in a domain, about intrinsic difficulties of a domain, and about what is irrelevant. One cannot engage in planning without carrying out cognitive activities, such as generating problem-solving steps and sequencing those steps. Similarly, one cannot check one's outcome of a calculation without comparing the outcome with an estimation of it, or recalculating the outcome in another way.

In summary then, metacognition consists of knowledge and regulatory skills that are used to control one's cognition. While metacognition is used in a general sense to subsume a number of individual components, all of these components are intercorrelated (Schraw & Dennison, 1994), and yield two general components corresponding to knowledge about cognition and regulation of cognition. Preliminary evidence suggests these two components are intercorrelated somewhere in the $r$=0.50 range. Schraw (1998) emphasises that knowledge of cognition and regulation of cognition are related to one another as Swanson (1990) found that declarative knowledge of cognition facilitated regulation of problem solving among fifth and sixth grade students. Schraw (1994) reported that college students' judgements of their ability to monitor their reading comprehension were significantly related to their observed monitoring accuracy and test performance. Pintrich and his colleagues (1990) found that knowledge of strategies was related to self-reported strategy use. Schraw, Horn, Thorndike-Christ & Bruning (1995) supports this finding.

Research revealed metacognition to be the most powerful predictor of learning (Veenman, Van Hout-Wolters & Afflerbach, 2006). Metacognition was originally referred to as the knowledge about leaning and regulating one's cognitive activities in learning processes (Veenman et al., 2006). A recent definition describes metacognition as "one's knowledge and beliefs about one's own cognitive processes and one's resulting attempts to regulate those cognitive processes to maximise learning and memory" (Ormrod as cited in Steward et al., 2007, p. 32). Metacognition also involves knowing how to reflect and analyse thought, how to draw conclusions from analysis, and how to put what has been learned into practise (Downing, Kwong, Chan, Lam & Downing, 2009). Metacognition is an important concept in cognitive theory that is defined as a learner's awareness of his or her own learning process (Smith, 2008). Favell (1979) mentions that metacognition plays an important role in communication, reading comprehension, language acquisition, social cognition, attention, self-control, memory, self-instruction, writing, problem solving, and personality development. A variety of studies have examined the influence of metacognitive skills on adult performance (Stewart & Cooper, 2005). Everson and Tobias (2001) report that research shows there is a difference in the metacognition of effective learners and ineffective learners, the effective use of metacognition has been shown to predict learning performance (Pintrich & DeGroot, 1990). Students with higher metacognitive skills outperformed those with lower metacognitive skills in problem-solving tasks, regardless of their overall aptitude. In a study comparing self-regulated learning in college undergraduates and graduate students (Lindner, Harris & Gordon, 1996), research showed a strong correlation between metacognition and degree completion.

Recent research (Garner & Alexander, 1989; Pressley & Ghatala, 1990) indicates that metacognitively aware learners are more strategic and perform better than unaware learners as the awareness allows individuals to plan, sequence, and monitor their learning in a way that directly improves performance. Despite their intertwined relation with cognitive processes, metacognitive skills cannot be equated with intellectual ability. There is ample evidence that metacogntive skills, although moderately correlated to intelligence, contribute to learning performance on top of intellectual ability. Intellectual ability uniquely accounts for 10 percent of variance in learning on average, metacognitive skills uniquely account for 17 percent of variance in learning, whereas both predictors share another 20 percent of variance in learning people of different ages and backgrounds, for different type of tasks, and for different domains (Veenman, Wilhelm & Beishuizen, 2004; Veenman & Spaans, 2005). The implication is that an adequate level of metacognition may compensate for people's cognitive limitations. Intelligence only gives students a head start in metacognition, but does not further affect its developmental course (Afferbach et al., 2006).

Regulation of cognition will be seen as an additional learning competency and a discussion hereof will follow below. Knowledge of cognition will be seen as an additional learning competency potential and will be discussed later in this paper.

#### 2.6.2.2.1 Regulation of cognition

Like motivation, metacognition is often viewed as a core element necessary for self-regulated learning (Butler & Winne, 1995; Pintrich et al., 2000; Zimmerman, 1994). Historical research on metacognition has roots that stretch into many areas of psychology, including work focused on cognitive development, memory, executive processing, and learning strategies. Metacognition is most frequently described as consisting of at least two theoretically distinguishable components, namely regulation of cognition and knowledge of cognition.

Regulation of cognition constitutes the control aspect of learning and refers to a set of sub-processes that help students control their learning. Pintrich et al. (2000) and Schraw and Mosham (1995) suggest that activities typically viewed as efforts to regulate cognition include planning how to complete a task, selecting the cognitive strategies one will use, monitoring the effectiveness of the strategies one has chosen, and modifying or changing the cognitive strategies one is using when problems are encountered. Narrowly defined, regulation of cognition describes students' efforts to monitor, control, or adjust their cognitive processing in response to shifting task demands or conditions (Baker, 1994; Brown, 1987). Research on this facet of metacognition indicates that students who more effectively regulate the cognitive strategy that they use tend to show more adaptive performance or achievement outcomes (Baker, 1994; Butler & Winne, 1995; Pressley, Borkowski & Schneider, 1987; Schraw & Moshman, 1995). Self-regulation of cognition involves the control of various cognitive strategies for learning, such as the use of deep processing strategies that result in better learning and performance than students showed previously (Garcia & Pintrich, 1994; Pintrich, Smith, Garcia & McKeachie, 1993). Research supports the assumption that metacognitive regulation improves performance in a number of ways, including better use of attentional resources, better use of existing strategies, and greater awareness of comprehension breakdowns (Schraw, 1998). A number of studies also report significant improvement in learning when regulatory skills and an understanding of how to use these skills are included as part of classroom instruction (Cross & Paris, 1988; Brown & Palincsar, 1989). *Regulation of cognition* should therefore also be included in the model as a learning competency that forms part of the array of competencies that constitute *classroom learning performance*. Regulation at the same time also forms part of the array of competencies that constitute *learning performance during evaluation*. Unlike *classroom learning performance* the latter latent variable is, however, not deconstructed in the proposed du Toit-De Goede learning potential structural model.

Regulation of cognition comprises a group of five sub-processes namely planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation (Shraw, 1998; Wolters, 2003). During the 1970's research revealed that successful students use monitoring and planning processes that are fundamentally different compared to their peers who are less academically successful in school. The monitoring and planning processes used by successful students were characterised as having self-regulatory components (Paris & Newman, 1990).

### ***Planning***

According to a synthesis of definitions of planning this concept can be described as selecting, predicting, planning, scheduling, goal-setting, allocating resources and coordinating an action or strategy necessary to the accomplishment of an action or goal prior to learning (Brown, 1987; Henri, 1992; Jacobs & Paris, 1987; Shraw & Dennison, 1994). Planning reflects students' tendency to set goals or think through what they want to get done before beginning a task. Planning involves the selection of appropriate strategies and the allocation of resources that affect performance. Examples include making predictions before reading, strategy sequencing, and allocating time or attention selectively before beginning a task. Berieter and Scardamalia (1987) did a study on skilled writers which revealed that the ability to plan developed through childhood and adolescence, improving dramatically between the ages of 10 and 14. Older, more experienced writers engage in more global as opposed to local planning and in addition, more experienced writers are better able to plan effectively regardless of text "content", whereas poor writers are unable to do so.

### *Information management strategies*

Murphy (2008) describes information management strategies as skills and strategy sequences used to process information more efficiently. These include organising, elaborating, summarising, selective focusing, connecting new information to former knowledge and deliberating on how to select what to learn.

### *Comprehension monitoring*

Shraw (1998) describes monitoring as the continuously keeping track of the level of one's comprehension of learning material and the level of task performance. The ability to engage in periodic self-testing while learning is a good example. Monitoring entails asking oneself questions about how well one is doing and whether one's goals are being met during learning (Murphy, 2008). Research by Pressley and Ghatala (1990) indicate that monitoring performance develops slowly and is quite poor in children and even adults. Several recent studies have found a link between metacognitive knowledge and monitoring accuracy (Schraw, 1994; Schraw, Dunkle, Bendixen & Roedel, 1995). Delclos and Harrington (1991) also suggest that monitoring ability improves with training and practise.

### *Debugging strategies*

Debugging strategies refer to strategies used to correct comprehension and performance errors. These strategies could take the form of self-questions: "What else could I try?", "What are possible sources of errors?" Debugging during learning refers to analysing where a student went wrong or finding the source of the misunderstanding preventing high quality or efficacy of their learning.

### *Evaluating*

Evaluating refers to appraising the quality of learning outcomes and efficacy of one's learning (Schraw, 1998). Shraw and Dennison (1994) further describe evaluation as an analysis of performance and strategy effectiveness after a learning episode. A number of studies by Baker (1982; 1989; 1994; 2002) indicate that metacognitive knowledge and regulatory skills such as planning are related to evaluation. Evaluation can thus be described as the assessment, appraisal, evaluation, analysis or verification of one's knowledge, understanding, skills, performance and strategy efficiency and effectiveness after learning (Brown, 1987; Henri, 1992; Jacobs & Paris, 1987; Shraw & Dennison, 1994). A typical example of evaluating would be re-evaluating one's goals and conclusions.

Researchers have distinguished many more specific components of metacognition, but they seem to disagree about the nature of those components. For instance, metamemory is often merely studied from a declarative-knowledge perspective, while monitoring processes are heavily involved in generating this knowledge (Veenman et al*.,* 2006). Another component of metacognition is metacognitive experiences, which occur before, during and after reading. For example, these could be experiences with a certain type of text, experiences in school or experiences with the demands of completing certain tasks (Smith, 2008).

King (1991) developed a regulatory checklist (Figure 2.3) based on three sub-processes of regulation of cognition. This checklist serves the purpose to provide an overarching heuristic that facilitates the regulation of cognition. King (1991) only recognised three sub-processes of regulation of cognition, unlike some researchers (e.g. Shraw, 1998; Wolters, 2003) who recognised an additional two sub-processes (debugging strategies and information management strategies). King (1991) developed this checklist to prove that application of the sub-processes of regulation of cognition can lead to one individual outperforming another who does not make use of these sub-processes. King's regulatory checklist (Figure 2.3) shows three main categories or sub-processes, including planning, monitoring, and evaluating and enables novice learners to implement a systematic regulatory sequence that helps them control their performance. Research by King (1991) found that fifth-grade students who used a checklist similar to Figure 2.3 outperformed control students on a number of measures, including written problem-solving, asking strategic questions and elaborating performance.

***Planning***

1. What is the nature of the task?
2. What is my goal?
3. What kind of information and strategies do I need?
4. How much time and resources will I need?

***Monitoring***

1. Do I have a clear understanding of what I am doing?
2. Does the task make sense?
3. Am I reaching my goals?
4. Do I need to make changes?

***Evaluating***

1. Have I reached my goal?
2. What worked?
3. What didn't work?
4. Would I do things differently next time?

***Figure 2.3*** A regulatory checklist. Adapted from "Effects of training in strategic questioning on children's problem-solving performance." by A King, 1991, *Journal of Educational Psychology, 83*, p. 307–317. Copyright 1991 by the American Psychological Association. Adapted with permission.

King (1991) concluded that explicit prompts in the form of checklists help students be more strategic and systematic when solving problems. Delcos and Harrington (1991) performed a similar study by examining fifth- and six-grader's ability to solve computer problems after being assigned to one of three conditions: specific problem-solving training, specific problem-solving training plus self-monitoring training, no training. The self-monitoring problem-solving group solved more of the difficult problems than either of the remaining groups and took less time to do so.

The preceding argument concluded that *regulation of cognition* should be included in the expanded model as a learning competency that forms part of the array of competencies that constitute *classroom learning performance*. Adding *regulation of cognition* to the model, however, now begs the question how this latent variable should be embedded in the network of structural relations that have thus far been hypothesised to exist between the latent variables thus far included in the model. It seems unlikely that *abstract reasoning capacity* and *information processing capacity* will structurally influence *regulation of cognition*. The question therefore seems to be if structural relations should be hypothesised between *regulation of cognition, transfer*, *automatisation*, *time-at-task* and *learning performance during evaluation?* It has already been hypothesised that *time-at-task* should positively impact on *transfer* and *automatisation*. It, however, seems, unlikely that *regulation of cognition* will directly affect *time-at-task*. It seems more likely that *regulation of cognition* will have an indirect effect on *time-at-task* by impacting on the conditions that serve as prerequisites to exert effort and persist at learning. *Cognitive engagement* is posited in the subsequent discussion on additional learning competency potential latent variables that have to be added to the De Goede (2007) model as a crucial latent variable mediating the effect of *regulation of cognition* on *time-at-task*.

#### 2.6.2.3 Academic self-leadership

The concept of self-leadership was introduced by Manz in 1983 as an extension of the notion of self-management and is deeply rooted in the psychology literature. Self-leadership has been described as a process in which people direct and motivate themselves to behave and perform in a desired way. According to Manz (1986) and Manz and Neck (2004) self-leadership is a process through which individuals control their own behaviour, influencing and leading themselves through the use of a specific set of behavioural and cognitive strategies.

Markham and Markham (1995, p. 346) characterise self-leadership in the following way:

> In short, the application of self-management techniques tends to allow employees significant self-influence regarding how to complete a task to meet a standard (as defined by the system), whereas self-leadership addresses what should be done and why, in addition to how to do it.

The theoretical foundation of self-leadership is built upon social learning theory (Bandura, 1977) and social cognitive theory (Bandura, 1986). The social learning theory explains how people can influence their own cognition, motivation, and behaviour. The social cognitive theory explains that people and their environment interact continually and behavioural consequences serve as sources of information and motivation (Norris, 2008). The concept of self-leadership is also based on the assumptions of theories of self-control (e.g. Cautela, 1969; Mahony & Arnkoff, 1979), self-regulation (e.g. Carver & Scheier, 1981) and the intrinsic motivation literature (e.g. Deci, 1975). Self-leadership is also derived from positive cognitive psychology (e.g. Seligman, 1991). According to Markham and Markham (2005) self-leadership addresses what should be done and why, rather than how (Georgianna, 2007). It can be seen as a self-evaluation process through which individuals identify and replace ineffective behaviours and negative thought processes with more effective behaviours and positive thought processes which can enhance personal accountability and improving professional performance (DiLiello & Houghton, 2006).

Research has demonstrated positive relations between self-leadership and performance (Bandura & Schunk, 1981; Dolbier, Soderstroom & Steinhardt, 2001; Neck, Neck, Manz & Godwin, 1999). Konradt and Andressen (2009) found self-leadership to have a positive and significant impact on performance (b=.24, $p<.01$), while Neubert and Wu (2006) found that self-leadership was positively and significantly related to self-reports of in-role performance ($r=.46$; $p<.05$). Sahin (2011) found that education was slightly but statistically significantly correlated with the predictor variable self-leadership ($r=.17$, $p<.05$).

Self-leadership is a normative constellation of behavioural and cognitive strategies derived from descriptive theories such as self-regulation, social cognition, and motivation (Georgianna, 2006). The above definitions and descriptions of self-leadership will for the purposes of this study be defined more narrowly and specifically under the construct presented as academic self-leadership. These definitions of self-leadership are confined to the influencing, self-direction and motivation geared towards the academic domain and subsequent learning. Individuals who display academic self-leadership will hold a vision of achieving academic success in their thoughts and will manage and control behaviours directed at achieving their vision.

The concept of self-leadership consists of a variety of interwoven strategies that address individuals' self-awareness, volition, motivation, cognition, and behaviour (Manz &

Neck, 1991; Mϋller, 2006; Neck & Manz, 2006; Prussia et al., 1998). The four strategies associated with self-leadership are:

- behaviour-focused strategies,
- self-reward strategies,
- natural reward strategies, and
- constructive thought strategies.

The hypotheses proposed in what follows below, will focus on the construct of academic self-leadership rather than on its separate behavioural dimensions, even though more specific relationships could be suggested between specific dimensions of academic self-leadership and the latent variables that are affected by self-leadership. Individuals differ in their skills and use of self-leadership strategies and these differences can influence how effectively they achieve their goals (Manz, 1986; 1996; Prussia et al., 1998).

#### 2.6.2.3.1 Behaviour-focused strategies

Behaviour modification theories suggest that *self-regulation*[7], self-management and self-control constitute the core behaviour-oriented strategies of self-leadership (Georgianna, 2006). Behaviour-focused strategies heighten self-awareness and facilitate personal behaviour management through methods such as self-goal setting, self-reward, self-punishment, *self-observation*, and self-cueing (Manz, 1992; Manz & Neck, 1999). Literature suggests that the process of setting challenging and specific goals can significantly increase individual performance levels. Behaviour-focused self-leadership strategies are designed to encourage positive, desirable behaviours that lead to successful outcomes, while suppressing negative, undesirable behaviours that lead to unsuccessful outcomes (D'Intino, Goldsby, Houghton & Neck, 2007).

The behaviour modification theory depicts self-regulation as an on-going process used to manage automatic behaviours and impulses. It is conceptualised as a construct that

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[7] This line of reasoning also brings to the fore the question of whether self-regulation shares some dimensions with metacognitive regulation?

represents the manner in which humans control impulses, habits and learned behaviours, innate programming, and motivation. People can self-regulate without formal self-management techniques, but formal self-management techniques can enhance natural self-regulation by crystallising personal goals and promoting development of effective strategies for achieving personal goals (Allen et al., 2009). Zimmerman (1989) was the first to propose the construct of self-regulated learning in educational psychology, and believes that self-regulated learning is a process in which learners actively participate to some extent in their own learning in terms of metacognition, motivation and action. Zimmermans and Pons (1986) also believe that self-regulation ability is the best predictor of students' learning performance.

Self-regulation theory provides a broad descriptive view of human behaviour and seeks to explain how behaviour happens. Within the process of behavioural self-regulation a sensor monitoring performance in the environment yields a signal that is compared to a set standard or desired state. If a discrepancy is detected between the current performance and the desired performance standard a behavioural change is facilitated through an adjustment of effort. Alternatively the standard of behaviour can also be cognitively re-evaluated and adjusted downward to meet the level of performance. In either case the objective is the reduction of the discrepancy between the actual performance level and the standard or goal. Self-regulation theory suggests a hierarchical organisation of the self-regulatory system in the form of super-ordinate and subordinate feedback loops or goals which function simultaneously in shaping behaviour. There is also an upward drift towards higher levels of goal abstraction as a person becomes more comfortable with his or her behaviour. A key component in self-regulation theory is the concept of confidence or hope as manifested in terms of performance related expectancies. Individuals who are confident or hopeful (i.e. possess positive expectancies for goal attainments) tend to persist or even increase efforts while those who lack confidence or hope tend to search for the availability of alternative goals or disengage altogether. Through conscious and intentional self-goal-setting processes, individuals may increase self-regulatory effectiveness in terms of increased effort and better performance outcomes. Self-reward, self-punishment and self-cueing each have a certain potential for enhancing self-regulation (Neck & Houghton, 2006).

When self-regulation fails, individual's thoughts, feelings, and behaviours are driven by immediate internal and external stimuli. The failure of self-regulation is associated with a broad range of societal problems such as crime, alcoholism, gambling, and domestic violence. Proper self-management can reduce self-regulation failure by formalising self-goal setting, self-monitoring, and operating on oneself and the environment to reduce discrepancies between behaviour and self-set goals. In organisational settings, self-management is used to improve work behaviours such as learning, attendance, and task performance (Allen et al., 2009).

Self-regulated learning occurs when students activate and sustain cognitions and behaviours systematically oriented towards attainment of learning goals. Self-regulated learning processes involve goal-directed activities that students instigate, modify and sustain (Zimmerman, 1989). These activities include attending to instruction, processing and integrating knowledge, rehearsing information to be remembered, and developing and maintaining positive beliefs about learning capabilities and anticipated outcomes of actions (Schunk, 1989). Two processes that affect self-regulated learning as a facet of the behavioural focused strategy of academic self-leadership are goal setting and perceived self-efficacy which will briefly be described here and then in detail as separate variables later in this study.

A goal is what an individual is consciously trying to accomplish. For the purpose of this study goal setting therefore refers to establishing a goal and modifying it as necessary. Perceived self-efficacy refers to beliefs concerning one's capabilities to attain designated levels of performance (Bandura, 1986, 1988). The effects of goals on behaviour depend on their properties: specificity, proximity, and difficulty level (Bandura, 1988; Lock, Shaw, Saari, & Latham, 1981). According to Schunk (1990) goals incorporating specific performance standards are more likely to enhance learning and activate self-evaluations than general goals. Specific goals boost performance by providing more information on the amount of effort required for success and on the self-satisfaction anticipated. Specific goals promote self-efficacy because progress is more easy to gauge. Proximal goals also result in greater motivation than distant goals as the perception of progress raises self-efficacy. Goal difficulty also influences the effort individuals expend to attain a goal. Assuming requisite skills, individuals expend greater effort to attain difficult goals than when standards are lower. Individuals may initially doubt whether they can attain difficult goals, but working toward them builds self-efficacy (Schunk, 1990). Bandura (1986) hypothesised that self-efficacy should influence choice of activities, effort expended, and persistence. Individuals with low self-efficacy for learning may avoid difficult tasks and when faced with difficulty self-efficacious learners expend greater effort and persist longer than individuals who doubt their capabilities.

Pintrich (1999) believes that self-regulated learning significantly influences individual's learning achievements and that it is closely related to the application of metacognitive regulation. A discussion on some of the methods used during behaviour-focused strategies will follow next.

### Self-observation as a behaviour-focused strategy

Self-observation involves focusing on an individual's awareness of how, when, and why they engage in specific behaviours. This type of self-awareness is a necessary first step towards changing or eliminating ineffective or unproductive behaviours (Mahoney & Arnkoff, 1978, 1979; Manz & Neck, 2004; Manz & Sims, 1980). Self-observation can lead to a heightened self-awareness as to when and why one engages in specific behaviours and leads to the identification of behaviours that should be changed, enhanced, or eliminated and may also enhance and increase self-focus (Manz & Sims, 1980; Manz & Neck, 1999). Carver (1975) suggests that an increase in self-focus can promote increases in task focus and in the end task performance.

With accurate information regarding current behaviour and performance levels, individuals can more effectively set effective behaviour altering goals for themselves (Manz & Neck, 2004; Manz & Sims, 1980).

### Self-goal setting as a behaviour-focused strategy

Goals can be seen as an objective or aim and is something we want enough to make an effort, with the end in mind, to reach it. Deciding what one really wants to do is crucial to one's success, achievement and happiness.

Goal-setting theory is based on the simplest of introspective observations, namely, that conscious human behaviour is purposeful. It is regulated by the individual's goals

(Latham & Locke, 1991). Human beings possess a higher form of consciousness, the capacity to reason. They have the power to conceptualise goals and set long term purposes (Locke, 1969). According to Binswanger (1991) purposeful action in human beings is volitional. People thus have to choose to discover what is beneficial to their welfare, they must set goals to achieve it, they must choose the means for attaining these goals, and then they must choose to act on the basis of these judgements. The domain of goal-setting theory lies within the domain of purposefully directed action. This theory focuses on why some people perform better at work tasks than others. Latham and Locke (1991) suggest that if people are equal in ability and knowledge, then the cause for one individual to outperform the other must be motivational. Goal-setting theory's emphasis is on an immediate level of explanation of individual differences in task performance (Ryan, 1970). This theory states that the simplest and most direct motivational explanation of why some people perform better than others is because they have different performance goals.

The best goals are ones that pull you. They tug at you so you are drawn to them. You just "have to" do it. Even better are the tugging goals where you enjoy the journey. People drawn to their goals or endlessly enjoying the journey find that they don't choose their goals, they discover them.

Extensive literature research by Locke and Latham (1990) suggest that the process of setting challenging and specific goals can significantly increase individual performance levels. Self-goal setting is "likely the most critical" aspect of self-leadership and relevant to learning performance according to Boss and Sims (2008). Rewards set by an individual along with self-set goals, can aid significantly in energising the effort necessary to accomplish the goals (Mahoney & Arnkoff, 1978, 1979; Manz & Sims, 1980; Manz & Neck, 2004). A multitude of research has shown that the act of setting challenging and specific goals can have a dramatic effect in motivating individual performance (Houghton & Neck, 2002). A finding by Locke and Latham (1990) pertaining to goal content is that specific and challenging or difficult goals lead to a higher level of performance than vague but unchallenging goals, or the setting of no goals.

#### 2.6.2.3.2 Self-reward strategies

Self-reward is a way of congratulating oneself, no matter how small and can be effectively used to reinforce desirable behaviours and goal attainments (Manz &Sims, 1990).

Self-rewards may be something simple or intangible, such as mentally congratulating oneself for an important accomplishment, or something more concrete like a special vacation at the completion of a difficult project (Neck & Houghton, 2006).

Empirical results indicate that goal-setting that includes self-reward is an effective way to increase positive transfer of training (Gist et al., 1991). Like mentioned earlier, self-rewards can be tangible or abstract but the rewards must be of some value to the individual if it is to provide sufficient leverage for action. Self-set rewards, coupled with self-set goals can aid significantly in energising effort necessary to accomplish the goals (Manz & Neck, 2004). The creation of self-reward contingencies increases the value of goal achievement, thereby leading to increased effort and persistence and consequently engagement in pursuit of goal attainment.

In a learning context the learning goals will firstly be set in terms of the outcomes that the learner wishes to achieve by initiating the learning action. If it is assumed that the learner sees a causal relationship between *time-at-task* and *learning performance during evaluation*. *Time-at-task* becomes a first level outcome that is seen as instrumental in the achievement of the primary second level outcome. *Academic self-leadership* can therefore be expected to positively influence *time-at-task*. This relationship is proposed with regard to the academic self-leadership sub-strategies of self-set rewards and self-set goals. However, even though this more specific path is proposed between self-set rewards and *time-at-task*, the broader hypothesis will be tested that the construct academic self-leadership positively influences time-at-task when empirically evaluating the proposed du Toit-De Goede learning potential structural model.

**Hypothesis 3: *Academic self-leadership* positively influences *time-at-task.***

### Self-punishment

Self-punishment, like self-reward, can effectively be used to increase the occurrence of desirable behaviours and goal attainments and to reduce the occurrence of undesirable behaviours (Manz & Sims, 1990). Self-punishment or self-correcting feedback can consist of a positively framed and introspective examination of failures and undesirable behaviours leading to the reshaping of such behaviours. Manz and Sims (2001) however suggest that excessive use of self-punishment involving criticism and guilt can be detrimental to performance and should be avoided.

### Self-cueing

Self-cueing strategies involve manipulating the external environment to encourage constructive behaviours and reducing or eliminating destructive behaviours. Concrete environmental cues like lists, notes or motivational posters can help keep attention and effort focused on goal attainment (D'Intino et al., 2007). Individuals who make use of self-cueing strategies for learning should therefore be more inclined to engage with their learning material (Burger, 2011).

## 2.6.2.3.3 Natural reward strategies

Natural reward strategies are intended to create situations in which a person is motivated or rewarded by inherently enjoyable features of a given activity so that the task itself becomes naturally rewarding (D'Intino et al., 2007). Natural reward strategies also increase intrinsic motivation, self-determination, and feelings of competence. According to Manz and Neck (2004) natural reward strategies are designed to leverage intrinsic motivation to enhance learning motivation. This provides support for hypothesis 7.

There are two primary natural reward strategies (Mans & Neck, 2004; Manz & Sims, 2001). The first involves building more pleasant and enjoyable features into a given activity so that the task itself becomes naturally rewarding. The second strategy consists of shaping perceptions by focusing attention away from the unpleasant aspects of a task and refocusing it on the task's inherently rewarding aspects. Both these strategies are likely to create feelings of competence and self-determination, two primary mechanisms of intrinsic motivation.

Natural reward strategies are thus designed to help create feelings of competence and self-determination, which in turn energise performance-enhancing task-related behaviours. Individuals who are motivated internally by learning will be motivated to learn.

#### 2.6.2.3.4 Constructive thought strategies

Constructive thought strategies are designed to facilitate the formation of constructive thought patterns and habitual ways of thinking that can positively impact performance (D'Intino et al., 2007). Constructive thought strategies create positive habitual ways of thinking and negative destructive self-talk is replaced by optimistic self-talk. Constructive thought strategies can change thinking patterns and positively impact outcome expectations (Norris, 2008). Constructive thought pattern strategies include *identifying and replacing dysfunctional beliefs and assumptions*, *practising mental imagery* and *positive self-talk*. The influence of self-talk and mental imagery on enhanced behaviour, emotions and cognitions has been empirically supported in education (Swanson & Kozleski, 1985)

**Managing beliefs and assumptions** (identifying and replacing dysfunctional beliefs)

Managing beliefs and assumptions involves the evaluation and challenging of irrational beliefs and assumptions, which can be a serious hindrance to individual performance, and replacing them with more constructive thought processes (Manz & Neck, 2004). Individuals should first examine their thought patterns, confronting and replacing dysfunctional irrational beliefs and assumptions with more constructive thought processes. Neck and Houghton (2006) suggest that by confronting beliefs and assumptions that lead to distortions and replacing them with more realistic and less dysfunctional ones, feedback may become less distorted and self-regulation more effective which can aid more effective learning performance. Evaluating and challenging dysfunctional beliefs and assumptions can thus have a positive effect on self-regulatory feedback processes

### Practicing mental imagery

Driskell, Copper and Moran (1994) describe mental imagery as the symbolic and covert cognitive creation of an experience or task prior to actual overt physical muscular movement. Individuals who envision successful performance of an activity in advance of actual performance are more likely to perform successfully when faced with the actual task (Manz & Neck, 2004). Boss and Sims (2008) state that imagery creates a tangible target which can be 'seen' before it actually occurs which motivates individuals. Driskell et al. (1994) performed a meta-analysis and found a statistically significant positive effect for mental imagery on individual performance tasks.

### Positive self-talk

Neck and Manz (1992, 1996) define self-talk as what people covertly tell themselves and it involves mental self-evaluations and reflections (Ellis, 1977; Neck & Manz, 1992). Seligman (1991) suggests that by carefully analysing self-talk patterns, negative or pessimistic self-talk can be suppressed or eliminated and replaced with more optimistic self-dialogues. Swanson and Kozleski's (1985) studies showed that self-talk training can positively influence academic performance in handicapped children.

Together self-management of beliefs and assumptions, mental imagery and self-talk contribute to the creation of constructive thought patterns or habitual ways of thinking which affect emotional and behavioural reactions (Neck & Manz, 1992).

## 2.6.3 ADDITIONAL LEARNING COMPETENCY POTENTIAL LATENT VARIABLES PROPOSED FOR INCLUSION IN THE EXPANDED LEARNING POTENTIAL STRUCTURAL MODEL

### 2.6.3.1 Knowledge of cognition

A person's learning competency potential determines (directly and/or indirectly) the level of competence at which academic leadership is displayed, the time devoted to the learning task, the success achieved in transferring existing knowledge onto novel problems and the success with which the derived insight is automated and is made up of a nomological network of person-centred characteristics.

Knowledge about one's assumptions, beliefs and values paves the way for critical reflection and creates opportunities for change and professional growth (Black & Halliwell, 2000; Schratz, 1992). When a person utilises metacognitive strategies, he/she demonstrates awareness and regulation of his/her mental processes (Griffith & Ruan, 2005). A person who utilises metacognitive strategies knows how to learn because he/she is aware of what he/she knows and he/she must do in order to gain new knowledge. Metacognitive people exhibit the qualities of good readers (Griffith & Ruan, 2005; Randi, Grigorenko & Sternberg, 2005) and are successful in school (Sternberg, 1998). De Goede (2007) also suggested that metacognition, and specifically *knowledge of cognition*, can be an important learning competency potential latent variable that affects the ability of learners to plan, sequence and monitor their learning in a way that directly improves performance.

Schraw (1998) suggest that metacognitive knowledge may compensate for low ability or lack of relevant prior knowledge. This suggestion is supported by Veenman, Wilhelm and Beishuizen, (2004) and Veenman and Spaans (2005). One compelling case in point was provided by Swanson (1990), who found that metacognitive knowledge compensated for IQ when comparing fifth and sixth-grade students' problem solving. High-metacognition students reported using fewer strategies, but solved problems more effectively than lower-metacognition students, regardless of measured ability level. This study suggests that metacognitive knowledge is not strongly correlated with ability, although there does appear to be a modest, positive relationship between the two (Alexander et al*.*, 1995). It also suggests that metacognitive knowledge contributes to successful problem-solving over and above the contribution of IQ and task-relevant strategies. One may thus have average ability as measured by paper-and-pencil tests, yet possess a high degree of regulatory knowledge (Schraw, 1998).

*Knowledge of cognition* refers to a person's declarative knowledge about the interactions between person, task, and strategy characteristics (Flavell & Wellman, 1977; Schraw, 1998; Schraw, Crippen & Hartley, 2006). Schraw and Moshman (1995) classified *knowledge of cognition* as students' awareness of themselves, learning procedures/strategies, and the situations under which a specific strategy is most efficient. Parallel to this framework, Flavell (1992), who first introduced the concept of metacognition, suggested that metacognitive knowledge includes knowledge of person, task, and strategy variables. The person variable concerns the self-knowledge about one's strength and weaknesses. The task variable encompasses the knowledge that different tasks can have different goals or demands and consequently require different strategies. The strategy variable includes knowledge about what strategies can be effective in realising goals and under which conditions (Sungur & Senler, 2009). In her discussion of the first dimension of *knowledge about cognition*, Brown (1987) suggested that it is relatively stable, often statable and can be fallible. She acknowledged that this type of knowledge is assumed to be late developing and that it requires learners 'stepping back' and considering their own cognitive processes as objects of thought and reflection. Simplified, knowledge of cognition refers to what individuals know about their own cognition or cognition in general and includes three sub processes: declarative knowledge, procedural knowledge and conditional knowledge (Paris et al., 1984; Smith, 2008:2; Schraw, 1998; Schraw, Crippen and Hartley, 2006).

### *Declarative metacognitive knowledge*

Declarative knowledge refers to the knowledge learners have about themselves as learners and the factors that influence their performance. It includes facts, rules, concepts and strategies that are stored in a learner's long-term memory. For example, research examining what learners know about their own memory indicates that adults have more knowledge than children about the cognitive processes associated with memory (Baker, 1989). Most adult learners know the limitations of their memory system and can plan accordingly (Smith, 2008; Schraw, 1998; Schraw, Crippen & Hartley, 2006). Similarly, successful learners appear to have more knowledge about different aspects of memory such as capacity limitations, rehearsal and distributed learning (Garner, 1987; Schneider & Pressley, 1989). Schunk (2007) mentions that declarative knowledge or 'know-what' knowledge is expressed verbally, in other words, concepts are declared.

### *Procedural knowledge*

Procedural knowledge refers to knowledge about doing things (Schraw, 1998). Much of this knowledge is represented as heuristics and strategies. This sub-process relates to how learners' declarative knowledge is applied, or how learners can achieve a desired result or execute a learning strategy. More specifically procedural knowledge refers to knowledge about strategies and other procedures. For instance, most adults possess a basic repertoire of useful strategies such as note-taking, slowing down for important information, skimming unimportant information, using mnemonics, summarising main ideas, and periodic self-testing (Schraw, Crippen & Hartley, 2006). Schunk (2007) mentions that procedural knowledge or 'know-how" knowledge is acquired by performing unfamiliar tasks. Individuals with a high degree of procedural knowledge perform tasks more automatically, are more likely to possess a larger repertoire of strategies, to sequence strategies effectively (Pressley et al., 1987), and use qualitatively different strategies to solve problems (Glaser & Chi, 1988). A typical example would include how to chunk and categorise new information.

### *Conditional knowledge*

Conditional knowledge refers to knowing when and why to use declarative and procedural knowledge (Garner, 1990). Schraw (1998) describes this concept as knowledge of why and when to use a particular strategy. For example, effective learners know when and what information to rehearse. Learners tap into conditional knowledge when they identify when and under what conditions they need certain strategies for optimal learning. Individuals with a high degree of conditional knowledge are better able to assess the demands of a specific learning situation and, in turn, select strategies that are most appropriate for that situation (Smith, 2008; Schraw, 1998; Schraw, Crippen & Hartley, 2006). Chang (2006) and Schunk (2007) mention that conditional knowledge or "know-when" knowledge requires mastering a problem and knowing both the effective solution and when and how to apply such. Conditional knowledge is important because it helps students selectively allocate their resources and use strategies more effectively (Reynolds, 1992). Conditional knowledge also enables students to adjust to the changing situational demands of each learning task (Schraw, 1998).

Research suggests that an individual's knowledge of cognition is late developing and explicit (Alexander, Carr & Schwanenflufel, 1995; Baird & White, 1996). Adults tend to have more knowledge about their own cognition and are better able to describe that knowledge compared to children and adolescents. According to Butler and Winne (1995) many adults are unable to explain their expert knowledge and performance and often fail to spontaneously transfer domain-specific knowledge to a new setting. They suggest that metacognitive knowledge need not be explicit to be useful and, in fact, may be implicit in some situations.

Sungar and Senler (2009) did an analysis on Turkish high school students during which they examined metacognition in terms of *knowledge of cognition* and *regulation of cognition*. They found that Turkish high school students have more declarative and conditional knowledge than procedural knowledge and that they mostly use debugging strategies. They also found that motivational variables are positively linked to students' metacognition and that students appear to adopt approach goals more than avoidance goals. Sungar and Senler (2009) also examined the relationship between *knowledge of cognition* and *regulation of cognition* and found a positive relationship between these two components. They suggest that higher levels of declarative knowledge, procedural knowledge, and conditional knowledge were associated with higher levels of planning, information management, monitoring, debugging and evaluating strategy use. This finding is parallel to the finding demonstrated by Shraw and Dennison (1994) supporting the assertion that the two components of metacognition can work in harmony to improve academic performance. Veenman (2005) suggests that metacognitive knowledge often poorly predicts learning outcomes, as Flavell (1979) states that a good deal of metacognitive knowledge has its roots in a person's belief system which is personal and subjective by nature. Veenman, Kok, and Blöte (2005) suggested that the knowledge of cognition does not automatically initiate the *regulation of cognition* but that this is dependent on factors such as task demand and domain-specific knowledge. Meloth (1990) found that explicit instruction on *knowledge of cognition* led to an improvement of participants to their study's *knowledge of cognition* and that this increase was associated with improved strategy use and comprehension performance. Schraw (Schraw, 1994, 1997; Schraw & Dennison, 1994) and others have considered the relationship between the two components of metacognition. For instance, some work suggests that it is possible that *knowledge of cognition* is a prerequisite for regulation of cognition (Baker, 1989). Kuhn

(1999) and Zohar and Ben-David (2009) favour the notion that *regulation of cognition* may fail either due to incorrect and incomplete conditional knowledge, or due to lack of knowledge about how to execute a strategy. Schraw and Dennison (1994) also provided some evidence to suggest that *knowledge of cognition* may precede *regulation of cognition*. Using a self report measure of metacognition, they reported that knowledge of cognition was a better predictor of performance on a reading comprehension test than was regulation of cognition. Further, those with high knowledge of cognition were more likely to demonstrate greater regulation of cognition. Although in the Schraw and Dennison study the relationships between metacognitive components yielded statistical significance (r=.54 and r=.45), each made unique contributions, leading these authors to state the two did not share a compensatory relationship as Sperling, Howard, Stanley and DuBois (2004) suggest. In other work, Schraw (1994, 1997) further addressed the relationship between knowledge and regulation of cognition. In the 1994 study, he reported that knowledge and regulation of cognition were significantly related only for those with high monitoring ability. It is thus proposed that knowledge of cognition will positively influence regulation of cognition.

**Hypothesis 4: In the proposed elaborated learning potential structural model it is hypothesised that *knowledge of cognition* will positively influence *regulation of cognition.***

Schraw (1998) discusses an instructional aid that he has been using for years to improve knowledge of cognition. He refers to this aid as a *strategy evaluation matrix* (SEM), a sample of this SEM is shown in Figure 2.4. Empirical evidence suggests that using summary matrices like the SEM may significantly improve learning (Jonassen, Beissner & Yacci, 1993).

| Strategy | How to use | When to use | Why to use |
|---|---|---|---|
| Skim | Search for headings, highlighted words, previews, summaries | Prior to reading an extended text | Provides conceptual overviews, helps to focus one's attention |
| Slow down | Stop, read, and think about information | When information seems especially important | Enhances focus of one's attention |
| Activate prior knowledge | Pause and think about what you already know. Ask what you don't know | Prior to reading or an unfamiliar task | Makes new information easier to learn and remember |
| Mental integration | Relate main ideas. Use these to construct a theme or conclusion | When learning complex information or a deeper understanding is needed | Reduces memory load. Promotes deeper level of understanding. |
| Diagrams | Identify main ideas, connect them, list supporting details under main ideas, connect supporting details | When there is a lot of interrelated factual info | Helps identify main ideas, organize them into categories. Reduces memory load |

***Figure 2.4*** A final hand-in date for graduating in April will be announced laterA strategy evaluation matrix. Adapted from "Promoting general metacognitive awareness" by G Schraw, 1998, *Instructional Science,* 26, p.113-125. Copyright 1998 by Khuwer Academic Publishers. Reprinted with permission.

When examining this SEM it is evident that Schraw (1998) places emphasis on activating prior knowledge by using and applying existing knowledge onto novel and unfamiliar tasks. If learners apply existing knowledge to new novel problems, transfer takes place. This suggests that as students advance, they not only acquire more metacognitive knowledge, but they are able to use this knowledge in a more flexible manner, particularly in new areas of learning by transferring existing knowledge onto novel problems in order to successfully automate the derived insight. Schraw's (1998) SEM supports Ferguson's theory (1954) which states that when an individual is faced with a novel learning task he or she will first attempt to find a way of coping with the problem by 'scanning' existing knowledge, skills and abilities for a way of coping with a similar problem. If a way of coping is found, which was automated before, the individual will use a learned response to deal with the current novel problem he or she is facing. In the case where no way of coping with the new novel problem is found, fluid intelligence or abstract reasoning capacity will be used to deal with the task by transferring existing relevant, but not directly applicable skills, knowledge and abilities to a solution of the novel problem. The individual can then add the task mastered, through the novel problem they encountered, to their existing pool of skills, knowledge and abilities. The individual's pool of skills, knowledge and abilities is thus elaborated which will enable him or her to apply knowledge from a more elaborate pool when next faced with a novel problem (De Goede, 2007).

It is thus clear from the above discussion that knowledge of cognition (declarative, procedural and conditional knowledge) can enhance the ability of a learner to transfer existing relevant, but not directly applicable, skills, knowledge and abilities to a solution of a novel problem.

#### 2.6.3.2 Cognitive engagement

Engagement is a relatively stable cognitive state where a person is psychologically present and focused on learning and its related activities, and has been characterised as a positive, fulfilling, and persistent cognitive state (Ho, Wong & Lee, 2011). Rotgans and Schmidt (2011) define cognitive engagement as the extent to which a person is willing and able to take on the learning task at hand. This includes the amount of effort a person is willing to invest in working on the task and how long they persist. Engagement is generally considered to be among the better predictors of learning and is often positively related to learning performance. Skinner and Belmont (1993) defined engagement in learning as follows (p. 572):

> 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 border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest.

Engaged learners are characteristically focused, directed, goal-oriented and relentless during their interaction with social and environmental learning conditions (Reeve, Jang, Carrell, Jeon & Barch, 2004). Reed and Schallert (1993) report that engaged learners describe their learning experience as focused concentration, attention, and deep comprehension. Skinner and Belmont (1993) describe learners' engagement as the "intensity and emotional quality of children's involvement in initiating and carrying out learning activities (p. 572). Turner, Meyer, Cox, Logan, DiCinto and Thomas (1998) characterises the involvement concept as a 'complex interaction of student cognition, motivation and affect" (p. 730). Engaged learners show sustained involvement, they initiate action when given the opportunity, they exert intense effort and concentration and will cognitively harness and invest themselves when performing a learning task, whereas disengaged workers tend to mentally detach or uncouple themselves from the learning task.

According to Ho et al. (2011) cognitive engagement comprises two factors – absorption and attention. Absorption refers to the intensity of focus and immersion that one experiences when working, and individuals who are absorbed would be deeply engrossed and not easily distracted by other activities. Attention on the other hand pertains to the amount of cognitive resources, including concentration and psychic energy, that an individual spends thinking about work, and can be thought of as a finite cognitive resource that individuals can choose to allocate in different ways. Absorption entails a much more intense level of concentration and immersion in one's work and relates to the quality of cognitive efforts and investment in work, whereas attention simply pertains to the amount of cognitive resources expended and deals with quantity of such cognitive efforts (Ho et al., 2011).

For the purpose of this study *cognitive engagement* is constitutively defined in accordance with the theoretical position of Ho et al. (2011) as the intensity of focus and immersion with which the learner engages with the learning material and the extent to which the learner is deeply engrossed and not easily distracted when engaging with the learning material.

The discussion of *cognitive engagement* thus far treated the construct as a learning competency potential variable. Some authors (e.g., Burger, 2012; Richardson & Newby, 2006) however treat cognitive engagement as a learning competency. Richardson and Newby (2006) defined cognitive engagement as the integration and utilisation of students' motivations and strategies in the course of learning. The concept of engagement has emerged as the learner competency encompassing sustained, effortful, and enthusiastic participation in learning tasks (Darabi, Nelson & Paas, 2007). This line of reasoning suggests that *cognitive engagement* involves an individual directing his or her energy towards the learning task in an attempt to form structure and ultimately to transfer existing knowledge to the current task. Burger (2012) likewise argued that *time cognitively engaged* involves the time a learner spends directing his or her energy towards the learning task in an attempt to form structure and ultimately to transfer existing knowledge to the current task. More specifically, Burger (2012, p. 35) defined t*ime cognitively engaged* in her study as "the extent to which individuals were spending time attending to and expending mental effort in their learning tasks encountered."

*Transfer*, as defined earlier, refers to the adaptation of knowledge and skill to address novel, cognitively demanding problems different from those already encountered. In order for *Transfer* to take place, an individual should attempt to create meaningful structure in the problem by adapting existing knowledge which requires continuous 'intellectual pressure' on the problem. Students are often asked to report on factors such as mental effort they expend on these tasks during items relating to cognitive aspects of engagement and the importance of these efforts in confronting academic challenges are commonly accepted. Teachers consider lack of effort to be a major source of low achievement. Burger (2012) similarly argued that it is vital that the learner is intellectually in-gear and remains in-gear for some time if he/she is to successfully find meaningful structure in novel learning material. The effort the learner exerts, as well as for how long that individual exerts that effort, is therefore vital in its combination. Both these aspects are for Burger (2012) encapsulated in the *time cognitively engaged* construct.

For the purpose of this study a distinction is made between *cognitive engagement* as a learning competency potential latent variable and time at task as a *learning competency*.

Research in engagement (Ho et al. 2011)has demonstrated that when individuals are cognitively absorbed in their learning, they are not only less easily distracted by matters that are peripheral to the learning, but also less easily deterred by problems or challenges that arise in the course of learning. Because of intense focus and concentration, individuals will be better able to overcome obstacles that arise and thus become more successful and effective and thereby accomplishing superior performance. A cognitively engaged person is more likely to find opportunities to improve performance and take up actions to improve him or herself, as evidenced by the finding that engagement is positively related to proactive behaviours such as displaying personal initiative and pursuing opportunities to develop oneself. It is expected that cognitive absorptions and attention will be positively related to learning performance, and that the state of *cognitive engagement* will mediate the positive effect of *regulation of cognition* on *time-at-task* and that the latter will affect *transfer of knowledge* and *automatisation* (Ho et al., 2011).

**Hypothesis 5: *Cognitive engagement* will positively affect *time-at-task.***

Cognitive engagement can be characterised as a psychological state in which learners are intensely focussed on and immersed in the learning task and for that reason put in a lot of effort to truly understand a topic and in which they persist studying over a long period of time. It is therefore expected that cognitive absorption and attention will be positively related to learning performance. The creation of self-reward contingencies increases the value of goal achievement which leads to increased effort and persistence and consequently engagement in pursuit of goal attainment. Self-set rewards, coupled with self-set goals, can aid significantly in energising the efforts necessary to accomplish goals (Mahoney as cited in Arnkoff, 1978, 1979; Manz & Sims, 1980; Manz & Neck, 2004). It is thus hypothesised that *academic self-leadership* will positively influence *cognitive engagement*.

**Hypothesis 6: *Academic self-leadership* will positively influence *cognitive engagement.***

*Regulation of cognition*, which constitutes the control aspect of learning, is hypothesised to be influenced by *knowledge of cognition* which includes knowledge of oneself and possible implementation strategies. *Regulation of cognition* also is expected to influence the two learning competencies, *transfer of knowledge* and *automatisation*. The influence *regulation of cognition* might have on these two learning competencies, will probably not be direct, but rather via *cognitive engagement* and *time-at-task*. Research in cognitive psychology suggests that cognitive states are a proximal predictor of performance outcomes. Building on this perspective, it is proposed that the influence of *regulation of cognition* on *transfer of knowledge* and *automatisation* be mediated by the state of *cognitive of engagement* and *time-at-task*. This mediating relationship is premised on the notion that *cognitive engagement*, in the form of absorption and attention, contributes to superior learning performance. These mechanisms (cognitive absorptions and attention) will, via their effect on *time-at-task,* mediate the positive effect of *regulation of cognition* on *transfer of knowledge* and *automatisation* (Ho et al., 2011). The discussion above supports the following hypotheses:

**Hypothesis 7: The positive effect of *cognitive engagement* on *transfer of knowledge* is mediated by *time-at-task*.**

**Hypothesis 8: The positive effect of *cognitive engagement* on *automatisation* is mediated by *time-at-task*.**

**Hypothesis 9: *Regulation of cognition* will positively influence *cognitive engagement*.**

#### 2.6.3.3 Learning motivation

The term motivation is derived from the Latin verb *movere*, which means to move (Webster's Collegiate Dictionary, 1941). Motivation is literally the desire to do things and can be seen as the crucial element in setting and attaining goals.

It seems rather self-evident that motivation and performance are important constructs to explain differences in employee behaviour in the workplace. It is however not that straight forward to explain how motivation is critical for performance and therefore motivation needs to be defined first. Pintrich and Schunk (2002) define motivation as "the process whereby goal-directed activity is instigated and sustained" (p. 5). According to Pintrich (1999) motivation is the most important component of learning in any educational environment. It is considered to be one of the most critical determining factors of students' success. Motivation to learn can further be defined as a specific desire on the part of the trainee to learn the content of the training programme (Colquitt, LePine & Noe, 2000; Hicks & Kilmoski, 1987; Noe & Scmidtt, 1986; Ryman & Biersner, 1975). Gibson, Ivancevich, Donnelly and Konopaske (2006) describe motivation as forces acting on an individual that initiate and direct behaviour. According to Kanfer (1991) motivation is typically mobilised to explain variability in behaviour not attributable to stable individual differences like cognitive ability or strong situational coercion. He also defines motivation as a psychological mechanism governing the direction, intensity and persistence of action not solely due to individual differences in ability.

The De Goede (2007) learning potential structural model fails to recognise the importance of motivation during learning performance as it only acknowledges the fact that cognitive abilities affect learning performance through *abstract reasoning ability* and *information processing capacity*. Cognitive ability must be considered the single best predictor of learning performance (Hunter, 1986; Hunter & Hunter, 1984; Ree & Earle, 1991; Schmidt, 2002). The research results of whether cognitive ability predicts job performance is so overwhelming that there is no doubt that this is in fact the case (Sackett, Schmitt, Ellingson, & Kabin, 2001). De Goede (2007) argues that it is extremely unlikely that cognitive ability will be the sole determinant of learning performance and suggested that an understanding of learning motivation can be a plausible additional determinant of learning performance. Pintrich and De Groot (1990) also support De Goede (2007) as they believe that knowledge of cognitive and metacognitive strategies is usually not enough to promote achievement in students, students also need to be motivated to use the strategies as well as regulate their cognition and effort (Paris, Lipson, & Wixson, 1983; Pintrich, Cross, Kozma, & Mckeachie, 1986). Students need both the “will” and ‘skill” to be successful in classrooms (Blumenfeld, Pintrich, Meece, & Wessels, 1982; Paris et al., 1983; Pintrich, 1989). The interaction between ability and motivation is also acknowledged in the expectancy theory of motivation. From this it seems clear that ability, in the absence of motivation, or motivation in the absence of ability is insufficient to yield performance. Colquitt et al. (2000, p. 696) found that motivation to learn explained variance in learning over and above cognitive ability and it was therefore concluded that there was ‘much more than *g*’. Although there are classroom situations and tasks that can foster motivation (Corno & Rohrkemper, 1985; Malone, 1981), there is also evidence to suggest that students’ perceptions of the classroom, as well as their individual motivational orientations and beliefs about learning are relevant to *cognitive engagement* and *classroom learning performance* (e.g. Ames & Archer, 1988; Nolen, 1988). Wexley and Latham (1981) add that it is widely accepted that learning and specifically *transfer* will only occur when trainees have both the ability and motivation to acquire and apply new skills.

The foregoing argument presents compelling ground for the inclusion of *learning motivation* as a learning competency potential latent variable in the De Goede (2007) learning potential structural model. More support for this is found in the empirical evidence of Clark (1990), Hicks and Klimoski (1987) and Ralls and Klein (1991) where they found that motivation and learning are related. Nunes (2003) added to this by mentioning that it was found that motivated individuals take a more active role in training/learning and get more from the experience than individuals who are not motivated, as the motivated individuals are more primed or ready to learn. There thus appears to be a robust positive relationship between motivation to learn and learning outcomes (Baldwin, Magjuka & Loher, 1991; Martocchio & Webster, 1992; Noe & Schmitt, 1986; Tannenbaum, Mathieu, Salas & Cannon-Bowers, 1991). Learning motivation likely determines the extent to which an individual directs their energy towards the learning task in an attempt to form structure and ultimately to transfer existing knowledge to the current task. Tannenbaum et al. (1991) also found that *motivation to learn* is an important factor affecting transfer. Learning competencies thus serve as mediators between *learning motivation* and learning outcomes. Pintrich and De Groot (1990) found that students who are motivated to learn the material (not just get good grades) and believed that their school work was interesting and important were more *cognitively engaged* in trying to learn and comprehend the material. They also found that these students were more likely to be self-regulating and to report that they persisted in their academic work.

*Academic self-leadership* and the corresponding behaviour focused strategy of setting goals are both aimed at learning. It is therefore hypothesised that *academic self-leadership* should positively influence *learning motivation*. Furthermore it is also hypothesised that *motivation to learn* will positively influence academic self-leadership. *Motivation to learn* serves as a mobiliser and driver of academic self-leadership. It is hypothesised that *motivation to learn* will positively influence *academic self-leadership*.

**Hypothesis 10: In the proposed elaborated learning potential structural model, it is hypothesised that *motivation to learn* will positively affect *transfer* and automatisation through *cognitive engagement* and *time-at-task*.**

**Hypothesis 11: In the proposed elaborated learning potential structural model it is hypothesised that *motivation to learn* will positively influence *academic self-leadership* as it serves as a mobiliser and driver of *academic self-leadership*.**

The latter hypothesis is based on research that has shown that motivation is often considered a process that is triggered by leadership techniques like goal setting to influence subsequent performance (Campion, Medsker & Higgs, 1993). According to Houghton and Neck (2002) a multitude of research has shown that the act of setting challenging and specific goals can have a dramatic effect in motivating individual performance (Locke & Latham, 1990). Self-leadership theory can be classified as a motivational theory in which motivation is assumed to be triggered by behavioural and cognitive strategies that influence the initiation, direction, intensity and persistence of behaviour (Manz, 1992). This classification is based on Bandura's belief that self-leadership is built upon the theoretical foundation of social learning theory which postulates that individuals influence their own motivation. It is therefore hypothesised that *Academic self-leadership*, self-leadership aimed towards learning, should influence *Learning Motivation.*

**Hypothesis 12: In the proposed elaborated learning potential structural model it is hypothesised that *academic self-leadership* will positively influence *learning motivation.***

### 2.6.3.4 Academic self-efficacy

Bandura (1986) refers to self-efficacy as an individual's opinion of their own intrinsic ability to organise their behaviour to do things in such a way as to be satisfied with the outcome. He further defines self-efficacy as people's judgements of their capabilities to organise and execute courses of action required for the attainment of designated types of performance (Bandura, 1986, p. 391). Social cognitive theory provides insight regarding self-efficacy and explains where self-efficacy comes from and how it develops (Maddux, 2002). This theory postulates that people are active shapers of their environment, not merely passive reactors (Bandura, 1986; Barone, Maddux, & Snyder, 1997). According to Maddux (2002) self-efficacy develops over time and through experiences. Self-efficacy helps explain the behaviours people will engage in, how long they will persist, and how much effort they will expend to reach their goals (Satterfield & Davidson, 2000). Bandura (1997) further describes self-efficacy as beliefs about personal capabilities to produce a desired effect by individual action. The self-assessments that people make in determining personal capacity to perform, refer to self-efficacy (Bandura, 1986, 1991;

Gist, 1987; Neck & Houghton, 2006). In other words self-efficacy involves judgements of capabilities to perform tasks rather than personal qualities (Bandura, 1995; 1997). The concept of self-efficacy is less concerned with the number of cognitive, social, emotional and behavioural skills a person has and more with what an individual believes can be done with what is available under a variety of circumstances (Bandura, 1997). Bandura (1991) further states that self-efficacy relates to enduring patterns in cognition and is termed by some as a personality trait. People with high self-efficacy may be more likely to overcome difficulties through self-initiated change, more likely to be goal-directed and more persistent in the achievement of that goal (Maddux, 2002). Neck and Houghton (2006) suggest that self-efficacy can influence aspirations, effort, persistence and thought patterns.

Self-efficacy has been assessed on different levels of specificity and three levels of self-efficacy can be distinguished (Bandura, 1997; Woodruff & Cashman, 1993). Self-efficacy was originally defined as task specific (Bandura, 1977) which most likely is the most common and widely researched form of self-efficacy and it refers to self-efficacy for performance of a specific task as the first level. Secondly, domain efficacy is more general and refers to efficacy for performance within an entire definable domain of tasks, for example 'research self-efficacy' (Forester, Kahn & Hesson-McInnis, 2004) or for the purpose of this study *academic self-efficacy*. There may be differences in self-efficacy across tasks within the domain, but overall there is a global belief in one efficacy within that domain. The third level is referred to as general self-efficacy which refers to an accumulation of life successes that have emerged as a result of previous experience (Bandura, 1977; Chen et al., 2001). Chen, Gully and Eden (2004) indicated that general self-efficacy is a motivational belief or judgement about personal capabilities that influences personal action in a wide variety of situations. DeRue and Morgeson (2007) posited that individuals with high general self-efficacy attribute success to ability and failure to insufficient effort. The concept of self-efficacy is of particular importance to self-leadership as a major objective of self-leadership strategies is the enhancement of self-efficacy perceptions in advance of higher performance levels (e.g. Manz, 1986; Manz and Neck, 2004; Neck and Manz, 1992, 1996a; Prussia et al*.,* 1998). High levels of task-specific self-efficacy lead to higher performance standards (Bandura, 1991), greater effort and greater persistence in the pursuit of goals and objectives, and ultimately greater effectiveness (e.g. Bandura and Cervone, 1983, 1986).

Empirical evidence tends to support the usefulness of self-leadership strategies in promoting self-efficacy perceptions. Frayne and Latham (1987) and Latham and Frayne (1989) demonstrated a positive relationship between self-management training and self-efficacy for reducing absenteeism. Neck and Manz (1996a) reported a significant difference in self-efficacy levels between a group that had received self-leadership training and a non-training control group. Prussia and colleagues (Prussia et al*.,* 1998) examined the role of self-efficacy as a mediator of the relationship between self-leadership strategies and performance outcomes. Their results indicated significant relationships between self-leadership strategies, self-efficacy perceptions and task performance. These findings all suggest that self-efficacy may function as the primary mechanism through which self-leadership strategies affect performance. A study conducted by Konradt and Andressen (2009) showed self-efficacy to have a positive impact on performance. Neck, Neck, Manz and Godwin (1991) developed a model which is supported by Bandura (1977, 1986) and shows that self-efficacy perceptions directly influence individual performance. Burger (2012) hypothesised in her study that an increase in *academic self-efficacy*, the belief in one's academic ability, would lead to an increase in one's *academic self-leadership*. However, her results somewhat unexpectantly indicated that this relationship was negative. Subsequent theorising did, however, indicate that the negative structural relationship between these two latent variables, to some degree, does make substantive theoretical sense. Burger (2012) argued that if an individual believes that he/she is capable of succeeding in an academic or learning task, that individual may not see the need to implement academic self-leadership strategies as the individual may feel that he/she is capable of performing successfully without the implementation of these strategies. She suggests that cross-validation research will be vital in resolving this debate.

From the above it can be hypothesised that academic self-efficacy will have a negative effect on *academic self-leadership*.

**Hypothesis 13: In the proposed elaborated learning potential structural model it is hypothesised that *academic self-efficacy* will have a negative effect on *academic self-leadership.***

Ziv and Ziman (2006) define *academic self-efficacy* as an individual's perceived capability to manage learning behaviour, master academic subjects and fulfil academic expectations. Shunk (1991) defines *academic self-efficacy* as subjective convictions that one can successfully carry out given academic tasks at designated levels. *Academic self-efficacy* pertains to individuals perceptions about learning (Girasoli & Hannafin, 2008) and is defined here as the belief that one can successfully execute the actions needed to produce a desired academic outcome. Lee and Klein (2002) showed that *academic self-efficacy* and learning were significantly positively correlated during both the early and late phases of training and learning. This finding, however, begs the question through which a structurally linked network of learning competencies *academic self-efficacy* affects *transfer* and *automatisatrion* as the core learning competencies. Self-efficacy thus does not only have a relationship with performance in general, but also one's capability to learn or perform academic tasks effectively. When the self-efficacy construct is operationalised in order to gain information about the individual's efficacy beliefs that might relate to academic or learning success, the construct can be described as *academic self-efficacy*. This construct has been documented as an important factor for learning and achievement and the importance of self-efficacy theory for the understanding and the prediction of career-relevant behaviours, such as academic achievement, has been recognised (Bell & Kozlowski, 2002; Lodewyk & Winne, 2005).

Pintrich and De Groot (1990) conducted a study in which they found that self-efficacy was positively related to students' *cognitive engagement* and *learning performance during evaluation*. Students who believed they were capable were more likely to report use of cognitive strategies, to be more self-regulating in terms of reporting more use of metacognitive strategies, and to persist more often at difficult or uninteresting academic tasks. These relations were independent of and did not interact with prior achievement levels in intrinsic value and test anxiety. Pintrich and De Groot (1990) however found that self-efficacy was not significantly related to performance on seatwork, exams, or essays when the cognitive engagement variables were included in the regression analyses. This suggests that self-efficacy plays a facilitative role in relation to *cognitive engagement* suggested by Schunk (1985), but that the *cognitive engagement* variables are more directly tied to actual performance. It can therefore be hypothesised that *academic Self-efficacy* positively influences *cognitive engagement*.

**Hypothesis 14: *Academic self-efficacy* will positively influence *Cognitive Engagement.***

Betz (1994) postulates that self-efficacy is an important personal resource and has a strong relationship with career development. Self-efficacy beliefs have also shown to predict the level of mastery of educational requirements when variations in actual ability, prior level of academic achievement, scholastic aptitude and vocational interest were controlled (Brown, Lent & Larkin, 1989; Lent, Lopez & Bieschke, 1993). Bandura, Barbaranelli, Caprara and Pastorelli (2001) indicate how a high sense of self-efficacy for self-regulated learning and mastery of academic course work fosters academic aspirations and scholastic achievement in the research they did. They found that children of high perceived academic efficacy achieve good academic progress, have high educational aspirations and favour career levels in fields that require advanced educational development; these findings are supported by Zimmerman et al., 1992. During their study Pintrich and De Groot also found that intrinsic value was very strongly related to use of cognitive strategies and self-regulation, independent of initial performance levels or self-efficacy and test anxiety. Students who were motivated to learn, and not just motivated to get good grades, and believed that their school work was interesting and important, were more cognitively engaged in trying to learn and comprehend the material. In addition these students were more likely to be self-regulating and to report that they persisted in their academic work. Student's intrinsic value and motivation to learn is an important component when looking at how students come to use different cognitive strategies and become self-regulating learners (cf., Meece et al., 1988; Nolen, 1988). Brown and Lent (1991) found that self-efficacy beliefs were generally related to academic behaviours in ways that support Bandura's (1977, 1986) theory and its extension to educational-vocational behaviour (Hackett & Betz, 1981; Schunk, 1987). Their study provides support for the relationships of self-efficacy beliefs to academic performance and persistence. Lane, Lane and Kyprianou (2004) found that self-efficacy contributed strongly to the prediction of grades in postgraduate students who enrolled in a business course. Zimmerman et al. (1992) also adds that the influence of efficacy beliefs within an academic context is pervasive as a significant predictor of academic performance. Self-efficacy beliefs seem to have greater predictive value of learning and achievement compared to other motives.

LePine and Noe (2000) found that cognitive ability was also weakly to moderately related to post-training efficacy (*r*=.22). Zimmerman et al. (1992) found that a high sense of efficacy for self-regulated learning and academic mastery in children fosterd scholastic achievement both directly and by raising academic aspirations.

Nunes (2003) found a significant (p<.01) correlation between learning motivation and ability to learn. Ability to learn in the De Goede structural model refers to information processing capacity and abstract reasoning capacity. Nunes (2003) made use of the Pearson's product-moment correlation coefficient to investigate the relationship between ability to learn, by making use of the Mental Alertness Scale and trainee motivation was measured by making use of the Motivation to Learn Scale. She found a small positive significant correlation between the variables (r=.260, n=113, p<0.05). Nunes's (2003) findings suggest that individuals that have sufficient ability to learn should be more motivated to learn, which forms part of De Goede's (2007) elaborated learning potential structural model. Self-efficacy has been assessed quite frequently and has been found to be positively related to motivation to learn and to training outcomes, such as skill acquisition, post training self-efficacy, transfer and job performance (Colquitt et al., 2000). When viewed from the perspective of expectancy theory (Vroom, 1964) self-efficacy should affect motivation by affecting the effort-performance expectancy (P[E→P]). Since motivation is, according to the expectancy theory, the result of the multiplicative combination of the valence of performance and the effort-performance expectancy, and since self-efficacy can by definition be expected to affect the effort-performance expectancy, self-efficacy should affect motivation. It is therefore proposed that *academic self-efficacy*, will have a positive effect on *learning motivation*.

**Hypothesis 15: In the proposed elaborated learning potential structural model it is hypothesised that *academic self-efficacy* will have a positive effect on *learning motivation.***

Achievements generally tend to motivate and encourage people to do more and achieve more as their self-confidence increases. Performance accomplishments are hypothesised to be important in influencing self-efficacy (Bandura, 1977). In Bandura's model (1977) expectations of personal efficacy are derived from four principal sources of information: performance accomplishments, vicarious experience, verbal persuasion and physiological states. From Bandura's (1977) work it is clear that self-efficacy is developed through several mechanisms, the largest contributors being self-referenced information such as mastery experience or performance accomplishment. Bandura (1997) found that the relation of past performance to subsequent performance is mediated through, amongst others, efficacy beliefs. Bandura (1993) also showed that a student's self-efficacy is influenced by the feedback they receive and the attributions they make regarding the feedback. When we successfully complete something, we set a new challenging goal for ourselves which we want to achieve. For example: I train hard to be able to run 10 kilometers, I then enter a race and reach my goal by receiving a medal when completing the race. This accomplishment creates a belief in me (self-efficacy) that I am capable of long distance running as I was successful in my first race. I then train more and challenge myself by entering a 15 kilometre running race as I already know that I am capable of running 10 kilometres. If I did not succeed in my first goal, the chances of me setting a new goal would be very small, as this would not have boosted my self-esteem (self-efficacy). This example is similar to Bandura's (1997) belief that learning performance raises levels of self-efficacy. Hammond and Feinstein (2005) and Linnenbrink, Pintrich and Arbor (2003) support Bandura's belief that the more a student learns and the better they perform, the higher their self-efficacy. The desire for the runner to set new challenging goals is supported by Schunk (1987) who adds that performance feedback affects subsequent efficacy and the entire process takes place within an ongoing, continuous feedback loop. Gist (1987) suggests that accomplishments as a source of efficacy information are especially influential because it is based on personal mastery experiences. Bandura (1977) also believes that successes raise mastery expectations and failures lower them. From my example and the relevant research it can be hypothesised that performing learning tasks successfully will have a positive influence on academic self-efficacy as a form of feedback.

**Hypothesis 16: In the proposed elaborated learning potential structural model it is hypothesised that *learning performance during evaluation* will positively influence *academic self-efficacy* as a form of feedback.**

Schunk (1989) theorised that students perceive various personal and contextual elements such as their ability, the difficulty of the task, the degree of effort required, help available and their past successes and failures when engaging with a task. Bandura (1986) stated that the nature of a student's engagement during learning is the most influential source of self-efficacy information. Bandura (1993) later asserted that self-efficacy influences how students respond to tasks. Schunk (1991) found that when students perceive their capabilities to be below the task's difficulty, low efficacy expectation may cause stress which impairs productive cognitive engagement. Higher self-efficacy appears to reassure and compose learners who face challenging tasks whereas low self-efficacy invites students to emphasise errors and other information which handicaps performance (Pajares, 1996b). Schunk (1991) supports Bandura's (1993) assertion when he mentions that external and internal evaluations are produced as a student engages with a task which can strengthen or weaken self-efficacy. These evaluations serve as a form of feedback. Lodewyk and Winne (2005) support these theories by stating that self-efficacy predicts choices students make about how to engage with tasks: 'A person with the same knowledge and skills may perform poorly, adequately, or extraordinarily depending on fluctuations in self-efficacy thinking' (Bandura, 1993, p. 119). This supports the inference that being cognitively engaged in a task gives students the opportunity to generate internal feedback about their learning and achievement and that this feedback affects academic self-efficacy (Bandura, 1993; Schunk, 1989, 1991). The question is, however, whether it is the *cognitive engagement per se* that provides the opportunity for evaluation or whether it is the subsequent success at *transfer* and *automatisation,* as well as the subsequent successful transfer of the newly obtained insight into novel (action) learning problems encountered during evaluation. Learners have to cognitively engage with their learning material (for a period of time) if they are to succeed at *transfer* in the classroom and later during evaluation. The study holds the position that *cognitive engagement* does not directly affect *academic self-efficacy* but that its effect is mediated by *time-at-task, transfer, automatisation* and *learning performance during evaluation.* Hypothesis 14, hypothesis 5 and hypotheses 2a and 2b therefore already capture this line of reasoning.

### 2.6.3.5 Goal orientation

Goal orientation theory is a social-cognitive theory of achievement motivation (Svinicki, 2005). The goal theory originated early in the 20th century but became a particularly important theoretical framework in the study of academic motivation after 1985 (Ames, 1992a; Dweck, 1986; Maehr, 1984, Nicholls, 1984). Whereas other motivational theories (e.g., attribution theory) examine students' beliefs about their successes and failures, goal orientation theory examines the reasons why students engage in their academic work. Although goal orientation theory is predominantly studied in the domain of education, it has also been used in studies in the domains of sports psychology, health psychology, and social psychology (Svinicki, 2005).

Goals provide standards against which people compare their present performance (Bandura, 1986; Locke & Latham, 1990). When students adopt a goal, they may experience a sense of efficacy for attaining it, which motivates them to engage in appropriate activities to attend to instruction, persist, and expend effort. Students' initial self-efficacy is substantiated as they observe their goal progress because perceptions of progress convey they are becoming skilful. Self-efficacy sustains motivation and leads learners to establish new goals when they master their present ones[8] (Bandura, 1988; Schunk, 1991).

Two variables that have been of particular interest to researchers in the field of educational psychology are achievement goals and metacognition (Coutinho, 2007). Achievement goals are the type of outcomes people pursue in learning environments (Coutinho, 2007). There are two main types of achievement goals namely mastery goals and performance goals. Research suggests that goal orientations may exist independently of each other; a person may adopt only one goal or both goals with one being a primary goal and the other being a secondary goal (Coutinho, 2007).

Button, Mathieu and Zajac (1996), Dweck (1986) and Pintrich (2000) support the distinction of mastery and performance orientations (or goals) as two separate constructs which are unrelated. Students hold mastery goals (also referred to as being mastery-oriented) when their goal is to truly understand or master the task at hand. Students who are mastery-oriented are interested in self-improvement and tend to compare their current level of achievement to their own prior achievement. Students hold performance goals (also referred to as being performance-oriented) when their goal is to demonstrate their ability compared to others. Students who are performance-oriented are interested in competition, demonstrating their competence, and outperforming others; they tend to use other students as points of comparison, rather than themselves (Svinicki, 2008).

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[8] This line of reasoning also brings to the fore the possibility that goal orientation might moderate the effect of learning performance during evaluation on learning motivation and on academic self-efficacy.

Some researchers have operationalised performance goals somewhat differently and referred to them as "extrinsic goals" (Anderman & Johnston, 1998; Pintrich & de Groot, 1990). When students hold an extrinsic goal, their reasons for engaging in academic tasks are to either earn a certain reward (e.g., a good grade) or to avoid a punishment. According to Svinicki (2005) students can hold multiple goals simultaneously; thus it is possible for a student to be both mastery-approach oriented and performance-approach oriented; such a student truly wants to learn and master the material, but is also concerned with appearing more competent than others. Duda and Nicholls (1992) provide evidence that mastery and performance orientations are related to different personal beliefs. Performance orientation is related to the belief that success requires high ability, whereas mastery orientation is related to the belief that success requires interest, effort and collaboration.

Goal orientations were originally defined as situated orientations for action in an achievement task (Ames, 1992a; Dweck, 1986; Nicholls, 1984). Rather than focusing on the content of what people are attempting to achieve (i.e., objectives, specific standards), goal orientations define why and how people are trying to achieve various objectives (Anderman & Maehr, 1994) and refer to the overarching purposes of achievement behaviour. These orientations were conceived of as encompassing the experience of the person in the situation, guiding interpretation of events and producing patterns of cognition, emotion and behaviour (Ames, 1992a; Elliott & Dweck, 1988). Whereas the original definition of goal orientations focussed on the situated purposes for action, these orientations have also been conceived of as more enduring dispositions towards engagement (e.g., Nicholls, 1992). Researchers have long recognised the role of individual differences in learning and transfer (Ford, Smith, Weissbein & Gully, 1998). Learners differ in what they do during learning and in their capability to succeed in particular types of learning situations (Snow, 1989). An individual difference construct of interest in current instructional and educational research is the goal orientation of the learner (Svinicki, 2005).

### *Mastery goal orientation*

Mastery goals orient a person to a focus on learning and mastery of content, and have been linked to adaptive outcomes such as strong self-efficacy, good metacognition and good performance. People with mastery goals seek challenging tasks and strive under difficult situations. When faced with failure, they respond with solution-oriented instructions, as well as sustained or increased positive effect and sustained or improved performance (Coutinho, 2007).

A mastery orientation includes the belief that effort leads to improvement in outcomes and that ability is malleable (Ford et al*.,* 1998). Ames (1992a) defines mastery goal orientation as an individual's purpose of developing competence. Individuals with a mastery orientation are focused on developing new skills, attempting to understand their tasks, and successfully achieving self-referenced standards for mastery (Ames, 1992; Dweck, 1986; Dweck & Leggett, 1988). Mastery goals orient a person to a focus on learning and mastery of content, and have been linked to adaptive outcomes such as strong self-efficacy, good metacognition and good performance (Coutinho, 2007; Ford et al., 1998). People with mastery goals seek challenging tasks and thrive under difficult situations. When faced with failure, they respond with solution-oriented instructions, as well as sustained or increased positive affect and sustained or improved performance (Coutinho, 2007). Students who pursue a mastery goal tend to experience a sense of self-efficacy when attaining it and be motivated to engage in task-appropriate activities (e.g., expend effort, persist, use effective strategies) (Bandura, 1986; Schunk, 1989). Learners' self-efficacy is substantiated as they work on the task and assess their progress (Wentzel, 1992). Perceived progress in skill acquisition and a sense of self-efficacy for continued learning sustain self-regulatory activities and enhance skilful performance (Schunk, 1991). Research by Ames and Archer (1988) also found that classroom settings emphasising mastery goals lead students to use more effective learning strategies, to prefer challenging tasks, to have a more positive attitude toward the class, and to have a stronger belief that success follows from effort. According to Ford et al. (1998), individuals with a higher mastery orientation engage in greater metacognitive activities during learning. They also found that metacognition partially mediated the relationship between mastery orientation and self-efficacy (Ford et al., 1998). Students' endorsement of mastery goals orientation has been regularly found to be associated with positive outcomes such as self-efficacy, persistence, preference for challenge, self-regulated learning, and positive affect and well-being (Ames, 1992a; Dweck & Leggett, 1988; Elliot, 1999; Kaplan, Middleton, Urdan, & Midgley, 2002b; Midgley, 2002; Pintrich, 2000a; Urdan, 1997). The relationship of mastery goal orientation with these outcomes have been supported by experimental, correlational, as well as qualitative research. For example, eliciting a mastery goals orientation in experiments was found to be related to self-regulated learning (Graham & Golan, 1991), transfer of problem-solving strategies and achievement on task (Bereby-Meyer & Kaplan, 2005). Some longitudinal–correlational studies that controlled for previous achievement and perceived ability found that mastery goal orientation predicted continuing motivation (e.g., intrinsic motivation, number of courses taken, majoring in a domain) (e.g. Cury, Elliot, Da Fonseca, & Moller, 2006; Harackiewicz, Barron, Taur, & Elliot, 2002b). In addition, many correlational studies have supported the relations between mastery goals and a host of positive outcomes including effort and persistence (Elliot, McGregor, & Gable,1999), employment of deep learning strategies (Elliot et al., 1999; Kaplan & Midgley,1997), retention of information learned (Elliot & McGregor, 1999), self-efficacy (Kaplan & Maehr, 1999), positive emotions (Roeser, Midgley, & Urdan, 1996), and general well-being (Dykman, 1998).

### *Performance goal orientation*

Performance goals encourage people to focus on scoring better than others or avoiding the appearance of incompetence. People with performance goals strive to demonstrate ability and avoid negative judgements of competence. They prefer simple tasks, and evade challenges and obstacles in order to guarantee success. When confronted with challenging tasks they may react by withdrawing, demonstrating negative affect, make negative ability attributions or by showing decreased interest in the task (Coutinho, 2007).

Individuals with a performance orientation to learning believe that ability is demonstrated by performing better than others, by surpassing normative-based standards, or by succeeding with little effort (Ames, 1992a; Dweck, 1986). Performance-oriented students focus on managing the impression that others have of their ability: attempting to create an impression of high ability and avoid creating an impression of low ability (Dweck, 1986). This is done through comparison with others' ability (Nicholls, 1984). A performance goal orientation thus encourages people to focus on scoring better than others or avoiding the appearance of incompetence (Coutinho, 2007). Students who are performance-oriented are interested in competition, demonstrating their competence, and outperforming others; they tend to use other students as points of comparison, rather than themselves (Svinicki, 2005).

Researchers have operationalised performance goals as "extrinsic goals" (Anderman & Johnston, 1998; Pintrich & de Groot, 1990). When students hold an extrinsic goal, their reasons for engaging in academic tasks are to either earn a certain reward (e.g., a good grade) or to avoid a punishment.

Performance goals may not highlight the importance of the processes and strategies underlying task completion or raise self-efficacy for acquiring skills (Schunk & Swartz, 1993a, 1993b). As students work on the tasks, they may not compare their present and past performances to determine progress. Performance goals can lead to one socially comparing one's work with that of others to determine progress. Social comparisons can result in low perceptions of ability among students who experience difficulties, which adversely affects task motivation (Ames, 1992a; Jagacinski, 1992). People with performance goals strive to demonstrate ability and avoid negative judgements of competence and strive to publicly achieve greater success compared with others (Ford et al., 1998; Ames, 1992a; Jagacinski, 1992). They prefer simple tasks, and evade challenges and obstacles in order to guarantee success. When confronted with challenging tasks they may react by withdrawing, demonstrating negative affect, making negative ability attributions or by showing decreased interest in the task (Dweck, 1986; Dweck & Leggett, 1988; Elliott & Dweck, 1988; Coutinho, 2007). These social comparisons can result in low perceptions of ability among students who experience difficulties, which adversely affects task motivation (Ames, 1992a; Jagacinski, 1992). Classrooms emphasising performance goals lead students to focus on their ability, to evaluate their ability negatively, and to attribute their failures to lack of ability (Ames & Archer, 1988).

Unlike the findings concerning mastery goals, research findings concerning performance goals are inconsistent. Often, performance goals orientation has been associated with a maladaptive pattern of cognition, affect, and behaviour (Ames, 1992a; Dweck & Leggett, 1988). For example, performance goal orientation was found to be associated with use of surface rather than deep learning strategies and with negative affect in events involving challenge or difficulty (Ames, 1992a). However, a few studies did not find such negative characteristics. Moreover, whereas some studies found no associations between performance goal orientation and positive outcomes, others have found weak or even moderate associations between this orientation and variables such as self-efficacy, use of effective learning strategies, grades, and positive attitudes and affect (Elliot, 1999; Urdan, 1997). About a decade ago, several researchers, most notably Elliot (1997, 1999), argued that the inconsistent pattern of results concerning the relations of performance goal orientation with adaptive outcomes may stem from failing to account for a distinction between "approach" and "avoidance" orientations within performance goals (cf., Atkinson, 1957). An "approach" orientation refers to a focus on the possibility of achieving success, whereas an "avoidance" orientation refers to a focus on the possibility of failure, and on the attempt to avoid it (Elliot, 1997; Elliot & Harackiewicz, 1996; Middleton & Midgley, 1997; Skaalvik, 1997; Vandewalle, 1997). In terms of mastery goals, mastery-approach oriented students are interested in truly mastering an academic task; in contrast, mastery-avoid oriented students are interested in avoiding misunderstanding the task. In terms of performance goals, performance-approach oriented students are interested in demonstrating that they are more competent than other students (i.e., have more ability than others); in contrast, performance-avoid oriented students are interested in avoiding appearing incompetent or stupid (Elliot, 1997; Svinicki, 2008; Kaplan and Maehr, 2007). Studies that distinguished between performance-approach and performance-avoidance goals suggest quite strongly that performance avoidance goals are associated with negative outcomes (Elliot, 1999). Performance-avoidance goals have been found to be associated with low efficacy, anxiety, avoidance of help-seeking, self-handicapping strategies, and low grades (Urdan, Ryan, Anderman, & Gheen, 2002). The pattern of associations related to performance-approach goals is mostly considered positive as this goal orientation was found to be related to outcomes such as persistence, positive affect, and grades (Elliot, 1999; Harackiewicz et al., 2002b). Some studies however found this goal orientation to be also associated with negative outcomes such as anxiety, disruptive behaviour, and low retention of knowledge (Midgley, Kaplan & Middleton, 2001). According to Midgley et al. (2001), other researchers argued that performance-approach goals would lead students to focus on strategies that aim at enhancing demonstration of ability rather than at learning, and therefore might contribute to grades, but not necessarily to understanding and deep processing. Notably, one possible problem with performance-approach goals is the potential of their transformation into performance-avoidance goals when students experience changes in circumstances and in perceived-competence or the likelihood of failure (Middleton, Kaplan & Midgley, 2004). Currently, the issue concerning the potential benefits of performance-approach goals in educational settings is still under debate (Elliot & Moller, 2003; Harackiewicz, Barron, Pintrich, Elliot & Thrash, 2002a; Hidi & Harackiewicz, 2000; Kaplan & Middleton, 2002).

More recently, the distinction between approach and avoidance orientations was applied to mastery goals (Elliot, 1999; Pintrich, 2000a; Linnenbrink & Pintrich, 2000, 2002). The little research conducted on mastery-avoidance goals makes it hard to evaluate their prevalence among students and to provide generalisations regarding the patterns of engagement that are associated with them (Pintrich, 2003). In the few published studies that examined mastery-avoidance goals to date, this orientation was found to be mostly unrelated to cognitive strategies or to grades, but negatively related to intrinsic motivation (Cury et al., 2006) and positively related to negative emotions such as test anxiety and worry (Elliot & McGregor, 2001), and to help-seeking threat (Karabenick, 2003).

A meta-analysis by Utman (1997) compared the effects of experimentally eliciting achievement goal orientations on the performance of participants in the task found a strong support to the benefit of eliciting a mastery goal orientation over eliciting a performance goal orientation. This meta-analysis, found an overall moderate effect (Cohen's d of .53) of eliciting a mastery goals orientation on performance, in comparison to eliciting a performance goals orientation.

Mastery and performance orientations to learning represent different ideas of success and different reasons for engaging in learning (Ames, 1992a). Research suggests that these goal orientations may exist independently of each other; a person may adopt only one goal or both goals with one being a primary goal and the other being a secondary goal (Coutinho, 2007).

Meece, Blummenfeld, and Hoyle (1988) assessed goal orientations, intrinsic motivation to learn, and cognitive engagement patterns during science lessons. They found that students who emphasised task-mastery (analogous to mastery goals) reported more active cognitive engagement characterised by self-regulatory activities (e.g., review material not understood). Intrinsic motivation related positively to goals stressing learning and understanding. Research findings suggest quite unequivocally that mastery goals are an adaptive motivational orientation (Kaplan & Maehr, 2007). This implies that when mastery goal are perceived to be emphasised in an achievement context and when students endorse them as an orientation, quality of engagement in tasks is higher, students are likely to invest in the task, seek challenge, persist longer, feel more positively about it, and be more productive. Indeed, experimental and correlational research suggests that mastery goal orientation is not only related to learning and thinking processes in achievement situations, but also appears to be associated with an adaptive orientation toward life more broadly, encourages appropriate social behaviour, positive feeling about self and others, and a sense of well-being. Performance goal orientation is regularly present in achievement contexts and is very prevalent in schools. This orientation is often consciously promoted as valuable, maybe even perceived as necessary to motivate performance and achievement in education and also in the world of sports and work. It is clear that performance goal orientation, particularly performance-approach goals, can be associated with positive outcomes, and indeed, in some settings and for some students they are likely to be related to achievement and positive attitudes (Kaplan & Maehr, 2007). However, it is also clear that in many cases, and particularly when students believe that they are lacking competence to perform effectively and when they are concerned with failure, a performance goal orientation appears to have important implications for common practices in schools, including the use of competitive incentives, the social comparison of students, the strong emphasis on evaluation per se, and the salience of the possibility of failure (Kaplan & Maehr, 2007).

The presence of good metacognition has been proven a strong predictor of academic success in educational psychology as it enables a person to be strategic in learning. Research on the relationship between achievements goals, metacognition and success, which was based on the hypothesis that the relationship between goals and academic success is fully mediated by metacognition proved the following:

People with mastery goals are more likely to have good metacognition and thereby they would perform well. People with performance goals may not enjoy the fruit of success even though they strive to perform well, due to their poor metacognition. This research suggests that people should be encouraged to adopt a mastery approach to learning, and those who tend to be driven by performance goals may benefit from training related to mastery goals and metacognition. People who strive to deeply comprehend information tend to be successful in their performance. Mastery goals influence success through metacognition, as people with mastery goals may have superior metacognitive skills and strategies that they use to master information. The use of superior metacognition eventually leads to enhanced performance and success (Coutinho, 2007). Metacognitive knowledge may also compensate for low ability or lack of relevant prior knowledge and contributes to problem solving over and above IQ and task-relevant strategies (Schraw, 1998).

Learning can be controlled through the use of metacognitive learning strategies. By making use of these strategies people become aware that learning is a process and that they may need to learn a certain strategy so they can accomplish learning more effectively (Smith, 2008). Metacognitive strategies are thought to be particularly important when learning abstract and generalised information. The perceived importance of metacognitive strategies is a direct result of a paradigm shift in learning theory and resulting change in beliefs about learning that are used as a rationale for educational purposes. There is now consensus among cognitive scientists that knowledge is not transmitted from teacher to learner but rather constructed by learners through reflection on their experience (Slezak, Caelli & Clark, 1995).

From the above, it can be hypothesised that mastery goal orientation positively influences self-efficacy, cognitive engagement, learning motivation and metacognitive regulation.

**Hypothesis 17: In the proposed elaborated learning potential structural model it is hypothesised that *mastery goal orientation* positively influences *academic self-efficacy*.**

**Hypothesis 18: In the proposed elaborated learning potential structural model it is hypothesised that mastery goal orientation positively influences learning motivation.**

**Hypothesis 19: In the proposed elaborated learning potential structural model it is hypothesised that mastery goal orientation has a positive influence on metacognitive regulation.**

## 2.7 THE EXPANDED DU TOIT-DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL

The twenty path specific hypotheses derived through theorising in the foregoing literature study can be summarised in the form of a structural model. The du Toit-De Goede learning potential structural model is shown in Figure 2.5. The structural model constitutes the overarching substantive research hypothesis offered by this study in response to the research initiating question of why variance in *learning performance during evaluation* occurs in affirmative development programmes.

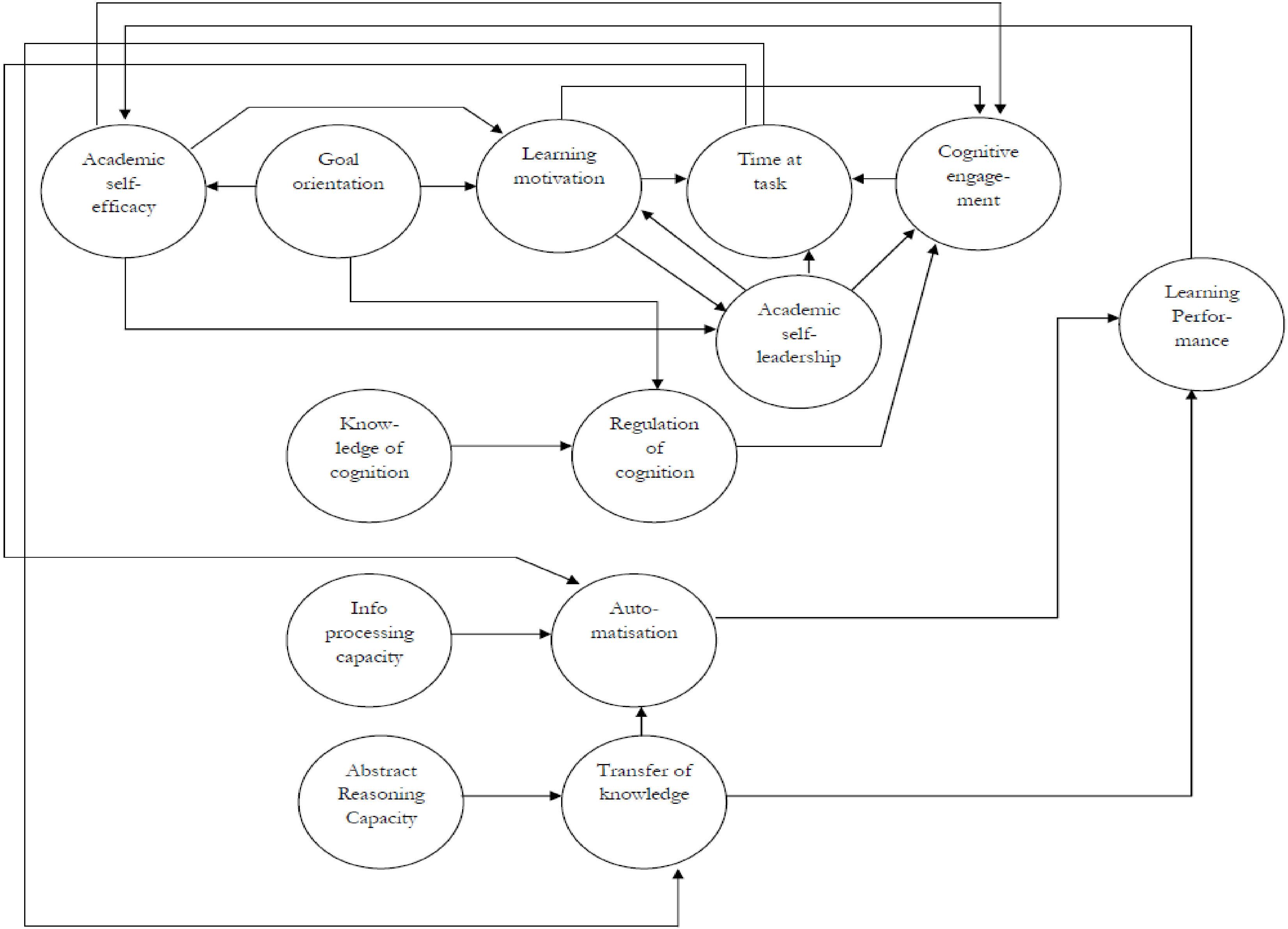

***Figure 2.5*** The hypothesised du Toit-De Goede expanded learning potential structural model

# CHAPTER 3
# RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

There is a large body of research showing that cognitive ability is a highly relevant predictor construct in terms of its ability to predict performance in a wide range of jobs as well as learning performance. No other single measure appears to work so well, in such a wide range of circumstances, as a predictor of overall (job/learning) performance as a good measure of general cognitive ability. Neither job nor learning performance, however, depends solely on cognitive ability. An extensive nomological network of non-cognitive attributes also affects performance. Research therefore emphasises the importance of looking at non-cognitive or non-ability predictors of performance in both job and educational achievement (Chamorro-Premuzic & Furnham, 2006). Cronbach (1949) mentions that whereas ability tests are useful indicators of what a person can do and infer maximal performance, non-cognitive factors may provide useful information about what a person will do with the focus on typical performance.

De Goede (2007) suggested that non-cognitive variables should be added to his learning potential structural model as it seems extremely unlikely that cognitive ability be the sole determinant of learning performance. This forms the primary although not sole motivation for the attempt to expand the De Goede (2007) learning potential structural model in this study by adding additional non-cognitive variables.

Science is committed to an ‘epistemic imperative” to search for valid explanations (Babbie & Mouton, 2001). These explanations can be considered valid (i.e., permissible) to the extent that the explanations closely fit (i.e., can accont for) the available data (Babbie & Mouton, 2001). Research methodology serves the epistemic ideal of science. The validity and credibility of the implicit claim of the study to have come to the correct verdict on the fit of the structural model depends on the methodology used to arrive at the verdict. The methodology used should be made explicit so that the merits of the researcher’s conclusions and the verdict can be evaluated by knowledgeable colleagues by inspecting the scientific rigour of the chosen methodology. In the case where the methodology used is not made explicit, the verdict cannot be evaluated and will have to be accepted at face value whilst the verdict might be inappropriate due to an inappropriate or incorrect procedure for investigating the merits of the structural model. An accurate description of and thorough motivation for the methodological choices that were made should thus be provided. This will allow knowledgeable peers to identify methodological flaws and to point out the implications of these for the validity of the conclusions. The methodology used in this study will therefore be discussed quite extensively below.

## 3.2 REDUCED LEARNING POTENTIAL STRUCTURAL MODEL

The learning potential structural model depicted in Figure 2.5 includes the two original learning competencies identified by Taylor (1994) and included in the De Goede (2007) model, namely *transfer* and *automisation.* In testing his model De Goede (2007) operationalised these two learning competencies by means of the APIL-B developed by Taylor (1997). De Goede and Theron (2010), however, later questioned the wisdom of this decision. They argued that the *transfer* and *automatisation* latent variables should not be operationalised in terms of abstract geometrical figures when assessing the extent to which transfer occurs during class room learning since it is actual prior learning that is transferred onto specific novel learning material that learners are confronted with in the classroom. Stimuli from the actual learning task with which learners are confronted in the classroom should therefore be used to operationalise these latent variables. In the classroom specific crystalised ability developed through prior learning is transferred onto the novel learning problems that learners are confronted with in the classroom. The meaningful structure that is created in which the learning material is embedded through transfer of specific crystalised ability developed through prior learning subsequently has to be automated. It is this *transfer* that takes place in the classroom and the ensuing *automatisation* of the insight derived through *transfer* that determines the level of *learning performance during evaluation*. The operational measures of *transfer* and *automatisation* that have to be used to evaluate the model depicted in Figure 2.5 therefore have to be specific to the learning material relevant to the specific development procedure that the research participants used in the study are attending. *Transfer* and *automatisation* are learning competencies. In the APIL-B they are measured by observing learning (of nonsensical, geometrical figures) over time. If the success with which learners *transfer* prior learning onto the classroom learning material is to be measured in the classroom, as well as the success with which they *automate* the insight derived through transfer, the measures will have to be integrated into the training programme. To achieve that seems rather difficult.

Given the practical difficulty of finding or developing appropriate measures of *transfer* and *automatisation* it would be better to rather reduce the du Toit-de Goede learning potential structural model by deleting *transfer* and *automatisation* from the model depicted in Figure 2.5. The question is whether the two original learning competency potential latent variables should still be retained in the reduced model. If they are, *abstract reasoning capacity* and *information processing capacity* will have to affect *learning performance during evaluation* directly in the reduced structural model. It, however, seems unlikely that *abstract reasoning capacity* will affect *learning performance during evaluation* directly. It seems more likely that *abstract reasoning capacity* will moderate the effect of post-developed crystalised ability on *learning performance during evaluation*. To test a model with interaction effects included would, however, increase the methodological complexity (Little, Boviard & Widaman, 2006) of the study beyond that which could be expected of a master's study. The two original learning competency potential latent variables (*abstract reasoning capacity* and *information processing capacity*) were therefore also deleted from the du Toit-de Goede learning potential structural model. Deleting the original De Goede (2007) learning competencies and learning competency potential latent variables from the du Toit-de Goede learning potential structural model, however, has the effect of removing all existing structural paths to *learning performance during evaluation*. Since the effect of *time-on-task* on *learning performance during evaluation is hypothesised* to be mediated by *transfer* and *automatisation* this linkage is simplified in the reduced du Toit-de Goede model by omitting the two mediating variables. It is therefore hypothesised that *time-on-task* has a direct positive effect on *learning performance during evaluation* in the reduced du Toit-de Goede model.

**Hypothesis 20: In the proposed reduced du Toit-de Goede learning potential structural model it is hypothesised that *time-on-task* has a direct positive effect on *learning performance during evaluation*.**

The reduced du Toit – De Goede learning potential structural model is shown in Figure 3.1.

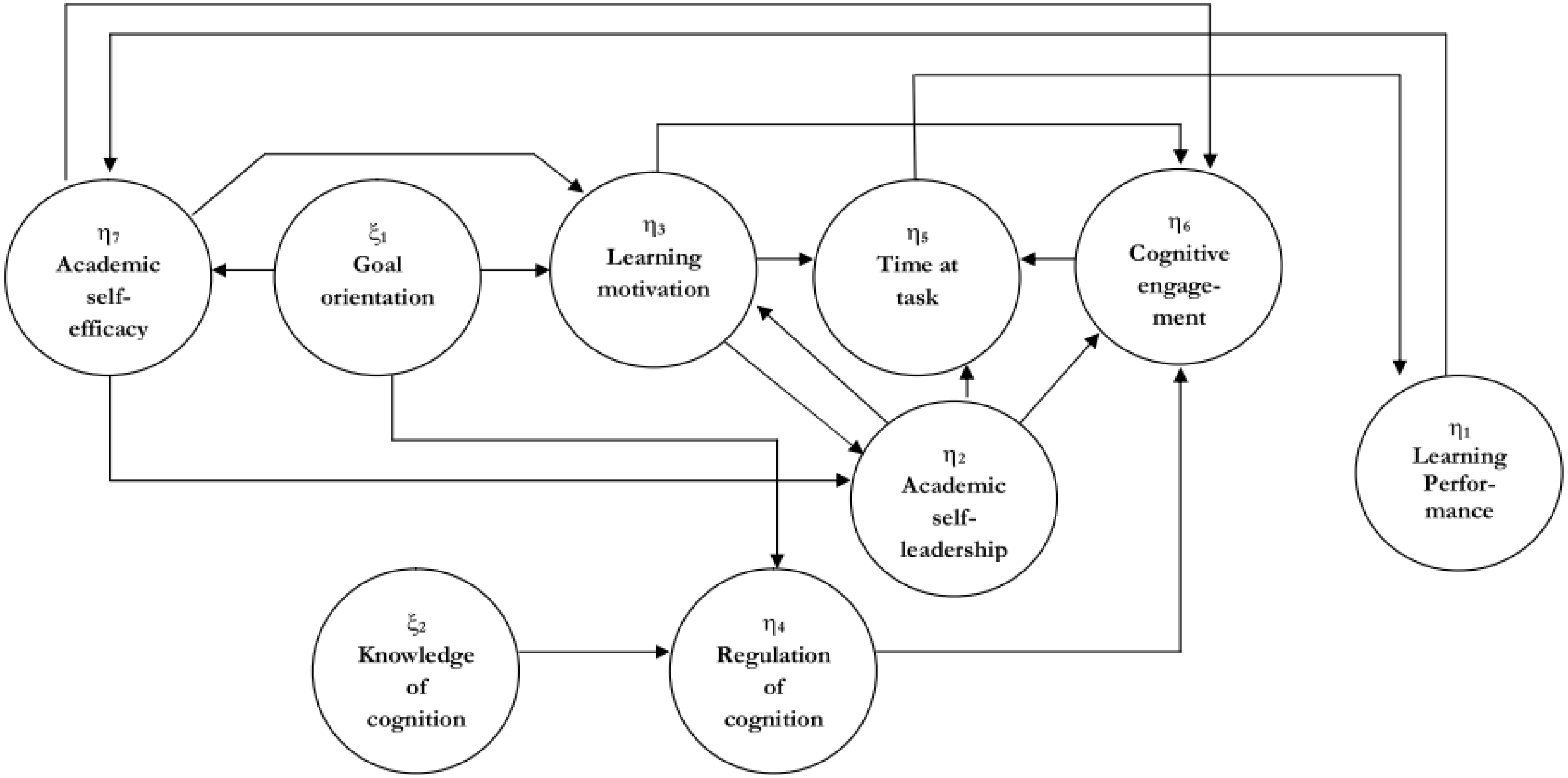

***Figure 3.1*** Reduced du Toit – De Goede learning potential structural model

The fact that the reduced du Toit – De Goede learning potential structural model no longer contains any of the original De Goede latent variables does not contradict the research objective as defined earlier. The original du Toit – De Goede model clearly represents a hypothesis on how the De Goede model can be elaborated. If the reduced model should fail to fit this would clearly cast serious doubt on the merits of the extensions that are proposed. If the reduced model should fit and the estimated path coefficients are significant this will increase confidence in the elaborated model. Neither scenario would, however, render sufficient evidence to pronounce a definite verdict on the merits of the original du Toit – De Goede model.

## 3.3 SUBSTANTIVE RESEARCH HYPOTHESIS

The objective of this study is to modify and elaborate De Goede's (2007) proposed learning potential structural model by elaborating the network of latent variables through which the learning competency potential latent variables have to work to affect the *classroom learning performance* latent variables and the *learning performance during evaluation* latent variable and to empirically test this elaborated model. The theoretical argument presented in the literature study resulted in the inclusion of additional learning competency latent variables, cognitive and non-cognitive learning potential latent variables in the original model and the modification of the causal paths. The resultant elaborated and modified structural model is depicted in Figure 2.5. Because of the practical problems associated with the appropriate operationalisation of the two original learning competencies (transfer and automatisation) as explained above, this expanded structural model has subsequently been reduced (see Figure 3.1).

The overarching substantive hypothesis of this study (Hypothesis 1) is that the reduced du Toit-de Goede learning potential structural model depicted in Figure 3.1 provides a valid account of the psychological process that determines the level of learning performance achieved by trainees in an affirmative development programme during evaluation. The overarching substantive research hypothesis can be dissected into the following seventeen more detailed, specific direct-effect substantive research hypotheses[9]:

Hypothesis 2: *Academic self-leadership* ($\eta_2$) will positively influence *time–at-task* ($\eta_5$).

Hypothesis 3: *Knowledge of cognition* ($\xi_2$) will positively influence *regulation of cognition* ($\eta_4$).

Hypothesis 4: *Cognitive engagement* ($\eta_6$) will positively influence *time-at-task* ($\eta_5$).

Hypothesis 5: *Academic self-leadership* ($\eta_2$) will positively influence *cognitive engagement* ($\eta_6$).

Hypothesis 6: *Regulation of cognition* ($\eta_4$) will positively influence *cognitive engagement* ($\eta_6$).

Hypothesis 7: *Motivation to learn* ($\eta_3$) will positively affect *cognitive engagement* ($\eta_6$).

Hypothesis 8: *Motivation to learn* ($\eta_3$) will positively affect *time-at-task* ($\eta_5$).

Hypothesis 9: *Motivation to learn* ($\eta_3$) will positively influence *academic self-leadership* ($\eta_2$).

Hypothesis 10: *Academic self-leadership* ($\eta_2$) will positively influence *learning motivation* ($\eta_3$).

Hypothesis 11: *Academic self-efficacy* ($\eta_7$) will have a negative effect on *academic self-leadership* ($\eta_2$).

Hypothesis 12: *Academic self-efficacy* ($\eta_7$) will positively influence *cognitive engagement* ($\eta_6$).

Hypothesis 13: *Academic self-efficacy* ($\eta_7$) will have a positive effect on *learning motivation* ($\eta_3$).

Hypothesis 14: *Learning performance during evaluation* ($\eta_1$) will positively influence *academic self-efficacy* ($\eta_2$).

Hypothesis 15: *Mastery goal orientation* ($\xi_1$) positively influences *academic self-efficacy* ($\eta_7$).

Hypothesis 16: *Mastery goal orientation* ($\xi_1$) positively influences *learning motivation* ($\eta_3$).

Hypothesis 17: *Mastery goal orientation* ($\xi_1$) has a positive influence on *metacognitive regulation* ($\eta_4$).

Hypothesis 18: *Time-on-task* ($\eta_5$) has a direct positive effect on *learning performance during evaluation* ($\eta_1$).

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[9] Indirect effect substantive hypotheses in which mediator variables mediate the effect of $\xi_i$ on $\eta_j$ or the effect of $\eta_i$ on $\eta_j$ are not formally stated. Neither will formal statistical hypotheses be formulated for these effects. The significance of the indirect effects will nonetheless be tested.

## 3.4 RESEARCH DESIGN

The overarching substantive research hypothesis makes specific claims with regard to the learning potential structural model. This model as depicted in Figure 3.1 hypothesises specific structural relations between various latent variables contained in this model. In order to empirically investigate these overarching substantive hypothesis and the array of specific direct-effect substantive research hypotheses, a strategy is required which will provide unambiguous empirical evidence in terms of which to evaluate the substantive hypothesis. The research design constitutes this plan or strategy (Kerlinger & Lee, 2000) and serves as a guideline or blueprint of how research will be conducted (Babbie & Mouton, 2001). The research design is set up firstly to procure answers to the research question and secondly to control variance (Kerlinger & Pedhazur, 1973). Which design will best suit the intended research is mainly dictated by the nature of the research hypothesis and the type of evidence required to test the hypothesis. The purpose of the research design is to attempt to ensure empirical evidence that can be interpreted unambiguously for or against the hypothesis being tested.

This study will make use of an *ex post facto* correlational research design to test the overarching substantive research hypothesis. This type of design was described by Kerlinger and Lee (2000) as a systematic empirical inquiry in which the researcher does not have direct control of independent variables as their manifestations have already occurred or because they are inherently not manipulable. The aim of *ex post facto* correlational research is to discover what happens to the levels/states of one variable when the levels/states of other variables change (Murray & Thomas, 2003). Inferences about the hypothesised relationships existing between the latent variables $\xi_j$ and $\eta_i$ are made from concomitant variation in exogenous and endogenous indicator variables (Diamantopoulos & Sigauw, 2000; Kerlinger & Lee, 2000).

In terms of the logic of the ex post facto correlational design measures of the observed variables are obtained and the observed covariance matrix is calculated (Diamantopoulos & Sigauw, 2000). Estimates for the freed structural and measurement model parameters are obtained in an iterative fashion with the objective of reproducing the observed covariance matrix as closely as possible (Diamantopoulos & Siguaw, 2000). If the fitted model fails to reproduce the observed covariance matrix accurately (Diamantopoulos &

Siguaw, 2000; Kelloway, 1998) it will mean that the elaborated learning potential structural model does not provide an acceptable explanation for the observed covariance matrix. It then follows that the structural relationships hypothesised by the model do not provide an accurate portrayal of the psychological process shaping learning performance[10]. The opposite, however, is not true. 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 matrix. It can therefore not be concluded that the psychological process depicted in the model necessarily must have produced the levels of learning performance observed in the employees sampled for the study. A high degree of fit between the observed and estimated covariance matrices will only imply that the psychological processes portrayed in the structural model provide one plausible explanation for the observed covariance matrix.

*Ex post facto* research has three major interrelated limitations, namely the inability to manipulate the independent variables, the lack of power to randomise and the risk of improper interpretation. When compared to experimental designs, *ex post facto* research lacks control and erroneous interpretations may originate due to the possibility of more than one explanation for the obtained difference or correlation (Kerlinger & Lee, 2000). This is especially risky when there are no clearly formulated hypotheses, which is, however, not true for this study. Kerlinger and Lee (2000) therefore warn that results from *ex post facto* research should be treated with caution. The value of *ex post facto* design lies in the fact that most research in the social sciences does not lend itself to experimentation. A certain degree of controlled inquiry may be possible, but experimentation is not, thus making an *ex post facto* design valuable in this regard (Kerlinger & Lee, 2000).

The argument unfolded by the literature study resulted in hypotheses on the manner in which the dimensions of learning potential are expected to influence *learning performance*

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[10] This conclusion, however, will only be warranted if prior evidence exists that the measurement model fits closely.

*during evaluation*. The *ex post facto* nature of the research design, however, will preclude the drawing of causal inferences from significant correlation coefficients.

## 3.5 STATISTICAL HYPOTHESIS

The format in which the statistical hypotheses are formulated depend on the logic underlying the proposed research design as well as the nature of the envisaged statistical analyses. The proposed learning potential structural model contains a number of endogenous latent variables and the model proposes causal paths between these endogenous latent variables. The notational system used in the formulation of the hypotheses follows the structural equation modelling convention associated with LISREL (Du Toit & Du Toit, 2000; Jöreskog & Sörbom, 1996b). Structural equation modelling offers the only possibility of testing the proposed structural model as an integrated, complex hypothesis. The use of multiple regressions to test the proposed paths will require that the model be dissected into as many sub-models as there are endogenous latent variables. Dissecting the model will invariably result in a loss of meaning. The explanation as to why trainees vary in the level of learning performance they achieve is not located in any specific point in the structural model but rather is contained in the whole network of relationships between the latent variables.

The overarching substantive research hypothesis states that the structural model depicted in Figure 3.1 provides a valid account of the psychological process that determines the level of learning performance achieved by trainees in an affirmative development programme during evaluation. If the overarching substantive research hypothesis is interpreted to mean that the structural model provides a perfect account of the psychological dynamics underlying *learning performance during evaluation*, the substantive research hypothesis translates into the following exact fit null hypothesis:

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

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

Exact fit of the model is highly improbable in that the hypothesised model is most likely only an approximation of reality and therefore the model will rarely fit in the population exactly. The close fit null hypothesis takes into account the error of approximation and is therefore more realistic (Diamantopoulos & Siguaw, 2000). If the error due to approximation in the population is equal to or less than .05 the model can be said to fit closely (Diamantopoulos & Siguaw, 2000). 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 during evaluation*, the substantive research hypothesis therefore translates into the following close fit null hypothesis:

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

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

The overarching substantive research hypothesis was dissected into twenty more detailed, specific substantive research hypotheses. These twenty detailed research hypotheses translate into the following path coefficient statistical hypotheses depicted in Table 3.1.

Table 3.1

*Path coefficient statistical hypotheses*

| | | | |
|---|---|---|---|
| Hypothesis 2 | Hypothesis 7 | Hypothesis 12 | Hypothesis 17 |
| $H_{03}$:$\beta_{52}=0$ | $H_{08}$: $\beta_{63}=0$ | $H_{013}$: $\beta_{67}=0$ | $H_{018}$: $\gamma_{41}=0$ |
| $H_{a3}$: $\beta_{52}>0$ | $H_{a8}$: $\beta_{63}>0$ | $H_{a13}$: $\beta_{67}>0$ | $H_{a22}$: $\gamma_{41}>0$ |
| Hypothesis 3 | Hypothesis 8 | Hypothesis 13 | Hypothesis 18 |
| $H_{04}$:$\gamma_{42}=0$ | $H_{09}$: $\beta_{53}=0$ | $H_{014}$: $\beta_{37}=0$ | $H_{019}$: $\beta_{15}=0$ |
| $H_{a4}$: $\gamma_{42}>0$ | $H_{a9}$: $\beta_{53}>0$ | $H_{a14}$: $\beta_{37}>0$ | $H_{a19}$: $\beta_{15}>0$ |
| Hypothesis 4 | Hypothesis 9 | Hypothesis 14 | |
| $H_{05}$: $\beta_{56}=0$ | $H_{010}$: $\beta_{23}=0$ | $H_{015}$: $\beta_{21}=0$ | |
| $H_{a5}$: $\beta_{56}>0$ | $H_{a10}$: $\beta_{23}>0$ | $H_{a15}$: $\beta_{21}>0$ | |
| Hypothesis 5 | Hypothesis 10 | Hypothesis 15 | |
| $H_{06}$: $\beta_{62}=0$ | $H_{011}$: $\beta_{32}=0$ | $H_{016}$: $\gamma_{71}=0$ | |
| $H_{a6}$: $\beta_{62}>0$ | $H_{a11}$: $\beta_{32}>0$ | $H_{a16}$: $\gamma_{71}>0$ | |
| Hypothesis 6 | Hypothesis 11 | Hypothesis 16 | |
| $H_{07}$: $\beta_{64}=0$ | $H_{012}$: $\beta_{27}=0$ | $H_{017}$: $\gamma_{31}=0$ | |
| $H_{a7}$: $\beta_{64}>0$ | $H_{a12}$: $\beta_{27}<0$ | $H_{a17}$: $\gamma_{31}>0$ | |

## 3.6 MEASURING INSTRUMENTS

In order to evaluate the fit of the elaborated learning potential structural model, depicted in Figure 3.1, in accordance with the directives of the *ex post facto* correlational design, the latent variables comprising the model had to be operationalised. To obtain empirical proof that the relationships postulated by the proposed learning potential structural model offered a plausible explanation for differences observed in *learning performance during evaluation*, measures of the various exogenous and endogenous latent variables comprising the model were needed. In addition evidence that the chosen manifest indicators were indeed valid and reliable measures of the latent variables they were linked to was needed. This evidence was a necessary prerequisite to come to valid and credible conclusions of the proposed learning potential structural model's ability to explain variance in *learning performance during evaluation*. The validity and credibility of the claim that lack of model fit discredits the specific structural relations hypothesised by the model depicted in Figure 3.1 hinges on the assumption that the indicator variables provided reliable, valid and unbiased measures of the latent variables they were required to represent. Available research evidence in the literature on the reliability and validity of the selected measuring instruments is presented below, to justify the choice of measuring instruments. The success with which the indicator variables represented the latent variables comprising the structural model in this specific study was evaluated empirically by means of the following analyses: item analysis, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

### 3.6.1. TIME AT TASK AND COGNITIVE ENGAGEMENT

Chapman (2003) states that "student engagement depicts students' willingness to participate in routine school activities, such as attending classes, submitting required work, and following teachers' directions in class". Students who are engaged show sustained behavioural involvement in learning activities and are more likely to come to understand their learning material at a deeper level. Learners need to think deeply about the content to be learned and to think critically and creatively about the material to be learned (Linnenbrink, Pintrich & Arbor, 2003). Understanding of learning material is considered a better indicator of learning compared to simply memorising this material.

Cognitive engagement was measured by the Academic Engagement Scale for Grade School Students (AES-GS). The Academic Engagement Scale for Grade School students was devised to measure the level of engagement of a student in his education and makes use of three subscales to assess the entirety of academic engagement (Tinio, 2009). The three subscales for Academic engagement include Behavioural Engagement, Emotional Engagement and Cognitive Engagement, which were patterned from the studies done by Chapman (2003), Hughes, Luo, Kwok, and Loyd (2008) and Sciarra and Seirup (2008). For the purpose of this study the Academic Engagement Scale for Grade School Students (AES-GS) was adapted and the cognitive engagement scale used to measure cognitive engagement. Tinio (2009) administered the AES-GS to 250 sixth and seventh graders. A Cronbach Alpha of .89 was obtained which indicates the high reliability of the scale. Engagement is associated with how much time and effort a student invests in his/her education and the Academic Engagement Scale for Grade School Students was devised to measure the level of engagement of a learner in their education. This scale is essential because it can be an avenue of improving the education of a student.

The cognitive engagement scale of the Academic Engagement Scale for Grade School Students (AES-GS) constructed by Tinio (2009) will be adapted and used to measure *time-at-task*. A time component will be included in the scale in order to measure the 'quantity' aspect of *time-at-task* and not only the 'quality' aspect of the construct. The scale, therefore, not only measures whether the learner is engaged cognitively with his or her study material but also whether the learner believes she/he spent enough time cognitively engaged with his or her learning tasks. Items pertaining to the time the learner spent cognitively engaged were included to see whether the learner set aside enough time, as well as made use of the time set aside in order to learn the study material.

Four item parcels were calculated by taking the mean of the even and uneven numbered items of the *cognitive engagement* and *time-at-task* scales to form two composite indicator variables for the *cognitive engagement* and *time-at-task* latent variables in the structural model.

### 3.6.2 KNOWLEDGE OF COGNITION AND REGULATION OF COGNITION

Metacognition has two constituent parts: *knowledge of cognition* and *regulation of cognition*. Researchers have noted challenges in assessing metacognition and have proven that metacognition is not directly observable in students (Sperling, Howard, Miller & Murphy, 2002). This current study employed the Brown (1978) framework of metacognition as the theoretical foundation, as this framework suggests that metacognition consists of two components: *Knowledge of cognition* and *regulation of cognition*. These components were assessed by using version B of the Junior Metacognitive Awareness Inventory (Jr. MAI), developed by Sperling et al. (2002). This measure used Schraw and Dennison's (1994) Metacognitive Awareness Inventory as a reference measure. Two self-report inventories were developed. The first inventory (Jr. MAI, Version A) included 12 items with a three-choice response (never, sometimes, or always) for use with learners in grades 3 through 5. The second inventory (Jr. MAI, Version B) included the same 12 items but also included 6 additional items and used a 5-point Likert scale for use with learners in grades 6 through 9. The additional 6 items were added to reflect higher levels of regulation that would likely be evidenced in older, more experienced learners.Items were examined and considered to find those that loaded strongly on the knowledge of cognition (declarative knowledge, conditional knowledge and procedural knowledge), and regulation of cognition (planning, monitoring, information management, evaluation, and debugging) factors. These items were also checked for relevance to a younger population and some were given more of a context to assist younger learners' understanding. Based on the relevance of the items, two versions of the Jr. MAI were created to assess the metacognitive skills in learners (Sperling et al., 2002).

Sperling et al. (2002) administered one version of the Junior Metacognitive Awareness Inventory to students in grades 3-9 (Version A) and another version (Version B) to students in grades 6-9. The grade 3-9 students responded to Version A, which was a self-report inventory with 12 statements such as, "I ask myself if I learned as much as I could have when I finish a task". Students rated the frequency with which they used each strategy by using a 3-point scale ranging from "never" to "always". Students in grades 6-9 responded to Version B, which contained similar statements but more of them (18 instead of 12 items). Students responding to Version B used a 5-point Likert scale to rate their agreement with each statement. The empirical results generally support the construct validity of the two measures of metacognition in that researchers obtained a 2-factor solution, with items loading essentially as hypothesised. Students' performance on these measures correlated positively and significantly with other measures of metacognition, particularly for students in grades 3-5. This provides evidence of convergent validity. Both the theoretical constructs of *knowledge of cognition* and *regulation of cognition* were represented through exploratory factor analysis. The construct examination of the Jr. MAI indicated statistically significant correlations with all other inventories of metacognition in older learners and significant correlations with two other inventory measures and teacher ratings of metacognition in younger learners. The Jr. MAI inventories are an important addition to research and instrumentation regarding metacognition since the factor structure across samples indicates that the Jr. MAI measures metacognition more broadly than existing measures, which often focus solely on regulation components. Based on the findings, the Jr. MAI appears to be a reliable measure of metacognition and the evidence with respect to initial construct validity is promising. Dr Rayne Sperling (2012) suggested through a personal communication with her, that version B of the Jr. MAI would be a good measure to use for the purpose of this study.

Four item parcels were calculated by taking the mean of the even and uneven numbered items of version B of the Jr. MAI to form composite indicator variables for the *regulation of cognition* and *knowledge of cognition* latent variables in the reduced du Toit-De Goede structural model.

### 3.6.3 ACADEMIC SELF-LEADERSHIP

*Academic self-leadership* was measured by adapting Houghton and Neck's (2002) Revised Self-Leadership Questionnaire (RSLQ). The RSLQ was developed by building on previous versions of self-leadership questionnaires (e.g. Anderson & Prussia, 1997; Cox, 1993; Houghton & Neck, 2002). The RSLQ consists of 35 items in nine distinct sub-scales namely self-observation, self-goal setting, self-reward, self-punishment, natural rewards, self-cueing, evaluating beliefs and assumptions, visualising successful performance and self-talk which represents the three primary self-leadership dimensions (Houghton & Neck, 2002). The three second-order self-leadership dimensions include behaviour-focused strategies, natural reward-focused strategies and constructive thought-focused strategies. These subscales were discussed under the self-leadership section of the literature review. The reliabilities of the nine underlying subscales range from .74 to .93 (Houghton & Neck, 2002). Norris (2003) also reported high reliability of the scales with a Cronbach's Alpha coefficient of .88 for the behaviour focused dimension, .78 for the natural rewards dimension, .88 for the constructive thought dimension and .93 for general self-leadership.

In adapting the scale some items were deleted and all the items were adapted to some degree, in addition items 6, 15, 24 and 30 were excluded from the self-punishment scale as advised by Jeffery Houghton (Burger, 2012). These nine subscales, with the corresponding items are presented in Table 3.2.

Table 3.2

*RSLQ sub-scales*

| **Sub-scale** | **Scale item** | **Factor number** |
|---|---|---|
| Visualising successful performance | 1, 2, 3 | 1 |
| Self-goal setting | 4, 5 | 2 |
| Self-talk | 6, 7 | 3 |
| Self-reward | 8, 9 | 4 |
| Evaluating beliefs and assumptions | 10, 11 | 5 |
| Self-punishment | 12, 13, 14 | 6 |
| Self-observation | 15, 16, 17 | 7 |
| Focusing thoughts on natural rewards | 18, 19, 20, 21 | 8 |
| Self-cueing | 22, 23 | 9 |

The learners were asked to indicate their level of agreement or disagreement on each item on a five-point scale ranging from not at all accurate (1) to completely accurate (5). The mean score on the three higher-order self-leadership factors were calculated to form three composite indicator variables for the *academic self-leadership* latent variable in the structural model if evidence in support of the three second-order factor structure is found in the study.

### 3.6.4 LEARNING MOTIVATION

The *motivation to learn* variable was measured by means of a questionnaire developed by Nunes (2003). The motivation to learn questionnaire (MLQ) is a combined questionnaire developed to measure trainee motivation to learn and intention to learn. The Motivation to Learn Questionnaire consisted of three sections. Section A was designed to give an indication of the demographic data of the trainees. Section B measured Motivation to Learn and Section C measured Intention to Learn by means of a Likert-type scale (Nunes, 2003). The motivation to learn section (section B) was used for the purposes of this study and measured the trainee's specific desire to learn the content of the training programme. Nunes's (2003) 20 item motivation to learn scale revealed a Cronbach alpha of .9405 with n=114 which indicates a high reliability of the scale (Nunes, 2003).

Two item parcels were calculated by taking the mean of the even and uneven numbered items of the learning motivation scale to form two composite indicator variables for the *learning motivation* latent variable in the structural model.

### 3.6.5 ACADEMIC SELF-EFFICACY

Bandura (2006) states that self-efficacy differs operationally from other self-related constructs in that self-efficacy items are phrased in terms of what individuals can do rather than what they will do or usually do in a particular domain. Bandura (1994) refers to self-efficacy as one's belief in one's competence to exercise control over one's actions and to achieve at a given task or event. Self-efficacy beliefs revolve around questions of 'can' and the answers to self-efficacy questions that individuals pose to themselves reveal their confidence in their ability to accomplish the task. For the purpose of this study, *academic self-efficacy* refers to an individual's opinion of their own intrinsic ability to learn or perform academic tasks effectively. During the measurement of academic self-efficacy the aim was to gain information about an individual's efficacy beliefs that might relate to academic or learning success.

No single existing *academic self-efficacy* measure appropriate to this study could be found. The majority of *academic self-efficacy* measures are focused on older students including adults (e.g. Gibson & Dembo, 1984; Gorrell & Patridge, 1985; Gorrell & Capron, 1988, 1989). In some cases self-efficacy data is presented with little accompanying information about the measure itself (Andrews & Debus, 1978). In other cases self-efficacy data is assembled from a more concrete activity approach (Bandura & Schunk, 1981; Schunk, 1981, 1982, 1983). *Academic self-efficacy* was therefore measured by items taken and adapted from three measurement scales, namely the Morgan-Jinks Student Efficacy Scale (MJSES), the Self-Efficacy for Learning Form (SELF), as well as the scale developed in a study by Vick and Packard (2008).

The Morgan-Jinks Student efficacy Scale (MJSES) was designed to gain information about student efficacy beliefs that might relate to school success (Jinks & Morgan, 1999, p.226). This scale has proved useful in a number of formal research settings, including master's theses and doctoral dissertations. Factor analysis on the MJSES has revealed that three major factors were operating within the scale namely; talent items; context items and the third consisted of items that were written as effort items. In the current study the context and effort scales were eliminated as they were not relevant to the current investigation. The subscale alpha for the talent subscale was .78 (Jinks & Morgan, 1999). Additionally, self-reported grades were a dependent variable in the MJSES scales therefore items pertaining to this were excluded in the adapted form of the MJSES in the study. Having actual performance information is clearly preferable to self-report data. All items in the MJSES were designed for a Likert-scale response, using a four-interval scale of really agree, kind of agree, kind of disagree, and really disagree. The informal nature of the response categories was an attempt to make the choices consistent with children's language patterns; similar descriptors such as not sure, maybe, pretty sure, and really sure, have been used by other researchers (Schunk, 1981). This four-interval scale was used in the scale of this current study.

The Self-Efficacy for Learning form (SELF) was developed by Zimmerman and Kitsantas (2005). This scale was developed to assess self-efficacy for self-regulated learning and 57 items were constructed to capture students' certainty about coping with challenging academic problems or context. These problems or context could be having missed a class or having problems concentrating on a reading assignment Zimmerman and Kitsantas (2005) examined the psychometric properties of the SELF with a sample of high school girls to emphasise the role of homework in their curriculum. The item format was designed to be a demanding test for self-efficacy beliefs because it involves adapting to difficult learning conditions. The scale was found to have a unitary factorial structure. A high level of internally consistent reliability (Cronbach's alpha=.96) and a high level of validity in predicting the students' college-reported grade point average, GPA, (*r*=.68), their judgments of responsibility for their academic outcomes (r=.71), and the quality (r=.75) and quantity (r=.74) of their homework. The SELF was made use of in the construction of the *academic self-efficacy* scale in this study and items from this scale were included and adapted (Zimmerman & Kitsantas, 2007).

Vick and Packard (2008) adapted the Self-Efficacy subscale of the Motivated Strategies for Learning, or the MSLQ (Pintrich & De Groot, 1990) in order to assess learners' *academic self-efficacy*. The Self-Efficacy subscale consisted of 9 items measured on a 7-point scale ranging from 1(not at all true of me) to 7 (very true of me). The original items were directed toward a specific high school class. These items were adapted to inquire about classes in general; thus, items with "this class" were changed to "my classes". For example, "Compared with other students in this class I expect to do well" was changed to "Compared with other students in my classes I expect to do well." Their academic self-efficacy scale obtained a Cronbach's alpha of .90. This scale was also used in the construction of the *academic self-efficacy* scale in this study.

The resultant items are aimed to comprehensively represent the construct of *academic self-efficacy*, in-line with its constitutive definition, related to learning for grade 12 learners. Item analysis was 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 were considered for deletion, or revised. Exploratory factor analysis was used to examine the unidimensionality assumption.

Two item parcels were calculated by taking the mean of the even and uneven numbered items of the academic self-efficacy scale to form two composite indicator variables for the *academic self-efficacy* latent variable in the structural model.

### 3.6.6 MASTERY GOAL ORIENTATION

Goal orientation is conceptualised as a mental framework for how individuals interpret and respond to achievement situations (Brett & VandeWalle, 1999). Past research has demonstrated that learning goal and performance goal orientation are systematically related to implicit theory of ability, as well as to a host of situational cues. The two goal orientations foster different response patterns. Performance goal orientation fosters a vulnerability characterised by avoidance of challenges and deterioration of performance when faced with obstacles. A learning (or mastery) orientation promotes mastery oriented responses.

Button et al. (1996) developed a goal orientation instrument which measures performance goal orientation, as well as *learning (mastery) goal orientation*, by carefully reviewing Dweck's theoretical and empirical work. Button et al. (1996) felt that Dweck's theory lacks clarity on several underlying conceptual issues and valid dispositional measures. They rather argued that goal orientation is best represented by two distinguishable dimensions that are uncorrelated. They tested their model by performing four independent studies which they compared and found that all the reliability estimates (Cronbach's alpha) met or exceeded the .75 level, which indicates a high reliability of the model. This comparison provided strong evidence for the construct validity of the measures of learning goal and performance goal orientation and supported their prediction that goal orientation is best represented by two distinguishable dimensions which are uncorrelated. This instrument was used to assess goal orientation for the purpose of this study.

Button et al.'s (1996) goal orientation instrument has two subscales: (a) Ten items that measure performance goal orientation, which suggests that individuals strive to either demonstrate, and thereby gain favorable judgements of, their competence via task performance, or to avoid negative judgements of their competence. (b) Ten items that measure *learning goal orientation*, which suggests that individuals strive to understand something new or to increase their level of competence in a given activity. Responses for each item in the model were based on a 7-point Likert-type response scale ranging from 7 (strongly agree) to 1 (strongly disagree). Only the *learning goal orientation* subscale will be used in this study.

Two item parcels were calculated by taking the mean of the even and uneven numbered items of the *learning goal orientation* subscale to form two composite indicator variables for the *mastery goal orientation* latent variable in the structural model.

### 3.6.7 LEARNING PERFORMANCE

*Learning performance during evaluation* was measured through the learners' grade 11 second term results in Afrikaans Home Language, English First Additional Language and Mathematics (not Mathematical Literacy). The second term subject marks thus served as the criterion measure for this study and were correlated with their questionnaire results. The subjects chosen for inclusion as criterion measures were those taken by most learners. If the nature of the subjects were not the same for all learners variance in *learning performance during evaluation* would in part depend on characteristics of the subject and the evaluation. Since learners from different schools were included in the sample variance in *learning performance during evaluation* to some degree does depend on characteristics of evaluation since papers are set independently in each school.

No psychometric evidence was available on the reliability and validity of the *learning performance during evaluation* measures. Neither was it possible to calculate such measures as part of the study. Only the subject marks were received for each learner from the participating schools. It is acknowledged that this is a rather serious methodological shortcoming in the study.

The subject marks served as indicator variables for the *learning performance during evaluation* latent variable in the structural model.

## 3.7 RESEARCH PARTICIPANTS

The units of analysis for this study were grade 12 pupils from schools in the Free State and Gauteng provinces.

The objective of the study was to elaborate the learning potential structural model proposed and tested by De Goede (2007). This research objective had been motivated explicitly from the perspective of affirmative development. This suggested that the reduced du Toit-De Goede learning potential structural model should be empirically tested on a sample of disadvantaged learners. However, if it is argued that the psychological dynamics (i.e., the nature of the nomological network of latent variables) underpinning learning performance of disadvantaged learners is not qualitatively different from that underpinning the learning performance of other learners, the same complex nomological network of latent variables that determine learning performance in affirmative development learners also operates to determine learning performance of learners not from previously disadvantaged backgrounds.

The level of latent variables will, however, almost certainly differ across advantaged and disadvantaged learners. Disadvantaged learners run the risk of not succeeding at learning because specific latent variables in the nomological net that determines learning performance have inappropriately high or low levels. Advantaged learners succeed at learning because they are fortunate enough that the latent variables that determine learning performance have appropriate levels. The fact that specific latent variables pointed out as the reason why disadvantaged learners fail at learning should not be interpreted to mean that these variables are unique to disadvantaged learners. The same variables also operate in the case of advantaged learners but because they are fortunate enough not to be held back by low levels on those latent variables they succeed at learning.

If the research sample was highly homogenous with regards to the degree of disavantagement/advantagement latent variables whose levels are strongly influenced by disadvantagement would have reduced variance. This could affect empirical results. This line of reasoning argues for a sample that is diverse in terms of degree of disadvantagement. The ideal therefore seems to be to have a sample of learners that come from different degrees of advantaged as well as disadvantaged backgrounds.

It should in addition be conceded that affirmative development typically is aimed at learners that have already left school. The question therefore needs to be asked whether it is permissible to use a sample of grade 12 learners to empirically test the reduced du Toit-De Goede learning potential structural model. The same argument that was presented above also applies here.

It was therefore regarded as permissible to select a sample that included learners that do not qualify as affirmative development candidates. The sample did however include Black as well as White learners. From this it can, however not be inferred that the sample was diverse in terms of degree of disadvantagement. A formal measure of degree of disadvantagement was not administered. This is acknowledged as a methodological weakness. The sample did not include adult learners. This is acknowledged as a further methodological limitation.

## 3.8 SAMPLING

The question on the nature of the target population of this study is related to the discussion presented in paragraph 3.7 above. When the research objective and the argument that was lead in its justification is interpreted narrowly the target population should be interpreted as the population of disadvantaged Black South African adults that could come into consideration when selecting candidates for affirmative development programmes. When the research objective and the argument that was lead in its justification is interpreted more broadly as an argument making a case for admission to development programmes based on learning potential the target population could be interpreted as the population of adult South African learners.

The extent to which observations can or may be generalised to the target population is a function of the number of subjects in the chosen sample and the representativeness of the sample, while the power of inferential statistics tests also depends on sample size (Elmes, Kantowitz & Roediger,. 1999; De Goede & Theron, 2010).

The sampling population in this study was grade 12 learners in the Free State and Gauteng Department of Education schools. Irrespective of whether the target population is interpreted more narrowly or more broadly it cannot be claimed that the sampling population is representative of the target population and neither can it be claimed that the sample is representative of the sampling population. The results of this study should therefore be generalised with circumspection.

Non-probability sampling, more specifically convenience sampling, was used for the purpose of this study. Pupils from the various schools who were in grade 12 and have completed their second semester of grade 11 at the relevant schools, who were willing to take part and had a signed parental consent form qualified to be included in the sample. Pupils who have completed (passed or failed) the second semester of grade 11 received an average mark for each of the following subjects: Afrikaans Home Language, English First Additional Language and Mathematics (not Mathematical Literacy) and these marks were correlated with their survey results.

Sample sizes of 200 observations or more appear to be satisfactory for most SEM applications (Kelloway, 1998; MacCallum, Browne & Sugawara, 1996). Three issues should be taken into account when deciding on the appropriate sample size for a study that intends using SEM. The first consideration is the ratio of sample size to the number of parameters to be estimated. A situation in which more freed model parameters have to be estimated than there are observations in the sample would not be regarded as desirable. Larger sample sizes are required for elaborate measurement and structural models as they contain more variables and have more freed parameters that need to be estimated. Bentler and Chou (cited in Kelloway, 1998, p. 20) recommend that the sample size to number of parameter estimated ratio should fall between 5:1 and 10:1. The proposed structural model (Figure 3.1) and the proposed procedure for operationalising the latent variables (see paragraph 3.6) would in terms of the Bentler and Chou (cited in Kelloway, 1998) guideline require a sample of 215 - 430 students to provide a convincing test of the structural model (60 freed parameters).

The statistical power associated with the test of the hypothesis of close fit ($H_0$: RMSEA $\leq .05$) against the alternative hypothesis of mediocre fit ($H_a$: RMSEA $>.05$) is a second consideration to take into account when deciding on the appropriate sample size. In the context of SEM, statistical power refers to the probability of rejecting the null hypothesis of close fit ($H_0$: RMSEA $\leq$ .05) when in fact it should be rejected (i.e., the model fit actually is mediocre, ($Ha$: RMSEA $>.05$). Overly high statistical power would mean that any attempt to obtain formal empirical proof for validity of the model would be futile. Even a slight deviation from close fit would result in a rejection of the close fit null hypothesis. In contrast overly low power on the other hand would mean that even if the model fails to fit closely the close fit null hypothesis would still not be rejected. Not rejecting the close fit under conditions of low power will therefore not provide pursuasive evidence on the validity of the model. Power tables were compiled by

MacCallum et al. (1996). These tables were used to derive sample size estimates for the test of close fit, given the effect sizes assumed above, a significance level ($\alpha$) of .05, a power level of .80 and degrees of freedom (df) of 147 (($\frac{1}{2}$[(p+q][p+q+1]-t)=190-43) . The MacCallum et al.'s (1996) table indicates that a sample of approximately[11] 130 observations would be required to ensure statistical power of .80 in testing the null hypothesis of close fit for the elaborated learning potential structural model. Accessing syntax developed by Preacher and Coffman (2006) in R at http://www.quantpsy.org/rmsea/rmsea.htm indicates that a sample of 101.953 participants would be adequate to ensure a .80 probability that an incorrect model with 147 degrees of freedom is correctly rejected. This is applicable when the probability of a Type 1 error in testing the null hypothesis of close fit is fixed at .05 (i.e., P(reject $H_0$: RMSEA $\leq$ .05|RMSEA=.08)).

Another aspect that needs to be taken into account when deciding on the appropriate sample size is practical and logistical considerations like cost, availability of suitable respondents and the willingness of the school/teachers to commit large numbers of students to the research.

Taking all three of the above considerations into account it was suggested that a sample of between 200 – 250 learners from various schools in the Free State and Gauteng provinces should be selected as research participants for the purpose of testing the proposed structural model. Any grade 12 learner who had completed their second semester of grade 11 at one of these schools could be included in the sample.

## 3.9 MISSING VALUES

The method used to impute missing values will depend on the number of missing values as well as the nature of the data, especially whether the data follows a multivariate normality.

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[11] The MacCallum et al. (1996) table only makes provision for degrees of freedom up to 100.

The following possible options to treat the problem of missing values will be explored:

- List-wise deletion
- Pair-wise deletion
- Imputation by matching
- Multiple imputation
- Full information maximum likelihood imputation

List-wise deletion requires the deletion of complete cases where there are missing values for any of the variables. This deletion can result in a severe reduction of the effective sample size. Pair-wise deletion focuses on deleting cases only for analysis on variables where values are missing (Dunbar-Isaacson, 2006). This form of deletion can produce problems in the calculation of the observed covariance matrix when the effective sample size for the calculation of the various covariance terms differs significantly.

Imputation by matching imputes values from other cases with a similar pattern of observed values on a set of matching variables. A minimisation criterion is applied on a set of matching variables (Jöreskog & Sörbom in Dunbar-Isaacson, 2006). Imputation does not take place for a case if the minimisation criterion is not satisfied or if no observation exists that has complete data on the set of matching variables (Enders et al., cited in Dunbar-Isaacson, 2006).

The multiple imputation method performs several imputations for each missing value. Each imputation creates a completed data set, which could be analysed separately in order to obtain multiple estimates of the parameters of the model (Davey et al., Raghunatha and Schafer in Dunbar-Isaacson, 2006, p.29). In LISREL missing values for each case are substituted with the average of the values imputed in each of the data sets (Du Toit & Du Toit, 2001). Reliable values are therefore delivered while at the same time the uncertainty in the estimates is reflected. The method of multiple imputation, makes the assumption that the data is missing at random and that the observed data follows an underlying multivariate normal distribution (Du Toit & Du Toit, 2001).

Full information maximum likelihood (FIML) utilises a repetitive approach, the expectation-maximisation (EM) algorithm, which computes a case-wise likelihood function using only the variables that are observed for specific cases. Estimates of missing values are obtained based on the incomplete observed data to maximise the observed data likelihood (Enders & Bandalos cited in Dunbar-Isaacson, 2006). FIML directly returns a covariance matrix calculated from the imputed data, which is considered a disadvantage. Further item analysis, dimensionality analysis and the calculation of item parcels is therefore not possible. FIML also makes the assumption that data is missing at random and that the observed data follows an underlying multivariate normal distribution (Du Toit & Du Toit, 2001).

The foregoing considerations were used to decide on the appropriate approach to deal with the problem of missing values after the data had been collected and the nature and extent of the missing values problem was known. The manner in which missing data values were treated is described in Chapter 4 paragraph 4.3

## 3.10 DATA ANALYSIS

Item analysis, exploratory factor analysis and structural equation modelling (SEM) will be used to analyse the data obtained through the various instruments and to test the proposed reduced du Toit-De Goede learning potential structural model as depicted in Figure 3.1.

### 3.10.1 ITEM ANALYSIS

The various scales used to measure each of the latent variables comprising the structural model depicted in Figure 3.1 were developed to measure a specific latent variable or dimension of a latent variable carrying a specific constitutive definition. Items were developed to indicate the standing of respondents on these specific latent variables by serving as stimuli to which respondents react with observable behaviour that is a relatively uncontaminated expression primarily of the specific underlying latent variable. The observed behavioural responses to the various scale stimuli are recorded on the (electronic or paper) response sheet. If these design intentions were successful it should reflect in a number of item statistics.

Item analysis was conducted to determine the internal consistency of the items of the measuring instruments utilised to test the proposed learning potential structural model.

The objective of item analysis was to identify items that do not successfully reflect the intended latent variable. Items are considered as poor items when they fail to discriminate between different levels of the latent variable they were designed to reflect and items that do not, in conjunction with their subscale counterparts, reflect a common latent variable[12]. Items which do not contribute to an internally consistent description of the sub-scales of the measuring instruments will be identified and considered for elimination (Henning, Theron & Spangenberg, 2004). Poor items were considered for removal based on a basket of psychometric evidence and a decision whether they should be deleted from the scale or not will then be based on the available evidence. The basket of evidence will include amongst others the following classical measurement theory item statistics: the item-total correlation, the squared multiple correlation, the change in subscale reliability when the item is deleted, the change in subscale variance if the item is deleted, the inter-item correlations, the item mean and the item standard deviation (Murphy & Davidshofer, 2005).

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 measurements.

Version 20 of SPSS (SPSS, 2013) will be used to perform the item analyses.

### 3.10.2 EXPLORATORY FACTOR ANALYSIS

The architecture of each of the scales and subscales used to measure the latent variables comprising the elaborated learning potential structural model reflects the intention to construct essentially one-dimensional sets of items. These items are meant to serve as stimuli to which test respondents react with observable behaviour that is primarily an expression of a specific uni-dimensional latent variable. The behavioural response to

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[12] Neither the item analyses nor the exploratory factor analyses of the various scales can, however, provide sufficient evidence to permit a conclusive verdict on 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 on the latent variables will have to be elaborated into fully fledged structural models that also map the latent variables onto outcome latent variables in accordance with the directives of the constitutive definitions of the latent variables.

each item is however never only dependant on the latent variable of interest but also gets influenced by a number of other latent variables and random error influences that are not relevant to the measurement objective (Guion, 1998). The assumption is that only the relevant latent variable is a common source of variance across all the items comprising a subscale. The assumption is therefore that if the latent variable of interest is statistically controlled then the partial correlation between items will approach zero (Hulin, Drasgow & Parson, 1983). The intention is to furthermore obtain relatively uncontaminated indications of the specific underlying latent variable via the items comprising the scale.

To examine the uni-dimensionality assumption and the assumption that the latent variable explains a substantial proportion of the variance observed in each item, exploratory factor analyses will be performed on each of the subscales developed with the intention to reflect a unidimensional construct or dimension of a construct. Principal axis factor analysis will serve as extraction technique (Tabachnick & Fidell, 2001) and, in the case of factor fission, the extracted solution will be subject to oblique rotation (Tabachnick & Fidell, 2001). Principal 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 (Tabachnick & Fidell, 2001). Although an oblique rotation is slightly more difficult to interpret than an orthogonal rotation, it is more realistic in that it makes provision for the possibility that, if factor fission should occur, the extracted factors can be correlated. A factor loading will be considered acceptable if $\lambda_{ij}>.50$. Hair et al. (2006) recommend in the context of confirmatory factor analysis that factor loadings should be considered satisfactory if $\lambda_{ij}>.71$. Hair et al.'s (2006) critical cut-off value is considered to be a bit strict in the case of individual items but will be utilised when interpreting the factor loadings of the item parcels in the measurement model fitted prior to the evaluation of the fit of the structural model.

SPSS version 20 (SPSS, 2013) will be used to perform the dimensionality analyses.

### 3.10.3 STRUCTURAL EQUATION MODELLING

#### 3.10.3.1 Variable type

The appropriate moment matrix to analyse and the appropriate estimation technique to use to estimate freed model parameters depend on the measurement level on which the indicator variables are measured. Paragraph 3.5 indicated that two or more linear composites of individual items will be formed to represent each of the latent variables when evaluating the fit of the structural model. Apart from simplifying the fitting of the structural model by reducing the number of freed model parameters and the required sample size, the creation of linear composite indicator variables for each latent variable has the additional advantage of creating more reliable indicator variables (Nunnally, 1978). Marsh, Hau, Balla and Grayson (1998), however, emphasise that solutions in confirmatory factor analysis tend to be better when one is using larger numbers of indicators variables to represent the latent variables. The use of individual items as indicator variables can result in an extremely complex comprehensive LISREL model, which will in turn require an extremely large sample to ensure credible parameter estimates. Consequently it was decided to use composite indicator variables. The assumption is made that the indicator variables are continuous variables, measured on an interval level (Jöreskog & Sörbom, 1996a; 1996b; Mels, 2003). The covariance matrix will therefore be analysed with maximum likelihood estimation provided the multivariate normality assumption is met (Du Toit & Du Toit, 2001; Mels, 2003).

#### 3.10.3.2 Multivariate normality

The maximum likelihood estimation technique assumes that the indicator variables used to operationalise the latent variables in the structural model follow a multivariate normal distribution. LISREL uses this technique by default to obtain estimates for the freed model parameters. The null hypothesis that this assumption is satisfied will be formally tested in PRELIS. If the null hypothesis of multivariate normality is rejected, i.e. the data does not follow a multivariate normal distribution, normalisation will be attempted (Jöreskog & Sörbom, 1996a). If the null hypothesis of multivariate normality is still rejected, robust maximum likelihood estimation will be used (Mels, 2003).

### 3.10.3.3 Confirmatory factor analysis

The structural model fit indices can only be interpreted unambiguously for or against the fitted structural model if evidence exists that indicates that the indicator variables used to operationalise the latent variables successfully do so (Diamantopoulos & Siguaw, 2000). The fit of the measurement model used to operationalise the structural model therefore needs to be evaluated and then the fitting of the structural model can be done. Successful operationalisation can be concluded if the measurement model fits closely, the estimated factor loadings are all statistically significant ($p<.05$), the completely standardised factor loadings are large and the measurement error variances are statistically significant ($p<.05$) but small.

The covariance matrix will be analysed when fitting the measurement model. Maximum likelihood estimation will be used if the multivariate normality assumption is satisfactory (before or after normalisation). If normalisation should fail to achieve multivariate normality in the indicator variable distribution, robust maximum likelihood estimation (RML) will be used to estimate the freed measurement model parameters. LISREL 8.8 (Du Toit & Du Toit, 2001) will be used to perform the confirmatory factor analysis.

The decisions taken in paragraph 3.6 on how to operationalise the latent variables in the structural model depicted in Figure 3.1, so as to permit the empirical evaluation of the fit of the model, imply a specific measurement model. The measurement model describes the manner in which latent variables express themselves in indicator variables. Although the comprehensive LISREL model comprises an exogenous as well as an endogenous measurement model, a single exogenous measurement model will be fitted to examine the success of the operationalisation of the latent variables in which all 10 latent variables in Figure 3.1 are treated as if they were exogenous latent variables. The measurement model was fitted with uncorrelated measurement error terms.

The measurement hypothesis under evaluation is that the measurement model provides a valid account of the process that produced the observed covariance matrix (Hair et al., 2006). If the measurement hypothesis would be interpreted to mean that the measurement model provides a perfect account of the manner in which the latent variables manifest themselves in the indicator variables, the measurement hypothesis translates into the following exact fit null hypothesis:

$$H_{020}\text{: RMSEA=0}$$

$$H_{a20}\text{: RMSEA}\geq 0$$

If the measurement hypothesis would be interpreted to mean that the measurement model only provides an approximate account of the dynamics that produced the observed covariance matrix, the measurement hypothesis translates into the following close fit null hypothesis:

$$\text{H021:RMSEA}\leq .05$$

$$\text{Ha21:RMSEA}\geq .05$$

If the exact or close measurement fit is found (i.e. $H_{020}$ or $H_{021}$ will not be rejected) the following 19 null hypotheses on the slope of the regression of the j$^{th}$ item parcel on the k$^{th}$ latent variable will be tested:

$H_{0i}$: $\lambda_{jk}=0$; i=22, 23, …, 40; j=1, 2, …, 19; k=1, 2, …, 9

$H_{ai}$: $\lambda_{jk}\neq 0$; i=22, 23, …, 40; j=1, 2, …, 19; k=1, 2, …, 9

If the exact or close measurement fit will be found (i.e. $H_{01}$ or $H_{02}$ will not be rejected), the following 19 null hypotheses will be tested with regards to the freed variance elements in the variance-covariance matrix $\mathbf{\Theta_\delta}$:

$H_{0i}$: $\Theta_{\delta_{jj=}}0$; i=41, 42,..., 59; j=1, 2.....19

$H_{ai}$: $\Theta_{\delta_{jj>}}0$; i=41, 42,..., 59; j=1, 2.....19

### 3.10.3.4 Interpretation of measurement model fit and parameter estimates

Measurement model fit will be interpreted by inspecting the full array of goodness of fit indices provided by LISREL (Diamantopoulos & Siguaw, 2000). Measurement model fit refers to the ability of the fitted measurement model to reproduce the observed covariance matrix. If this reproduced covariance matrix approximates the observed covariance matrix, the model fits well. The magnitude and distribution of the standardised residuals and the magnitude of model modification indices calculated for $\Lambda_{X,}$ $\Theta_\delta$ and $\Theta_\varepsilon$ will also enjoy further attention in order to assess the quality of the model fit. Large modification index values indicate measurement model parameters that, if set free, will improve the fit of the model. Large numbers of large and significant modification index values comment negatively on the fit of the model in as far as it suggests that numerous possibilities exist to improve the fit of the model proposed by the researcher. Inspection of the model modification indices for the abovementioned matrices here serve the sole purpose of commenting on the model fit.

If close measurement model fit is obtained (i.e., $H_{021}$ fails to be rejected) or if at least reasonable measurement model fit is obtained, the significance of the estimated factor loadings will be determined by testing $H_{0p}$: $\lambda_{ij=}0$; p=22, 23, …, 40[13]; i=1, 2, …, 19; j=1, 2, …, 9 against $H_{ap}$: $\lambda_{ij}>0$; p=22, 23, …, 40; i=1, 2, …, 19; j=1, 2, …, 9. The magnitude of the factor loading estimates will be considered acceptable if the completely standardised factor loading estimates are equal to or greater than .71 (Hair et al*.,* 2006). Satisfaction of this criterion would imply that at least 50% of the variance in the indicator variables can be explained by the latent variables they were assigned to represent.

### 3.10.3.5 Fitting of the structural model

In the case where $H_{021}$ fails to be rejected, i.e. close measurement model fit is obtained, or if at least reasonable measurement model fit is obtained, if $H_{022}$ – $H_{040}$ are rejected and if the magnitude of completely standardised factor loading estimates are satisfactory, $H_{01}$ and $H_{02}$ (see paragraph 3.4) will be tested by fitting the comprehensive LISREL model (comprising the structural model and the measurement model). The comprehensive LISREL model was fitted with uncorrelated structural error terms. The comprehensive LISREL model will be fitted by analysing the covariance matrix. Maximum likelihood estimation will be used if the multivariate normality assumption is satisfied (before or after normalisation). If normalisation fails to achieve multivariate normality in the indicator variable distribution robust maximum likelihood estimation will be used to obtain estimates for the freed model parameters. LISREL 8.8 (Du Toit & Du Toit, 2001) will be used to perform the structural equation analysis.

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[13] There are p=19 factor loadings freed in the 19 x 9 $\Lambda_X$ factor loading matrix.

### 3.10.3.6 Interpretation of structural model fit and parameter estimates

The full spectrum of indices provided by LISREL will be inspected to interpret comprehensive structural model fit (Diamantopoulos & Siguaw, 2000). Further consideration will also be given to the magnitude and distribution of the standardised residuals and the magnitude of model modification indices calculated for **Γ**, **B**, and **Ψ**. Large modification index values indicate structural model parameters that, if set free, will improve the fit of the model. Large numbers of large and significant modification index values comment negatively on the fit of the model in as far as it suggests that numerous possibilities exist to improve the fit of the model proposed by the researcher. Inspection of the model modification indices for the aforementioned matrices here will primarily serve the purpose of commenting on the model fit. Inspection of the model modification calculated for the Γ and B matrices will, however, also be used to explore possible modifications to the current structural model (see paragraph 3.10.3.7) if such modifications make substantive theoretical sense.

In the case where $H_{02}$ fails to be rejected, i.e. close comprehensive model is obtained, or if at least reasonable comprehensive model fit is obtained, $H_{03}$-$H_{019}$ will be tested. The magnitude of the completely standardised path coefficients will be interpreted for all significant (direct effect) path coefficients. The significance and magnitude of the indirect and total effects will also be examined for each hypothesised influence[14] in the model[15]. The proportion of variance explained in each of the endogenous latent variables by the model will be interpreted.

In the final analysis the psychological explanation of learning performance as it is provided in the structural model depicted in Figure 3.1 will be considered satisfactory if the comprehensive model fits the data well, the measurement model fits the data well, the path coefficients for the hypothesised structural relations are significant and the model explains a substantial proportion of the variance in each of the endogenous latent variables (especially the learning competency latent variables and especially *learning performance during evaluation*).

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[14] The term influence refers here to either the effect of $\xi_{j}$ on $\eta_i$ or the effect of $\eta_j$ on $\eta_i$.

[15] Strictly speaking formal statistical hypotheses should have been explicitly stated for the indirect and total effects in the model.

#### 3.10.3.7 Considering possible structural model modifications

The modification indices and completely standardised expected change values (Diamantopoulos & Siguaw, 2000) calculated for the $\boldsymbol{\Gamma}$ and $\mathbf{B}$ matrices will be inspected to determine whether any meaningful possibilities exist to improve the fit of structural model through the addition of additional paths. Modification of the model will be considered if the proposed structural changes can be theoretically substantiated, if the sign of the expected change agrees with the theoretical rationale that justifies freeing the path and if the magnitude of the completely standardised expected change warrants freeing the path (Diamantopoulos & Siguaw, 2000; Henning, Theron & Spangenberg, 2004). Allowing for correlated structural error terms and for correlated measurement error terms will not be considered because it will be difficult to theoretically justify freeing these paths in the model fitted in a cross-sectional design.

## 3.11 EVALUATION OF RESEARCH ETHICS

The purpose of reflecting on potential ethical risks associated with the proposed research as outlined in this proposal is to protect the dignity, rights, safety and well-being of the research participants involved in this study. Empirical behavioural research requires the active or passive involvement of people. That may result in the dignity, rights, safety and well-being of the research participants being compromised to some degree. The critical question is whether this compromise can be justified in terms of the purpose of the research. The envisaged research in this study has a benevolent purpose as argued in the introduction of this proposal. The critical question is therefore whether the costs that research participants have to incur balances with the benefits that accrue to society (Standard Operating Procedure, 2012).

The research participant has the right to voluntarily decide whether he/she wishes to accept an invitation to participate in research. To make an informed decision on whether he/she wishes to participate in the research the participant needs to be informed on the objective and purpose of the research, what participation in the research will involve, how the research results will be disseminated and used, who the researchers are, what their affiliation is, where and how they can make further inquiries abouit the research if they wish to do so, what their rights as participants are and where they can obtain more information on their research rights (Standard Operating Procedure, 2012).

In the case of minors (below the age of eighteen) parents or guardians of the minors have the right to decide whether their child may participate in the research. Again parents can only make an informed decision in this regard if they are comprehensively informed on the same aspects referred to above. If parents/guardians provide (informed) consent for their child's participation in the research minors, nonetheless, still have the right to decide whether they wish to participate in the research or not. The principal of informed decision-making also applies here.

The information provided to potential research participants (and their parents/guardians in the case of minors) needs to be provided in a vernacular that is accessible to the age and educational level of the participants (Standard Operating Procedure, 2012).

In Annexure 12 of the Ethical Rules of Conduct for Practitioners Registered under the Health Professions Act (Act no. 56 of 1974) (Republic of South Africa, 2006) it is required of a psychologist doing research to enter into an agreement with participants on the nature of the research, the participants' responsibilities as well as those of the researcher. The agreement in terms of which the research participant provides informed consent should meet the following requirements according to Annexure 12 (Republic of South Africa, 2006, p.42):

> 89. (1) A psychologist shall use language that is reasonably understandable to the research participant concerned in obtaining his or her informed consent.
> 
> (2) Informed consent referred to in subrule (1) shall be appropriately documented, and in obtaining such consent the psychologist shall –
> 
> > (a) inform the participant of the nature of the research;
> > 
> > (b) inform the participant that he or she is free to participate or decline to participate in or to withdraw from the research;
> > 
> > (c) explain the foreseeable consequences of declining or withdrawing;
> > 
> > (d) inform the participant of significant factors that may be expected to influence his or her willingness to participate (such as risks, discomfort, adverse effects or exceptions to the requirement of confidentiality);
> > 
> > (e) explain any other matters about which the participant enquires;

> (f) when conducting research with a research participant such as a student or subordinate, take special care to protect such participant from the adverse consequences of declining or withdrawing from participation;
> (g) when research participation is a course requirement or opportunity for extra credit, give a participant the choice of equitable alternative activities; and
> (h) in the case of a person who is legally incapable of giving informed consent, nevertheless –
>
> > (i) provide an appropriate explanation;
> > (ii) obtain the participants assent; and
> > (iii) obtain appropriate permission from a person legally authorized to give such permission.

The researcher will obtain informed parental consent for all participating learners and will obtain learner assent from all research participants that receive parental consent. The learner assent formulation has been integrated as a preamble in the survey questionnaire. The parental consent formulation and the learner assent formulation is shown in Appendix A.

Annexure 12 of the Ethical Rules of Conduct for Practitioners Registered under the Health Professions Act (Act no. 56 of 1974) (Republic of South Africa, 2006, p.41) requires psychological researchers to obtain institutional permission from the organisation from which research participants will be solicited:

> A psychologist shall –
> (a) obtain written approval from the host institution or organisation concerned prior to conducting research;
> (b) provide the host institution or organisation with accurate information about his or her research proposals; and
> (c) conduct the research in accordance with the research protocol approved by the institution or organisation concerned.

Informed institutional permission for the research has been obtained from the Free State Department of Education (FSDOE) and from the principals of the schools involved. A copy of the research proposal accompanied the application for institutional permission addressed to the FSDOE.

The information collected via the survey questionnaire from grade 12 learners will not be anonymous information. The identity of learners completing the survey questionnaire needs to be known so as to allow the researcher to collate the survey results for each learner with his/her academic marks as measures of *learning performance during evaluation*. The informed consent and informed assent formulations inform parents and learners of this fact.

The data collected will be treated as confidential. Results will only be presented in aggregate form. The emphasis in the study is not on describing the level of learners on the various latent variables but rather on the relationships hypothesised between the various latent variables. Feedback will be provided to the participating schools on the results of the study.

The study does not involve the assessment of critical latent variables where the possibility of unusually high or low scores could signal serious threats to the well-being of research participants. Annexure 12 of the Ethical Rules of Conduct for Practitioners Registered under the Health Professions Act (Act no. 56 of 1974) (Republic of South Africa, 2006, p.41) requires psychological researchers to disclose confidential information under the following circumstances:

> A psychologist may disclose confidential information –
>
> (a) only with the permission of the client concerned;
>
> (b) when permitted by law to do so for a legitimate purpose, such as providing a client with the professional services required;
>
> (c) to appropriate professionals and then for strictly professional purposes only;
>
> (d) to protect a client or other persons from harm; or
>
> (e) to obtain payment for a psychological service, in which instance disclosure is limited to the minimum necessary to achieve that purpose.

The informed parental consent formulation informs parents of points (a) and (b). In the absence of *prima facie* arguments that necessitate (d) no reference is made of this in the informed consent and assent formulations. No specific steps have therefore been taken to make arrangements for contingency support. The principal outline in Annexure 12 will nonetheless be honoured if results should indicate that the well-being of any research participant is threatened.

The instruments that are used to collect data from research participants are all available in the public domain. None of the instruments can be regarded as psychological tests as defined by the Health Professions Act (Republic of South Africa, 1974).

An application for ethical clearance of the proposed research study has been submitted to the Research Ethics Committee Human Research (Humanities) of Stellenbosch University.

# CHAPTER 4
# RESEARCH RESULTS

## 4.1 INTRODUCTION

The purpose of Chapter 4 is to present and discuss the results of the various statistical analyses performed. This chapter will start off by discussing the item analysis and dimensionality analysis executed to determine the psychometric integrity of the indicator variables meant to represent the various latent variables included in the learning potential structural model, followed by an evaluation of the extent to which the data satisfied the statistical data assumptions relevant to the data analysis techniques utilised. The fit of the measurement model is subsequently evaluated. In evaluating the success with which the latent variables comprising the structural model had been operationalised no distinction is made between the exogenous and endogenous measurement models. On condition of acceptable measurement model fit and acceptable measurement model parameter estimates, the fit of the comprehensive LISREL model is considered.

## 4.2 SAMPLE

Grade 12 learners from four former model C public high schools participated in the study. The schools are based in the Free State and Gauteng and consist of a socio-economically diverse group of students. Initially the sample consisted of 212 students from the four schools. However, after incomplete questionnaires were disregarded and only learners who had Afrikaans first language, English second language and Mathematics (not SG) during the 3rd and 4th terms of grade 11 were considered, the final sample decreased to 200 learners. Demographic information such as gender and racial categories was also collected from the sample and displayed in Figure 4.1 below, in order to compare the results of this study to the results of future replicated studies.

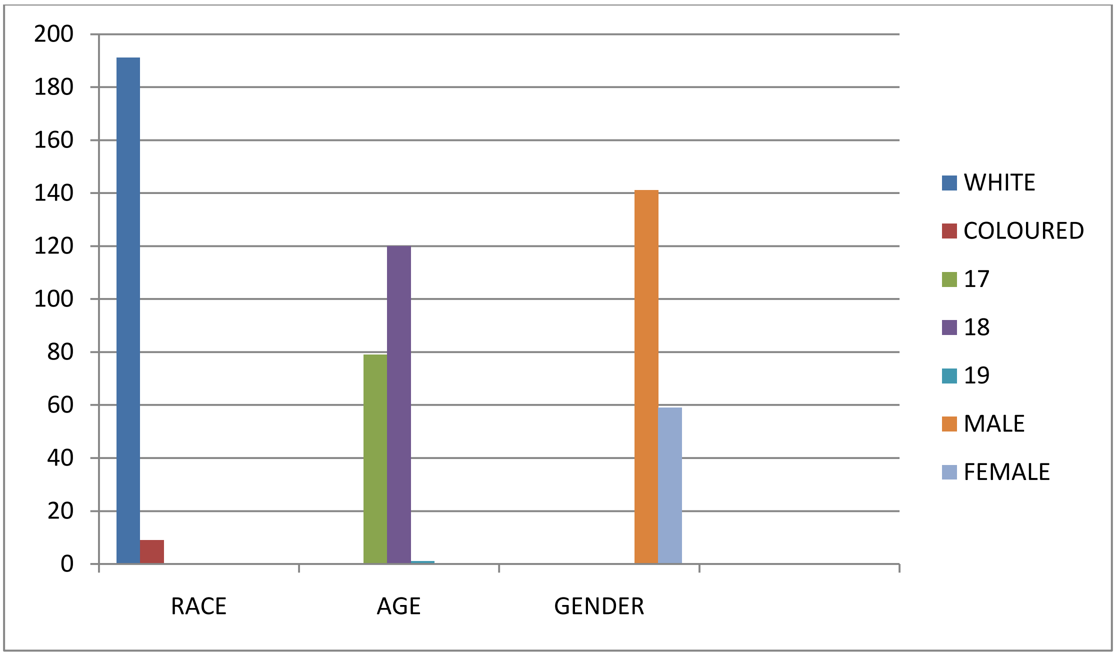

***Figure 4.1*** Demographic characteristics of the final sample of 200 learners

## 4.3 MISSING VALUES

Missing values presented a problem that had to be addressed before the data could be analysed. Missing values did not seriously plague the majority of the items comprising the scales used to operationalise the latent variables in the model. The maximum number of respondents who failed to respond to any individual item was 12 out of the sample of 212. The 12 respondents who did fail to respond to any items, failed so severely that it was deemed better to disregard these cases from the imputed data set which decreased the final sample to 200 learners. The 200 learners, who did form part of the final sample, had no missing values on any item.

## 4.4 ITEM ANALYSIS

Item analysis was performed on the items of the different measuring instruments, to identify and eliminate possible items that do not contribute to an internally consistent description of the various latent variables forming part of the proposed revised talent management competency model (Theron, 2010). The rationale behind performing an item analysis is that item analysis can be very informative when a scale is unreliable or fails to show expected levels of validity. It can also help explain why a scale is reliable or unreliable as well as suggest ways of improvement. Problematic items were not included in the calculation of the composite indicator variables and were therefore not used to represent latent variables in the model.

Items were considered for deletion based on a basket of psychometric evidence. The basket of evidence included the following classical measurement theory item statistics: the item-total correlation, the squared multiple correlation, the change in subscale reliability when the item is deleted, the change in subscale variance if the item is deleted, the inter-item correlations, the item mean and the item standard deviation (Murphy & Davidshofer, 2005). Item analysis was conducted on the data set by means of the SPSS Reliability Procedure (SPSS 21.0).

### 4.4.1 ITEM ANALYSIS: TIME AT TASK AND COGNITIVE ENGAGEMENT

The cognitive engagement scale of the Academic Engagement Scale for Grade School Students (AES-GS) constructed by Tinio (2009) was adapted and used to measure *time-at-task*. A time component was included in the scale in order to measure the 'quantity' aspect of *time-at-task* and not only the 'quality' aspect of the construct. Items were therefore added to the cognitive engagement scale to assess the time that the learner perceives she/he spent cognitively engaging with his or her learning tasks. The revised cognitive engagement scale of the Academic Engagement Scale for Grade School Students (AES-GS) therefore included both *time at task* items (8) and *cognitive engagement* items (17). *Time at task* and *cognitive engagement* were treated as two separate latent variables in the proposed learning potential structural model. Separate item analyses were therefore performed on the *time at task* scale and *time cognitively engaged* scale. The scale consisted of 25 items.

#### 4.4.1.1 Item analysis: Time at task

The results of the item analysis of the items of the *time at task* scale are shown in Table 4.1. The *time at task* scale obtained an unsatisfactory low Cronbach's alpha of .598. Inspection of the means and standard deviations revealed the absence of extreme means and small standard deviations. The item means ranged from 1.08 to 4.06 on a 7-point scale and the standard item deviations ranged from 1.222 to 1.799. The inter-item correlation matrix revealed correlations ranging between -.363 and .617.

Table 4.1

*Item statistics for the time at task scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .598 | .639 | 8 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| TCE2 | 3.91 | 1.222 | 200 |
| TCE6 | 3.61 | 1.421 | 200 |
| TCE8 | 1.08 | 1.276 | 200 |
| TCE10 | 3.41 | 1.498 | 200 |
| TCE11 | 3.22 | 1.425 | 200 |
| TCE21 | 3.73 | 1.392 | 200 |
| TCE22 | 4.06 | 1.347 | 200 |
| TCE25 | 2.54 | 1.799 | 200 |

| | TCE2 | TCE6 | TCE8 | TCE10 | TCE11 | TCE21 | TCE22 | TCE25 |
|---|---|---|---|---|---|---|---|---|
| TCE2 | 1.000 | .474 | -.095 | .411 | .557 | .617 | .400 | -.363 |
| TCE6 | .474 | 1.000 | -.014 | .361 | .527 | .470 | .354 | -.138 |
| TCE8 | -.095 | -.014 | 1.000 | -.069 | .021 | -.124 | -.234 | .125 |
| TCE10 | .411 | .361 | -.069 | 1.000 | .515 | .468 | .309 | -.188 |
| TCE11 | .557 | .527 | .021 | .515 | 1.000 | .592 | .320 | -.244 |
| TCE21 | .617 | .470 | -.124 | .468 | .592 | 1.000 | .569 | -.348 |
| TCE22 | .400 | .354 | -.234 | .309 | .320 | .569 | 1.000 | -.206 |
| TCE25 | -.363 | -.138 | .125 | -.188 | -.244 | -.348 | -.206 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| TCE2 | 21.64 | 26.282 | .528 | .484 | .505 |
| TCE6 | 21.94 | 24.604 | .551 | .355 | .485 |
| TCE8 | 24.47 | 33.969 | -.081 | .079 | .659 |
| TCE10 | 22.13 | 24.982 | .479 | .317 | .505 |
| TCE11 | 22.33 | 23.678 | .626 | .512 | .459 |
| TCE21 | 21.81 | 24.242 | .599 | .590 | .471 |
| TCE22 | 21.49 | 27.095 | .391 | .367 | .539 |
| TCE25 | 23.01 | 37.889 | -.304 | .169 | .761 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 61.41 | 152.324 | 12.342 | 15 |

All the corrected item total correlations were larger than .30 except for TCE8 (-.081) and TCE25 (-.304). In addition, the squared multiple correlations were mostly larger than .30, except for items TCE8 (.079) and TCE25 (.169). The results furthermore revealed that items TCE8 and TCE25, if deleted, would increase the current Cronbach alpha.

TCE8 and TCE25 were flagged as problematic. The low inter-item correlations of TCE8 and TCE25 with the remainder of the items, the low item-total correlation (-.081 and -.304), the low squared multiple correlation (.079 and .169) and the increase in Cronbach's alpha (.598 to .659 or .761) raised the concern that TCE8 and TCE25 share insufficient variance with the remainder of the items in the scale. This basket of evidence was considered sufficient to justify the removal of these two items.

The *time at task* scale was therefore reduced from 8 to 6 items by deleting TCE8 and TCE25. This deletion resulted in the *time at task* scale obtaining a highly acceptable Cronbach's alpha of .836. Inspection of the means and standard deviations after deletion revealed the absence of extreme means and small standard deviations. The item means ranged from 3.22 to 4.06 and the standard item deviations ranged from 1.222 to 1.498. The inter-item correlation matrix revealed correlations ranging between .309 and .617. All the corrected item total correlations were larger than .30 indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory and that the items were reflecting the same underlying factor. In addition, the squared multiple correlations were all larger than .30. The results after deletion of items TCE8 and TCE25 furthermore revealed that no other items, if deleted, would increase the current Cronbach alpha. No additional items were therefore considered for deletion.

#### 4.4.1.2 Item analysis: Cognitive Engagement

The item analysis results for the *time cognitively engaged* scale are shown in Table 4.2. The *time cognitively engaged* scale obtained a highly acceptable Cronbach alpha value of .924. Inspection of the means and standard deviations revealed the absence of extreme means and small standard deviations. The item means ranged from 3.56 to 4.35 on a 7-point scale and the standard item deviations ranged from 1.045 to 1.476. The inter-item correlation matrix revealed correlations ranging between .192 and .786.

Table 4.2

*Item statistics for the time cognitively engaged scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .924 | .926 | 17 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| TCE1 | 4.01 | 1.215 | 200 |
| TCE3 | 3.96 | 1.168 | 200 |
| TCE4 | 4.29 | 1.158 | 200 |
| TCE5 | 4.35 | 1.197 | 200 |
| TCE7 | 4.16 | 1.149 | 200 |
| TCE9 | 4.15 | 1.283 | 200 |
| TCE12 | 4.27 | 1.045 | 200 |
| TCE13 | 4.14 | 1.236 | 200 |
| TCE14 | 4.03 | 1.250 | 200 |
| TCE15 | 3.83 | 1.293 | 200 |
| TCE16 | 4.22 | 1.452 | 200 |
| TCE17 | 4.05 | 1.104 | 200 |
| TCE18 | 4.26 | 1.131 | 200 |
| TCE19 | 3.56 | 1.476 | 200 |
| TCE20 | 4.31 | 1.114 | 200 |
| TCE23 | 4.07 | 1.187 | 200 |
| TCE24 | 4.22 | 1.139 | 200 |

| | TCE1 | TCE3 | TCE4 | TCE5 | TCE7 | TCE9 | TCE12 | TCE13 |
|---|---|---|---|---|---|---|---|---|
| TCE1 | 1.000 | .786 | .294 | .308 | .395 | .502 | .607 | .384 |
| TCE3 | .786 | 1.000 | .369 | .319 | .439 | .473 | .511 | .411 |
| TCE4 | .294 | .369 | 1.000 | .592 | .555 | .286 | .297 | .256 |
| TCE5 | .308 | .319 | .592 | 1.000 | .522 | .192 | .335 | .269 |
| TCE7 | .395 | .439 | .555 | .522 | 1.000 | .270 | .378 | .264 |
| TCE9 | .502 | .473 | .286 | .192 | .270 | 1.000 | .494 | .440 |
| TCE12 | .607 | .511 | .297 | .335 | .378 | .494 | 1.000 | .550 |
| TCE13 | .384 | .411 | .256 | .269 | .264 | .440 | .550 | 1.000 |
| TCE14 | .599 | .606 | .242 | .290 | .399 | .383 | .556 | .482 |
| TCE15 | .490 | .448 | .339 | .373 | .340 | .504 | .399 | .333 |
| TCE16 | .338 | .286 | .510 | .394 | .422 | .279 | .448 | .274 |
| TCE17 | .415 | .399 | .568 | .532 | .620 | .361 | .464 | .415 |
| TCE18 | .473 | .430 | .534 | .520 | .521 | .434 | .421 | .420 |
| TCE19 | .319 | .299 | .430 | .348 | .388 | .298 | .309 | .274 |
| TCE20 | .584 | .554 | .317 | .349 | .295 | .555 | .567 | .574 |
| TCE23 | .595 | .567 | .323 | .423 | .365 | .538 | .662 | .456 |
| TCE24 | .285 | .271 | .371 | .401 | .407 | .349 | .418 | .445 |

| | TCE14 | TCE15 | TCE16 | TCE17 | TCE18 | TCE19 | TCE20 | TCE23 | TCE24 |
|---|---|---|---|---|---|---|---|---|---|
| TCE1 | .599 | .490 | .338 | .415 | .473 | .319 | .584 | .595 | .285 |
| TCE3 | .606 | .448 | .286 | .399 | .430 | .299 | .554 | .567 | .271 |
| TCE4 | .242 | .339 | .510 | .568 | .534 | .430 | .317 | .323 | .371 |
| TCE5 | .290 | .373 | .394 | .532 | .520 | .348 | .349 | .423 | .401 |
| TCE7 | .399 | .340 | .422 | .620 | .521 | .388 | .295 | .365 | .407 |
| TCE9 | .383 | .504 | .279 | .361 | .434 | .298 | .555 | .538 | .349 |
| TCE12 | .556 | .399 | .448 | .464 | .421 | .309 | .567 | .662 | .418 |
| TCE13 | .482 | .333 | .274 | .415 | .420 | .274 | .574 | .456 | .445 |
| TCE14 | 1.000 | .457 | .290 | .374 | .376 | .227 | .500 | .534 | .300 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TCE15 | .457 | 1.000 | .381 | .407 | .499 | .383 | .477 | .590 | .435 |
| TCE16 | .290 | .381 | 1.000 | .542 | .510 | .499 | .366 | .386 | .387 |
| TCE17 | .374 | .407 | .542 | 1.000 | .771 | .438 | .450 | .443 | .479 |
| TCE18 | .376 | .499 | .510 | .771 | 1.000 | .424 | .550 | .489 | .552 |
| TCE19 | .227 | .383 | .499 | .438 | .424 | 1.000 | .304 | .349 | .222 |
| TCE20 | .500 | .477 | .366 | .450 | .550 | .304 | 1.000 | .593 | .382 |
| TCE23 | .534 | .590 | .386 | .443 | .489 | .349 | .593 | 1.000 | .398 |
| TCE24 | .300 | .435 | .387 | .479 | .552 | .222 | .382 | .398 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| TCE1 | 65.84 | 170.088 | .679 | .712 | .918 |
| TCE3 | 65.89 | 171.539 | .659 | .687 | .919 |
| TCE4 | 65.56 | 174.067 | .579 | .537 | .921 |
| TCE5 | 65.50 | 173.899 | .562 | .489 | .921 |
| TCE7 | 65.69 | 173.493 | .603 | .527 | .920 |
| TCE9 | 65.70 | 171.912 | .581 | .465 | .921 |
| TCE12 | 65.58 | 173.120 | .686 | .631 | .918 |
| TCE13 | 65.71 | 173.103 | .567 | .492 | .921 |
| TCE14 | 65.82 | 171.756 | .603 | .521 | .920 |
| TCE15 | 66.02 | 170.060 | .633 | .504 | .919 |
| TCE16 | 65.63 | 169.099 | .579 | .471 | .921 |
| TCE17 | 65.80 | 171.307 | .711 | .693 | .918 |
| TCE18 | 65.59 | 170.123 | .735 | .704 | .917 |
| TCE19 | 66.29 | 171.391 | .505 | .364 | .924 |
| TCE20 | 65.54 | 171.858 | .685 | .585 | .918 |
| TCE23 | 65.78 | 169.620 | .714 | .624 | .917 |
| TCE24 | 65.63 | 175.030 | .556 | .443 | .921 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 69.85 | 193.086 | 13.896 | 17 |

All the corrected item total correlations were larger than .30 indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the squared multiple correlations were all larger than .30. The results furthermore revealed that none of the items, if deleted, would significantly increase the current Cronbach alpha. None of the items were therefore deleted.

### 4.4.2 ITEM ANALYSIS: KNOWLEDGE OF COGNITION AND REGULATION OF COGNITION

The latent variable *metacognition* consists of two latent components: *Knowledge of cognition* and *regulation of cognition*. These two metacognition latent variables were assessed by using version B of the Junior Metacognitive Awareness Inventory (Jr. MAI), developed by Sperling et al. (2002). The Jr. MAI, Version consisted of 18 items and used a 5-point Likert scale. The operationalisation of *metacogntion* of the Jr. MAI thus corresponds to the constitutive definition of the construct as used in this study and therefore separate item analysis were performed on the *knowledge of cognition* scale and *regulation of cognition* scale.

#### 4.4.2.1 Item analysis: Knowledge of cognition

The knowledge of cognition scale comprised 9 items. Table 4.3 presents the item statistics for the *knowledge of cognition* scale. The *knowledge of cognition* scale obtained an acceptable value for the Cronbach alpha reliability coefficeient (.761), even though this is lower than the cut off of .80. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The means ranged from 3.27 to 4.57 (on a 7-point scale) and the standard deviations ranged from .741 to .959. The inter-item correlation matrix revealed correlations ranging between -.055 and .613.

Almost all the corrected item total correlations were larger than .30 except for MA14 (.187) indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the majority of the squared multiple correlations were larger than .30, except for items MA12 (.299), MA13 (.283), MA14 (.163) and MA16 (.232). This was not sufficient reason for concern to delete these items as there is no other compelling evidence to support deletion of these items. The results furthermore revealed that item MA14, if deleted, would increase the Cronbach alpha from its current value of .761 to .788.

MA14 was flagged as problematic. The low (and at times even negative) inter-item correlations of MA14 with the remainder of the items, the low item-total correlation (.187), the low squared multiple correlation (.163) and the increase in Cronbach's alpha (.761 to .788) raised the concern that MA14 shares insufficient variance with the remainder of the items in the scale. This basket of evidence was considered sufficient to justify the removal of this item. The *knowledge of cognition* scale was therefore reduced from 9 to 8 items by deleting MA14. This deletion resulted in the *knowledge of cognition* scale obtaining a Cronbach alpha value of .788. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The mean ranged from 3.27 to 4.57 (on a 7-point scale) and the standard deviation ranged from .741 to .959. The inter-item correlation matrix revealed correlations ranging between .036 and .613.

Almost all the corrected item total correlations were larger than .30 after the deletion of item MA14, except for MA16 (.232) indicating that the correlation between each item and the total score calculated from the remaining items was mostly satisfactory. In addition, the squared multiple correlations were mostly larger than .30, except for items MA12 (.294), MA13 (.279) and MA16 (.232). The results, after the deletion of item MA14, furthermore revealed that item MA16, if deleted, would increase the Cronbach alpha from its current value (.788) to .809. MA16 was thus flagged as problematic. The low inter-item correlations of MA16 with the remainder of the items, the low item-total correlation, the low squared multiple correlation and the increase in Cronbach's alpha raised the concern that MA16 shares insufficient variance with the remainder of the items in the scale. This basket of evidence was considered sufficient to justify the removal of this item. The *knowledge of cognition* scale was therefore reduced from 8 to 7 items by deleting MA16. This deletion resulted in the *knowledge of cognition* scale obtaining a Cronbach's alpha of .809. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The mean ranged from 3.91 to 4.57 (on a 7-point scale) and the standard deviation ranged from .741 to .922. The inter-item correlation matrix revealed correlations ranging between .145 and .613. All the corrected item total correlations were larger than .30 indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the majority of the squared multiple correlations were larger than .30. The results furthermore revealed that none of the items, if deleted, would significantly increase the current Cronbach alpha. None of the items were therefore deleted.

Table 4.3

*Item statistics for the knowledge of cognition scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .761 | .774 | 9 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| MA1 | 4.44 | .889 | 200 |
| MA2 | 4.16 | .910 | 200 |
| MA3 | 4.26 | .840 | 200 |
| MA4 | 4.10 | .922 | 200 |
| MA5 | 4.41 | .796 | 200 |
| MA12 | 4.57 | .741 | 200 |
| MA13 | 3.91 | .922 | 200 |
| MA14 | 3.40 | 1.134 | 200 |
| MA16 | 3.27 | .959 | 200 |

| | MA1 | MA2 | MA3 | MA4 | MA5 | MA12 | MA13 | MA14 | MA16 |
|---|---|---|---|---|---|---|---|---|---|
| MA1 | 1.000 | .360 | .472 | .396 | .613 | .460 | .370 | -.011 | .134 |
| MA2 | .360 | 1.000 | .464 | .449 | .264 | .342 | .377 | .108 | .170 |
| MA3 | .472 | .464 | 1.000 | .344 | .413 | .344 | .376 | .096 | .189 |
| MA4 | .396 | .449 | .344 | 1.000 | .378 | .289 | .353 | .136 | .176 |
| MA5 | .613 | .264 | .413 | .378 | 1.000 | .419 | .320 | .092 | .129 |
| MA12 | .460 | .342 | .344 | .289 | .419 | 1.000 | .145 | -.055 | .036 |
| MA13 | .370 | .377 | .376 | .353 | .320 | .145 | 1.000 | .176 | .250 |
| MA14 | -.011 | .108 | .096 | .136 | .092 | -.055 | .176 | 1.000 | .355 |
| MA16 | .134 | .170 | .189 | .176 | .129 | .036 | .250 | .355 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| MA1 | 32.06 | 17.881 | .562 | .498 | .720 |
| MA2 | 32.34 | 18.023 | .523 | .360 | .725 |
| MA3 | 32.24 | 18.191 | .558 | .364 | .721 |
| MA4 | 32.40 | 17.960 | .523 | .310 | .725 |
| MA5 | 32.09 | 18.575 | .537 | .440 | .726 |
| MA12 | 31.93 | 19.804 | .386 | .299 | .747 |
| MA13 | 32.59 | 18.143 | .497 | .283 | .729 |
| MA14 | 33.10 | 19.725 | .187 | .163 | .788 |
| MA16 | 33.23 | 19.374 | .308 | .175 | .760 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 36.50 | 22.894 | 4.785 | 9 |

### 4.4.2.2 Item analysis: Regulation of cognition

The *regulation of cognition* scale comprised 9 items. Table 4.4 presents the item statistics for the *regulation of cognition* scale. The *regulation of cognition* scale obtained a value for Cronbach's alpha of .755. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The item means ranged from 3.06 to 4.16 (on a 7-point scale) and the item standard deviations ranged from .851 to 1.290. The inter-item correlation matrix revealed correlations ranging between .007 and .462. The low minimum of the inter-item correlations is some reason for concern.

Table 4.4

*Item statistics for the regulation of cognition scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .755 | .765 | 9 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| MA6 | 3.06 | 1.290 | 200 |
| MA7 | 3.09 | 1.212 | 200 |
| MA8 | 3.76 | 1.019 | 200 |
| MA9 | 3.82 | .972 | 200 |
| MA10 | 3.67 | 1.028 | 200 |
| MA11 | 4.03 | .940 | 200 |
| MA15 | 3.76 | 1.073 | 200 |
| MA17 | 3.47 | 1.111 | 200 |
| MA18 | 4.16 | .851 | 200 |

| | MA6 | MA7 | MA8 | MA9 | MA10 | MA11 | MA15 | MA17 | MA18 |
|---|---|---|---|---|---|---|---|---|---|
| MA6 | 1.000 | .376 | .122 | .109 | .159 | .007 | .167 | .012 | .120 |
| MA7 | .376 | 1.000 | .209 | .368 | .460 | .196 | .342 | .263 | .186 |
| MA8 | .122 | .209 | 1.000 | .462 | .313 | .259 | .346 | .143 | .304 |
| MA9 | .109 | .368 | .462 | 1.000 | .567 | .413 | .313 | .299 | .332 |
| MA10 | .159 | .460 | .313 | .567 | 1.000 | .374 | .286 | .324 | .369 |
| MA11 | .007 | .196 | .259 | .413 | .374 | 1.000 | .276 | .116 | .314 |
| MA15 | .167 | .342 | .346 | .313 | .286 | .276 | 1.000 | .223 | .394 |
| MA17 | .012 | .263 | .143 | .299 | .324 | .116 | .223 | 1.000 | .051 |
| MA18 | .120 | .186 | .304 | .332 | .369 | .314 | .394 | .051 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| MA6 | 29.74 | 26.264 | .224 | .163 | .773 |
| MA7 | 29.71 | 23.292 | .524 | .360 | .716 |
| MA8 | 29.04 | 25.345 | .440 | .271 | .731 |
| MA9 | 28.98 | 24.156 | .606 | .462 | .707 |
| MA10 | 29.13 | 23.742 | .609 | .454 | .704 |
| MA11 | 28.77 | 26.268 | .388 | .240 | .739 |
| MA15 | 29.04 | 24.546 | .489 | .293 | .723 |
| MA17 | 29.33 | 26.334 | .292 | .171 | .755 |
| MA18 | 28.64 | 26.481 | .421 | .275 | .735 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 32.80 | 30.894 | 5.558 | 9 |

Almost all the corrected item total correlations were larger than .30 except for MA6 (.224) and MA17 (.292) indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the squared multiple correlations were mostly below .30, except for items MA7 (.360), MA9 (.462) and MA10 (.454). This was reason for concern and provided sufficient reason to flag items MA6 and MA17 as problematic items. The low inter-item correlations of MA6 and MA17 with the remainder of the items, the low item-total correlations (.224 and .292), the low squared multiple correlations (.163 and .171) and the increases in Cronbach's alpha (.755 to .773), if item MA6 was deleted, raised the concern that these items might share insufficient variance with the remainder of the items in the scale. This basket of evidence was considered sufficient to justify the removal of item MA6 but to retain item MA17. The *regulation of cognition* scale was therefore reduced from 9 to 8 items by deleting MA6. This deletion resulted in the *regulation of cognition* scale obtaining a Cronbach's alpha of .773. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The mean ranged from 3.09 to 4.16 (on a 7-point scale) and the standard deviation ranged from .851 to 1.212. The inter-item correlation matrix revealed correlations ranging between .116 and .567.

All the corrected item total correlations were larger than .30 after the deletion of item MA6, indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the majority of the squared multiple correlations were now smaller than .30. The results, after the deletion of item MA6, furthermore revealed that item MA17, if deleted, would only slightly increase the current Cronbach alpha value from .755 to .759. This basket of evidence was not considered sufficient to justify the removal of item MA17. The updated results of the item analysis of the *regulation of cognition* scale did not raise any concerns and no other items of the scale were deleted.

### 4.4.3 ITEM ANALYSIS: ACADEMIC SELF-LEADERSHIP

The *Academic Self-Leadership* scale comprised 23 items. The original questionnaire by Houghton and Neck which comprised 35 items was reduced to 23 as explained in Chapter 3. Burger (2012), in accordance with research presented by Houghton and Neck (2002) defined academic self-leadership as a multi-dimensional construct which consists of nine sub-scales, as mentioned earlier in Chapter 3. The small number of items in the nine subscales makes it somewhat less than ideal to perform item analysis in each of the sub-scales, item statistics have very little diagnostic value if a subscale contains only two items. All the correlation-based item statistics will return identical values for both items. especially those subscales containing only two items. Burger (2012) conducted item analysis on the three hypothesised second-order dimensions. The classical measurement theory item statistics and the coefficient of internal consistency calculated during item analysis assume classically parallel measures. This assumption is violated if items from various subscales are combined as if they measure the same thing to the same degree. The item analysis was consequently performed on each of the nine subscales separately despite the constraints imposed by the short ubscales.The results for the item analysis for the Academic Self-leadership scale are depicted in Table 4.5a to Table 4.5i.

Table 4.5a

*Item statistics for the Academic Self-Leadership* sub*scale Visualising successful performance*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.776** | **.777** | **3** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL1 | **4.08** | **1.165** | **200** |
| ASL2 | **3.81** | **1.479** | **200** |
| ASL3 | **3.67** | **1.501** | **200** |

| | ASL1 | ASL2 | ASL3 |
|---|---|---|---|
| ASL1 | **1.000** | **.440** | **.540** |
| ASL2 | **.440** | **1.000** | **.633** |
| ASL3 | **.540** | **.633** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **3.848** | **3.665** | **4.075** | **.410** | **1.112** | **.043** | **3** |
| Item Variances | **1.933** | **1.356** | **2.254** | **.898** | **1.662** | **.250** | **3** |
| Inter-Item Correlations | **.538** | **.440** | **.633** | **.193** | **1.439** | **.007** | **3** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL1 | **7.47** | **7.255** | **.543** | **.308** | **.776** |
| ASL2 | **7.74** | **5.500** | **.624** | **.415** | **.687** |
| ASL3 | **7.88** | **5.061** | **.696** | **.486** | **.599** |

| Mean | Varian | Std. | N of |
|---|---|---|---|

| | ce | Deviation | Items |
|---|---|---|---|
| 11.55 | 12.018 | 3.467 | 3 |

Table 4.5b

*Item statistics for the Academic Self-Leadership* sub*scale Self goal setting*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .687 | .699 | 2 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL4 | 3.09 | 1.897 | 200 |
| ASL5 | 3.91 | 1.501 | 200 |

| | ASL4 | ASL5 |
|---|---|---|
| ASL4 | 1.000 | .537 |
| ASL5 | .537 | 1.000 |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | 3.500 | 3.090 | 3.910 | .820 | 1.265 | .336 | 2 |
| Item Variances | 2.927 | 2.253 | 3.600 | 1.347 | 1.598 | .907 | 2 |
| Inter-Item Correlations | .537 | .537 | .537 | .000 | 1.000 | .000 | 2 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL4 | 3.91 | 2.253 | .537 | .289 | . |
| ASL5 | 3.09 | 3.600 | .537 | .289 | . |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 7.00 | 8.915 | 2.986 | 2 |

Table 4.5c

*Item statistics for the Academic Self-Leadership* sub*scale Self talk*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .845 | .845 | 2 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL6 | 4.20 | 1.427 | 200 |
| ASL7 | 4.20 | 1.439 | 200 |

| | ASL6 | ASL7 |
|---|---|---|

| | | |
|---|---|---|
| ASL6 | **1.000** | **.732** |
| ASL7 | **.732** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **4.198** | **4.195** | **4.200** | **.005** | **1.001** | **.000** | **2** |
| Item Variances | **2.054** | **2.037** | **2.070** | **.033** | **1.016** | **.001** | **2** |
| Inter-Item Correlations | **.732** | **.732** | **.732** | **.000** | **1.000** | **.000** | **2** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL6 | **4.20** | **2.070** | **.732** | **.536** | **.** |
| ASL7 | **4.20** | **2.037** | **.732** | **.536** | **.** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **8.40** | **7.115** | **2.667** | **2** |

Table 4.5d

*Item statistics for the Academic Self-Leadership* sub*scale Self reward*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.890** | **.890** | **2** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL8 | **3.55** | **1.861** | **200** |
| ASL9 | **3.42** | **1.903** | **200** |

| | ASL8 | ASL9 |
|---|---|---|
| ASL8 | **1.000** | **.802** |
| ASL9 | **.802** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **3.483** | **3.415** | **3.550** | **.135** | **1.040** | **.009** | **2** |
| Item Variances | **3.543** | **3.465** | **3.621** | **.156** | **1.045** | **.012** | **2** |
| Inter-Item Correlations | **.802** | **.802** | **.802** | **.000** | **1.000** | **.000** | **2** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL8 | **3.42** | **3.621** | **.802** | **.643** | **.** |
| ASL9 | **3.55** | **3.465** | **.802** | **.643** | **.** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **6.97** | **12.768** | **3.573** | **2** |

Table 4.5e

*Item statistics for the Academic Self-Leadership* sub*scale Evaluating beliefs and assumptions*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.768** | **.768** | **2** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL10 | **3.77** | **1.239** | **200** |
| ASL11 | **3.89** | **1.292** | **200** |

| | ASL10 | ASL11 |
|---|---|---|
| ASL10 | **1.000** | **.624** |
| ASL11 | **.624** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **3.828** | **3.770** | **3.885** | **.115** | **1.031** | **.007** | **2** |
| Item Variances | **1.602** | **1.535** | **1.670** | **.135** | **1.088** | **.009** | **2** |
| Inter-Item Correlations | **.624** | **.624** | **.624** | **.000** | **1.000** | **.000** | **2** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL10 | **3.89** | **1.670** | **.624** | **.389** | **.** |
| ASL11 | **3.77** | **1.535** | **.624** | **.389** | **.** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **7.66** | **5.202** | **2.281** | **2** |

Table 4.5f

*Item statistics for the Academic Self-Leadership* sub*scale Self punishment*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.800** | **.800** | **3** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL12 | **4.26** | **1.408** | **200** |
| ASL13 | **3.75** | **1.543** | **200** |
| ASL14 | **4.21** | **1.502** | **200** |

| | ASL12 | ASL13 | ASL14 |
|---|---|---|---|
| ASL12 | **1.000** | **.578** | **.523** |
| ASL13 | **.578** | **1.000** | **.615** |
| ASL14 | **.523** | **.615** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **4.073** | **3.750** | **4.260** | **.510** | **1.136** | **.079** | **3** |
| Item Variances | **2.206** | **1.982** | **2.379** | **.397** | **1.200** | **.041** | **3** |
| Inter-Item Correlations | **.572** | **.523** | **.615** | **.092** | **1.176** | **.002** | **3** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL12 | **7.96** | **7.486** | **.613** | **.380** | **.761** |
| ASL13 | **8.47** | **6.451** | **.684** | **.469** | **.686** |
| ASL14 | **8.01** | **6.874** | **.642** | **.420** | **.731** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **12.22** | **14.193** | **3.767** | **3** |

Table 4.5g

*Item statistics for the Academic Self-Leadership* sub*scale Self observation*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.853** | **.853** | **3** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL15 | **3.95** | **1.361** | **200** |
| ASL16 | **4.26** | **1.350** | **200** |
| ASL17 | **4.05** | **1.350** | **200** |

| | ASL15 | ASL16 | ASL17 |
|---|---|---|---|
| ASL15 | **1.000** | **.624** | **.699** |
| ASL16 | **.624** | **1.000** | **.656** |
| ASL17 | **.699** | **.656** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **4.083** | **3.945** | **4.260** | **.315** | **1.080** | **.026** | **3** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Item Variances | **1.832** | **1.822** | **1.851** | **.030** | **1.016** | **.000** | **3** |
| Inter-Item Correlations | **.659** | **.624** | **.699** | **.076** | **1.121** | **.001** | **3** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL15 | **8.31** | **6.032** | **.727** | **.537** | **.792** |
| ASL16 | **7.99** | **6.241** | **.694** | **.483** | **.823** |
| ASL17 | **8.21** | **5.963** | **.752** | **.568** | **.768** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **12.25** | **12.741** | **3.569** | **3** |

Table 4.5h

*Item statistics for the Academic Self-Leadership* sub*scale Focussing thoughts on natural rewards*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.806** | **.805** | **4** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL18 | **3.95** | **1.348** | **200** |
| ASL19 | **3.63** | **1.548** | **200** |
| ASL20 | **3.86** | **1.574** | **200** |
| ASL21 | **4.11** | **1.498** | **200** |

| | ASL18 | ASL19 | ASL20 | ASL21 |
|---|---|---|---|---|
| ASL18 | **1.000** | **.545** | **.473** | **.403** |
| ASL19 | **.545** | **1.000** | **.607** | **.461** |
| ASL20 | **.473** | **.607** | **1.000** | **.558** |
| ASL21 | **.403** | **.461** | **.558** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **3.884** | **3.625** | **4.105** | **.480** | **1.132** | **.040** | **4** |
| Item Variances | **2.234** | **1.817** | **2.476** | **.660** | **1.363** | **.086** | **4** |
| Inter-Item Correlations | **.508** | **.403** | **.607** | **.204** | **1.505** | **.005** | **4** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL18 | **11.59** | **14.847** | **.569** | **.341** | **.781** |
| ASL19 | **11.91** | **12.806** | **.665** | **.463** | **.734** |
| ASL20 | **11.68** | **12.500** | **.683** | **.478** | **.725** |
| ASL21 | **11.43** | **13.925** | **.572** | **.347** | **.779** |

| Mean | Varian | Std. | N of |
|---|---|---|---|

| | ce | Deviation | Items |
|---|---|---|---|
| **15.54** | **22.572** | **4.751** | **4** |

Table 4.5i

*Item statistics for the Academic Self-Leadership* sub*scale Self cuing*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| **.943** | **.943** | **2** |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASL22 | **3.56** | **1.989** | **200** |
| ASL23 | **3.45** | **1.982** | **200** |

| | ASL22 | ASL23 |
|---|---|---|
| ASL22 | **1.000** | **.892** |
| ASL23 | **.892** | **1.000** |

| | Mean | Minimum | Maximum | Range | Maximum / Minimum | Variance | N of Items |
|---|---|---|---|---|---|---|---|
| Item Means | **3.503** | **3.450** | **3.555** | **.105** | **1.030** | **.006** | **2** |
| Item Variances | **3.942** | **3.927** | **3.957** | **.030** | **1.008** | **.000** | **2** |
| Inter-Item Correlations | **.892** | **.892** | **.892** | **.000** | **1.000** | **.000** | **2** |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASL22 | **3.45** | **3.927** | **.892** | **.796** | **.** |
| ASL23 | **3.56** | **3.957** | **.892** | **.796** | **.** |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| **7.01** | **14.920** | **3.863** | **2** |

Eight of the nine subscales returned acceptable reliability values ranging between .776 and .943. Only two of these eight subscales returned reliability coefficients below .80. Only the *Self-goal setting* subscale returned a somewhat problematic reliability coefficient of .687. In as far as the item statistics allowed this, no problem items were detected. To calculate the reliability of the *Academic self leadership* scale the formula proposed by Nunnally (1978) to calculate the reliability of unweighted linear composite was used.

$$r_{tt_{comp}} = 1 - (\frac{\sum S^2 i - \sum rttiS^2 i}{S^2 t})$$

$$= 1 - (\frac{[110.444 - 91.30647]}{432.397})$$

$$= 1 - \left(\frac{19.13753}{432.397}\right)$$

$$= .955741$$

A very satisfactory reliability coefficient value of .955741 was therefore obtained for the *Academic Self-leadership* scale.

### 4.4.4 ITEM ANALYSIS: LEARNING MOTIVATION

The results for the item analysis for the *learning motivation* scale are depicted in Table 4.6. The *learning motivation* scale comprised 6 items and obtained an acceptable Cronbach alpha value of .883. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The means ranged from 5.15 to 5.63 (on a 7-point scale) and the standard deviations ranged from 1.074 to 1.365. The inter-item correlation matrix revealed correlations ranging between .460 and .703.

Table 4.6

*Item statistics for the learning motivation*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .883 | .885 | 6 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LM1 | 5.46 | 1.074 | 200 |
| LM2 | 5.34 | 1.245 | 200 |
| LM3 | 5.15 | 1.275 | 200 |
| LM4 | 5.24 | 1.350 | 200 |
| LM5 | 5.21 | 1.365 | 200 |
| LM6 | 5.63 | 1.253 | 200 |

| | LM1 | LM2 | LM3 | LM4 | LM5 | LM6 |
|---|---|---|---|---|---|---|
| LM1 | 1.000 | .528 | .691 | .503 | .485 | .618 |
| LM2 | .528 | 1.000 | .620 | .460 | .498 | .450 |
| LM3 | .691 | .620 | 1.000 | .703 | .629 | .613 |
| LM4 | .503 | .460 | .703 | 1.000 | .601 | .484 |
| LM5 | .485 | .498 | .629 | .601 | 1.000 | .547 |
| LM6 | .618 | .450 | .613 | .484 | .547 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| LM1 | 26.56 | 27.333 | .699 | .548 | .864 |

| | | | | | |
|---|---|---|---|---|---|
| LM2 | 26.68 | 26.761 | .623 | .420 | .875 |
| LM3 | 26.87 | 24.278 | .830 | .707 | .840 |
| LM4 | 26.78 | 25.241 | .684 | .536 | .866 |
| LM5 | 26.81 | 25.089 | .686 | .491 | .865 |
| LM6 | 26.39 | 26.228 | .665 | .483 | .868 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 32.02 | 36.336 | 6.028 | 6 |

All the corrected item total correlations were larger than .30, indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the squared multiple correlations were all larger than .30. Furthermore the results revealed that none of the items, if deleted, would increase the current Cronbach's alpha. The results of the item analysis of the *learning motivation* scale did not raise any concerns and all the items of the scale were retained.

### 4.4.5 ITEM ANALYSIS: ACADEMIC SELF-EFFICACY

The *academic self-efficacy* scale comprised 12 items. The results for the item analysis for the *academic self-efficacy* scale are shown in Table 4.7. The *academic self-efficacy* scale obtained an acceptable Cronbach alpha value of .886. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The mean ranged from 3.32 to 4.88 (on a 7-point scale) and the standard deviation ranged from 1.012 to 1.526. The inter-item correlation matrix revealed correlations ranging between -.035 and .691. The low inter-item correlations of item ASE3 with the remainder of the scale items pointed towards it being a problematic, wayward item.

Table 4.7

*Item statistics for the academic self-efficacy scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .886 | .895 | 12 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| ASE1 | 4.39 | 1.146 | 200 |
| ASE2 | 4.59 | 1.140 | 200 |
| ASE3 | 3.32 | 1.526 | 200 |

| | | | |
|---|---|---|---|
| ASE4 | 3.99 | 1.293 | 200 |
| ASE5 | 4.19 | 1.145 | 200 |
| ASE6 | 4.54 | 1.060 | 200 |
| ASE7 | 4.28 | 1.178 | 200 |
| ASE8 | 4.22 | 1.198 | 200 |
| ASE9 | 4.21 | 1.101 | 200 |
| ASE10 | 4.10 | 1.224 | 200 |
| ASE11 | 4.26 | 1.084 | 200 |
| ASE12 | 4.88 | 1.012 | 200 |

| | ASE1 | ASE2 | ASE3 | ASE4 | ASE5 | ASE6 | ASE7 | ASE8 | ASE9 | ASE10 | ASE11 | ASE12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASE1 | 1.000 | .515 | -.035 | .563 | .542 | .388 | .534 | .393 | .429 | .424 | .495 | .336 |
| ASE2 | .515 | 1.000 | -.011 | .473 | .392 | .530 | .573 | .411 | .438 | .354 | .371 | .425 |
| ASE3 | -.035 | -.011 | 1.000 | .092 | .035 | .094 | .021 | .001 | .047 | -.012 | .003 | -.026 |
| ASE4 | .563 | .473 | .092 | 1.000 | .691 | .592 | .642 | .472 | .440 | .541 | .468 | .352 |
| ASE5 | .542 | .392 | .035 | .691 | 1.000 | .529 | .623 | .578 | .530 | .643 | .495 | .346 |
| ASE6 | .388 | .530 | .094 | .592 | .529 | 1.000 | .624 | .415 | .454 | .497 | .410 | .554 |
| ASE7 | .534 | .573 | .021 | .642 | .623 | .624 | 1.000 | .587 | .470 | .562 | .502 | .480 |
| ASE8 | .393 | .411 | .001 | .472 | .578 | .415 | .587 | 1.000 | .590 | .633 | .592 | .399 |
| ASE9 | .429 | .438 | .047 | .440 | .530 | .454 | .470 | .590 | 1.000 | .652 | .557 | .312 |
| ASE10 | .424 | .354 | -.012 | .541 | .643 | .497 | .562 | .633 | .652 | 1.000 | .587 | .432 |
| ASE11 | .495 | .371 | .003 | .468 | .495 | .410 | .502 | .592 | .557 | .587 | 1.000 | .350 |
| ASE12 | .336 | .425 | -.026 | .352 | .346 | .554 | .480 | .399 | .312 | .432 | .350 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| ASE1 | 46.55 | 75.817 | .604 | .484 | .876 |
| ASE2 | 46.35 | 76.237 | .586 | .471 | .877 |
| ASE3 | 47.62 | 86.117 | .026 | .039 | .915 |
| ASE4 | 46.95 | 71.801 | .717 | .612 | .869 |
| ASE5 | 46.74 | 73.550 | .730 | .630 | .869 |
| ASE6 | 46.40 | 75.537 | .680 | .571 | .872 |
| ASE7 | 46.65 | 72.621 | .756 | .628 | .867 |
| ASE8 | 46.72 | 73.863 | .674 | .566 | .871 |
| ASE9 | 46.72 | 75.429 | .656 | .541 | .873 |
| ASE10 | 46.83 | 72.896 | .708 | .625 | .869 |
| ASE11 | 46.68 | 75.899 | .641 | .492 | .874 |
| ASE12 | 46.06 | 78.927 | .514 | .392 | .880 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 50.93 | 89.191 | 9.444 | 12 |

All the corrected item total correlations were larger than .30 except for ASE3 (.026) indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the majority of the squared multiple correlations were larger than .30, except for items ASE3 (.039). The results furthermore revealed that item ASE3, if deleted, would increase the current Cronbach alpha from .886 to .915.

ASE3 was thus flagged as problematic. The low inter-item correlations of ASE3 with the remainder of the items, the low item-total correlation, the low squared multiple correlation and the increase in Cronbach's alpha raised the concern that ASE3 shares insufficient variance with the remainder of the items in the scale. This basket of evidence was considered sufficient to justify the removal of this item. The *academic self-efficacy* scale was therefore reduced from 12 to 11 items by deleting ASE3. This deletion resulted in the *academic self-efficacy* scale obtaining a value for Cronbach's alpha of .915. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The means ranged from 3.99 to 4.88 (on a 7-point scale) and the standard deviations ranged from 1.012 to 1.293. The inter-item correlation matrix revealed correlations ranging between .312 and .691.

All the corrected item total correlations were larger than .30 after the deletion of item ASE3, indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the squared multiple correlations were now all larger than .30. The results, after the deletion of item ASE3, furthermore revealed that no other item, if deleted, would increase the current Cronbach alpha. The updated results of the item analysis of the *academic self-efficacy* scale did not raise any concerns and no other items of the scale were deleted.

### 4.4.6 ITEM ANALYSIS: MASTERY GOAL ORIENTATION

This study utilised a measure developed by Button et al. (1996). This *goal orientation* instrument has two subscales: (a) Ten items that measure *performance goal orientation,* which suggests that individuals strive to demonstrate, and thereby gain favourable judgments of their competence via task performance, or to avoid negative judgments of their competence, and (b) ten items that measure *learning goal orientation*, which suggests that individuals strive to understand something new or to increase their level of competence in a given activity. As this study is only formally pursuing the relationship between *learning goal-orientation* (and not *performance goal-orientation*) and *learning performance*, item analysis was only performed on the items comprising *learning goal-orientation* even though both scales were included in the questionnaire.

The *learning goal-orientation,* scale comprised 10 items. Table 4.8 presents the item statistics for the *learning goal-orientation,* scale. The *learning goal-orientation,* scale obtained an acceptable Cronbach alpha value of .875. Inspection of the item means and item standard deviations revealed the absence of extreme means and small standard deviations. The means ranged from 5.21 to 6.04 (on a 7-point scale) and the standard deviations ranged from 1.041 to 1.391. The inter-item correlation matrix revealed correlations ranging between .191 and .669.

Table 4.8

*Item statistics for the learning goal-orientation scale*

| Cronbach's Alpha | Cronbach's Alpha Based on Standardised Items | N of Items |
|---|---|---|
| .875 | .878 | 10 |

| | Mean | Std. Deviation | N |
|---|---|---|---|
| GO11 | 5.23 | 1.384 | 200 |
| GO12 | 5.44 | 1.391 | 200 |
| GO13 | 5.21 | 1.225 | 200 |
| GO14 | 5.58 | 1.175 | 200 |
| GO15 | 5.27 | 1.283 | 200 |
| GO16 | 5.73 | 1.120 | 200 |
| GO17 | 5.75 | 1.041 | 200 |
| GO18 | 5.28 | 1.323 | 200 |
| GO19 | 5.66 | 1.192 | 200 |
| GO20 | 6.04 | 1.067 | 200 |

| | GO11 | GO12 | GO13 | GO14 | GO15 | GO16 | GO17 | GO18 | GO19 | GO20 |
|---|---|---|---|---|---|---|---|---|---|---|
| GO11 | 1.000 | .501 | .508 | .307 | .418 | .309 | .284 | .299 | .191 | .219 |
| GO12 | .501 | 1.000 | .578 | .427 | .486 | .489 | .398 | .340 | .305 | .389 |
| GO13 | .508 | .578 | 1.000 | .476 | .518 | .411 | .375 | .408 | .292 | .248 |
| GO14 | .307 | .427 | .476 | 1.000 | .623 | .669 | .599 | .348 | .470 | .348 |
| GO15 | .418 | .486 | .518 | .623 | 1.000 | .646 | .533 | .370 | .445 | .305 |
| GO16 | .309 | .489 | .411 | .669 | .646 | 1.000 | .619 | .333 | .545 | .365 |
| GO17 | .284 | .398 | .375 | .599 | .533 | .619 | 1.000 | .318 | .470 | .392 |
| GO18 | .299 | .340 | .408 | .348 | .370 | .333 | .318 | 1.000 | .453 | .331 |
| GO19 | .191 | .305 | .292 | .470 | .445 | .545 | .470 | .453 | 1.000 | .491 |
| GO20 | .219 | .389 | .248 | .348 | .305 | .365 | .392 | .331 | .491 | 1.000 |

| | Scale Mean if Item Deleted | Scale Variance if Item Deleted | Corrected Item-Total Correlation | Squared Multiple Correlation | Cronbach's Alpha if Item Deleted |
|---|---|---|---|---|---|
| GO11 | 49.94 | 58.599 | .485 | .344 | .873 |
| GO12 | 49.74 | 55.743 | .632 | .485 | .861 |
| GO13 | 49.97 | 57.702 | .623 | .485 | .861 |
| GO14 | 49.60 | 57.277 | .683 | .564 | .857 |
| GO15 | 49.90 | 55.709 | .702 | .552 | .855 |
| GO16 | 49.44 | 57.574 | .705 | .616 | .856 |
| GO17 | 49.42 | 59.551 | .633 | .479 | .862 |
| GO18 | 49.89 | 58.822 | .504 | .306 | .871 |
| GO19 | 49.51 | 58.914 | .572 | .462 | .865 |
| GO20 | 49.14 | 61.575 | .483 | .327 | .871 |

| Mean | Variance | Std. Deviation | N of Items |
|---|---|---|---|
| 55.17 | 70.805 | 8.415 | 10 |

All the corrected item total correlations were larger than .30, indicating that the correlation between each item and the total score calculated from the remaining items was satisfactory. In addition, the squared multiple correlations were all larger than .30. Furthermore the results revealed that none of the items, if deleted, would increase the current Cronbach's alpha. The results of the item analysis of the *learning goal-orientation* scale did not raise any concerns and all the items of the scale were retained.

### 4.4.7 SUMMARY OF ITEM ANALYSIS RESULTS

The results of the item analysis performed on the various scales used to operationalise the latent variables in the structural model are summarised in Table 4.9. The reliability of the final scales used to represent the latent variables in the structural model depicted in Figure 3.1 can generally be considered satisfactory.

Table 4.9

*Summary of the item analysis results*

| Scale | Mean of the final scale | Standard deviation of the final scale | Cronbach's alpha of the final scale | Number of deleted items | Number of items retained in the scale |
|---|---|---|---|---|---|
| Time at task | 30.37 | 7.526 | .841 | 2 | 8 |
| Cognitive engagement | 61.41 | 12.342 | .918 | 0 | 15 |
| Knowledge of cognition | 33.10 | 4.441 | .788 | 1 | 8 |
| Regulation of cognition | 32.80 | 5.558 | .755 | 0 | 9 |
| Academic Self-Leadership | 32.02 | 6.028 | .883 | 0 | 6 |
| Learning motivation | 32.02 | 6.028 | .883 | 0 | 6 |
| Academic Self-Efficacy | 47.62 | 9.280 | .915 | 1 | 12 |
| Mastery Goal orientation | 55.17 | 8.415 | .875 | 0 | 10 |

## 4.5 DIMENSIONALITY ANALYSIS

Specific design intentions guided the construction of the various scales used to operationalise the latent variables in the structural model (Figure 2.5) being tested in this study. Items comprising the scales and the subscales were designed to operate as stimulus sets to which test takers respond with behaviour that is primarily an expression of a specific unidimensional underlying latent variable. Unrestricted principal axis factor analyses with oblique rotation were performed on the various scales and subscales. The objective of the analyses was to evaluate this assumption and to evaluate the success with which each item, along with the rest of the items in the particular subscale, measures the specific latent variable it was designed to reflect. The items that were deleted in the preceding item analyses were not included in the factor analyses. The decision on how many factors are required to adequately explain the observed correlation matrix was based on the eigenvalue-greater–than-one rule and on the scree test (Tabachnick & Fidell, 2001). Factor loadings of items on the factor they were designed to reflect were considered satisfactory if they were greater than .50. The adequacy of the extracted solution as an explanation of the observed inter-item correlation matrix was evaluated by calculating the percentage large (>.05) residual correlations.

### 4.5.1 DIMENSIONALITY ANALYSIS: TIME AT TASK AND COGNITIVE ENGAGEMENT

#### 4.5.1.1 Time at task scale

Items TCE8 and TCE25 were found to be poor items in the item analysis and were therefore not included in the dimentionality analysis of the *time at task* scale.

The correlation matrix indicated that the matrix was factor analysable as all the correlations were bigger than .30 and all were statistically significant ($p<.05$) providing further support that the matrix was factor analysable. The scale obtained a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of .844 and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable. The eigenvalue-greater-than-one rule and the scree plot suggested the extraction of one factor, since there was only one factor that obtained an eigenvalue greater than 1. The scree plot also suggested that one factor should be extracted. The factor matrix indicated that all the items loaded satisfactorily on the one extracted factor ($\lambda_{i1}$>.50). The resultant factor structure is shown in Table 4.10.

Table 4.10

*Factor structure for the time at task scale*

| | Factor |
|---|---|
| | 1 |
| TCE2 | .735 |
| TCE6 | .630 |
| TCE10 | .592 |
| TCE11 | .752 |
| TCE21 | .827 |
| TCE22 | .556 |

33% of the non-redundant residuals obtained absolute values greater than .05. The credibility of the extracted factor solution was therefore reasonably satisfactory. The unidimensionality assumption was therefore corroborated.

### 4.5.1.2 Cognitive engagement scale

None of the items of the *cognitive engagement* scale were deleted during the item analysis. All the items were therefore included in the dimentionality analysis of the *cognitive engagement* scale. The correlation matrix showed that all correlations were statistically significant (p<.05), however not all inter-item correlations were bigger than .30. The scale obtained a KMO of .911 and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable. The eigenvalue-greater-than-one rule suggested the extraction of two factors, since two factors obtained eigenvalues greater than 1. The position of the inflection point in the scree plot confirmed this inference. Therefore, even though, the *cognitive engagement* latent variable was conceptualised as a uni-dimentional construct, two factors had to be extracted to adequately explain the observed correlation matrix. The uni-dimentionality assumption that the 17 underlying items comprising the *Cognitive engagement* sub-scale reflect a single underlying factor is thus rejected. The resultant pattern matrix is presented in Table 4.11.

Table 4.11a

*Rotated factor structure for the cognitive engagement scale*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| **TCE1** | **.853** | -.075 |
| **TCE3** | **.779** | -.027 |
| TCE4 | -.150 | **.842** |
| TCE5 | -.046 | **.717** |
| TCE7 | .026 | **.684** |
| **TCE9** | **.664** | -.005 |
| **TCE12** | **.727** | .049 |
| **TCE13** | **.579** | .067 |
| **TCE14** | **.749** | -.059 |
| **TCE15** | **.490** | .222 |
| TCE16 | .044 | **.632** |
| TCE17 | .035 | **.808** |
| TCE18 | .162 | **.697** |
| TCE19 | .074 | **.509** |
| **TCE20** | **.737** | .041 |
| **TCE23** | **.742** | .068 |
| TCE24 | .190 | **.454** |

Nine items loaded strongly (>.3) onto factor 1 while eight of the items loaded strongly onto factor 2. Items TCE1, 3, 9, 12, 13, 14, 15, 20 and 23 all load on factor 1. The loadings of all the items on factor 1 is quite substantial but for TCE15 that has a loading smaller than .50. These items all seem to share a theme of the amount of time and cognitive effort exerted on academic tasks. Items TCE4, 5, 7, 16, 17, 18, 19 and 24 all load onto factor 2 (>.50). These items all seem to share a theme of concentration and participation/engagement during academic tasks. Both themes can be regarded as meaningful facets of *cognitive engagement.* The results shown in Table 4.11 therefore represent a meaningful fission of the *cognitive engagement* latent variable.

However, the *cognitive engagement* latent variable was originally conceptualised as a unidimentional construct in this study. The two-factor solution is therefore in conflict with the original design intention of the measure. In order to determine how well the items of the *cognitive engagement* scale reflect a single (higher-order) underlying latent variable the analysis was re-run, by forcing the extraction of a single factor. The resultant factor structure is shown in Table 4.11b. All the items loaded above .5 on the single factor and it therefore appears that all the items satisfactorily served as indicators of a second-order *cognitive engagement* factor.

Table 4.11b

*Forced single-factor structure for the cognitive engagement scale*

| | Factor<br>1 |
|---|---|
| TCE18 | **.763** |
| TCE23 | **.748** |
| TCE17 | **.735** |
| TCE20 | **.719** |
| TCE1 | **.718** |
| TCE12 | **.717** |
| TCE3 | **.695** |
| TCE15 | **.656** |
| TCE14 | **.639** |
| TCE7 | **.623** |
| TCE9 | **.612** |
| TCE13 | **.599** |
| TCE16 | **.596** |
| TCE4 | **.590** |
| TCE5 | **.583** |
| TCE24 | **.580** |
| TCE19 | **.518** |

The residuals correlations were computed for both the 2-factor solution as well as the forced single-factor solution. For the 2-factor solution 26% of the non-redundant residuals obtained absolute values greater than .05, thus suggesting that the rotated factor solution provides a credible explanation for the observed inter-item correlation matrix. For the forced single-factor solution however 96 (70.0%) of the residual correlations had absolute values greater than .05.

### 4.5.2 DIMENSIONALITY ANALYSIS: KNOWLEDGE OF COGNITION AND REGULATION OF COGNITION

*Metacognition* consists of two components: *Knowledge of cognition* and *regulation of cognition*. These components were assessed by using version B of the Junior Metacognitive Awareness Inventory (Jr. MAI), developed by Sperling et al. (2002) that comprises two subscales. Separate dimensionality analyses were performed on the *knowledge of cognition* scale and *regulation of cognition* scale.

#### 4.5.2.1 Knowledge of cognition

Items MA14 and MA16 were found to be poor items in the item analysis and were therefore not included in the dimentionality analysis of the *knowledge of cognition* scale.

The correlation matrix indicated that the matrix was factor analysable as the majority of the correlations were bigger than .30 and all were statistically significant ($p<.05$) providing further support that the matrix was factor analysable. The scale obtained a KMO of .830 and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable. The eigenvalue-greater-than-one rule suggested the extraction of one factor. The scree plot also suggested that one factor should be extracted. The factor matrix indicated that all the items loaded satisfactorily on one factor ($\lambda_{i1}>.50$). The resultant factor structure is shown in Table 4.12. The unidimensionality assumption was therefore to some degree supported.

Table 4.12

*Factor structure for the knowledge of cognition scale*

| | Factor<br>1 |
|---|---|
| MA1 | .753 |
| MA2 | .595 |
| MA3 | .656 |
| MA4 | .587 |
| MA5 | .667 |
| MA12 | .541 |
| MA13 | .513 |

A disappointingly large percentage (47%) of the non-redundant residuals obtained absolute values greater than .05. The credibility of the extracted factor solution as an explanation of the observed inter-item correlation matrix was therefore somewhat tenuous.

### 4.5.2.2 Regulation of cognition

Item MA6 was found to be a poor item in the item analysis and was therefore not included in the dimentionality analysis of the *regulation of cognition* scale.

The correlation matrix indicated that the majority of correlations were not bigger than .30. All items except for MA17 and MA18 correlated significantly ($p<.05$) with the rest of the items of the scale. The scale obtained a KMO of .803 providing sufficient evidence that this scale was factor analysable. The Bartlett's Test of Spherically ($p=.00$) allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable. The eigenvalue-greater-than-one rule suggested the extraction of two factors, since two factors obtained eigenvalues greater than 1. Therefore, even though, the *regulation of cognition* latent variable was conceptualised as a uni-dimentional construct, two factors had to be extracted to adequately explain the observed correlation matrix. The pattern matrix is presented in Table 4.13.

Table 4.13

*Rotated factor structure for the regulation of cognition scale*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| MA7 | .112 | **.508** |
| MA8 | **.477** | .111 |
| MA9 | **.400** | **.449** |
| MA10 | .287 | **.561** |
| MA11 | **.452** | .114 |
| MA15 | **.489** | .114 |
| MA17 | -.077 | **.527** |
| MA18 | **.750** | -.167 |

The EFA finding in this study indicated that the *regulation of cognition* scale measured two underlying factors. Consequently, the results obtained in this study were, therefore, in conflict with the original design intention of the scale. Table 4.13 shows that five of the eight items loaded on factor 1 ($\lambda_{i1}$>.30) whereas four factors loaded on factor 2 ($\lambda_{i2}$>.30). However, only one of the items that loaded on factor 1 returned a satisfactory factor loading ($\lambda_{i1}$>.50) whereas three of the four items that loaded on factor two returned satisfactory loadings ($\lambda_{i2}$>.30). Item MA9 loaded on both factors and is considered a complex item and this led to the decision to delete this item. The identity of the two extracted factors was not that readily apparent from the wording of the items that load on the two factors. It did, however, appear as if the items that loaded on factor 2 share the theme of retrospective reflection on the learning success that has been achieved and the effectiveness of the learning strategy that was used. The items that loaded on factor 1, in contrast, seem to share the theme of forward-looking reflection on the anticipated learning success and the anticipated effectiveness of the learning strategy. Both themes can be regarded as meaningful facets of *regulation of cognition*. The results shown in Table 4.13 therefore seem to represent a meaningful fission of the *regulation of cognition* latent variable.

Based on the fact that the proposed structural model treated *cognitive engagement* as a single, undifferentiated latent variable and the Burger (2012) results also provided support for this, the factor analysis was repeated without the complex item MA9, and this time the extraction of a single factor was forced. This assisted in determining whether the items of this scale reflect a single factor. The results indicated that all the items achieved loadings greater than .50, except item MA17 (.347). This proved a strong indication that even though evidence of meaningful factor fission did exist for this instrument, a more general second-order cognitive engagement theme was supported by the results. It was decided to rerun the dimensionality analysis after deleting the item with the lowest factor loading (MA17). The results of the exploratory factor analysis after the deletion of MA17 in which the extraction of a single factor was still requested, are displayed in Table 4.14.

Table 4.14

F*actor matrix when forcing the extraction of a single factor (regulation of cognition without items MA9 and MA17)*

| | Factor |
|---|---|
| | 1 |
| MA7 | .503 |
| MA8 | .506 |
| MA10 | .667 |
| MA11 | .506 |
| MA15 | .588 |
| MA18 | .568 |

Table 4.14 indicates that all the items achieved loadings greater than .50 on the single extracted factor, which is satisfactory. The residual correlations were computed for both the 1-factor and the 2-factor solutions. For the 2-factor solution only 21% of the non-redundant residuals obtained absolute values greater than .05. The credibility of the extracted 2-factor solution was therefore reasonably beyond question. The 1-factor solution also provided a reasonably credible explanation in that 33% of the residual correlations were greater than .05, which was still considered satisfactory.

### 4.5.3 DIMENSIONALITY ANALYSIS: LEARNING MOTIVATION SCALE

The correlation matrix indicated that the matrix was factor analysable as all the correlations were bigger than .30 and all were statistically significant (p<.05) providing further support that the matrix was factor analysable. The scale obtained a KMO of .872 and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable.

The eigenvalue-greater-than-one rule suggested the extraction of one factor. The scree plot also suggested that one factor should be extracted. The factor matrix indicated that all the items loaded quite strongly on the single extracted factor ($\lambda_{i1}$>.50). The resultant factor structure is shown in Table 4.15.

Table 4.15

*Factor structure for the learning motivation scale*

| | Factor |
|---|---|
| | 1 |
| LM1 | .753 |
| LM2 | .668 |
| LM3 | .905 |
| LM4 | .733 |
| LM5 | .728 |
| LM6 | .715 |

Only 20% of the non-redundant residuals obtained absolute values greater than .05. The credibility of the extracted factor solution was therefore reasonably satisfactory. The unidimensionality assumption was therefore corroborated.

### 4.5.4 DIMENSIONALITY ANALYSIS: ACADEMIC SELF-EFFICACY SCALE

Items ASE3 and ASE5 were found to be poor items in the item analysis and were therefore not included in the dimentionality analysis of the *academic self-efficacy* scale.

The correlation matrix indicated that the matrix was factor analysable as all the correlations were bigger than .30 and all were statistically significant (p<.05) providing further support that the matrix was factor analysable. The scale obtained a KMO of .897

and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable.

The eigenvalue-greater-than-one rule and the scree plot both suggested the extraction of one factor. The factor matrix indicated that all the items loaded satisfactorily on the single extracted factor (($\lambda_{i1}$>.50). The resultant factor structure is shown in Table 4.16.

Table 4.16a

*Factor structure for the Academic self-efficacy scale*

| | Factor |
|---|---|
| | 1 |
| ASE1 | .644 |
| ASE2 | .644 |
| ASE4 | .731 |
| ASE6 | .710 |
| ASE7 | .806 |
| ASE8 | .722 |
| ASE9 | .694 |
| ASE10 | .755 |
| ASE11 | .691 |
| ASE12 | .569 |

A disappointingly large percentage (64%) of the non-redundant residual correlations obtained absolute values greater than .05. The credibility of the extracted factor solution was therefore somewhat tenuous. The high percentage large residual correlations suggest the presence of a second factor. When requesting SPSS to extract a second factor the pattern matric shown in Table 4.16b emerged.

Table 4.16b

*Rotated two-factor structure for the Academic self-efficacy scale*

| | Factor | |
|---|---|---|
| | 1 | 2 |
| ASE6 | **.820** | .064 |
| ASE2 | **.760** | .091 |
| ASE7 | **.730** | -.126 |
| ASE4 | **.629** | -.168 |
| ASE12 | **.570** | -.017 |
| ASE1 | **.502** | -.186 |
| ASE10 | -.020 | **-.850** |
| ASE8 | .018 | **-.764** |
| ASE9 | -.013 | **-.761** |
| ASE11 | .038 | **-.697** |
| ASE5 | **.336** | **-.486** |

For the forced two-factor solution a more satisfactory percentage (25.0%) of the nonredundant residual correlations had absolute values greater than .05. This indicated that the forced 2-factor solution provided a more credible account of the process that brought about the observed inter-item orrelation matrix. Factor 2 seemed to represent a factor that represents *an assessment of the capability to achieve set goals*. Factor 1 had a less obvious interpretation. Factor 1 seemed to represent the *belief that obstacles, challenges and problems related to the successful completion of grade 11 could be overcome*. Both these factors could be interpreted as logical facets of a second-order *academic self-efficacy* factor. The results depicted in table 4.16a indicate that all the items may be regarded as satisfactory indicators of the second-order *academic self-efficacy* factor.

### 4.5.5 DIMENSIONALITY ANALYSIS: MASTERY GOAL ORIENTATION SCALE

This study utilised a measure developed by Button et al. (1996). This *goal orientation* instrument has two subscales that measure *performance goal orientation* and *learning goal orientation*. This study only included *learning goal-orientation* in the learning potential structural model. The dimensionality analysis was therefore only performed on the *learning goal-orientation* subscale.

The correlation matrix showed that all correlations were statistically ignificant (p<.05), although not all correlations were bigger than .30. The scale obtained a KMO of .873 and the Bartlett's Test of Spherically allowed for the identity matrix null hypothesis to be rejected, thus there was strong evidence that the correlation matrix was factor analysable. The eigenvalue-greater-than-one rule and the scree plot both suggested the extraction of one factor. The factor matrix indicated that all the items loaded satisfactorily on the single extracted factor (>.50). The resultant factor structure is shown in Table 4.17.

Table 4.17

*Factor structure for the mastery goal orientation scale*

| | Factor<br>1 |
|---|---|
| GO12 | .628 |
| GO13 | .598 |
| GO14 | .782 |
| GO15 | .766 |

| | |
|---|---|
| GO16 | .816 |
| GO17 | .720 |
| GO19 | .621 |
| GO20 | .507 |

42% of the non-redundant residuals obtained absolute values greater than .05. The credibility of the extracted factor solution was therefore somewhat tenuous. Nonetheless the findings suggest that the position that the *mastery goal orientation* subscale is unidimensional is tenable.

### 4.5.6 DIMENSIONALITY ANALYSIS: ACADEMIC SELF-LEADERSHIP SCALE

*Academic self-leadership* was measured by adapting Houghton and Neck's (2002) Revised Self-Leadership Questionnaire (RSLQ). The RSLQ consists of 35 items in nine distinct sub-scales namely self-observation, self-goal setting, self-reward, self-punishment, natural rewards, self-cueing, evaluating beliefs and assumptions, visualising successful performance and self-talk which represents the three primary self-leadership dimensions (Houghton & Neck, 2002).The three second-order self-leadership dimensions are behaviour focused strategies, natural reward-focused strategies and constructive thought-focused strategies. For the purpose of this study 12 items were deleted from the orginal scale and the remaining 23 items were adapted to some degree.

The majority of the nine scales in the reduced RSLQ used in this study contain only two items (see Table 3.2). This precludes the use of exploratory factor analysis to examine the uni-dimensionality assumption. It was therefore decided to rather examine the fit of the second-order measurement model. The first-order self-leadership dimensions of *self-goal setting*, *self-reward*, *self-punishment*, *self-observation*, and *self-cueing* load on the second-order self-leadership dimension *behaviour focused strategies*. *Natural reward self-leadership* is measured with a single 4-item scale. The first-order self-leadership dimensions of *visualising successful performance, self-talk* and *evaluating beliefs and assumptions* load on the second-order self-leadership dimension *constructive thought-focused strategies* (Houghton & Neck, 2002).

The first-order RSLQ measurement model fitted closely (RMSEA=.045: p>.05). All the unstandardised factor loadings were statistically significant (p<.05) and all the completely standardised factor loadings were larger that the critical cutoff value of .50 and all items four loaded .71 or higher on their designated first-order self-leadership dimension. The second-order RSLQ measurement model failed to converge. The problem was due to inadmissible high correlations between the three second-order factors. A second-order measurement model was subsequently fitted in which all nine first-order academic self-leadership dimensions loaded on a single higher-order self-leadership factor. This model converged, showed close fit (RMSEA=.047: p>.05). All the unstandardised factor loadings were statistically significant (p<.05) and 19 of the completely standardised factor loadings exceeded .71 with four completely standardised loadings of .66, .68, .68 and .69. The unstandardised $\gamma$ coefficients expressing the slope of the regression of the first-order self-leadership dimensions onto the single second-order factor were all statistically significant (p<.05). The completely standardised $\gamma$ coefficients varied between .97 and .34. *Self-talk* (.50), *self-reward* (.34), *evaluating beliefs and assumptions* (.69), *self-punishment* (.61) and *self-cuing* (.54) returned the lowest loading. The remainder of the the first-order self-leadership dimensions all obtained $\gamma$ coefficients of .78 or higher.

The foregoing results justified the conclusion that the RSLQ measures nine *academic self-leadership* dimensions as indicated in Table 3.2 and that these nine first-order self-leadership dimensions may be interpreted as measures of a single higher-order self-leadership factor. This study, however, failed to obtain support for the position that the RSLQ measures three second-order self-leadership dimensions. This to some degree erodes confidence in the measures of the RSLQ.

## 4.6 CONCLUSIONS DERIVED FROM THE ITEM- AND DIMENSIONALITY ANALYSIS

The item analyses revealed that six scales achieved alpha values exceeding the desired threshold of .80 thus indicating sufficient internal consistency on those scales. The *knowledge of cognition* scale and *regulation of cognition* scale, however revealed, only marginally acceptable levels of internal consistency. The level of internal consistency for these two subscales was, however, still sufficiently high not to threaten the retention of these constructs in the structural model. At a more detailed level, the item statistics revealed that there were a number of poor items and after gaining a basket of evidence incriminating these items, five items were deleted across the eight scales.

With regard to the dimensionality analyses, six of the scales passed the uni-dimensionality assumption as was originally hypothesised and two of the scales did not. Two factors had to be extracted for the *regulation of cognition* and the *cognitive engagement* subscales. In both cases the factor fission produced meaningful facets of the original factors. In the case of both the *cognitive engagement* and the *regulation of cognition* subscales the forced extraction of a single factor produced satisfactory solutions.

## 4.7 ITEM PARCELING

When using LISREL to evaluate a structural model, the individual items comprising the scales used to operationalise the latent variables comprising the model can be used. This, however, quite often leads to cumbersome comprehensive models in which a large number of model parameters have to be estimated. Such models in turn require large samples so as to ensure an adequate ratio of observations to freed parameters. A solution is to form at least two parcels of indicator variables from the items of each scale used to operationalise the latent variables in the structural model. Only items that remained in the scale after the item and dimensionality analyses were used in the calculation of indicator variables to represent each of the latent variables in the structural model.

## 4.8 DATA SCREENING PRIOR TO CONFIRMATORY FACTOR ANAYLSIS AND THE FITTING OF THE STRUCTURAL MODEL

Multivariate statistics in general and structural equation modelling in particular are based on a number of critical assumptions. Before proceeding with the main analyses it was necessary to assess the extent to which the data complied with these assumptions (Tabachnick & Fidell, 2007). Failure of the data to satisfy these assumptions can seriously erode the quality of obtained solutions. The effect of non-normality in particular was considered. The default method of estimation when fitting measurement and structural models to continuous data (maximum likelihood) assumes that the distribution of indicator variables follows a multivariate normal distribution (Mels, 2003). Failure to satisfy this assumption results in incorrect standard errors and chi-square estimates (Du Toit & Du Toit, 2001; Mels, 2003).

The results of the item and exploratory factor analysis warranted the use of the retained items in the formation of item parcels for each of the latent variables. Indicator variables (i.e., parcels) were created with SPSS by combining the even numbered items and the uneven numbered items in two linear composites. The composite indicator variables were subsequently imported into PRELIS. The parcels were treated as continuous variables.

The univariate and multivariate normality of the composite item parcels in this study was evaluated via PRELIS. The univariate tests examine each variable individually for departures from normality. This is done by examining whether the standardised coefficients of skewness and kurtosis are significantly different from zero. Departures from normality are indicated by significant skewness and/or kurtosis values. If any of the observed variables deviate substantially from univariate normality, then the multivariate distribution cannot be normal. However, the converse is not true; if all the univariate distributions are normal, it does not necessarily mean that multivariate normality would have been achieved. Consequently, it is also important to examine multivariate values of skewness and kurtosis and not solely investigate univariate normality.

The indicator variables were firstly evaluated in terms of their univariate and multivariate normality. Thereafter, if required, the data was normalised through PRELIS after which the transformed indicator variables were again evaluated in terms of their univariate and multivariate normality.

The results of the tests of univariate and multivariate normality of the learning potential indicator variable distributions are depicted in Tables 4.18 and 4.19.

### 4.8.1 RESULTS BEFORE NORMALISATION

Table 4.18

*Test of univariate normality before normalisation*

| | **Skewness** | | **Kurtosis** | | **Skewness and Kurtosis** | |
|---|---|---|---|---|---|---|
| **Variable** | **Z-Score** | **P-Value** | **Z-Score** | **P-Value** | **Chi-Square** | **P-Value** |
| AFR | -1.185 | 0.236 | -0.881 | 0.378 | 2.181 | 0.336 |
| MATH | -1.939 | 0.053 | -1.542 | 0.123 | 6.137 | 0.046 |
| ENG | -2.644 | 0.008 | -1.199 | 0.231 | 8.427 | 0.015 |
| ASL_1 | -2.011 | 0.044 | 0.334 | 0.739 | 4.157 | 0.125 |
| ASL_2 | -0.786 | 0.432 | -1.383 | 0.167 | 2.530 | 0.282 |

| | | | | | | |
|---|---|---|---|---|---|---|
| LM_1 | -3.829 | 0.000 | 1.111 | 0.267 | 15.897 | 0.000 |
| LM_2 | -3.654 | 0.000 | 1.147 | 0.251 | 14.670 | 0.001 |
| ASE_1 | -0.947 | 0.344 | -3.524 | 0.000 | 13.313 | 0.001 |
| ASE_2 | -2.616 | 0.009 | -0.449 | 0.654 | 7.044 | 0.030 |
| LGO_1 | -5.239 | 0.000 | 2.511 | 0.012 | 33.748 | 0.000 |
| LGO_2 | -3.862 | 0.000 | 2.243 | 0.025 | 19.945 | 0.000 |
| TTASK_1 | -1.914 | 0.056 | 0.097 | 0.922 | 3.671 | 0.160 |
| TTASK_2 | -1.795 | 0.073 | 0.010 | 0.992 | 3.222 | 0.200 |
| TCE_1 | -0.628 | 0.530 | -1.416 | 0.157 | 2.399 | 0.301 |
| TCE_2 | -0.591 | 0.555 | -0.999 | 0.318 | 1.347 | 0.510 |
| MR_1 | -1.902 | 0.057 | 0.227 | 0.821 | 3.617 | 0.160 |
| MR_2 | -2.909 | 0.004 | 0.935 | 0.350 | 9.338 | 0.009 |
| MK_1 | -6.219 | 0.000 | 3.296 | 0.001 | 49.538 | 0.000 |
| MK_2 | -4.369 | 0.000 | 2.531 | 0.011 | 25.492 | 0.000 |

Table 4.19

*Test of multivariate normality before normalisation*

| | Skewness | | | Kurtosis | | Skewness and Kurtosis | |
|---|---|---|---|---|---|---|---|
| **Value** | **Z-Score** | **P-Value** | **Value** | **Z-Score** | **P-Value** | **Chi-Square** | **P-Value** |
| 62.846 | 12.662 | 0.000 | 454.905 | 9.321 | 0.000 | 247.203 | 0.000 |

The exceedence probabilities associated with the chi-square value for skewness and kurtosis indicates that 11 of the 19 indicator variables failed the test of univariate normality (p<.05). Furthermore, the null hypothesis that the data follows a multivariate normal distribution also had to be rejected ($\chi^2$=247.203; p<.05). Since the quality of the solution obtained in the structural equation modelling is to a large extent dependent on multivariate normality, it was decided to normalise the variables through PRELIS. The results of the test for univariate normality on the normalised indicator variables are presented in Table 4.20 and the results of the test for multivariate normality in Table 4.21.

### 4.8.2 RESULTS AFTER NORMALISATION

Table 4.20

*Test of univariate normality after normalisation*

| | Skewness | | Kurtosis | | Skewness and Kurtosis | |
|---|---|---|---|---|---|---|
| **Variable** | **Z-Score** | **P-Value** | **Z-Score** | **P-Value** | **Chi-Square** | **P-Value** |
| AFR | -0.002 | 0.998 | 0.092 | 0.926 | 0.009 | 0.996 |
| MATH | 0.000 | 1.000 | 0.0989 | 0.922 | 0.010 | 0.995 |
| ENG | 0.018 | 0.986 | 0.030 | 0.976 | 0.001 | 0.999 |
| ASL_1 | -0.007 | 0.994 | 0.089 | 0.929 | 0.008 | 0.996 |
| ASL_2 | 0.006 | 0.995 | 0.083 | 0.934 | 0.007 | 0.997 |
| LM_1 | -0.313 | 0.754 | -0.361 | 0.718 | 0.228 | 0.892 |
| LM_2 | -0.342 | 0.732 | -0.436 | 0.663 | 0.307 | 0.858 |
| ASE_1 | -0.073 | 0.942 | -0.185 | 0.854 | 0.039 | 0.980 |

| | | | | | | |
|---|---|---|---|---|---|---|
| ASE_2 | -0.121 | 0.903 | -0.139 | 0.890 | 0.034 | 0.983 |
| LGO_1 | -0.251 | 0.802 | -0.286 | 0.775 | 0.145 | 0.930 |
| LGO_2 | -0.258 | 0.797 | -0.379 | 0.705 | 0.210 | 0.900 |
| TTASK_1 | -0.130 | 0.897 | -0.211 | 0.833 | 0.061 | 0.970 |
| TTASK_2 | -0.079 | 0.937 | -0.046 | 0.963 | 0.008 | 0.996 |
| TCE_1 | 0.007 | 0.994 | -0.103 | 0.918 | 0.011 | 0.995 |
| TCE_2 | -0.017 | 0.986 | 0.066 | 0.948 | 0.005 | 0.998 |
| MR_1 | -0.195 | 0.845 | -0.359 | 0.719 | 0.167 | 0.920 |
| MR_2 | -0.164 | 0.870 | -0.298 | 0.766 | 0.115 | 0.944 |
| MK_1 | -2.034 | 0.042 | -2.173 | 0.030 | 8.860 | 0.012 |
| MK_2 | -0.981 | 0.327 | -1.361 | 0.174 | 2.815 | 0.245 |

Table 4.21

*Test of multivariate normality after normalisation*

| | **Skewness** | | | **Kurtosis** | | **Skewness and Kurtosis** | |
|---|---|---|---|---|---|---|---|
| **Value** | **Z-Score** | **P-Value** | **Value** | **Z-Score** | **P-Value** | **Chi-Square** | **P-Value** |
| 53.231 | 7.815 | 0.000 | 438.168 | 7.488 | 0.000 | 117.148 | 0.000 |

The results indicate that the normalisation procedure succeeded in rectifying the univariate normality problem on the indicator variables and that all the individual variables are displaying a univariate normal distribution. The results indicate that even after the normalisation procedure, the null hypothesis that the data follows a multivariate normal distribution still had to be rejected ($\chi^2$=117.148; p<.05). The normalisation procedure did, however, succeed in reducing the deviation of the observed indicator distribution from the theoretical multivariate normal distribution as is evident by the decrease in the chi-square statistic.

Maximum likelihood is the default method when fitting measurement and structural models to continuous data but requires the data to follow a multivariate normal distribution. Since normalisation did not have the desired effect and the data still did not meet the multivariate normality assumption after normalisation, the use of an alternative estimation method, more suited to the data, was considered. The robust maximum likelihood estimation technique was therefore used for the evaluation of the measurement and structural models as that is the suggested estimation technique for fitting models to non-normal continuous data. Since the normalisation had the effect of reducing the deviation of the observed indicator distribution from the theoretical multivariate normal distribution the normalised data set was used in the subsequent analyses.

## 4.9 EVALUATING THE FIT OF THE MEASUREMENT MODEL

The measurement model represents the relationship between the *learning potential* latent variables and their corresponding indicator variables. The fitted measurement model is expressed through equation 1:

$\mathbf{X}=\mathbf{\Lambda}_x\xi + \delta$ ------------------------------------------------------------------------------- 1

$\mathbf{\Lambda}_x$ represents the matrix of lambda coefficients ($\lambda$), which indicate the loading of the indicators on their designated latent variable. The vector of latent variables is signified by $\xi$, whereas $\delta$ is used to indicate a vector of measurement error terms (Diamantopoulos & Siguaw, 2000). **X** represents a vector of composite indicator variables. All the off-diagonal elements in the variance-covariance matrix $\mathbf{\Phi}$ were freed to be estimated. The variance-covariance matrix $\mathbf{\Theta}_\delta$ was defined as a diagonal matrix.

Ultimately, the purpose of the confirmatory factor analysis is to determine whether the operationalisation of the latent variables comprising the structural model in terms of item parcels was successful. The operationalization can be considered successful if the measurement model specified in equation 1 can successfully reproduce the observed covariance matrix (i.e., if the model fits well), if the factor loadings are statistically significant ($p<.05$) and large ($\lambda_{ij}\geq.71$) and if the $\mathbf{\Theta}_\delta$ estimates indicate that no more than 50% of the variance in the indicator variables can be explained in terms of measurement error and therefore that at least 50% of the variance in the indicator variables can be explained in terms of the latent variables they were tasked to reflect.

A visual representation of the fitted measurement model is provided in Figure 4.2.

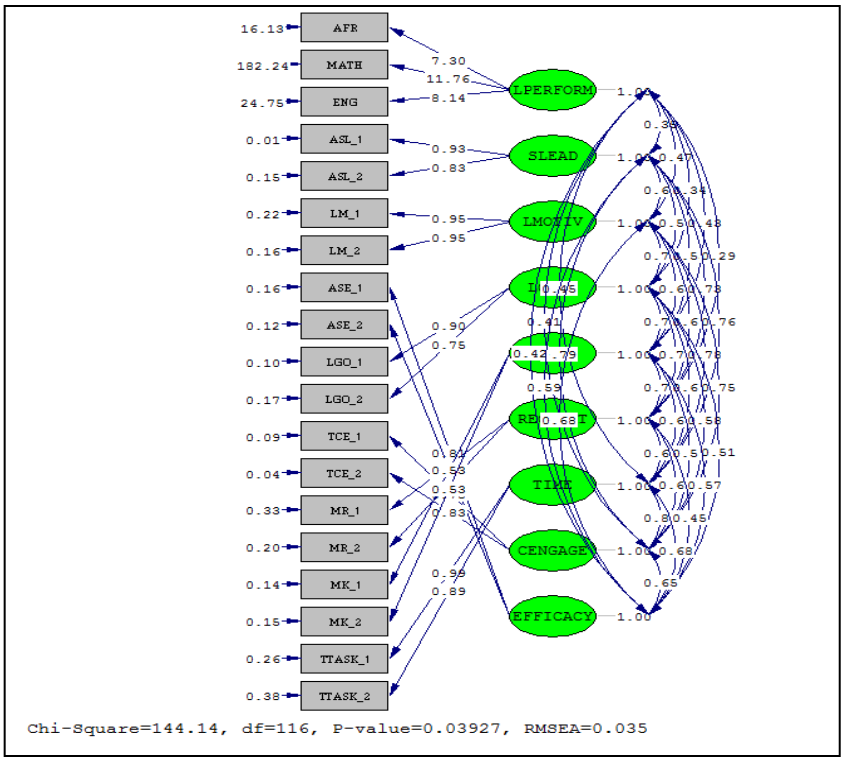

***Figure 4.2*** Representation of the fitted learning potential measurement model (completely standardised solution)

The results of the analysis will be discussed below in terms of:

a) an evaluation of overall model fit, based on the array of model fit indices as reported by LISREL;

b) An interpretation of the measurement model parameter estimates;

c) The standardised residuals; and

d) The modification indices

### 4.9.1 ASSESSING THE OVERALL GOODNESS –OF-FIT OF THE MEASUREMENT MODEL

The purpose of assessing the overall fit of a model is to determine the degree to which the model as a whole is consistent with the empirical data at hand (Diamantopoulos & Siguaw, 2000). A wide range of goodness-of-fit indices have been developed that can be used as a summary of the model's overall fit. However, Diamantopoulos and Siguaw (2000) warn that none of these indices are unequivocally superior to the rest in all conditions, and that specific indices have been shown to operate fairly differently under a range of conditions. These authors assert that sample size, estimation procedure, model complexity, degree of multivariate normality and variable independence, or any combination thereof, may influence the statistical power of the resulted indices. A decision on the fit of the model should therefore not be based on any single fit index but rather on an integrated evaluation of the whole spectrum of fit indices that are produced. The results of the full range of fit indices (both comparative and absolute) are reported in Table 4.22.

Table 4.22

*Goodness of fit statistics for the learning potential measurement model*

Goodness of Fit Statistics
Degrees of Freedom=116
Minimum Fit Function Chi-Square=171.922 (P=0.000580)
Normal Theory Weighted Least Squares Chi-Square=159.316 (P=0.00474)
Satorra-Bentler Scaled Chi-Square=144.142 (P=0.0393)
Chi-Square Corrected for Non-Normality=346.945 (P=0.0)
Estimated Non-centrality Parameter (NCP)=28.142
90 Percent Confidence Interval for NCP=(1.637 ; 62.812)
Minimum Fit Function Value=0.864
Population Discrepancy Function Value (F0)=0.141
90 Percent Confidence Interval for F0=(0.00823 ; 0.316)
Root Mean Square Error of Approximation (RMSEA)=0.0349
90 Percent Confidence Interval for RMSEA=(0.00842 ; 0.0522)
P-Value for Test of Close Fit (RMSEA<0.05)=0.922
Expected Cross-Validation Index (ECVI)=1.468
90 Percent Confidence Interval for ECVI=(1.335 ; 1.642)
ECVI for Saturated Model=1.910
ECVI for Independence Model=40.782
Chi-Square for Independence Model with 171 Degrees of Freedom=8077.580
Independence AIC=8115.580
Model AIC=292.142
Saturated AIC=380.000
Independence CAIC=8197.248
Model CAIC=610.217
Saturated CAIC=1196.680
Normed Fit Index (NFI)=0.982
Non-Normed Fit Index (NNFI)=0.995

Parsimony Normed Fit Index (PNFI)=0.666
Comparative Fit Index (CFI)=0.996
Incremental Fit Index (IFI)=0.996
Relative Fit Index (RFI)=0.974
Critical N (CN)=214.085
Root Mean Square Residual (RMR)=0.323
Standardised RMR=0.0304
Goodness of Fit Index (GFI)=0.922
Adjusted Goodness of Fit Index (AGFI)=0.873
Parsimony Goodness of Fit Index (PGFI)=0.563

The chi-square statistics ($\chi^2$) is the statistic traditionally used to evaluate the overall model fit in covariance structure models and provides a test of the hypothesis of exact model fit. This hypothesis is displayed below:

$$H_{020}\text{: RMSEA=0}$$

$$H_{a20}\text{: RMSEA>0}$$

The p-value associated with the $\chi^2$ (p=.000580) indicates a significant test statistic (p<.05). This suggests that there is a significant discrepancy between the covariance matric implied by the measurement model and the observed covariance matrix, thus resulting in the rejection of the exact fit null hypothesis (Kelloway, 1998). The measurement model is therefore not able to reproduce the observed covariance matrix to a degree of accuracy in the sample that can be explained by sampling error only. The discrepancy between the observed and reproduced covariance matrices in the sample would unlikely have arisen by chance if the exact fit null hypothesis is true in the population. $H_{020}$ is therefore rejected.

A statistically significant chi-square results in the rejection of the null hypothesis implying imperfect model fit and possible rejection of the model. Although the chi-square statistic seems to offer an attractive measure of the model's fit, caution needs to be exerted as it is sensitive to departures from multivariate normality, sample size, and also assumes that the model fits perfectly in the population. This represents a somewhat unrealistic position that a model is able to reproduce an observed covariance matrix to a degree of accuracy that could be explained in terms of sampling error only. It is suggested, due to these reasons, that it should be regarded as a goodness (or badness)-of-fit measure in the sense that large $\chi^2$ values correspond to bad fit and small $\chi^2$ values to good fit. The degrees of freedom serve as a standard by which to judge whether $\chi^2$ is large or small. A well-fitting model would ideally be indicated by a chi-square value that approximates the degrees of freedom. In practice, $\chi^{2/}$df (144.142/116=1.24) for the measurement model suggests that the model fits the data well. Ratios less than 2 have, however, been interpreted as indicating over-fitting. Judged by these standards the model could, when viewed optimistically, be seen to fit the data well, or viewed somewhat pessimistically, be seen to have over-fitted. Kelloway (1998), however, comments that the guidelines indicative of good fit (ratios between 2 and 5) have very little justification other than the researcher's personal modelling experience, and does not advise a strong reliance on the normed chi-square.

As stated earlier, the assumption of the chi-square that the model fits the population perfectly is highly unlikely and thus the rejection of the null hypothesis of exact model fit was not surprising. It is therefore sensible to rather assess the degree of lack of fit of the model. The non-centrality parameter (NCP) is used to assess the degree of lack of fit of the model. the NCP will therefore test that the model fit is not perfect. An estimate of $\lambda$ is obtained by subtracting the degrees of freedom from the chi-square statistic. The larger the $\lambda$, the farther apart the true hypothesis is from the null hypothesis. A NCP of 28.142 was obtained with a 90 percent confidence interval of (1.637; 62.812).

The root mean square of approximation (RMSEA) is generally regarded as one of the most informative fit indices, as it takes into consideration the complexity of the model. The root mean square of approximation (RMSEA) is a popular measure of fit that expresses the difference between the observed and estimated sample covariance matrices. The RMSEA-value shows how well the model, with unknown but optimally chosen parameter values, fits the population covariance matrix if it were available. Theron (2010) and Diamantopoulos and Siguaw (2000) suggest that values below .05 are generally regarded as indicative of a good model fit in the sample, values above .05 but less than .08 indicate reasonable fit, values greater than .08 but less than .10 show mediocre fit, and values exceeding .10 are generally regarded as indicative of poor fit.

This model achieved a RMSEA value of .0349 with a confidence interval of (.00842; .0522) which indicated good close fit in the sample. The probability of obtaining this sample RMSEA estimate value under the assumption that the model fits closely in the population (i.e., RMSEA=.05) was sufficiently high (.922) not to discard this assumption as a permissible position. This indicates that the null hypothesis of close model fit ($H_{021}$:

RMSEA≤.05) is not rejected at a 5% significance level (p>.05). The 90 percent confidence interval for RMSEA should be considered in collaboration with the RMSEA-value, as it assists in the evaluation of the precision of the fit statistic. Byrne (2001) explains that if this interval is small, it is indicative of a higher level of precision in the reflection of the model fit in the population. Since the 90 percent confidence interval for RMSEA (.00842; .0522) was small and its upper bound fell just marginally above the target value of .05, it provided further support of good close model fit. Hence it was concluded that this model provided a plausible explanation and an approximate reproduction of the observed covariance matrix.

The expected cross-validation Index (ECVI) focuses on overall error. This value expresses the difference between the reproduced sample covariance matrix derived from fitting the model on the sample at hand, and the expected covariance that would be obtained in another sample of equivalent size, from the same population (Byrne, 1998; Diamantopoulos & Siguaw, 2000). It, therefore, essentially focuses on the difference between $\Sigma$ and $\Sigma(\theta)$. To assess the model's ECVI, it must be compared to the ECVI of the independence model and the ECVI of the saturated model. The model ECVI (1.468) is smaller than the value obtained for the independence model (40.782). The model ECVI (1.468) is also smaller than the saturated model (1.910). Therefore, a model more closely resembling the fitted model seems to have a better chance of being replicated in a cross-validation sample than the saturated or independence models.

Akaike's information criterion (AIC) and the consistent version of AIC (CAIC) comprises what are known as information criteria and are used to compare models (Van Heerden, 2013). Information criteria attempt to incorporate the issue of model parsimony in the assessment of model fit by taking the number of estimated parameters into account. The model AIC and CAIC must be compared to those of the independence- and the saturated models, similar to the EVCI. The AIC (292.142) suggested that the fitted measurement model provided a more parsimonious fit than the independent model (8115.580) and the saturated model (380.000). Similarly, the CAIC (610.217) also achieved a value lower than both the independence model (8197.248) and the saturated model (1196.680). These results provide further support that the fitted model stands a better chance of being replicated in a cross-validation sample than the independence model and the saturated model.

The comparative fit indices (CFI) contrast how much better the given model reproduces the observed covariance matrix than a (a priori) baseline model which is usually an independence or null model. The fit indices include the normed fit index (NFI=.982), the non-normed fit index (NNFI=.995), the comparative fit index (CFI=.996), the incremental fit index (IFI=.996), and relative fit index (RFI=.974). The closer these values are to unity (1.00), the better the fit of the model. However, Diamantopoulos and Siguaw (2000) suggest that values above .90 provide a strong indication of a well-fitting model. The results reflected in Table 4.22, show that all these values fell comfortably above the .90 level. This provided a strong indication of satisfactory comparative fit relative to the independent model.

The critical N (CN) shows the size that a sample must achieve in order to acknowledge the data fit of a given model on a statistical basis (Van Heerden, 2013). As a rule-of-thumb, a critical N greater than 200 is suggestive that a model is a sufficient representation of the data. The results presented in Table 4.22 show that this model achieved a CN of 214.085, which was above the stated threshold.

The standardised root mean residual (SRMR) is considered as a summary measure of standardised residuals, which represent the average difference between the elements of the sample covariance matrix and the fitted covariance matrix. It refers to the standardised square root of the mean of the squared residuals, in other words, an average of the residuals between individual observed and estimated covariance and variance terms. Lower SRMR values indicate better fit and higher values symbolise worse fit. So, if the model fit is good, the fitted residuals should be small (Diamantopoulos & Siguaw, 2000). Kelloway (1998) suggested that SRMR-values that are smaller than .05 are indicative of an acceptable fit. The model produced a SRMR of .0304, which is significantly lower than the .05 cut-off value, thus indicative of good model fit.

The goodness-of-fit index (GFI) is an indicator of the relevant amount of variance and covariance accounted for by the model and this shows how closely the model comes to perfectly reproducing the observed covariance matrix. The adjusted goodness-of-fit index (AGFI) is GFI adjusted for the degrees of freedom in the model. These indexes above reflect how closely the model comes to perfectly reproducing the sample covariance matrix (Diamantopoulos & Siguaw, 2000). Values of GFI and AGFI range between 0 and 1. GFI and AGFI values greater than .90 are indicative of acceptable fit. The model achieved a GFI of .922 and an AGFI of .873 both indicative of good model fit.

The assessment of parsimonious fit acknowledges that model fit can always be improved by adding more paths to the model and estimating more parameters until perfect fit is achieved in the form of a saturated or just-identified model with no degrees of freedom (Kelloway, 1998). The parsimonious normed fit index (PNFI=.666) and the parsimonious goodness-of-fit index (PGFI=.563) approach model fit from this perspective. PNFI and PGFI range from 0 to 1, but do not have a recommendation on how high these values should be to achieve parsimonious fit. It has however been suggested that neither index is likely to reach the .90 cut-off used for other fit indices. According to Kelloway (1998) and Hair, Black, Babin, Anderson, and Tatham (2006) these indices are more meaningfully used when comparing two competing theoretical models and are not very useful indicators in this CFA analysis. For this reason emphasis will not be placed on the relatively low values achieved in these indices when evaluating model fit in this study.

The following set of fit indices contrast how much better the given model fits reproduce the observed covariance matrix than a baseline model which is usually an independence or null model. The fit indices presented include the normed fit index (NFI=.982), the non-normed fit index (NNFI=.995), the comparative fit index (CFI=.996), the incremental fit index (IFI=.996) and the relative fit index (RFI=.974). All indices in this group have a range between 0 and 1 (except the NNFI that can take values greater than 1) with values close to 1 (at least greater than .90) representing good fit. All values reported above fall comfortably above the .90 cut-off indicating good model fit.

In conclusion, the results of the overall fit assessment, especially the RMSEA, SRMR, and the NFI, NNFI, CFI, IFI, and RFI, seem to suggest that good measurement model fit was achieved.

### 4.9.2 INTERPRETATION OF THE MEASUREMENT MODEL PARAMETER ESTIMATES

Through the examination of the magnitude and the statistical significance of the slope of the regression of the observed variables on their respective latent variables, an indication of the validity of the measure is obtained. In other words, if a measure is designed to provide a valid reflection of a specific latent variable, then the slope of the regression of $X_i$ on $\xi_i$ in the fitted measurement model has to be substantial and statistically significant (Diamantopoulos & Sigauw, 2000).

Table 4.23 contains the regression coefficients of the regression of the manifest variables on the latent variables they were linked to. The unstandardised $\mathbf{\Lambda}_x$ matrix indicates the average change in the indicator variable associated with one unit increase in the latent variable. The regression coefficients/loadings of the manifest variables on the latent variables are significant ($p<.05$) if the absolute value of the t-values exceed 1.96. Significant indicator loadings provide validity evidence in the favour of the indicators (Diamantopoulos & Sigauw, 2000).

Table 4.23 indicates the unstandardised factor loading matrix. All the indicator variables load significantly on the latent variables that they were designed to reflect. Table 4.23 therefore indicates that all 19 factor loading null hypotheses $H_{0i}$: $\lambda_{jk}=0$; i=22, 23, …, 40; j=1, 2, …, 19; k=1, 2, …, 9 can be rejected.

Table 4.23

*Unstandardised lambda matrix*

| | LPERFORM | SLEAD | LMOTIV | LGOAL | KNOW | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|---|---|
| **AFR** | 7.296[16]<br>(0.505)<br>14.434 | | | | | | | | |
| **MATH** | 11.763<br>(1.146)<br>10.261 | | | | | | | | |
| **ENG** | 8.140<br>(0.606)<br>13.423 | | | | | | | | |
| **ASL_1** | | 0.934 | | | | | | | |

---

[16] The first value represents the unstandardised factor loading estimate, the second value the standard error of the estimate and the third value the z test statistic.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (0.047)<br>20.056 | | | | | | | |
| **ASL_2** | 0.832<br>(0.050)<br>16.744 | | | | | | | |
| **LM_1** | | 0.950<br>(0.058)<br>16.407 | | | | | | |
| **LM_2** | | 0.950<br>(0.055)<br>17.193 | | | | | | |
| **ASE_1** | | | | | | | | 0.814<br>(0.050)<br>16.443 |
| **ASE_2** | | | | | | | | 0.779<br>(0.048)<br>16.106 |
| **LGO_1** | | | 0.895<br>(0.052)<br>17.074 | | | | | |
| **LGO_2** | | | 0.753<br>(0.046)<br>16.472 | | | | | |
| **TCE_1** | | | | | | | 0.777<br>(0.043)<br>17.877 | |
| **TCE_2** | | | | | | | 0.834<br>(0.044)<br>19.083 | |
| **MR_1** | | | | | 0.608<br>(0.055)<br>11.008 | | | |
| **MR_2** | | | | | 0.511<br>(0.043)<br>11.746 | | | |
| **MK_1** | | | | 0.534<br>(0.037)<br>14.548 | | | | |
| **MK_2** | | | | 0.530<br>(0.037)<br>14.180 | | | | |
| **TTASK_1** | | | | | | 0.992<br>(0.062)<br>15.904 | | |
| **TTASK_2** | | | | | | 0.894<br>(0.063)<br>14.210 | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

According to Diamantopoulos and Sigauw (2000), a problem with the interpretation of the magnitude of the unstandardised factor loadings is that it is difficult to compare the validity of different indicators measuring different constructs because the unit of measurement differs across the latent variables. They therefore recommend that the magnitudes of the standardised loadings are also inspected. The completely standardised factor loading matrix is presented in Table 4.24. The values shown in this table could be interpreted as the regression slopes of the regression of the standardised indicator variables on the standardised latent variables. The completely standardised factor loadings therefore indicate the average change expressed in standard deviation units in the indicator variable associated with one standard deviation change in the latent variable. Factor loading estimates were considered to be satisfactory if the completely standardised factor loading estimates exceeded .71 (Hair et al., 2006). Satisfaction of this criterion would imply that at least 50% of the variance in the indicator variables can be explained by the latent variables they were assigned to represent. Interpreted in this sense (refer to Table 4.27), all loadings are greater than .71 except for the loading of *Mathematics* on *Learning Performance* which could be regarded as somewhat problematic.

Table 4.24

*Completely standardised lambda matrix*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **LGOAL** | **KNOW** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|---|---|
| **AFR** | 0.876 | | | | | | | | |
| **MATH** | **0.657** | | | | | | | | |
| **ENG** | 0.853 | | | | | | | | |
| **ASL_1** | | 0.996 | | | | | | | |
| **ASL_2** | | 0.909 | | | | | | | |
| **LM_1** | | | 0.895 | | | | | | |
| **LM_2** | | | 0.923 | | | | | | |
| **ASE_1** | | | | | | | | | 0.898 |
| **ASE_2** | | | | | | | | | 0.914 |
| **LGO_1** | | | | 0.942 | | | | | |
| **LGO_2** | | | | 0.879 | | | | | |
| **TCE_1** | | | | | | | | 0.936 | |
| **TCE_2** | | | | | | | | 0.974 | |
| **MR_1** | | | | | | 0.725 | | | |
| **MR_2** | | | | | | 0.750 | | | |
| **MK_1** | | | | | 0.821 | | | | |
| **MK_2** | | | | | 0.812 | | | | |
| **TTASK_1** | | | | | | | 0.888 | | |
| **TTASK_2** | | | | | | | 0.824 | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Determining the validity of the indicators in addition requires an investigation of the squared multiple correlations ($R^2$) of the indicators. A high $R^2$ value (>.50) would be indicative of high validity of the indicator as this indicates that a satisfactory proportion of variance in each indicator variable is explained by its underlying latent variable. The results are indicated in Table 4.25. *Mathematics* is the only indicator variable that reported a $R^2$ lower than .50. This is problematic as it means that more of the variance in this indicator can be attributed to systematic and random measurement error than can be attributed to *Learning Performance*.

Table 4.25

*Squared multiple correlations for item parcels*

| AFR | MATH | ENG | ASL_1 | ASL_2 | LM_1 | LM_2 | ASE_1 | ASE_2 | |
|---|---|---|---|---|---|---|---|---|---|
| 0.767 | **0.432** | 0.728 | 0.991 | 0.827 | 0.801 | 0.852 | 0.807 | 0.835 | |
| **LGO_1** | **LGO_2** | **TCE_1** | **TCE_2** | **MR_1** | **MR_2** | **MK_1** | **MK_2** | **TTASK_1** | **TTASK_2** |
| 0.887 | 0.773 | 0.876 | 0.949 | 0.525 | 0.563 | 0.674 | 0.659 | 0.788 | 0.680 |

The completely standardised theta-delta matrix indicates the variance in the measurement error terms. In other words, $\Theta_\delta$ indicates the proportion of variance in the indicator variable attributed to systematic and random measurement error and that cannot be explained in terms of latent variables. This is presented in Table 4.26 and represents the converse of the squared multiple correlations ($R^2$) of the indicators presented in Table 4.25. It can be seen from Table 4.26 that *Mathematics* is flagged as a problematic indicator of its respective latent variables in that more variance is explained by measurement error than is explained by the latent variable this indicator is meant to reflect.

Table 4.26

*Completely standardised theta-delta matrix*

| AFR | MATH | ENG | ASL_1 | ASL_2 | LM_1 | LM_2 | ASE_1 | ASE_2 | |
|---|---|---|---|---|---|---|---|---|---|
| 0.233 | 0.568 | 0.272 | 0.009 | 0.0173 | 0.199 | 0.148 | 0.193 | 0.165 | |
| **LGO_1** | **LGO_2** | **TCE_1** | **TCE_2** | **MR_1** | **MR_2** | **MK_1** | **MK_2** | **TTASK_1** | **TTASK_2** |
| 0.113 | 0.227 | 0.124 | 0.051 | 0.475 | 0.437 | 0.326 | 0.341 | 0.212 | 0.320 |

The unstandardised theta-delta matrix is presented in Table 4.27.

Table 4.27

*Unstandardised theta-delta matrix*

| **AFR** | **MATH** | **ENG** | **ASL_1** | **ASL_2** | **LM_1** | **LM_2** | **ASE_1** | **ASE_2** |
|---|---|---|---|---|---|---|---|---|
| 16.130[17] | 182.237 | 24.745 | 0.008 | 0.145 | 0.224 | 0.157 | 0.159 | 0.120 |
| (4.499) | (20.386) | (4.806) | (0.022) | (0.019) | (0.036) | (0.030) | (0.033) | (0.035) |
| 3.585 | 8.939 | 5.149 | **0.350** | 7.533 | 6.210 | 5.153 | 4.802 | 3.430 |

| **LGO_1** | **LGO_2** | **TCE_1** | **TCE_2** | **MR_1** | **MR_2** | **MK_1** | **MK_2** | **TTASK_1** | **TTASK_2** |
|---|---|---|---|---|---|---|---|---|---|
| 0.102 | 0.167 | 0.085 | 0.038 | 0.335 | 0.203 | 0.138 | 0.146 | 0.264 | 0.377 |
| (0.032) | (0.026) | (0.016) | (0.012) | (0.042) | (0.029) | (0.026) | (0.027 | (0.056) | (0.046) |
| 3.197 | 6.362 | 5.312 | 3.141 | 7.929 | 7.040 | 5.319 | 5.414 | 4.703 | 8.206 |

Table 4.27 shows that 18 of the 19 null hypotheses $H_{0i}$: $\Theta_{\delta_{jj=}}0$; i=41, 42,..., 59; j=1, 2.....19 formulated with regard to $\boldsymbol{\Theta}_{\boldsymbol{\delta}}$ can be rejected in favour of $H_{ai}$: $\Theta_{\delta_{jj>}}0$; i=41, 42,..., 59; j=1, 2.....19> Only $H_{044}$: $\Theta_{\delta_{44=}}0$ could not be rejected. Table 4.27 therefore indicates that the majority of indicators are significantly plagued by measurement error as is evident in the fact that all indicators (except ASL_1) report absolute t-values greater than 1.96. Perfectly reliable and valid measures of latent variables represent an unattainable ideal. The one insignificant measurement error variance estimate erodes confidence in the measurement model.

According to Diamantopoulos and Sigauw (2000), the examination of the standardised residuals and the modification indices provide relevant information that can be used for modification of the model focussing on improving model fit. At the same time, however, the standardised residuals and the modification indices calculated for $\boldsymbol{\Lambda}_{\mathbf{x}}$ and $\boldsymbol{\theta}_{\boldsymbol{\delta}}$ comment on the fit of the measurement model. If a limited number of ways exists in which the model fit can be improved this comments favourably on the fit of the model.

### 4.9.3 EXAMINATION OF MEASUREMENT MODEL RESIDUALS

Residuals refer to the difference between corresponding cells in the observed and fitted covariance matrix (Jöreskog & Sörbom, 1993). A standardised residual is a residual that is divided by its estimated standard error. Kelloway (1998) explained that residuals and especially standardised residuals provide diagnostic information on sources of lack of fit in models. Standardised residuals are z-scores and can be interpreted as large if they

---

[17] The first value represents the unstandardised measurement error variance estimate, the second value the standard error of the estimate and the third value the z test statistic.

exceed +2.58 or -2.58 (Diamantopoulos & Sigauw 2000). This is due to the fact that the standardised residual-values can be interpreted as standard normal deviates. A large positive residual indicates that the model underestimates the covariance between two variables, while a large negative residual indicates that the model overestimates the covariance between variables. Residuals should also be dispersed more or less symmetrical around zero. If the model generally underestimates covariance terms it indicates that additional explanatory paths should be added to the model, which could better account for the covariance between the variables. If, however, the model tends to overestimate the covariance between indicator variables, paths that are associated with the particular covariance terms should be deleted from the model (Jöreskog & Sörbom, 1993).

A summary of the standardised residuals is presented in Table 4.28.

Table 4.28

*Summary statistics for standardised residuals*

| Smallest Standardised Residual | -7.722 |
|---|---|
| Median Standardised Residual | 0.000 |
| Largest Standardised Residual | 4.894 |
| | |
| **Largest Negative Standardised Residuals** | |
| Residual for ASL_2 and ENG | -2.963 |
| Residual for ASE_2 and AFR | -2.882 |
| Residual for MR_1 and LGO_1 | -2.663 |
| Residual for MK_2 and ENG | -7.722 |
| | |
| **Largest Positive Standardised Residuals** | |
| Residual for LM_1 and MATH | 3.887 |
| Residual for LM_2 and MATH | 3.274 |
| Residual for ASE_1 and MATH | 2.815 |
| Residual for MR_1 and ASL_2 | 4.212 |
| Residual for TTASK_1 and LGO_2 | 4.894 |

Table 4.28 provides a summary of the standardised residuals and shows that five standardised residuals obtained values greater than 2.58, and four standardised residuals obtained values smaller than -2.58. The nine large residuals constitute 4.74% of the total number of unique variance and covariance terms in the observed variance covariance matrix. Therefore, only approximately 5% of the observed variances and covariances were inaccurately estimated from the measurement model parameter estimates. Thus only 5% of all the variance-covariance estimates that were derived from the measurement model parameters can be considered poor estimates. This can be regarded as an

acceptable and relatively small percentage and indicative of good model fit. Moreover the prevalence of large positive residuals is essentially the same as the number of large negative residuals. This suggested that the observed variance and covariance terms in the observed covariance matrix were typically underestimated as much as they were overestimated by the derived model parameter estimates.

The stem-and-leaf residual plot (Figure 4.3) captures the individual residual values and provides graphical information on the standardised residual distribution. If a model fits well, the stem-and-leaf plots will be characterised by residuals which are clustered symmetrically around the zero-point, with most residuals lying in the middle of the distribution and fewer in the tails.

```
- 7|7
 - 6|
 - 5|
 - 4|
 - 3|0
 - 2|9766200
 - 1|88654432210000
 - 0|999888876655444333333222222222111100000000000000000000000000000000000000+27
   0|111111122222333334444444555556666678888889999
   1|00111122234667
   2|02358
   3|39
   4|29
```

*Figure 4.3* Stem-and-leaf plot of standardised residuals

From the stem-and-leaf residual plot (Figure 4.3) it is evident that the standardised residuals appeared slightly positively skewed when the single negative outlier is ignored. This suggests that, in terms of estimation errors, the measurement model tended to underestimate rather than overestimate the observed covariance matrix. The slight domination of positive residuals, however, occurred in terms of residuals that are not considered large.

The Q-plot, presented in Figure 4.4, serves as an additional graphical display of residuals. This graph plotted the standardised residuals (horisontal axis) against the quintiles of the normal distribution (Diamantopoulos & Siguaw, 2000). When interpreting the Q-plot, it is crucial to note the extent to which the data points fall on a 45-degree reference line. Good model fit would be indicated if the points fall on the 45-degree reference line (Jöreskog & Sörbom, 1993). To the extent that the data points deviate from the 45-

degree reference line indicate less satisfactory fit. Figure 4.4 provides further evidence of reasonable model fit as it illustrates the fact that the standardised residuals for all pairs observed variables tend to only moderately depart from the 45-degree reference line and only via the nine poorly estimated variance-covariance terms. These findings are in line with the results reported in Figure 4.4 and Table 4.28. Subsequently, given the evaluation of the standardised residuals of the measurement model, it is also important to evaluate the measurement model modification indices.

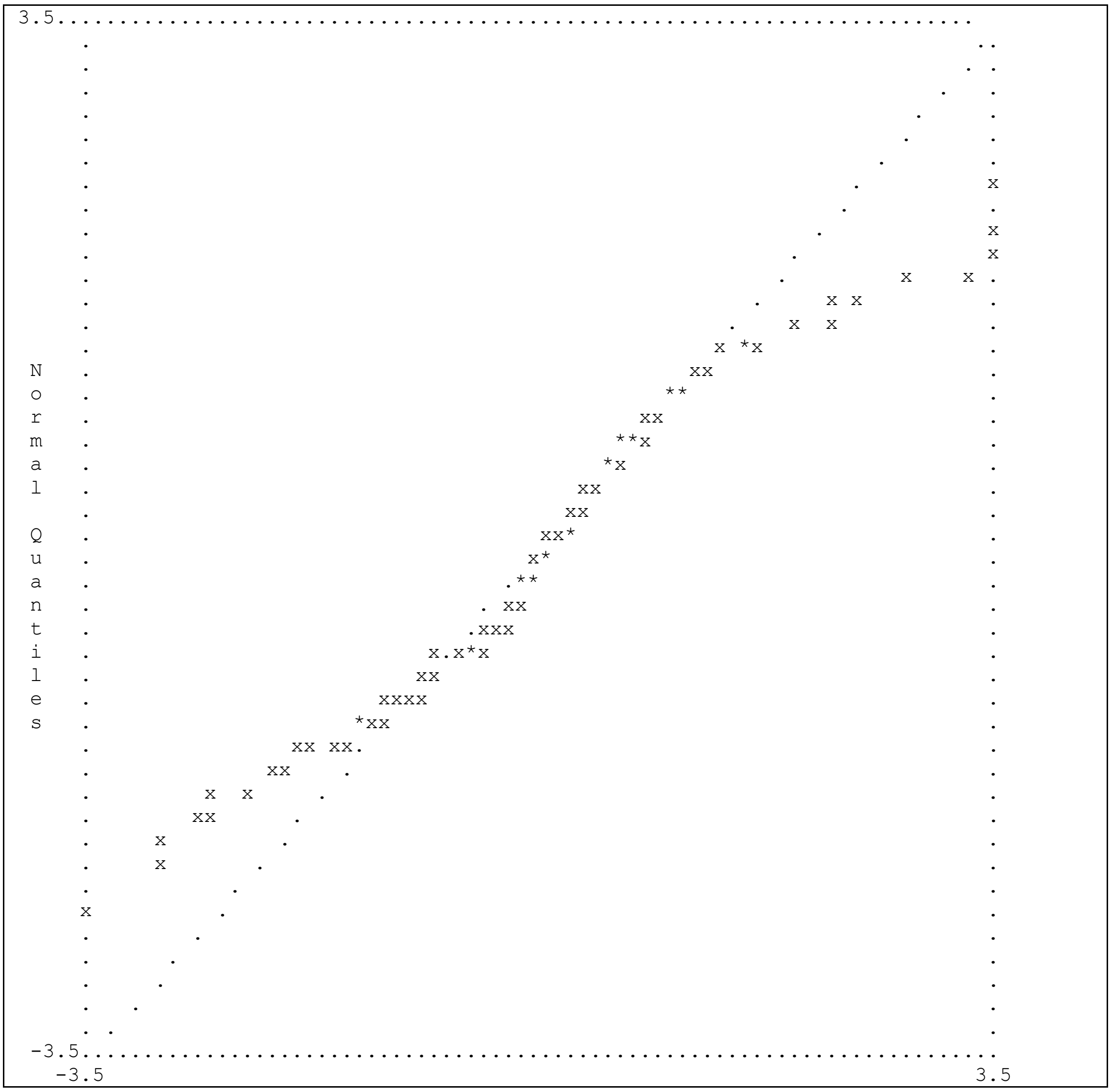

***Figure 4.4*** Q-plot of standardised residuals

### 4.9.4 MEASUREMENT MODEL MODIFICATION INDICES

The examination of the modification indices for the currently fixed parameters of the model provided an additional way of evaluating the fit of the model. Model modification indices are aimed at determining whether any of the currently fixed parameters, when freed in the model, would significantly improve the parsimonious fit of the model. The aim of examining the modification indices is to estimate the decrease that would occur in the (normal theory) $\chi^2$ statistic if parameters that are currently fixed are set free and the model is re-estimated. Modification indices with values larger than 6.64 (Theron, 2010) identify currently fixed parameters that would significantly ($p<.01$) improve the fit of the model if set free (Diamantopoulos & Siguaw, 2000). Diamantopoulos and Siguaw (2000) also suggest that modification to the model based on these statistics should be theoretically/substantially justified. In the evaluation of the modification indices calculated for $\boldsymbol{\Lambda}_X$ and $\boldsymbol{\theta}_\delta$ the emphasis did not fall as much on possible ways of actually modifying the measurement model as it still fell on evaluating the fit of the model. If only a limited number of ways existed to improve the fit of the model, this commented favourably on the fit of the current model. Modification indices calculated for the $\boldsymbol{\Lambda}_X$ and $\boldsymbol{\theta}_\delta$ matrices were examined in this study.

Examination of the modification index values calculated for the $\boldsymbol{\Lambda}_X$ matrix shown in Table 4.29, indicates that only four additional paths would significantly improve the fit of the model ($p<.01$).

Table 4.29

*Modification indices for lambda matrix*

| | LPERFORM | SLEAD | LMOTIV | LGOAL | KNOW | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|---|---|
| **AFR** | | 0.134 | 0.104 | 2.411 | 4.211 | 3.664 | 0.016 | 0.014 | **6.525** |
| **MATH** | | 0.218 | 2.666 | 0.154 | 0.005 | 0.303 | 0.939 | 0.647 | 5.645 |
| **ENG** | | 0.455 | 0.767 | 3.360 | 3.719 | 2.311 | 0.319 | 0.192 | 0.906 |
| **ASL_1** | 1.377 | | 0.424 | 4.230 | 0.010 | | | | **10.252** |
| **ASL_2** | 1.283 | | 0.114 | 2.325 | 0.008 | 3.093 | | | 5.646 |
| **LM_1** | 0.882 | 0.074 | | 0.072 | 0.928 | 0.305 | 0.035 | 0.108 | 0.982 |
| **LM_2** | 0.846 | 0.073 | | 0.049 | 0.737 | 0.242 | 0.020 | 0.082 | 0.974 |
| **ASE_1** | 1.213 | 2.561 | 3.057 | 1.590 | 0.036 | 0.201 | | 0.182 | |
| **ASE_2** | 1.274 | 6.171 | | 1.677 | 0.056 | 0.349 | | | |
| **LGO_1** | 1.866 | 0.104 | 0.407 | | 5.988 | 0.048 | 5.420 | 0.412 | 1.255 |
| **LGO_2** | 1.804 | 0.088 | 0.248 | | 2.714 | 0.033 | 3.924 | 0.289 | 1.039 |
| **TCE_1** | 0.553 | 0.663 | 1.212 | 0.154 | 2.052 | 1.979 | 0.032 | | 0.071 |
| **TCE_2** | 0.574 | 0.642 | 1.285 | 0.150 | 2.170 | 2.105 | 0.283 | | 0.081 |
| **MR_1** | 0.435 | 3.296 | 0.453 | **8.493** | 2.131 | | 0.598 | 0.751 | 0.532 |
| **MR_2** | 0.476 | 2.058 | 0.391 | **7.194** | 1.716 | | 0.555 | 0.637 | 0.566 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **MK_1** | 1.081 | 1.708 | 0.191 | 0.002 | | 0.005 | 0.434 | 0.108 | 0.317 |
| **MK_2** | 1.251 | 1.715 | 0.224 | 0.004 | | 0.006 | 0.531 | 0.119 | 0.355 |
| **TTASK_1** | 2.224 | 0.033 | 0.063 | 0.166 | 0.140 | 1.139 | | 0.159 | 0.129 |
| **TTASK_2** | 2.304 | 0.120 | 0.326 | 0.293 | 0.239 | 2.991 | | | 0.194 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

The matrix showed that *Afrikaans* marks (as a measure of *learning performance*) and the first item parcel of *academic self-leadership*, also loaded onto the *academic self-efficacy* construct. The matrix further revealed that the two *metacognitive regulation* item parcels also loaded onto *goal orientation*. The fact that only 4 out of the 152 ([19x9]-19) possible ways of modifying the model (2.63%) would result in significant improvements to the model fit commented very favourably on the fit of the learning potential measurement model.

Examination of the $\theta_\delta$ matrix in Table 4.30 revealed five covariance terms that, if set free, would result in a statistically significant ($p<.01$) decrease in the $\chi^2$ measure. However, the values of the completely standardised expected changes do not warrant setting these parameters. There is also no persuasive theoretical argument to justify correlated measurement error terms. Again, the small percentage (2.92%) of covariance terms identified to significantly improve model fit if set free, was a positive comment on the merits of the measurement model.

Table 4.30

*Modification index values calculated for theta matrix*

| | AFR | MATH | ENG | ASL_1 | ASL_2 | LM_1 |
|---|---|---|---|---|---|---|
| **AFR** | | | | | | |
| **MATH** | 1.285 | | | | | |
| **ENG** | | 0.118 | | | | |
| **ASL_1** | 4.145 | 0.406 | 0.967 | | | |
| **ASL_2** | 3.109 | 0.589 | 0.233 | | | |
| **LM_1** | 1.917 | 0.043 | 0.476 | 0.306 | 1.357 | |
| **LM_2** | 0.464 | 0.905 | 0.526 | 0.248 | 1.097 | |
| **ASE_1** | 0.091 | 1.414 | 0.153 | 2.551 | 1.484 | 0.097 |
| **ASE_2** | 5.387 | 0.132 | 1.927 | 0.000 | 0.512 | 0.468 |
| **LGO_1** | 0.707 | 2.134 | 0.550 | 2.583 | 2.977 | 0.388 |
| **LGO_2** | 0.034 | 2.866 | 0.108 | 7.686 | 10.512 | 0.461 |
| **TCE_1** | 0.116 | 0.215 | 0.140 | 1.020 | 0.027 | 0.029 |
| **TCE_2** | 0.170 | 0.140 | 0.038 | 2.583 | 0.858 | 0.008 |
| **MR_1** | 3.538 | 4.149 | 1.073 | 0.183 | 0.074 | 0.827 |
| **MR_2** | 5.035 | 0.068 | 6.284 | 0.028 | 0.292 | 2.315 |
| **MK_1** | 1.621 | 3.427 | 0.298 | 0.226 | 0.373 | 2.525 |
| **MK_2** | 1.150 | 1.494 | 6.775 | 0.127 | 0.601 | 0.162 |
| **TTASK_1** | 0.178 | 0.032 | 1.080 | 2.061 | 2.031 | 0.176 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **TTASK_2** | 0.075 | 0.007 | 1.408 | 1.072 | 2.362 | 0.232 |

Table 4.30 (Continued)

*Modification index values calculated for theta matrix*

| | **LM_2** | **ASE_1** | **ASE_2** | **LGO_1** | **LGO_2** | **TCE_1** |
|---|---|---|---|---|---|---|
| **LM_2** | | | | | | |
| **ASE_1** | 0.833 | | | | | |
| **ASE_2** | 0.001 | | | | | |
| **LGO_1** | 0.046 | 1.024 | 4.337 | | | |
| **LGO_2** | 0.053 | 0.084 | 2.289 | | | |
| **TCE_1** | 0.579 | 0.000 | 0.103 | 0.271 | 0.138 | |
| **TCE_2** | 0.837 | 0.192 | 0.489 | 2.410 | 0.733 | |
| **MR_1** | 0.596 | 0.178 | 1.351 | 1.403 | 0.000 | 5.176 |
| **MR_2** | 1.887 | 0.214 | 0.067 | 0.904 | 0.040 | 0.010 |
| **MK_1** | 0.184 | 0.327 | 0.442 | 0.048 | 0.466 | 3.688 |
| **MK_2** | 0.504 | 0.198 | 0.292 | 2.864 | 5.327 | 1.758 |
| **TTASK_1** | 0.020 | 0.618 | 0.611 | 13.800 | 16.248 | 0.012 |
| **TTASK_2** | 0.024 | 0.146 | 0.144 | 0.276 | 0.298 | 0.272 |

Table 4.30 (Continued)

*Modification index values calculated for theta matrix*

| | **TCE_2** | **MR_1** | **MR_2** | **MK_1** | **MK_2** | **TTASK_1** | **TTASK_2** |
|---|---|---|---|---|---|---|---|
| **TCE_2** | | | | | | | |
| **MR_1** | 3.839 | | | | | | |
| **MR_2** | 0.037 | | | | | | |
| **MK_1** | 4.923 | 2.202 | 0.008 | | | | |
| **MK_2** | 2.839 | 2.052 | 0.003 | | | | |
| **TTASK_1** | 0.002 | 1.681 | 0.020 | 0.816 | 0.934 | | |
| **TTASK_2** | 0.095 | 0.162 | 1.426 | 0.188 | 0.249 | | |

The limited number of large positive standardised residuals in conjunction with the limited number of large modification index values commented very favourably on the fit of the measurement model.

### 4.9.5 DISCRIMINANT VALIDITY

Discriminant validity refers to the degree to which latent variables that are conceptualised to be qualitatively distinct but inter-related (i.e., correlated) constructs actually are measured as distinct constructs. The nine latent variables comprising the du Toit – De Goede learning potential structural model are expected to correlate. The nine latent variables are conceptualised as nine qualitatively distinct although related latent variables but they should, however, not correlate excessively high with each other. The phi matrix (Table 4.31) shows the latent variable inter-correlations.

Table 4.31

*The measurement model phi matrix*

| | LPERFORM | SLEAD | LMOTIV | LGOAL | KNOW | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|---|---|
| **LPERFORM** | 1.000 | | | | | | | | |
| **SLEAD** | 0.351<br>(0.060)<br>5.870 | 1.000 | | | | | | | |
| **LMOTIV** | 0.474<br>(0.065)<br>7.245 | 0.650<br>(0.055)<br>11.920 | 1.000 | | | | | | |
| **LGOAL** | 0.335<br>(0.064)<br>5.272 | 0.500<br>(0.065)<br>7.643 | 0.715<br>(0.044)<br>16.103 | 1.000 | | | | | |
| **KNOW** | 0.430<br>(0.066)<br>6.527 | 0.526<br>(0.064)<br>8.253 | 0.646<br>(0.070)<br>9.286 | 0.702<br>(0.068)<br>10.269 | 1.000 | | | | |
| **REGULAT** | 0.291<br>(0.074)<br>3.903 | 0.730<br>(0.058)<br>12.578 | 0.640<br>(0.069)<br>9.224 | 0.716<br>(0.060)<br>11.846 | 0.769<br>(0.079)<br>9.765 | 1.000 | | | |
| **TIME** | 0.453<br>(0.073)<br>6.199 | 0.759<br>(0.039)<br>19.272 | 0.776<br>(0.053)<br>14.663 | 0.610<br>(0.057)<br>10.673 | 0.597<br>(0.068)<br>8.797 | 0.649<br>(0.067)<br>9.755 | 1.000 | | |
| **CENGAGE** | 0.409<br>(0.062)<br>6.582 | 0.793<br>(0.031)<br>25.617 | 0.752<br>(0.045)<br>16.709 | 0.581<br>(0.060)<br>9.741 | 0.579<br>(0.069)<br>8.331 | 0.689<br>(0.057)<br>12.031 | 0.895<br>(0.030)<br>29.969 | 1.000 | |
| **EFFICACY** | 0.420<br>(0.069)<br>6.120 | 0.593<br>(0.058)<br>10.233 | 0.682<br>(0.054)<br>12.655 | 0.512<br>(0.070)<br>7.333 | 0.567<br>(0.068)<br>8.302 | 0.452<br>(0.081)<br>5.562 | 0.677<br>(0.056)<br>12.067 | 0.652<br>(0.058)<br>11.185 | 1.000 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

In Table 4.31, the top value represents the unstandardised $\varphi_{ij}$ estimate, while the second value reflects the standard error of $\varphi_{ij}$, and the third value shows the test statistic z. The results presented in Table 4.31 suggested that all the inter-latent variables correlations are statistically significant ($p<.05$). Correlations were considered excessively high if they exceeded a value of .90. Judged by the results presented, none of the correlations in the phi matrix were excessively high; only one of the latent variables correlated with a value exceeding .80 (.895), but still below .90. The absence of excessively high correlations between the latent variables in the phi matrix presented in Table 4.31 is however, not a very strong indication of discriminant validity (Myburg, 2013). A possibility exists that the latent performance dimensions might correlate unity in the parameter but still correlate less than unity in the statistic because of sampling errors.

To examine this possibility a 95% confidence interval was calculated for each sample estimate in **Φ** utilising an Excel macro developed by Scientific Software International (Mels, 2010). If any confidence interval includes the value of 1, it would imply that the null hypothesis $H_0$: p=1 cannot be rejected. Confidence in the claim that the two latent performance dimensions are unique, qualitatively distinct dimensions of the learning performance construct would thereby be seriously eroded. The 95% confidence intervals for the 36 inter-latent variable correlations are shown in Table 4.32. None of the 36 confidence intervals included unity. The discriminant validity of this measure was thereby indicated.

Table 4.32

*95% confidence interval for sample phi estimates*

| | 95% CONFIDENCE INTERVAL | | | |
|---|---|---|---|---|
| ESTIMATE | STANDARD ERROR ESTIMATE | LOWER LIMIT OF 95% CONFIDENCE INTERVAL | UPPER LIMIT OF 95% CONFIDENCE INTERVAL | PHI CELL |
| 0.351 | 0.060 | 0.228 | 0.463 | Φ21 |
| 0.474 | 0.065 | 0.337 | 0.591 | Φ 31 |
| 0.650 | 0.055 | 0.529 | 0.745 | Φ 32 |
| 0.335 | 0.064 | 0.204 | 0.454 | Φ 41 |
| 0.500 | 0.065 | 0.362 | 0.616 | Φ 42 |
| 0.715 | 0.044 | 0.617 | 0.791 | Φ 43 |
| 0.430 | 0.066 | 0.292 | 0.550 | Φ 51 |
| 0.526 | 0.064 | 0.389 | 0.640 | Φ 52 |
| 0.646 | 0.070 | 0.488 | 0.763 | Φ 53 |
| 0.702 | 0.068 | 0.543 | 0.812 | Φ 4 |
| 0.291 | 0.074 | 0.140 | 0.429 | Φ 61 |
| 0.730 | 0.058 | 0.595 | 0.825 | Φ 62 |
| 0.640 | 0.069 | 0.485 | 0.756 | Φ 63 |
| 0.716 | 0.060 | 0.577 | 0.815 | Φ 64 |
| 0.769 | 0.079 | 0.564 | 0.885 | Φ 65 |
| 0.453 | 0.073 | 0.299 | 0.584 | Φ 71 |
| 0.759 | 0.039 | 0.672 | 0.826 | Φ 72 |
| 0.776 | 0.053 | 0.649 | 0.861 | Φ 73 |
| 0.610 | 0.057 | 0.486 | 0.710 | Φ 74 |
| 0.597 | 0.068 | 0.447 | 0.714 | Φ 75 |
| 0.649 | 0.067 | 0.498 | 0.762 | Φ 76 |
| 0.409 | 0.062 | 0.281 | 0.523 | Φ 81 |
| 0.793 | 0.031 | 0.724 | 0.846 | Φ 82 |
| 0.752 | 0.045 | 0.650 | 0.828 | Φ 83 |
| 0.581 | 0.060 | 0.451 | 0.687 | Φ 84 |
| 0.579 | 0.069 | 0.428 | 0.699 | Φ 85 |
| 0.689 | 0.057 | 0.560 | 0.785 | Φ 86 |
| 0.895 | 0.030 | 0.818 | 0.940 | Φ 87 |
| 0.420 | 0.069 | 0.276 | 0.545 | Φ 91 |
| 0.593 | 0.058 | 0.468 | 0.695 | Φ 92 |
| 0.682 | 0.054 | 0.561 | 0.774 | Φ 93 |
| 0.512 | 0.070 | 0.362 | 0.636 | Φ 94 |
| 0.567 | 0.068 | 0.419 | 0.686 | Φ 95 |

| | | | | |
|---|---|---|---|---|
| 0.452 | 0.081 | 0.280 | 0.596 | Φ 96 |
| 0.677 | 0.056 | 0.552 | 0.772 | Φ 97 |
| 0.652 | 0.058 | 0.523 | 0.752 | Φ 98 |

None of the 36 confidence intervals included unity although the interval calculated for $ø_{87}$ included the value (.90) as can be seen in Table 4.32. This was earlier considered to be a critical value for excessively large correlations. These findings indicated discriminant validity for the du Toit – De Goede learning potential structural model latent variables.

## 4.10 SUMMARY OF THE MEASUREMENT MODEL FIT AND PARAMETER ESTIMATES

The results of the overall fit assessment indicated reasonable good model fit. The null hypothesis of exact model fit was rejected; however the null hypothesis of close model fit was not. The interpretation of the measurement model, the standardised residuals, and the modification indices all indicated good model fit. The measurement model showed good fit. All the indicator variables loaded statistically significantly (p<.05) on the latent variables they were tasked to reflect. The factor loadings of all but one (*Mathematics* on *Learning Performance)* of the composite indicator variables exceeded .71. Measurement error variances of all but one indicator variable (ASL_1) were statistically significant (p<.05), although they were all generally small. It was therefore concluded that the operationalisation of the latent variables comprising the structural model was successful.

The results seem to support the claim that the specific indicator variables reflect the specific latent variables they were meant to. It therefore was possible to derive an unambiguous verdict on the fit of the structural model from the fit of the comprehensive LISREL model. Should the comprehensive LISREL model fit poorly it inevitably will mean that problems exist in the structural model.

## 4.11 EVALUATING THE FIT OF THE STRUCTURAL MODEL

The structural model describes the relationship between the latent variables and represents a comprehensive hypothesis on the process or mechanism that produced the variance in the endogenous latent variables. The model is tested by evaluating its ability to explain why the observed variables representing the latent variables covary in the particular fashion that they do. The aim of this process is thus to determine whether the theoretical relationships specified between the latent variables are supported by the data (Diamantopoulos & Siguaw, 2000). When testing the structural model the focus is on the substantive relationships of interest.

The measurement model showed good fit and the indicator variables generally reflected their designated latent variables well, and therefore the structural relationships between latent variables hypothesised by the proposed model depicted in Figure 4.5 were tested via SEM. LISREL 8.8 was used to evaluate the fit of the comprehensive learning potential structural model. Robust maximum likelihood estimation was used to derive estimates of the freed model parameters. An admissible final solution of parameter estimates for the revised reduced learning potential structural model was obtained after 32 iterations. A visual representation of the fitted learning potential structural model is shown in Figure 4.5 and the overall fit statistics are presented in Table 4.33.

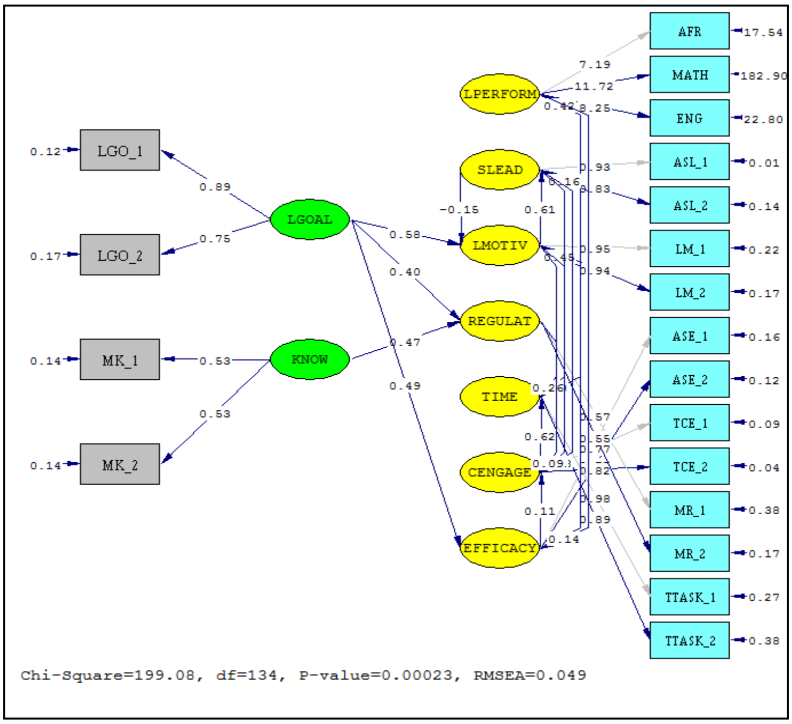

***Figure 4.5*** Representation of the fitted learning potential structural model (completely standardised solution)

The results of the analysis will be discussed below in terms of:

a) an evaluation of overall model fit, based on the array of model fit indices as reported by LISREL;
b) The standardised residuals;
c) An interpretation of the structural model parameter estimates; and
d) The modification indices calculated for $\Gamma$and **B**.

### 4.11.1 ASSESSING THE OVERALL GOODNESS-OF-FIT STATISTICS OF THE STRUCTURAL MODEL

The full spectrum of fit indices provided by LISREL to assess the absolute fit of the model is presented in Table 4.33.

Table 4.33

*Goodness of fit statistics for the learning potential structural model*

Degrees of Freedom=134
Minimum Fit Function Chi-Square=238.892 (P=0.000)
Normal Theory Weighted Least Squares Chi-Square=216.409 (P=0.000)
Satorra-Bentler Scaled Chi-Square=199.079 (P=0.000226)
Chi-Square Corrected for Non-Normality=676.186 (P=0.0)
Estimated Non-centrality Parameter (NCP)=65.079
90 Percent Confidence Interval for NCP=(31.212 ; 106.928)
Minimum Fit Function Value=1.200
Population Discrepancy Function Value (F0)=0.327
90 Percent Confidence Interval for F0=(0.157 ; 0.537)
Root Mean Square Error of Approximation (RMSEA)=0.0494
90 Percent Confidence Interval for RMSEA=(0.0342 ; 0.0633)
P-Value for Test of Close Fit (RMSEA<0.05)=0.513
Expected Cross-Validation Index (ECVI)=1.563
90 Percent Confidence Interval for ECVI=(1.393 ; 1.774)
ECVI for Saturated Model=1.910
ECVI for Independence Model=40.782
Chi-Square for Independence Model with 171 Degrees of Freedom=8077.580
Independence AIC=8115.580
Model AIC=311.079
Saturated AIC=380.000
Independence CAIC=8197.248
Model CAIC=551.785
Saturated CAIC=1196.680
Normed Fit Index (NFI)=0.975
Non-Normed Fit Index (NNFI)=0.989
Parsimony Normed Fit Index (PNFI)=0.764
Comparative Fit Index (CFI)=0.992
Incremental Fit Index (IFI)=0.992
Relative Fit Index (RFI)=0.969
Critical N (CN)=175.927
Root Mean Square Residual (RMR)=0.462
Standardised RMR=0.0732

Goodness of Fit Index (GFI)=0.897
Adjusted Goodness of Fit Index (AGFI)=0.854
Parsimony Goodness of Fit Index (PGFI)=0.633

Table 4.33 indicates that the comprehensive LISREL model achieved a Satorra-Bentler Chi-square value of 199.079 (p=.000226). The p-value associated with the Satorra-Bentler $\chi^2$ clearly showed a significant test statistic. A non-significant $\chi^2$ statistic would have been indicative that the model can reproduce the observed covariance matrix to a degree of accuracy that can only be explained in terms of sampling error (Kelloway, 1998). However, in this case, the exact fit null hypothesis ($H_{01}$: RMSEA=0) had to be rejected. The comprehensive LISREL model is therefore not able to reproduce the observed covariance matrix so accurately that the discrepancy between the observed and reproduced covariance matrices can be attributed to sampling error only.

The assumption under the exact fit null hypothesis ($H_{01}$) that the model fits the population perfectly is highly unlikely and thus the rejection of the null hypothesis of exact model fit was not surprising. It is therefore sensible to rather assess the degree of lack of fit of the model. The non-centrality parameter (NCP) is used to assess the degree of lack of fit of the model. NCP will therefore test that the model fit is not perfect. An estimate of $\lambda$ is obtained by subtracting the degrees of freedom from the chi-square statistic. The larger the $\lambda$, the farther apart the true hypothesis is from the null hypothesis. A NCP of 65.079 was obtained with a 90 percent confidence interval of (31.212; 106.928).

This model achieved a RMSEA value of .0494, indicated good close fit in the sample with a confidence interval of (.0342 ; .0633) which indicated reasonably close fit in the sample. The probability of obtaining this sample RMSEA estimate value under the assumption that the model fits closely in the population (i.e., RMSEA=.05) was sufficiently high (.513) not to discard this assumption as a permissible position. This indicates that the null hypothesis of close model fit ($H_{02}$: RMSEA≤.05) is not rejected at a 5% significance level (p>.05). The 90 percent confidence interval for RMSEA should be considered in collaboration with the RMSEA-value, as it assists in the evaluation of the precision of the fit statistic. Byrne (2001) explains that if this interval is small, it is indicative of a higher level of precision in the reflection of the model fit in the population. Since the 90 percent confidence interval for RMSEA (.0342; .0633) was reasonably small, the upper bound of the interval fell relatively close to the target value of .05 and the upper bound fell below the RMSEA value of .08 representing mediocre fit, it provided further support of good close/model fit. Hence it was concluded that this model provided an approximate reproduction of the observed covariance matrix and therefore a plausible explanation of the mechanism that produced the observed covariances.

Table 4.33 shows that the model ECVI (1.563) is smaller than the value obtained for the independence model (40.782). The model ECVI (1.563) is also smaller than the saturated model (1.910). Therefore, a model more closely resembling the fitted model seems to have a better chance of being replicated in a cross-validation sample than the saturated or independence models. However, it only has a slightly better chance than the saturated model.

The parsimonious normed fit index (PNFI=.764) and the parsimonious goodness-of fit index (PGFI=633) approach model fit from this perspective. These two values should range from 0 to 1.0, with higher values indicating a more parsimonious fit, as is evident in this case. According to Kelloway (1998) and Hair et al. (2006), the PNFI and the PGFI are more meaningfully used when comparing two competing theoretical models and are therefore not feasible for any of the CFA analyses in this study. This study did take cognisance of these two indices, but they did not play a superior role in the decision regarding the interpretation of the overall fit indices.

Table 4.33 shows that the model AIC (311.079) suggested that the fitted structural model provided a more parsimonious fit than the independent model (8115.580) and the saturated model (380.00). Similarly, the CAIC (551.785) also achieved a value lower than both the independence (8197.248) and the saturated models (1196.680). The fit indices presented in Table 4.33 reflect the normed fit index (NFI=.975 the non-normed fit index (NNFI=.989), the comparative fit index (CFI=.992), the incremental fit index (IFI=.992), and relative fit index (RFI=.969). The closer these values are to unity (1.00), the better the fit of the model. However, Diamantopoulos and Siguaw (2000) suggest that values above .90 provide a strong indication of a well-fitting model. The results reflected in Table 4.33, show that all these values fell comfortably above the .90 level.

This provided a strong indication of satisfactory comparative fit relative to the independent model.

The critical N (CN) shows the size that a sample must achieve in order to acknowledge the data fit of a given model on a statistical basis (Van Heerden, 2013). As a rule-of-thumb, a critical N greater than 200 is suggestive that a model is a sufficient representation of the data. The results presented in Table 4.33 show that this model achieved a CN of 175.927, which was not above the threshold, and therefore reduced confidence in the model.

Kelloway (1998) suggested that SRMR-values that are smaller than .05 are indicative of an acceptable fit. The model produced a SRMR of .0732, which was above the .05 cut-off value, and therefore indicative that some problems with model fit exists.

The AGFI (.854) adjusts the GFI (.897) for the degrees of freedom in the model and should be between 0 and 1.0; with values exceeding .90. The GFI and AGFI produced by this model can be regarded as satisfactory and indicative of good model fit.

The evaluation of the fit of the comprehensive model based on the fit statistics was augmented by examining the completely standardised residual variances and covariances.

### 4.11.2 EXAMINATION OF COMPREHENSIVE MODEL RESIDUALS

Residual variances and covariances reflect the difference in the elements of the observed variance-covariance matrix and the reproduced variance-covariance matrix that was derived from the model parameter estimates. Standardised residuals can be interpreted as standard normal deviates. A standardised residual with an absolute value greater than 2.58 would be interpreted as large at a 1% significance level (Diamantopoulos & Siguaw, 2000). Large standardised residuals are an indication of covariance (or the lack of covariance) between indicator variables that the model fails to explain. Large positive residuals reflect a model that underestimates the covariance terms between specific observed variables. The model can therefore be improved by adding paths to the model. Large negative residuals are an indication that the model over-estimates the covariance between specific observed variables. To rectify this problem, paths associated with the indicator variables can be removed (Diamantapoulos & Siguaw, 2000; Kelloway, 1998). A summary of the standardised residuals is presented in Table 4.34.

Table 4.34

*Summary statistics for standardised residuals*

| | |
|---|---|
| Smallest Standardised Residual | -6.069 |
| Median Standardised Residual | 0.337 |
| Largest Standardised Residual | 7.551 |
| | |
| **Largest Negative Standardised Residuals** | |
| Residual for TCE_2 and ENG | 6.069 |
| | |
| **Largest Positive Standardised Residuals** | |
| Residual for LM_1 and MATH | 3.169 |
| Residual for LM_2 and MATH | 3.466 |
| Residual for ASE_1 and MATH | 3.012 |
| Residual for ASE_2 and MATH | 2.707 |
| Residual for TCE_1 and TCE_1 | 6.157 |
| Residual for TCE_2 and ASL_1 | 3.047 |
| Residual for TCE_2 and TCE_1 | 7.551 |
| Residual for MR_1 and ASL_1 | 5.320 |
| Residual for MR_1 and ASL_2 | 5.159 |
| Residual for MR_1 and TCE_1 | 4.251 |
| Residual for MR_1 and TCE_ | 3.499 |
| Residual for MR_2 and ASL_1 | 4.023 |
| Residual for MR_2 and ASL_2 | 3.453 |
| Residual for TTASK_1 and MR_1 | 3.442 |
| Residual for LGO_1 and AFR | 3.042 |
| Residual for LGO_2 and TTASK_1 | 2.599 |
| Residual for MK_1 and AFR | 4.387 |
| Residual for MK_1 and ENG | 2.867 |
| Residual for MK_1 and ASE_2 | 2.842 |
| Residual for MK_1 and TCE_1 | 2.752 |
| Residual for MK_2 and AFR | 2.917 |

Table 4.34 shows that twenty-one standardised residuals obtained values greater than 2.58, and one standardised residual obtained a value smaller than -2.58. The twenty-two large residuals constitute 11.58% ((22/190)*100) of the total number of unique variance and covariance terms in the observed variance covariance matrix. Therefore, only approximately 12% of the observed variances and covariances were inaccurately estimated from the measurement model parameter estimates. This can be regarded as acceptable, and relatively small and indicative of good model fit. Also, it should be noted that the prevalence of large positive residuals was substantially greater than the occurrence of large negative residuals. This suggested that the covariance terms in the observed covariance matrix were typically underestimated by the derived model parameter estimates. The median standardised residual of .337 was indicative of the

slightly positively skewed distribution as will be observed in the stem-and-leaf plot (Figure 4.6) that follows from the dominance of large positive residuals.

The stem-and-leaf residual plot (Figure 4.6) captures the individual residual values and provides graphical information on the standardised residual distribution. If a model fits well, the stem-and-leaf plots will be characterised by residuals which are clustered symmetrically around the zero-point, with most residuals lying in the middle of the distribution and fewer in the tails.

```
 - 6|1
 - 5|
 - 4|
 - 3|
 - 2|0
 - 1|97754421110
 - 0|9999888876655544443321111000000000000000000000000000000000000000000
   0|111112222333333344455566667777777889999999
   1|0111122222223334444555566777888999
   2|0011222455666678899
   3|00024555
   4|034
   5|23
   6|2
   7|6
```

***Figure 4.6*** Stem-and-leaf plot of standardised residuals

The Q-plot, presented in Figure 4.7, serves as an additional graphical display of residuals. This graph plotted the standardised residuals (horisontal axis) against the quintiles of the normal distribution (Diamantopoulos & Siguaw, 2000). The data points did swivel away from the 45-degree reference line, which was a somewhat negative comment on the fit of the model. However, the deviation was only really evident mostly in the upper regions, and a little in the lower regions on the X-axis. These findings are in line with the results reported in Figure 4.6 and Table 4.34 where there were both large positive and large negative standardised residuals, but where the large positive standardised residuals dominated.

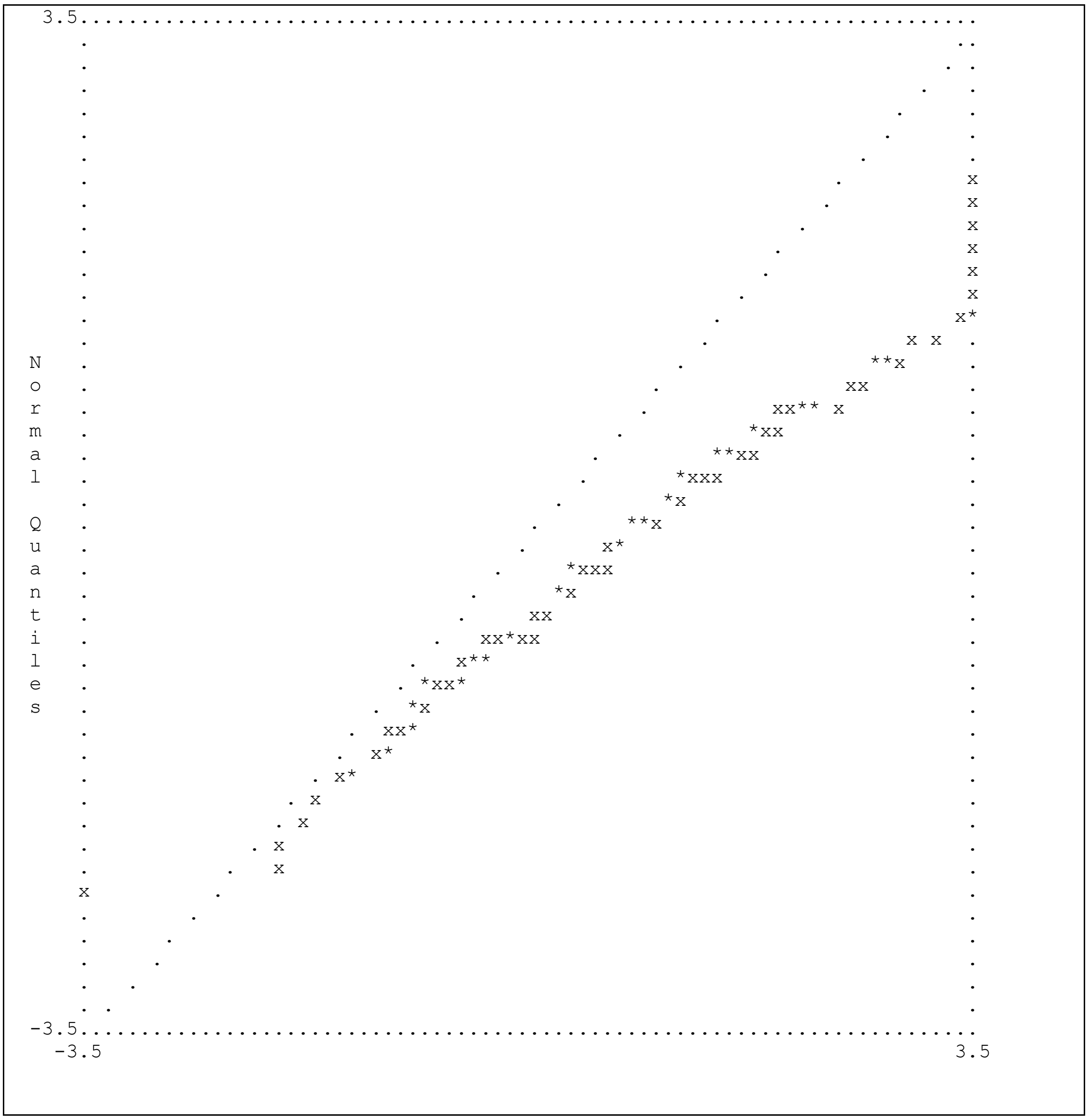

***Figure 4.7*** Q-plot of standardised residuals

Determining and evaluating the fit of the comprehensive model indicates to what extent the model can reproduce the observed covariance matrix (Diamantopoulos & Siguaw, 2000). The evidence presented up to this point showed that the comprehensive model was able to reproduce the observed covariance matrix to a degree of accuracy that warranted sufficient faith in the comprehensive model and the derived parameter estimates to justify the interpretation of these estimates. Consequently, the parameter estimates for **Γ** and **B** were interpreted. It is thereby not denied that the very real possibility exists that the fit of the model could be improved by freeing specific elements in **Γ** and **B** that are currently fixed to zero. This possibility will be investigated, once the path-specific null hypotheses have been tested, by examining the modification indices calculated for the relevant matrices defining the structural model.

### 4.11.3 INTERPRETATION OF THE STRUCTURAL MODEL PARAMETER ESTIMATES

The research was initiated by the question why variance in *learning performance during evaluation* exists. Through theorising a comprehensive learning potential hypothesis was developed from previous research reported in the literature. The fact that the close fit null hypothesis ($H_{02}$: RMSEA≤.05) has not been rejected provided support for the overarching substantive research hypothesis that the fitted learning potential structural model provides as a permissible approximate description of the psychological mechanism that determines learning performance during evaluation. This warrants the testing of the path-specific statistical null hypotheses (see Table 3.1). This required an examination of the unstandardised beta and gamma matrices. The unstandardised beta matrix is depicted in Table 4.35.

Table 4.35

*Unstandardised beta matrix*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | | | | 0.417<br>(0.079)<br>5.308 | | |
| **SLEAD** | | | 0.612<br>(0.137)<br>4.468 | | | | 0.162<br>(0.114)<br>**1.419** |
| **LMOTIV** | | -0.151<br>(0.137)<br>**1.101** | | | | | 0.453<br>(0.060)<br>5.025 |
| **REGULAT** | | | | | | | |
| **TIME** | | 0.097<br>(0.076)<br>**1.283** | 0.260<br>(0.101)<br>2.563 | | | 0.618<br>(0.111)<br>5.561 | |
| **CENGAGE** | | 0.476<br>(0.065)<br>7.295 | 0.313<br>(0.090)<br>3.485 | 0.094<br>(0.058)<br>**1.611** | | | 0.111<br>(0.073)<br>**1.513** |
| **EFFICACY** | 0.144<br>(0.084)<br>**1.722** | | | | | | |

Where:

LPERFORM=Learning performance LGOAL=Learning goal orientation TIME=Time-at-task

SLEAD= Academic self-leadership
LMOTIV=Learning motivation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Analysis of the beta matrix (see Table 4.35) indicates six paths that are not statistically significant (p>.05). Firstly, the path between *Academic self-efficacy* and *Academic self-leadership* obtained a t-value of 1.419, which is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{012}$: $\beta_{27}0$ was therefore not rejected. No support was therefore found for hypothesis 11 that *Academic self-efficacy* will have a negative effect on *academic self-leadership.* The path between *Academic self-leadership* and *learning motivation* obtained a t-value of -1.10, which again is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{011}$: $\beta_{32}=0$ was therefore not rejected. No support was therefore found for hypothesis 10 that *Academic self-leadership* will positively influence *learning motivation.* This relationship between *Academic self-leadership* and *learning motivation,* Hypothesis 10, was hypothesised to be positive. It was based on the argument that an increase in *Academic self-leadership* would result in an increase in *learning motivation*. Thirdly, the path between *Academic self-leadership* and *time–at-task* obtained a t-value of 1.283, which is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{03}$: $\beta_{52}=0$ was therefore not rejected. No support was therefore found for hypothesis 2 that *Academic self-leadership* will positively influence *time-at-task*. The fourth path which was found not to be statistically significant, was the path between *Learning performance during evaluation* and *academic self-efficacy*. The path obtained a t-value of 1.722 which is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{015}$: $\beta_{21}=0$ was therefore not rejected. No support was therefore found for hypothesis 14 that *Learning performance during evaluation* will positively influence *academic self-efficacy*. The next path which was found not to be statistically significant, was the path between *Regulation of cognition* and *cognitive engagement.* The path obtained a t-value of 1.611 which is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{07}$: $\beta_{64}=0$ was therefore not rejected. No support was therefore found for hypothesis 6 that *Regulation of cognition* will positively influence *cognitive engagement.* Lastly, the path between *Academic self-efficacy* and *cognitive engagement* was also found not to be statistically significant. The path obtained a t-value of 1.513 which is smaller than the required 1.96 and the estimate is therefore not statistically significant (p>.05). $H_{013}$: $\beta_{67}=0$ was therefore not rejected. No support was therefore found for hypothesis 12 that *Academic self-efficacy* will positively influence *cognitive engagement.*

Besides these insignificant relationships the other seven hypotheses in the beta matrix were supported. The path between *Academic self-leadership* and *cognitive engagement* obtained a t-value of 7.295, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{06}$: $\beta_{62}=0$ was therefore rejected. Support was therefore found for hypothesis 5 that *Academic self-leadership* will positively influence *cognitive engagement.* . The path between *Motivation to learn* and *cognitive engagement* obtained a t-value of 3.485, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{08}$: $\beta_{63}=0$ was therefore rejected. Support was therefore found for hypothesis 7 that *Motivation to learn* will positively influence *cognitive engagement.* The next path that was supported was the path between *Motivation to learn* and *time-at-task.* This path obtained a t-value of 2.563, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{09}$: $\beta_{53}=0$ was therefore rejected. Support was therefore found for hypothesis 8 that *Motivation to learn* will positively affect *time-at-task.* The path between *Motivation to learn* and *academic self-leadership* was also found to be significant as it *obtained* a t-value of 4.468, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{010}$: $\beta_{23}=0$ was therefore rejected. Support was therefore found for hypothesis 9 that *Motivation to learn* will positively influence *academic self-leadership.* The next significant path was the path between *Time-at-task* and *learning performance during evaluation* as it obtained a t-value of 5.308, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{019}$: $\beta_{15}=0$ was therefore rejected. Support was therefore found for hypothesis 18 that *Time-at-task* has a direct positive effect on *learning performance during evaluation.* The path between *Cognitive engagement* and *time-at-task* was also found to be significant as it obtained a t-value of 5.561, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{05}$: $\beta_{56}=0$ was therefore rejected. Support was therefore found for hypothesis 4 that *Cognitive engagement* will positively influence *time-at-task.* The final significant path was the path between *Academic self-efficacy* and *learning motivation* which obtained a t-value of 5.025, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{014}$: $\beta_{37}=0$ was therefore rejected. Support was therefore found for hypothesis 13 that *Academic self-efficacy* has a positive effect on *learning motivation.*

Table 4.36 shows the unstandardised gamma matrix. The gamma matrix reflecting the statistically significance of the $\gamma_{ij}$ estimates revealed that all four of the hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were supported ($p<.05$).

Table 4.36

*Unstandardised gamma matrix*

| | **LGOAL** | **KNOW** |
|---|---|---|
| **LPERFORM** | | |
| **SLEAD** | | |
| **LMOTIV** | 0.580<br>(0.090)<br>6.448 | |
| **REGULAT** | 0.400<br>(0.182)<br>2.197 | 0.472<br>(0.174)<br>2.707 |
| **TIME** | | |
| **CENGAGE** | | |
| **EFFICACY** | 0.486<br>(0.083)<br>5.865 | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation

LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition

TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

The path between *Mastery goal orientation* and *learning motivation* obtained a t-value of 6.448, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{017}$: $\beta_{31}=0$ was therefore rejected. Support was therefore found for hypothesis 16 that *Mastery goal orientation* will positively influence *learning motivation.* The path between *Mastery goal orientation* and *metacognitive regulation* also obtained a t-value greater than the required, with a value of 2.197 and the estimate is therefore statistically significant ($p<.05$). $H_{018}$: $\beta_{41}=0$ was therefore rejected. Support was therefore found for hypothesis 17 that *Mastery goal orientation* will positively influence *metacognitive regulation.*

Support was also found for the path between *Mastery goal orientation* and *academic self-efficacy,* as it obtained a significant ($p<.05$) t-value of 5.865. $H_{016}$: $\beta_{71}=0$ was therefore rejected and support was found that hypothesis 15 that *Mastery goal orientation* will positively influence *academic self-efficacy*. Lastly, the path between *Knowledge of cognition* and *regulation of cognition* obtained a t-value of 2.707, which is greater than the required 1.96 and the estimate is therefore statistically significant ($p<.05$). $H_{04}$: $\beta_{42}=0$ was therefore rejected. Support was therefore found for hypothesis 3 that *Knowledge of cognition* will positively influence *regulation of cognition.*

In total therefore eleven of the seventeen hypothesised paths were supported while six were not supported.

### 4.11.4 STRUCTURAL MODEL MODIFICATION INDICES

Model modification indices (MI) answer the question whether freeing any of the currently fixed parameters in the model will significantly improve the fit of the model. This is determined by calculating the extent to which the $\chi^2$ fit statistic decreases when each of the currently fixed parameters in the model is freed and the model re-estimated (Jöreskog & Sörbom, 1993).

Structural parameters currently fixed to zero with large modification index values (>6.6349) are parameters that, if set free, would improve the fit of the model statistically significantly ($p<.01$) (Diamantopoulos & Siguaw, 2000; Jöreskog & Sörbom, 1993). Parameters with high MI values should, however, only be freed if it makes substantive sense to do so (Kelloway, 1998). A convincing theoretical argument should be put forward in support of the proposed causal linkage. The completely standardised expected change for the parameter is the extent to which it would change from its currently fixed value of zero in the completely standardised solution if it is freed. The magnitude of the completely standardised expected change should be substantial enough to warrant freeing the parameter. The sign of the completely standardised expected change should in addition make sense in terms of the theoretical argument put forward in support of the proposed path (Jöreskog & Sörbom, 1993).

Jöreskog and Sörbom (1993) suggest that the modification indices calculated for the various matrices defining the structural model (i.e., **Γ**, **B**, and **Ψ**) should be inspected to identify the parameter with the highest modification index value. The parameter with the largest modification index is then freed if a convincing theoretical argument can be put forward in support of the proposed causal linkage and if the magnitude of the completely standardised expected change is substantial enough. If a convincing theoretical argument cannot be put forward in support of the proposed causal linkage, or if the magnitude of the completely standardised expected change is not substantial enough, the parameter with the second largest modification index should be considered. For the purpose of modifying the reduced structural model depicted in Figure 3.1 only the **Γ** and **B** matrices were inspected. Freeing any of the covariance terms in **Ψ** was not considered theoretically justified in a cross-sectional model.

Table 4.37 provides the modification index values for the unstandarised beta matrix and Table 4.38 the modification index values for the unstandardised gamma matrix. According to the process suggested by Jöreskog and Sörbom (1993) as described above, the parameter with the highest modification index value (29.360) was found in the beta matrix.

Table 4.37

*Modification indices for beta matrix*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | 0.146 | 4.194 | 1.307 | | 0.162 | 2.410 |
| **SLEAD** | 2.198 | | | **25.663** | 0.161 | 0.465 | |
| **LMOTIV** | 0.177 | | | 6.845 | 3.007 | 5.921 | |
| **REGULAT** | 0.125 | **29.360** | 2.692 | | 7.527 | 12.135 | 0.097 |
| **TIME** | 0.485 | | | 0.013 | | | 1.370 |
| **CENGAGE** | 1.460 | | | | 0.010 | | |
| **EFFICACY** | | | 0.120 | 11.869 | 1.592 | | |

Where:

LPERFORM=Learning performance
LGOAL=Learning goal orientation
TIME=Time-at-task
SLEAD= Academic self-leadership
KNOW= Knowledge of cognition
CENGAGE=Cognitive engagement
LMOTIV=Learning motivation
REGULAT=Regulation of cognition
EFFICACY=Academic self-efficacy

Table 4.38

*Modification indices for gamma matrix*

| | **LGOAL** | **KNOW** |
|---|---|---|
| **LPERFORM** | 2.534 | 6.015 |

| | | |
|---|---|---|
| **SLEAD** | | 3.489 |
| **LMOTIV** | | 3.140 |
| **REGULAT** | | |
| **TIME** | 1.097 | 0.798 |
| **CENGAGE** | 0.001 | 0.020 |
| **EFFICACY** | | **25.764** |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

According to Table 4.37, the parameter with the highest modification index value is $\beta_{42}$ that represents the slope of the structural relation between *Academic self leadership* and *regulation of cognition*. In other words, it is suggested that the addition of a path from *Academic self leadership* to *regulation of cognition* would significantly improve the fit of the model. The critical question is whether the proposed path makes substantive sense. If it does not, it should not be considered as a possible modification to the model. Exploring this train of thought, it does not seem altogether unreasonable to argue that an individual who displays higher levels of *Academic self-leadership* competence will, because of that competence, display higher levels of *regulation of cognition*. Given the constitutive definitions of the two constructs it can therefore be argued that an individual who is competent in the processes of self-evaluation through which he/she identifies and replaces ineffective behaviours and negative thought processes with more effective behaviours and positive thought processes would show more efforts to monitor, control, or adjust their cognitive processing in response to shifting task demands or conditions (*regulation of cognition*).

Self-leadership is described in the literature study as a process through which individuals control their own behaviour, influencing and leading themselves through the use of a specific set of behavioural and cognitive strategies, this is according to Manz (1986) and Manz and Neck (2004). Self-leadership addresses what should be done and why, in addition to how to do it. It can be seen as a self-evaluation process through which individuals identify and replace ineffective behaviours and negative thought processes with more effective behaviours and positive thought processes which can enhance personal accountability and improving professional performance (DiLiello & Houghton, 2006). *Regulation of cognition* again can be narrowly defined, as students' efforts to monitor, control, or adjust their cognitive processing in response to shifting task demands or conditions (Baker, 1994; Brown, 1987). When considering these definitions, a direct path between *Academic self leadership* and *regulation of cognition* seems to make less substantive theoretical sense than it initially did as having more control in one area would not necessarily lead to more control in another area. *Academic self leadership* and *regulation of cognition* seem to be related constructs of the same domain.

According to Table 4.37, the parameter with the third highest modification index value is $\beta_{24}$ that represents the slope of the structural relation between *regulation of cognition and academic self leadership*. In other words, it is suggested that the addition of a path from *regulation of cognition* to *academic self leadership* significantly improves the fit of the model. This is the exact opposite of the parameter with the highest modification index value, which did not make substantive sense, and therefore this additional path should not be considered.

According to Table 4.38, the parameter with the second highest modification index value is $\gamma_{72}$ that represents the slope of the structural relation between *metacognitive–knowledge and academic self-efficacy*. When exploring this train of thought, it does not seem unreasonable to argue that an individual with higher levels of *meta-cognitive knowledge* (in terms of the components parts therefore higher levels of declarative-, procedural- and conditional knowledge) would, because of it, have higher levels of *academic self-efficacy*. In other words, given the constitutive definitions of the two constructs it can be argued that an individual who knows more strategies, knows how to use these strategies and knows when to use these strategies would have a higher belief in his/her own ability to learn (*academic self-efficacy*). It does make substantive sense that an individual who knows more about how to learn would have higher levels of belief in his/her own ability to learn because of this knowledge. Furthermore to the substantive logic towards the addition of this path, the magnitude of the completely standardised expected change (not shown) is also substantial enough (.906) to support the addition of this path.

According to the procedure suggested by Jöreskog and Sörbom (1993) with regards to the modification of models, currently constrained paths should be freed one at a time as any change to the existing structural model will affect all existing parameter estimates and also all modification index values. Paths that will currently improve the fit of the model will therefore not necessarily do so in the revised model. Therefore, only the addition of the path between *meta-cognitive knowledge* and *academic self-efficacy* was considered at this stage in the analysis.

The fitted structural model was subsequently modified by inserting a path from *metacognitive knowledge* to *academic self-efficacy*. No paths were removed at this point. This decision was taken because the path-specific hypotheses that were tested referred to the specific paths when they were included in the specific model. The path coefficients that were found to be significant are partial regression coefficients. They therefore reflect the average change in $\eta_j$ that is associated with one unit change in $\eta_i$ [or $\xi_i$] when holding constant the other latent variables referred to in the structural equation for $\eta_j$. Deleting insignificant paths from the model would therefore change the original hypotheses. Moreover the modifications that were discussed in paragraph 4.11.4 examined the addition of additional paths to the existing model that was fitted. With the path between *meta-cognitive knowledge* and *academic self-efficacy* added, the structural model was fitted again. A visual representation of the elaborated model (model A), as well as the fit indices are presented in section 4.11.5.

### 4.11.5 ASSESSING THE OVERALL GOODNESS-OF-FIT STATISTICS OF THE MODIFIED STRUCTURAL MODEL (MODEL A)

A visual representation of the first modified learning potential structural model is presented in Figure 4.8. The full range of fit indices (both comparative and absolute) for the first modified model (model A) is presented in Table 4.39.

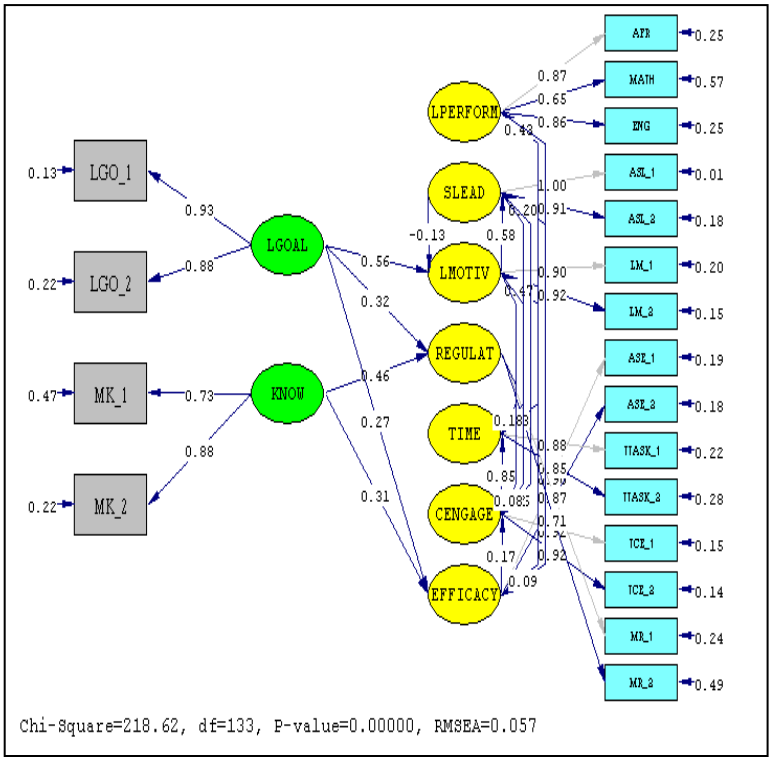

***Figure 4.8*** Representation of the first modified (model A) fitted learning potential structural model (completely standardised solution)

Table 4.39

*Goodness of fit statistics for the modified learning potential structural model (model A)*

Degrees of Freedom=133
Minimum Fit Function Chi-Square=246.560 (P=0.00)
Normal Theory Weighted Least Squares Chi-Square=236.232 (P=0.000)
Satorra-Bentler Scaled Chi-Square=218.621 (P=0.000)
Chi-Square Corrected for Non-Normality=580.185 (P=0.0)
Estimated Non-centrality Parameter (NCP)=85.621
90 Percent Confidence Interval for NCP=(48.948 ; 130.197)
Minimum Fit Function Value=1.239
Population Discrepancy Function Value (F0)=0.430
90 Percent Confidence Interval for F0=(0.246 ; 0.654)
Root Mean Square Error of Approximation (RMSEA)=0.0569
90 Percent Confidence Interval for RMSEA=(0.0430 ; 0.0701)
P-Value for Test of Close Fit (RMSEA<0.05)=0.196
Expected Cross-Validation Index (ECVI)=1.671
90 Percent Confidence Interval for ECVI=(1.487 ; 1.895)
ECVI for Saturated Model=1.910
ECVI for Independence Model=40.252
Chi-Square for Independence Model with 171 Degrees of Freedom=7972.231
Independence AIC=8010.231
Model AIC=332.621
Saturated AIC=380.000
Independence CAIC=8091.899
Model CAIC=577.625
Saturated CAIC=1196.680
Normed Fit Index (NFI)=0.973

Non-Normed Fit Index (NNFI)=0.986
Parsimony Normed Fit Index (PNFI)=0.756
Comparative Fit Index (CFI)=0.989
Incremental Fit Index (IFI)=0.989
Relative Fit Index (RFI)=0.965
Critical N (CN)=159.251
Root Mean Square Residual (RMR)=0.431
Standardised RMR=0.0583
Goodness of Fit Index (GFI)=0.889
Adjusted Goodness of Fit Index (AGFI)=0.841
Parsimony Goodness of Fit Index (PGFI)=0.622

Table 4.39 indicates that the comprehensive model achieved a Satorra-Bentler Chi-square value of 218.621 (p=.000), which showed that the null hypothesis of exact fit was again rejected. This model achieved a RMSEA value of .0569, which indicates reasonably good fit in the sample with a confidence interval of (.0430; .0701) which again indicates reasonable to good fit in the sample. The p-value of close fit was .196, indicating that the close fit null hypothesis cannot be rejected (p>.05). Seemingly the modifications to the initial structural, model has to some degree decreased the fit of the model to the data as judged by the RMSEA fit statistic. The sample RMSEA estimater slightly increased from its initial value of .0494 to .0569, indicating reasonably close model fit. The ECVI, AIC and CAIC all returned slightly higher values than those obtained in the initial model. The NFI, NNFI, CFI, IFI, RFI, GFI, PNFI, PGFI and AGFI all experienced a slight decrease in value. Model A produced an SRMR of .0583, which, is slightly above the .05 cut-off value, and therefore improved from its previous value of .0732, but still indicative that some problems with model fit exists.

### 4.11.6 INTERPRETATION OF THE STRUCTURAL MODEL PARAMETER ESTIMATES (MODEL A)

The unstandardised beta and gamma matrices were examined to determine whether the newly added path was statistically significant and whether the modification of the model affected the findings on the statistical significance of the paths in the initial model. The unstandardised beta matrix is depicted in Table 4.40 and the unstandardised gamma matrix in Table 4.41.

Table 4.40

*Unstandardised beta matrix*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | | | | 0.432<br>(0.080)<br>5.414 | | |
| **SLEAD** | | | 0.575<br>(0.139)<br>4.144 | | | | 0.199<br>(0.117)<br>**1.706** |
| **LMOTIV** | | -0.128<br>(0.134)<br>**0.958** | | | | | 0.466<br>(0.090)<br>5.159 |
| **REGULAT** | | | | | | | |
| **TIME** | | -0.029<br>(0.056)<br>**-0.518** | 0.184<br>(0.084)<br>2.174 | | | 0.852<br>(0.100)<br>8.487 | |
| **CENGAGE** | | 0.451<br>(0.070)<br>6.409 | 0.318<br>(0.092)<br>3.447 | 0.082<br>(0.056)<br>**1.146** | | | 0.165<br>(0.078)<br>2.117 |
| **EFFICACY** | 0.086<br>(0.089)<br>**0.965** | | | | | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Analysis of the beta matrix (see Table 4.40) indicates five paths, one less compared to the original structural model, that are not statistically significant (p>.05). Support was again found for all the paths which were significant in the original model. All these paths were thus still significant in model A. In addition, the path between *Academic self-efficacy* and *cognitive engagement* (t-value; 2.117) proposed under hypothesis 12, became significant in the revised model.

Table 4.41 shows the unstandardised gamma matrix. The gamma matrix reflecting the statistically significance of the $\gamma_{ij}$ estimates revealed that all four originally hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were still supported (p<.05). The estimated value of the newly freed element in $\Gamma$, $\gamma_{72}$ was statistically significant (p<.05). The newly added path from *meta-cognitive knowledge* to *academic self-efficacy* was therefore also supported. In total thirteen of the eighteen hypothesised paths were supported while five were not supported.

Table 4.41

*Unstandardised gamma matrix*

| | **LGOAL** | **KNOW** |
|---|---|---|
| **LPERFORM** | | |
| **SLEAD** | | |
| **LMOTIV** | 0.558<br>(0.087)<br>6.384 | |
| **REGULAT** | 0.321<br>(0.152)<br>2.112 | 0.461<br>(0.146)<br>3.162 |
| **TIME** | | |
| **CENGAGE** | | |
| **EFFICACY** | 0.267<br>(0.121)<br>2.206 | 0.315<br>(0.120)<br>2.627 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

### 4.11.7 MODIFICATION OF THE STRUCTURAL MODEL (MODEL A)

The modification indices for the gamma and beta matrices were again calculated and examined for the possible addition of paths to model A. In accordance with the process suggested by Jöreskog and Sörbom (1993), the parameter with the highest modification index value (29.547) was found in the beta matrix. Table 4.42 provides the results of the unstandarised beta matrix.

Table 4.42

*Modification indices for beta matrix (model A)*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | 0.136 | 3.792 | 0.013 | | 0.299 | 5.117 |
| **SLEAD** | 1.772 | | | **29.547** | 0.742 | 0.966 | |
| **LMOTIV** | 0.211 | | | **9.469** | 0.193 | 0.670 | |
| **REGULAT** | 0.488 | **24.753** | 2.302 | | 7.241 | 9.300 | 0.066 |
| **TIME** | 0.321 | | | 0.099 | | | 0.452 |
| **CENGAGE** | 1.793 | | | | 0.000 | | |
| **EFFICACY** | | | 0.585 | 0.058 | 1.560 | 1.696 | |

Where:

| | | |
|---|---|---|
| LPERFORM=Learning performance | LGOAL=Learning goal orientation | TIME=Time-at-task |
| SLEAD= Academic self-leadership | KNOW= Knowledge of cognition | CENGAGE=Cognitive engagement |
| LMOTIV=Learning motivation | REGULAT=Regulation of cognition | EFFICACY=Academic self-efficacy |

According to Table 4.42, the parameter with the highest modification index value is $\beta_{24}$ representing the slope of the regression of *regulation of cognition* on *self-leadership*. As mentioned during the discussion of the original model modification indices, a path between *academic self-leadership* and *regulation of cognition* did not make substantive theoretical sense neither did a path from *regulation of cognition* to *academic self-leadership*. According to Table 4.42, the parameter with the second highest modification index value is $\beta_{42}$ that describes the slope of the relationship between *academic self-leadership* and *regulation of cognition*. In other words, it is suggested that the addition of a path from *academic self-leadership* to *regulation of cognition* will significantly improve the fit of the model. This is the exact opposite of the parameter with the highest modification index value, which did not make substantive sense, and therefore it was decided to again reject this additional path and consider the parameter with the third highest modification index value.

According to Table 4.42, the parameter with the third highest modification index value is $\beta_{34}$ that describes the relationship between *metacognitive-regulation* and *learning motivation*. When exploring this train of thought, it would mean that an individual with higher levels of *metacognitive regulation* (in terms of the components parts therefore higher levels of declarative-, procedural- and conditional knowledge) would have higher levels of *learning motivation*. In other words, an individual who knows more strategies, and knows how and when to use these strategies would have a higher belief in their own ability to learn. It does make substantive sense that an individual who knows more about how to learn would have higher levels of belief in their own ability to learn. Students who use self-regulated learning strategies are intrinsically self-motivated. *Metacognitive regulation* probably affects *learning motivation* through the effect it has on the effort-performance expectancy. Furthermore to the substantive logic towards the addition of this path, the magnitude of the completely standardised expected change (matrix not shown) is also substantial enough (.222) to support the addition of this path.

According to the procedure suggested by Jöreskog and Sörbom (1993) with regards to the modification of models, currently constrained paths should be freed one at a time as any change to the existing structural model will affect all existing parameter estimates and also all modification index values. Paths that will currently improve the fit of the model will therefore not necessarily do so in the revised model. Therefore, only the addition of the path between *metacognitive regulation* and *learning motivation* was considered at this stage of the modification of the original model. With this change, the structural model was fitted again. A visual representation of the model, as well as the fit indices is presented in section 4.11.8.

### 4.11.8 ASSESSING THE OVERALL GOODNESS-OF-FIT STATISTICS OF THE MODIFIED STRUCTURAL MODEL (MODEL B)

A visual representation of the second modified learning potential structural model is presented in Figure 4.9. The full range of fit indices (both comparative and absolute) for the second modified model (model B) is presented in Table 4.43.

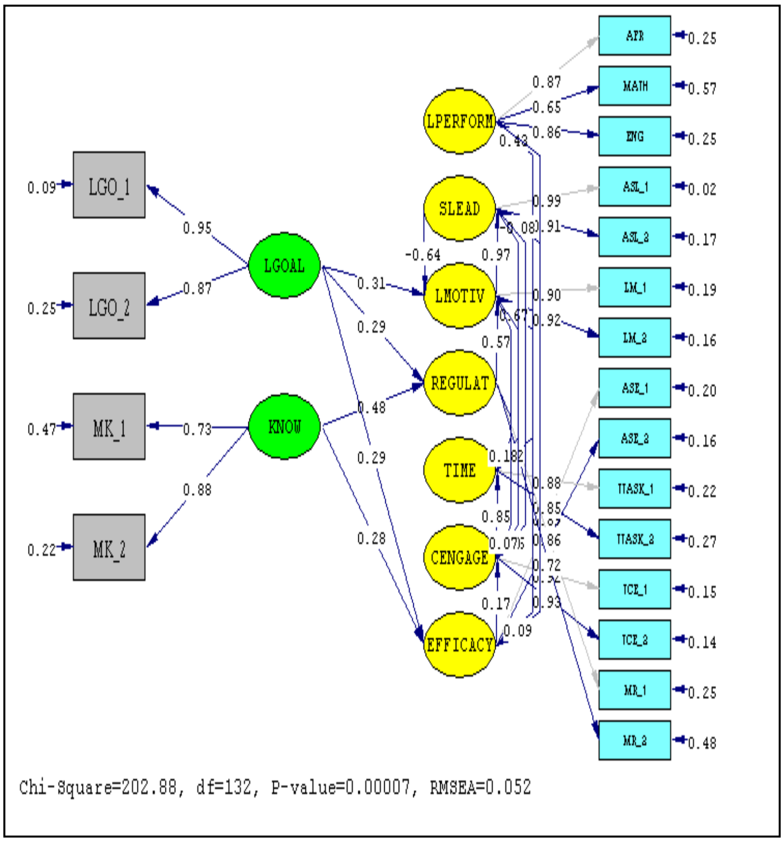

***Figure 4.9*** Representation of the second modified (model B) fitted learning potential structural model (completely standardised solution)

Table 4.43

*Goodness of fit statistics for the second modified learning potential structural model (model B)*

Degrees of Freedom=132
Minimum Fit Function Chi-Square=225.609 (P=0.000)
Normal Theory Weighted Least Squares Chi-Square=220.065 (P=0.000)
Satorra-Bentler Scaled Chi-Square=202.879 (P=0.000)
Chi-Square Corrected for Non-Normality=520.653 (P=0.0)
Estimated Non-centrality Parameter (NCP)=70.879
90 Percent Confidence Interval for NCP=(36.316 ; 113.395)
Minimum Fit Function Value=1.134
Population Discrepancy Function Value (F0)=0.356
90 Percent Confidence Interval for F0=(0.182 ; 0.570)
Root Mean Square Error of Approximation (RMSEA)=0.0519
90 Percent Confidence Interval for RMSEA=(0.0372 ; 0.0657)
P-Value for Test of Close Fit (RMSEA<0.05)=0.397
Expected Cross-Validation Index (ECVI)=1.602
90 Percent Confidence Interval for ECVI=(1.429 ; 1.816)
ECVI for Saturated Model=1.910
ECVI for Independence Model=40.252
Chi-Square for Independence Model with 171 Degrees of Freedom=7972.231
Independence AIC=8010.231
Model AIC=318.879
Saturated AIC=380.000
Independence CAIC=8091.899
Model CAIC=568.181
Saturated CAIC=1196.680
Normed Fit Index (NFI)=0.975
Non-Normed Fit Index (NNFI)=0.988
Parsimony Normed Fit Index (PNFI)=0.752
Comparative Fit Index (CFI)=0.991
Incremental Fit Index (IFI)=0.991
Relative Fit Index (RFI)=0.967
Critical N (CN)=170.409
Root Mean Square Residual (RMR)=0.433
Standardised RMR=0.0431
Goodness of Fit Index (GFI)=0.896
Adjusted Goodness of Fit Index (AGFI)=0.850
Parsimony Goodness of Fit Index (PGFI)=0.622

Table 4.43 indicates that the comprehensive model achieved a Satorra-Bentler Chi-square value of 202.879 (p=.000), which showed that the null hypothesis of exact fit was again rejected. This model achieved a RMSEA value of .0519 which indicates reasonable fit in the sample. The upper bound of the confidence interval fell below the critical value of .08 (0.0372; 0.0657) which also indicates reasonable to good fit in the sample. The p-value of close fit was .397, indicating that the close fit null hypothesis cannot be rejected (p>.05). The sample RMSEA value obtained for model B was marginally lower than the estimate obtained for model A (.0569). Other fit statistics also improved. The AIC and CAIC improved by returning smaller values than those obtained in the initial model whilst ECVI remained unchanged. The NFI, NNFI, CFI, IFI, RFI, GFI, and AGFI all increased in value. The PNFI however decreased marginally while the PGFI remained unchanged. Model B in addition produced an improved SRMR value of .0431, which was below the .05 cut-off value for the first time, and was therefore indicative of acceptable model fit.

### 4.11.9 INTERPRETATION OF THE STRUCTURAL MODEL PARAMETER ESTIMATES (MODEL B)

The unstandardised beta and gamma matrices were examined to determine whether the newly added path was statistically significant and whether the modification of the model affected the findings on the statistical significance of the paths in the initial model.
The unstandardised beta matrix is depicted in Table 4.44 and the unstandardised gamma matrix depicted in Table 4.45.

Table 4.44

*Unstandardised beta matrix*

| | **LPERFORM** | **SLEAD** | **LMOTIV** | **REGULAT** | **TIME** | **CENGAGE** | **EFFICACY** |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | | | | 0.433<br>(0.077)<br>5.639 | | |
| **SLEAD** | | | 0.974<br>(0.168)<br>5.795 | | | | -0.082<br>(0.139)<br>**-0.591** |
| **LMOTIV** | | -0.643<br>(0.263)<br>2.444 | | 0.574<br>(0.134)<br>4.275 | | | 0.670<br>(0.140)<br>4.792 |
| **REGULAT** | | | | | | | |
| **TIME** | | -0.017<br>(0.059)<br>**-0.219** | 0.177<br>(0.084)<br>2.111 | | | 0.848<br>(0.102)<br>8.307 | |
| **CENGAGE** | | 0.457<br>(0.070)<br>6.497 | 0.304<br>(0.110)<br>2.758 | 0.073<br>(0.080)<br>**0.914** | | | 0.169<br>(0.082)<br>2.063 |
| **EFFICACY** | 0.093<br>(0.087)<br>**1.065** | | | | | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Analysis of the beta matrix (see Table 4.44) indicates that four of the five paths that were not statistically significant (p>.05) in model A were still insignificant. The path between *Academic self-leadership* and *learning motivation* (t-value; 2.444) hypothesis 10, became significant in the revised model. The statistically significant $\beta_{32}$ value is however negative whereas hypothesis 10 originally hypothesised that *academic self-leadership* should have a positive effect on *learning motivation*. The statistically significant $\beta_{32}$ estimate therefore does not corrobotate hypothesis 10.The newly added path from *regulation of cognition* to *learning motivation* was found to be statistically significant ($p<.05$). All the other hypotheses in the beta matrix were still supported.

Table 4.45 shows the unstandardised gamma matrix. The gamma matrix reflecting the statistically significance of the $\gamma_{ij}$ estimates revealed that all five of the paths that were hypothesised in model A between the two exogenous latent variables in the model and the three exogenous latent variables were still supported ($p<.05$). In total fifteen of the nineteen hypothesised paths were supported while four were not supported.

Table 4.45

*Unstandardised gamma matrix*

| | **LGOAL** | **KNOW** |
|---|---|---|
| **LPERFORM** | | |
| **SLEAD** | | |
| **LMOTIV** | 0.312<br>(0.133)<br>2.342 | |
| **REGULAT** | 0.287<br>(0.146)<br>1.968 | 0.483<br>(0.143)<br>3.379 |
| **TIME** | | |
| **CENGAGE** | | |
| **EFFICACY** | 0.292<br>(0.115)<br>2.543 | 0.284<br>(0.115)<br>2.464 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

### 4.11.10 MODIFICATION OF THE STRUCTURAL MODEL (MODEL B)

The modification indices were calculated for the gamma and beta matrices of model B and again examined for the possible addition of paths to model B. In accordance with the process suggested by Jöreskog and Sörbom (1993), the parameter with the highest modification index value (48.659) was found in the beta matrix. Table 4.46 provides the results of the unstandardised beta matrix.

Table 4.46

*Modification indices for beta matrix (model B)*

| | LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | 0.083 | 3242 | 0.003 | | 0.197 | 5.040 |
| **SLEAD** | 2.059 | | | 6.869 | 0.043 | 0.100 | |
| **LMOTIV** | 0.026 | | | | | | |
| **REGULAT** | 3.201 | **11.177** | 10.854 | | 0.341 | 0.004 | 0.442 |
| **TIME** | 0.275 | | | 0.069 | | | 0.403 |
| **CENGAGE** | 1.613 | | | | 0.001 | | |
| **EFFICACY** | | **48.659** | 1.967 | 0.431 | 0.223 | 0.001 | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

According to Table 4.46, the parameter with the highest modification index value is $\beta_{72}$ that describes the slope of the regression of *academic self-leadership on academic self-efficacy*.

In support of this additional path, a series of studies conducted by Ruvolo and Markus (1992) lends support to the self-efficacy enhancing qualities of thought self-leadership. Specific thought self-leadership strategies include: self-management of beliefs and assumptions, mental imagery, and self-talk. These mental practises enable self-guided verbal persuasion, which are an important source that assist in improving self-efficacy (Ruvolo & Markus, 1992). They further proposed that the effect of mental practise on task performance can be explained by the intervening effect of self-efficacy. Specifically, they argue that mental practise facilitates enactive mastery, vicarious experience and self-guided verbal persuasion which are three sources of information that Bandura (1977) identified as necessary for increasing self-efficacy. Individuals can therefore symbolically experience the mastery of a task during mental practise. Further research results reported by Morin and Latham (2000) revealed that mental practice explained a significant proportion of the variance in self-efficacy ($R^2$=.16; p<.05). Based on this, Burger (2012) hypothesised that academic self-leadership positively influences academic self-efficacy. This relationship was also hypothesised to be reciprocal, based on the idea that effective leaders require higher levels of confidence, which amplifies the fact that self-efficacy is important for achieving success and effectiveness as a leader (Hannah, Avolio, Luthans & Harms, 2008).

Based on the persuasiveness of the foregoing theoretical argument and research evidence the path between *academic self-leadership* and *academic self-efficacy* was added to model B and the model fitted again. A visual representation of the model, as well as the fit indices is presented in section 4.11.11.

### 4.11.11 ASSESSING THE OVERALL GOODNESS-OF-FIT STATISTICS OF THE MODIFIED STRUCTURAL MODEL (MODEL C)

A visual representation of the third modified learning potential structural model is presented in Figure 4.10. The full range of fit indices (both comparative and absolute) for the first modified model (model C) is presented in Table 4.47.

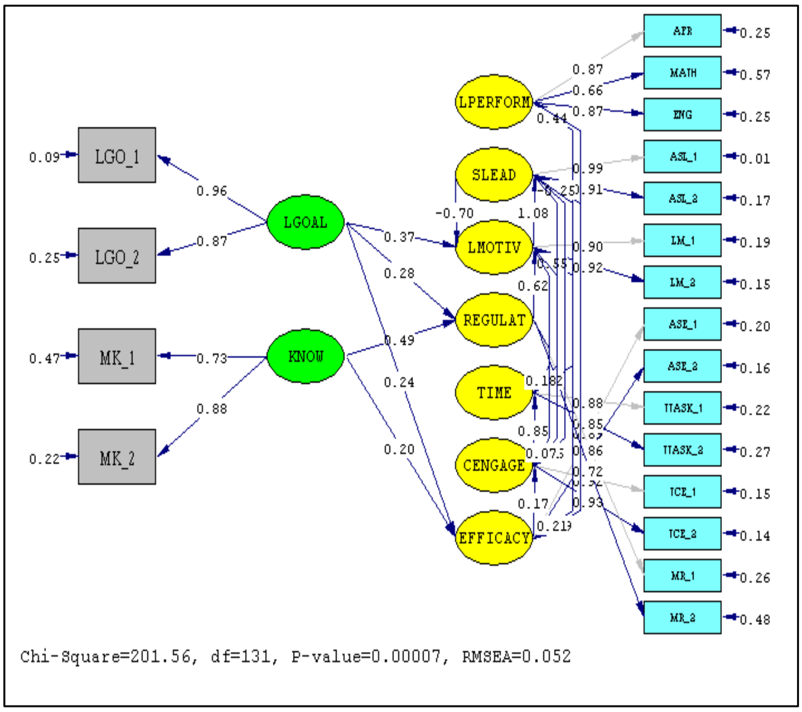

***Figure 4.10*** Representation of the third modified (model C) fitted learning potential structural model (completely standardised solution)

Table 4.47

*Goodness of fit statistics for the third modified learning potential structural model (model C)*

Degrees of Freedom=131
Minimum Fit Function Chi-Square=223.955 (P=0.000)
Normal Theory Weighted Least Squares Chi-Square=218.679 (P=0.000)
Satorra-Bentler Scaled Chi-Square=201.560 (P=0.000)
Chi-Square Corrected for Non-Normality=497.940 (P=0.0)
Estimated Non-centrality Parameter (NCP)=70.560
90 Percent Confidence Interval for NCP=(36.112 ; 112.960)
Minimum Fit Function Value=1.125
Population Discrepancy Function Value (F0)=0.355
90 Percent Confidence Interval for F0=(0.181 ; 0.568)
Root Mean Square Error of Approximation (RMSEA)=0.0520
90 Percent Confidence Interval for RMSEA=(0.0372 ; 0.0658)
P-Value for Test of Close Fit (RMSEA<0.05)=0.394
Expected Cross-Validation Index (ECVI)=1.606
90 Percent Confidence Interval for ECVI=(1.433 ; 1.819)
ECVI for Saturated Model=1.910
ECVI for Independence Model=40.252
Chi-Square for Independence Model with 171 Degrees of Freedom=7972.231
Independence AIC=8010.231
Model AIC=319.560
Saturated AIC=380.000
Independence CAIC=8091.899
Model CAIC=573.161
Saturated CAIC=1196.680
Normed Fit Index (NFI)=0.975
Non-Normed Fit Index (NNFI)=0.988
Parsimony Normed Fit Index (PNFI)=0.747
Comparative Fit Index (CFI)=0.991
Incremental Fit Index (IFI)=0.991
Relative Fit Index (RFI)=0.967
Critical N (CN)=170.388
Root Mean Square Residual (RMR)=0.428
Standardised RMR=0.0437
Goodness of Fit Index (GFI)=0.896
Adjusted Goodness of Fit Index (AGFI)=0.850
Parsimony Goodness of Fit Index (PGFI)=0.618

Table 4.47 indicates that the null hypothesis of exact fit still had to be rejected. The structural model achieved a statistically significant Satorra-Bentler chi-square value of 201.560 (p=.000). The RMSEA value of .0520 indicates reasonable fit in the sample. The upper bound of the confidence interval fell below .08 (.0372; .0658) which indicates reasonable to good fit in the sample. The p-value of close fit was 0.394, indicating that the close fit null hypothesis cannot be rejected (p>.05). The RMSEA value obtained for model C was marginally higher than the estimate obtained for model B (.0519), but still indicated reasonable model fit. The ECVI, AIC, CAIC and PNFI all returned marginally larger values that those obtained in the model B. The NFI, NNFI, CFI, IFI, RFI, GFI and AGFI all remained unchanged. The PNFI, however, decreased marginally.Model C produced a SRMR of .0437, which is slightly higher than the estimate obtained for model B but again fell below the .05 cut-off value indicative of acceptable model fit.

### 4.11.12 INTERPRETATION OF THE STRUCTURAL MODEL PARAMETER ESTIMATES (MODEL C)

The unstandardised beta and gamma matrices were examined to determine whether the newly added path was statistically significant and whether the modification of the model affected the findings on the statistical significance of the paths in the initial model.The unstandardised beta matrix is depicted in Table 4.48 and the unstandardised gamma matrix depicted in Table 4.49.

Table 4.48

*Unstandardised beta matrix*

| | LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | | | | 0.438<br>(0.075)<br>5.863 | | |
| **SLEAD** | | | 1.085<br>(0.247)<br>4.398 | | | | -0.249<br>(0.265)<br>**-0.937** |
| **LMOTIV** | | -0.701<br>(0.283)<br>2.481 | | 0.617<br>(0.152)<br>4.056 | | | 0.554<br>(0.194)<br>2.856 |
| **REGULAT** | | | | | | | |
| **TIME** | | -0.018<br>(0.059)<br>**-0.297** | 0.176<br>(0.084)<br>2.109 | | | 0.849<br>(0.102)<br>8.320 | |
| **CENGAGE** | | 0.456<br>(0.071)<br>6.423 | 0.307<br>(0.110)<br>2.787 | 0.071<br>(0.081)<br>**0.876** | | | 0.165<br>(0.083)<br>1.986 |
| **EFFICACY** | 0.094<br>(0.083)<br>**1.132** | 0.213<br>(0.242)<br>**0.881** | | | | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Analysis of the beta matrix (see Table 4.48) indicates four paths that are not statistically significant (p>.05). All four statistically insignificant paths in model B remained insignificant in model C. In addition the path coefficient associated with the newly added path from *academic self-leadership* to *academic self-efficacy* (t-value; 0.881) was also not statistically significant. No support is therefore found for the hypothesis that *academic self-leadership* affects *academic self-efficacy*. All the relationships that were found to be statistically significant in the beta matrix in model B were still significant in model C.

Table 4.49 shows the unstandardised gamma matrix. The gamma matrix reflecting the statistically significance of the $\gamma_{ij}$ estimates revealed that three of the five paths between the two exogenous latent variables in the model and the three endogenous latent variables were not supported (p>.05) in model C whereas all five paths were found to be statistically significant (p<.05) in model B. The hypothesised path between *metacognitive knowledge* and *academic self-efficacy* was no longer supported (t-value; 1.643) as well as the path from *learning goal orientation* to *academic self-efficacy* (t-value; 1.780. Similarly the hypothesised path from *learning goal orientation* to *regulation of cognition* (t-value; 1.946) was no longer found to be statistically significant (p<.05).

Table 4.49

*Unstandardised gamma matrix*

| | **LGOAL** | **KNOW** |
|---|---|---|
| **LPERFORM** | | |
| **SLEAD** | | |
| **LMOTIV** | 0.370<br>(0.169)<br>2.190 | |
| **REGULAT** | 0.284<br>(0.146)<br>**1.946** | 0.486<br>(0.143)<br>3.410 |
| **TIME** | | |
| **CENGAGE** | | |
| **EFFICACY** | 0.240<br>(0.135)<br>**1.780** | 0.202<br>(0.123)<br>**1.643** |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

In total twelve of the twenty hypothesised paths were supported while eight were not supported. Due to the increase in insignificant paths, it was decided not to interpret model C any further and to rather use model B as the final version of the revised learning potential structural model.

Model B contains two additional paths that were not hypothesised in the original model. They were added based on feedback obtained from the current data set.The fact that the data that suggested their addition to the original model supported their inclusion can therefore not be regarded as convincing evidence in support of these two added paths. The two paths that were added to the originally hypothesised model (*metacognitive regulation* affects *learning motivation* and *metacognitive knowledge* affects *academic self-efficacy*) should therefore still be regarded as hypotheses that should be tested on a new data set.

## 4.12 A FURTHER DISCUSSION OF THE PARAMETER ESTIMATES OF THE FINAL LEARNING POTENTIAL STRUCTURAL MODEL (MODEL B)

Diamantopoulos and Siguaw (2000) suggested that additional insights on the strength of the statistically significant (p<.05) structural relationships in the structural model can be obtained by interpreting the completely standardised beta and gamma parameter estimates provided by LISREL. This is because this output is not affected by differences in the unit of measurement of the latent variables and can therefore be compared across structural equations. The completely standardised beta and gamma parameter estimates reflect the average change, expressed in standard deviation units, in the endogenous latent variables, directly resulting from a one standard deviation change in an endogenous or exogenous latent variable to which it has been linked, holding the effect of all other variables constant (Diamantopoulos & Siguaw, 2000). The latter qualification is an important, but often neglected, consideration when interpreting the completely standardised (as well as the unstandardised) gamma and beta estimates. The completely standardised beta and gamma parameter estimates are presented in Table 4.50 and Table 4.51.

Table 4.50

*Final du Toit-de Goede learning potential structural model completely standardised beta matrix*

| | LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|---|
| **LPERFORM** | | | | | 0.433 | | |
| **SLEAD** | | | **0.974** | | | | -0.082 |
| **LMOTIV** | | -0.643 | | **0.574** | | | **0.670** |
| **REGULAT** | | | | | | | |
| **TIME** | | -0.017 | 0.177 | | | **0.848** | |
| **CENGAGE** | | 0.457 | 0.304 | 0.073 | | | 0.169 |
| **EFFICACY** | 0.093 | | | | | | |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Table 4.51

*Final du Toit-de Goede learning potential structural model completely standardised gamma matrix*

| | LGOAL | KNOW |
|---|---|---|
| **LPERFORM** | | |
| **SLEAD** | | |
| **LMOTIV** | 0.312 | |
| **REGULAT** | 0.287 | 0.483 |
| **TIME** | | |
| **CENGAGE** | | |
| **EFFICACY** | 0.292 | 0.284 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

The completely standardised parameter estimates revealed that of all the significant effects, the influence of *learning motivation* on *academic self-leadership* (.974) was the most pronounced. This is followed by the effect of *cognitive engagement* on *time-at-task* (.848); the influence of *academic self-efficacy* on *learning motivation* (.670) and the effect of *regulation of cognition* on *learning motivation* (.574). The negative relationship of *academic self- leadership* on *learning motivation* also appears to be reasonably robust (-.643) when compared with the magnitude of the other estimates presented. The influence of *academic self- leadership* on *learning motivation* was originally hypothesised to be positive. A negative influence does not conceptually make sense. The significant $\beta_{32}$ estimate was therefore not interpreted as evidence that corroborates hypothesis 10. Despite its impressive magnitude, the -.643 estimate of $\beta_{32}$ should therefore not be interpreted. It is interesting to note that the reasonably substantial relationship between *regulation of cognition* and *learning motivation* was not originally hypothesised but was added after running the analysis and investigating the modification indices. Both *learning goal orientation* and *metacognitive knowledge* only exert relative modest influences on the endogenous latent variables they were structurally linked to in the model.

Table 4.52 and Table 4.53 indicate the unstandardised psi and completely standardised psi matrices. The unstandardised psi matrix depicts the variances in the structural error terms and the completely standardised psi matrix the magnitude of the structural error variance estimates. One would expect these variances to be small but significant since one would not regard the model as perfect/complete. Table 4.52 indicates that six of the seven estimated variances were statistically significant ($p<.05$). Table 4.52 indicates that the structural error term associated with the endogenous latent variable *time-at-task* was statistically insignificant ($p>.05$). This suggests that the structural model (model B) succeeded in fully explaining all variance in $\eta_5$. Although this is ultimately the aim of cumulative research studies elaborating on previous structural models to gradually unpack the contents of the structural error terms, it is not an ideal that one considers realistically practically achievable. At least not in models of quite modest complexity like the model depicted in Figure 4.8. The current finding of a statistically insignificant structural error variance estimate for the *time-at-task* latent variable is a little bit too good to be true. This finding therefore erodes confidence in the model. In Table 4.31 and in Table 4.32 it is indicated that *cognitive engagement* and *time-at-task* correlate quite strongly (.895) and that the upper bound of the 95% confidence interval includes .90 (although it does not include unity). This to some degree raises the concern that the indicators used to measure these two latent variables failed to properly discriminate between the two latent variables. *Time-at-task* has been modelled to be influenced by *cognitive engagement*. To the extent that the discriminant validity concern will be warranted the insignificant structural error variance for the *time-at-task* endogenous latent variable can be explained by the fact that the variance in a latent variable is essentially explained by itself. This line of reasoning points to the need to seriously consider combining *cognitive engagement* and *time-at-task* into a single latent variable in future learning potential structural models.

Table 4.52

*Final du Toit-de Goede learning potential structural model unstandardised psi matrix*

| LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|
| 0.783 | 0.670 | 0.621 | 0.494 | 0.044 | 0.236 | 0.660 |

| | | | | | | |
|---|---|---|---|---|---|---|
| (0.123) | (0.124) | (0.234) | (0.106) | (0.034) | (0.039) | (0.093) |
| 6.436 | 5.383 | 2.648 | 4.649 | **1.276** | 6.051 | 7.122 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

The completely standardised psi matrix (Table 4.53) revealed that the learning potential structural model only really succeeded in successfully explaining variance in *cognitive engagement,* and to a lesser but still acceptable degree, in *regulation of cognition* (ignoring the exceptional success achieved in explaining variance in *time-at-task).* The model's inability to account for variances in especially *learning performance during evaluation,* and to a lesser degree, *academic self-leadership, academic self-efficacy* and *learning motivation* is rather disappointing. This suggests that future research attempts focusing on elaborating the current model will have to focus on adding latent variables that structurally link directly with *learning performance during evaluation.*

Table 4.53

*Final du Toit-de Goede learning potential structural model completely standardised psi matrix*

| LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|
| **0.783** | **0.670** | **0.621** | 0.494 | 0.044 | 0.236 | **0.660** |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Table 4.54 indicates the $R^2$ values for the seven endogenous latent variables. $R^2$ signifies the proportion of the variance in the endogenous latent variables that is accounted for by the learning potential structural model.

Table 4.54

*$R^2$ values of the seven endogenous latent variables in the final du Toit-de Goede learning potential structural model*

| LPERFORM | SLEAD | LMOTIV | REGULAT | TIME | CENGAGE | EFFICACY |
|---|---|---|---|---|---|---|
| 0.217 | 0.330 | 0.379 | **0.506** | **0.956** | **0.764** | 0.340 |

Where:

LPERFORM=Learning performance
SLEAD= Academic self-leadership
LMOTIV=Learning motivation
LGOAL=Learning goal orientation
KNOW= Knowledge of cognition
REGULAT=Regulation of cognition
TIME=Time-at-task
CENGAGE=Cognitive engagement
EFFICACY=Academic self-efficacy

Table 4.54 necessarily echoes the findings derived from Table 4.53. As is evident from Table 4.54 the learning potential structural model successfully accounts for the variance in *time-at-task*, *cognitive engagement* and *regulation of cognition*. The learning potential structural model, however, is less successful in explaining variance in *learning performance*, *academic self-leadership*, *learning motivation* and *academic self-efficacy*. The model's inability to account for the variance in these latent variables is somewhat disappointing. The model's inability to explain variance in *learning performance during evaluation* can, however, at least in part be attributed to the fact that the more cognitively oriented learning competencies (*transfer of knowledge* and *automatisation*) are excluded from the current structural model, as well as the cognitive learning competency potential latent variables (*information processing capacity* and *abstract thinking capacity*). This underlines the importance and urgency of finding a solution to the problem of appropriate operationalising of the *transfer of knowledge* and *automatisation* learning competencies. Without appropriate measures of the two learning competencies that measure the level of competence achieved on these competencies in the classroom, meaningful progress towards explaining more variance in the learning performance during evaluation latent variable will be significantly inhibited.

## 4.13 SUMMARY

The purpose of this chapter was to report on the results obtained from this study. The following chapter will discuss in greater depth the general conclusions drawn from the research. The practical implications of this study, limitations of the study and recommendations for future research will be discussed in Chapter 5.

# CHAPTER 5

# CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

## 5.1 INTRODUCTION

In this final chapter, the objectives of the study are briefly reviewed after which the research results as presented in Chapter 4 are discussed and interpreted. The chapter concludes with a discussion on the limitations of the research methodology, the practical implications of this study for HR and organisations, and lastly recommendations for future research.

## 5.2 BACKGROUND OF THIS STUDY

South Africa has a history of racial discrimination that was led by the Apartheid system which was characterised by legal racial segregation enforced by the National Party government of South Africa between 1948 and 1993. This system was designed for the sole purpose of benefiting White South African citisens and discriminating against Black South Africans. This was achieved by segregating amenities and public services and providing Black South Africans with services inferior to those of White South Africans. This segregation left the previously disadvantaged group members with underdeveloped competency potential, as opposed to the not previously disadvantaged group members, and has subsequently led to adverse impact in valid, fair, strict-top-down selection. This denial of the opportunity to accumulate human capital in turn deprived members of the previously disadvantaged groups the opportunity to enter into the market place and offer themselves to organisations as employable resources. If it is assumed that fundamental talent is uncorrelated with race, it then implies that there lies a vast reservoir of untapped human potential in this country. A method is therefore required to identify these. The effects of the past wrongdoings must be dealt with effectively and proactively. There is thus a responsibility and an opportunity for human resource managers in the private and public sector to identify and develop those individuals from the previously disadvantaged groups who have the potential to learn (Burger, 2012).

In South Africa an intellectually honest solution to the problem of adverse impact would be to provide development opportunities, rather than searching for an alternative selection instrument, to those individuals who have been denied opportunities in the past in order to develop skills, abilities and coping strategies necessary for job performance. Affirmative development will entail giving previously disadvantaged individuals access to the skills development and educational opportunities so as to equip themselves with the currently deficit skills, knowledge, and abilities. It is however necessary to identify individuals who have the potential to learn, who show the greatest probability to acquire the deficient attainments and dispositions, and who subsequently gain maximum benefit from such opportunities (De Goede & Theron, 2010). All individuals that currently do not have the crystallised abilities to do the job will not necessarily be able to develop these if given the chance. Thus, it is necessary to determine which of the individuals considered for an affirmative development opportunity will achieve the highest level of *classroom learning performance* and eventually *learning performance during evaluation*.

A need was therefore identified for Industrial Psychology researchers to assist organisations to identify the individuals who would gain maximum benefit from such affirmative development opportunities and to create optimal conditions so that those admitted to the programme will eventually succeed. In order to do this, an understanding of the factors which determine whether or not a learner will be successful if entered into an affirmative development opportunity, is required. De Goede (2007) conducted such a study. The objective of this study was to expand the discipline's understanding of learning potential and the role it plays in addressing the negative effects of South Africa's past by modifying and elaborating De Goede's (2007) learning potential structural model which he based on the work of Taylor (1989, 1992, 1994) that formed the theoretical basis of the APIL-B test battery, a learning potential measure. Non-cognitive factors were added to the De Goede (2007) learning potential structural model in order to gain a deeper understanding of the complexity underlying learning and the determinants of learning performance. Three competencies were added to the model namely *metacognitive regulation*, *time cognitively engaged* and *academic self-leadership*. *Metacognitive knowledge*, *cognitive engagement*, *learning motivation*, *academic self-efficacy*, and *learning goal orientation* were added to the model as additional learning competency potential latent variables. The elaborated model was subsequently empirically tested. The results are discussed below.

## 5.3 RESULTS

### 5.3.1 EVALUATION OF THE MEASUREMENT MODEL

The fit of the learning potential measurement model was analysed to determine to what extent the indicator variables successfully operationalised the learning potential latent variables. The overall goodness-of-fit of the measurement model was tested through structural equation modelling (SEM). Various fit indices were interpreted to assess the goodness-of-fit of the measurement model and it was found that the measurement model fits the data well, as close fit was obtained. The null hypothesis of exact fit was rejected; subsequently the null hypothesis of close fit was tested and not rejected. The interpretation of the array of measurement model fit statistics, the standardised residuals and the modification indices all indicated good model fit.

The factor loadings were statistically significant ($p<.05$) and mostly satisfactorily large and the error variances were statistically significant ($p<.05$) and mostly acceptably small. The portfolio of results obtained seemed to validate the claim that the specific indicator variables reflected the specific latent variables they were meant to reflect. Some concern was raised about the success with which the *Mathematics* marks reflected the *learning performance during evaluation* latent variable. Furthermore, the values of the squared multiple correlations for the indicators were generally quite high. The measurement error variances were generally quite low, thereby legitimising the use of the proposed operationalisation of the latent variables to empirically test the learning potential structural model. *Mathematics* and *Academic self-leadership* were the only two exceptions.

Discriminant validity was also tested and the results obtained revealed that it was highly unlikely that any of the inter-latent variable correlations were equal to 1 in the parameter. This meant that each latent variable may be regarded as a separate qualitative distinct variable although they do share variance.

Based on these findings, sufficient merit for the measurement model existed, and this proves that the operationalisation of the du Toit -De Goede learning potential model was successful. It would therefore be possible to derive a verdict on the fit of the structural model from the fit of the comprehensive LISREL model. As the measurement model showed good fit and the indicator variables generally reflected their designated latent variables well, the structural relationships between latent variables hypothesised by the proposed model depicted in Figure 3.1 were tested via SEM.

### 5.3.2 EVALUATION OF THE STRUCTURAL MODEL

The proposed learning potential structural model was fitted to the data and the initial fit was reasonably good, however the unstandardised beta and gamma matrices revealed that six of the seventeen paths were not supported. No support was found for the following six hypotheses: *Academic self-efficacy* influences *Academic self-leadership*; *Academic self-leadership* and *learning motivation; Academic self-leadership* and *time–at-task*; *Learning performance during evaluation* and *academic self-efficacy; Regulation of cognition* and *cognitive engagement;* and *Academic self-efficacy* and *cognitive engagement.* Analysis of the gamma matrix indicated that all four of the hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were supported (p<.05). It was decided and supported by Theron (Personal communication, 20 February, 2014), that none of the insignificant paths should be removed at this stage. Furthermore, it was also indicated that the fit of the model would be improved through adding the theoreticall justifiable path from *metacognitive-knowledge* to *academic self-efficacy.* After adding this additional path the analysis was re-run.

After the first modification, the fit of the structural model (model A) was subsequently re-evaluated and the model fit as judged by the chi-square statistic improved substantially although in some respects the model fit deteriorated slightly. However, opportunity for improvement still existed. The unstandardised beta and gamma matrices revealed that five, one less compared to the original structural model, of the now eighteen paths were not statistically significant (p>.05) and therefore not supported. No support was thus found for the following five hypotheses: *Academic self-efficacy* influences *Academic self-leadership*; *Academic self-leadership* influences *learning motivation; Academic self-leadership* influences *time–at-task*; *Learning performance during evaluation* influences *academic self-efficacy*; and *Regulation of cognition* influences *cognitive engagement.* Analysis of the gamma matrix indicated that all five of the hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were supported (p<.05).

Additionally it was suggested to include the path depicting the influence of *metacognitive regulation* and *learning motivation*. This proposed path made substantive theoretical sense. An individual with higher levels of *metacognitive regulation* (in terms of the component's parts therefore higher levels of declarative-, procedural- and conditional knowledge) would thus have higher levels of *learning motivation*. In other words, an individual who knows more strategies, knows how to use these strategies and knows when to use these strategies, would have a higher belief in their own ability to learn and therefore, via the improvement in the expectancy that effort will translate into performance, also a higher *learning motivation*. Again it was decided that none of the insignificant paths should be removed at this stage. After adding this additional path the analysis was re-run.

After the second modification, the fit of the structural model (model B) was subsequently re-evaluated and the model fit, as judged by the chi-square statistic, improved substantially although in some respects the model fit deteriorated slightly. However, opportunity for improvement still existed. The unstandardised beta and gamma matrices revealed that four of the five paths that were not statistically significant (p>.05) in model A were still insignificant and therefore not supported. This is two less compared to the original structural model and therefore only four of the now nineteen paths were not supported in model B. No support was found for the following four hypotheses: *Academic self-efficacy* influences *Academic self-leadership*; *Academic self-leadership* influences *time–at-task*; *Learning performance during evaluation* influences *academic self-efficacy*; and *Regulation of cognition* influences *cognitive engagement*. Analysis of the gamma matrix indicated that all five of the hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were supported (p<.05). Additionally it was suggested to include the pathway depicting the relationship between *academic self-leadership* and *academic self-efficacy*. Burger (2012) hypothesised that *academic self-leadership* positively influences *academic self-efficacy*. This relationship was also hypothesised to be reciprocal, based on the idea that effective leaders require higher levels of confidence, which amplifies the fact that self-efficacy is important for achieving success and effectiveness as a leader (Hannah, Avolio, Luthans & Harms, 2008). Again it was decided that none of the insignificant paths should be removed at this stage. After adding this additional path the analysis was re-run.

After the third modification, the fit of the structural model (model C) was subsequently re-evaluated and the model fit as judged by the chi-square statistic, improved marginally, but now with only twelve of the twenty hypothesised paths being supported, while eight were not supported. The unstandardised beta and gamma matrices revealed that all four statistically insignificant paths in model B remained insignificant (p>.05) in model C, which also revealed an additional insignificant path between *academic self-leadership* and *academic self-efficacy*. No support was thus found for the following hypotheses: *Academic self-efficacy* influences *Academic self-leadership*; *Academic self-leadership* influences *time–at-task*; *Learning performance during evaluation* influences *academic self-efficacy*; *academic self-leadership* influences *academic self-efficacy* and *regulation of cognition* influences *cognitive engagement*. Analysis of the gamma matrix indicated that two of the five hypothesised paths between the two exogenous latent variables in the model and the three endogenous latent variables were supported (p<.05). The hypothesised path between *metacognitive knowledge* and *academic self-efficacy* was not supported, neither was the path between *learning goal orientation* and *regulation of cognition* nor the path from *learning goal orientation* to *academic self-efficacy*. Due to the increase in insignificant paths, it was decided not to interpret model C any further and to use structural Model B rather than structural Model C. Therefore no paths were added to structural model C at this stage of the analysis as model B was considered to be the more convincing model.

The goodness of fit statistics for Model B indicated that the structural model fitted the data well. It was thus concluded that good model fit was achieved.

The modification of the learning potential structural model to create model B, resulted in the initial seventeen paths being expanded to the final nineteen paths. It was decided that none of the originally hypothesised paths should be deleted. The modified learning potential structural Model B, achieved acceptable/good model fit. The stem-and-leaf plot however indicated that, in terms of substantial estimation errors, the comprehensive model tended to underestimate the observed covariance matrix as the standardised residuals appeared slightly positively skewed. The final proposed and tested du Toit – De Goede learning potential structural model is presented in Figure 5.1.

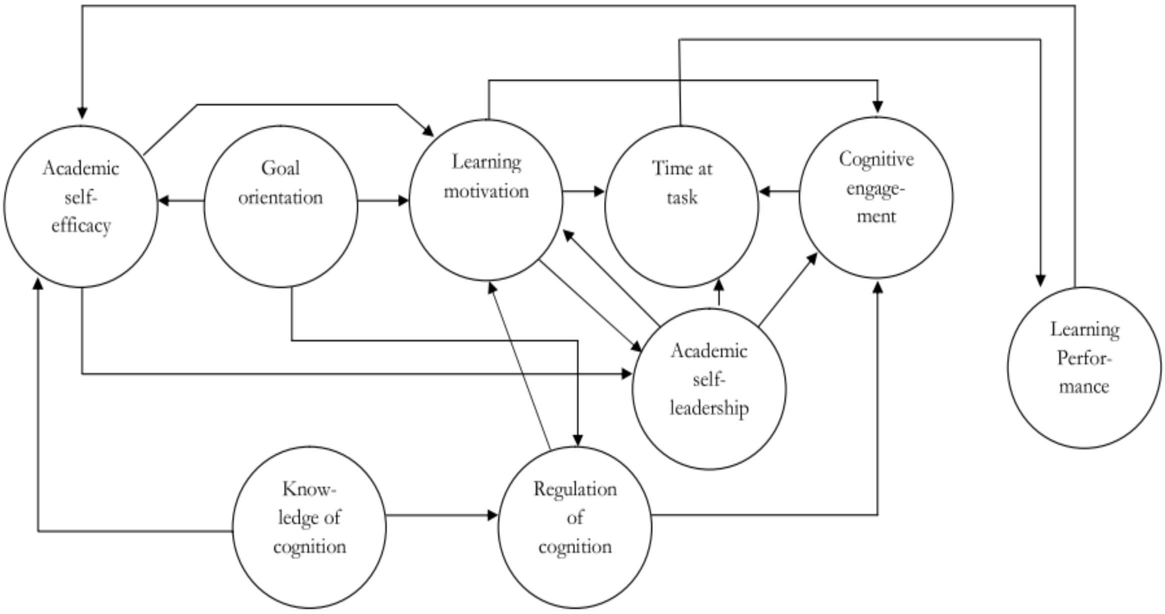

***Figure 5.1*** Final proposed and tested du Toit – De Goede learning potential reduced structural model

*Academic self-efficacy*, the belief's in one's academic capability, was shown in the current study to statistically significantly (p<.05) and positively influence *learning motivation*. In other words, a strong belief in one's capabilities increases motivation to learn. It makes sense that an individual who believes in their ability to be successful in academic tasks, will be more motivated during academic tasks than an individual who does not believe in their ability to be successful in academic tasks. More specifically *Academic self-efficacy* can be expected to affect the expectancy (P(E→P)) that exerted effort will result in successful academic performance. Furthermore, *academic self-efficacy* was shown to statistically significantly (p<.05) and positively influence *cognitive engagement*. In other words, the stronger an individual's belief in their academic capability to learn, the more cognitively engaged that individual will be in learning tasks. It was proposed in this study that *Academic self-efficacy* will have a negative effect on *academic self-leadership*. Although a negative path coefficient was obtained as hypothesised, the estimate was not statistically significant (p>.05). No support was therefore found for this hypothesis. Furthermore, *learning motivation* was shown to statistically significantly (p<.05) and positively influence *time-at-task*, *cognitive engagement*, as well as *academic self-leadership*. With regards to the relationship between *learning motivation* and *time-at-task* and between *learning motivation* and *cognitive engagement*, it was found that the more an individual is motivated to learn, the more time that individual will spend on the associated learning tasks and the more cognitively engaged that individual will be in these tasks. The relationship found between *learning motivation* and *academic self-leadership* indicated that the more motivated to learn the individual is, the more likely that individual is to lead him-/herself through the process of learning. *Learning motivation* was therefore found to serve as the force that brings an individual's intention to learn into action and it serves as a mobiliser /driver of *academic self-leadership*.

*Cognitive engagement* which takes into account effort exerted by an individual on a learning task, was found to statistically significantly (p<.05) and positively influence *time-at-task*. *Time-at-task* in turn revealed a statistically significantly (p<.05) and positive relationship with *learning performance*. This was the only construct in the learning potential structural model that evidenced a direct relationship with *learning performance* during evaluation. More *time cognitively engaged* with study material during classroom learning, thus results in higher academic results in the test that evaluates the extent to which classroom learning took place.

Initially it was hypothesised that *academic self-leadership* would positively influence *learning motivation* and *time at task*. *Academic self-leadership was* shown to statistically significantly (p<.05) and positively influence *learning motivation* positively, however no support was found for the hypothesised direct path between *academic self-leadership and time at task* (p>.05). It was also initially hypothesised that *learning performance* would positively influence *academic self-efficacy* via a feedback loop, however this path was also not supported (p>.05).

Results moreover indicate that *metacognitive regulation* statistically significantly (p<.05) and positively affects *learning motivation*. This relationship means that an individual, who engages in cognitive processes such as planning strategies and the allocation of resources, monitoring of progress and the effectiveness of strategies and eventually evaluating their own learning, tend to be be more motivated to learn than a individual who does not regulate their own cognitive processes during their learning. It was hypothesised that *metacognitive regulation* would positively influence *cognitive engagement;* however this path was not supported (p>.05).

Results of the analysis also indicate that *metacognitive-knowledge* statistically significantly (p<.05) and positively affects the competency *metacognitive-regulation*. This relationship made theoretical argument that if students cannot distinguish between what they know and do not know, they can hardly be expected to exercise control over their learning activities or to elect appropriate strategies to progress in their learning. *Metacognitive-knowledge* had been shown to statistically significantly (p<.05) and positively affect *academic self-efficacy*. In other words, an individual with higher levels of *metacognitive-knowledge* (in terms of component parts: therefore higher levels of declarative-, procedural- and conditional knowledge) would have higher levels of *academic self-efficacy*. It does make substantive sense that an individual who knows more about how to learn would have higher levels of belief in their own abilities to learn.

An individual with a *learning goal orientation* seeks to develop competence by acquiring new skills and mastering novel situations. Such individuals thus are motivated to excel at learning by the goal to master the learning material and acquire knowledge rather than surpass the academic performance of their colleagues. *Learning goal orientation* was shown to statistically significantly (p<.05) and positively influence *learning motivation, metacognitive regulation*, as well as *academic self-efficacy*. With regards to the relationship between *learning goal orientation* and *learning motivation*, it was found that the more an individual seeks to develop competence by acquiring new skills and mastering novel situations the more motivated he/she is to learn. The relationship found between *learning goal orientation* and *metacognitive regulation* indicated that the more an individual possesses the goal to learn and acquire knowledge, the more likely that individual is to engage in cognitive processes such as planning strategies and the allocation of resources, monitoring of progress and the effectiveness of strategies and eventually evaluating their own learning. The relationship found between *learning goal orientation* and *academic self-efficacy* indicated that the more an individual seeks to develop competence by acquiring new skills and mastering novel situations, the more these goals will develop beliefs about their capability to engage in subsequent tasks or activities (*academic self-efficacy*).

## 5.4 LIMITATIONS TO THE RESEARCH METHODOLOGY

A number of limitations to this study can be highlighted. Firstly, the proposed learning potential structural model was tested on a non-probability, convenience sample of Grade

11 learners from four high schools resorting under the Gauteng and Free State Departments of Education. The four high schools were also selected on a non-probability, convenience basis. Due to the non-probability sampling procedure that was used to select the sample it cannot be claimed that the sample is representative of the target population. Additionally, with reference to sampling limitation, the affirmative action perspective from which this study stems, one would want to argue that the sample needs to consist of participants that qualify as affirmative development candidates. Even though the sample was taken from different provinces, the sample is not as representative of the disadvantaged population as would be desired based on the auther's literature study. The results obtained in this study should be generalised to other developmental contexts with great circumspection. Replication of this research on other samples and in different developmental contexts is therefore encouraged.

Secondly it should be noted again that good model fit in SEM does not imply causality. Even though the structural model being evaluated hypothesised specific causal paths between the latent variables comprising the model, good model fit and significant path coefficients constitute insufficient evidence to conclude that these causal hypotheses have been confirmed. In the final analysis this is not due to limitation in the analysis technique as such but rather due to the *ex post facto* nature of the study that precludes the experimental manipulations of the relevant latent exogenous and endogenous variables (Kerlinger & Lee, 2000).

A third limitation relates to the measuring instruments used in this study. The instruments used are self-report measures. Self-report measures run the risk of social desirability. Social desirability refers to the risk that learners may be tempted to attempt to manipulate the answers in order to create a more favourable impression when completing a self-report questionnaire. This, in turn, impacts on the reported levels of each construct measured and therefore the results (Elmes, Kantowitz & Roediger, 2003). The use of self-reports also raises the question as to whether the reported results pertain to the individuals' actual experiences, or mainly illustrate their perceptions. Respondents' perceptions may differ from the actual state of being, causing them to rate themselves higher (or lower) on the constructs due to a false perception (Van Heerden, 2013). This limitation is especially a concern in this type of study as it was done on young inexperienced learners who might not be aware of the difference in their perceptions of themselves and their actual state. The learners may also be tempted to create a more favourable impression in order to appear on par with their peers in this competitive environment. Exclusive reliance on self-report measures in addition also creates method bias. In the structural model that was tested the focal endogenous latent variable learning performance during evaluation was at least not obtained via self-report measures but was tested objectively by using the results obtained on English 1st additional language, Afrikaans home language and Mathematics for the first semester of each learner.

Fourthly, the final du Toit–De Goede learning potential structural model depicted in Figure 5.1 was derived from the original du Toit–De Goede learning potential structural model depicted in Figure 3.1. Modifications made to the original model, addition of paths, were suggested by the sample data analyses in this study. The same data that suggested the modification cannot be used convincingly and definitely to test the path-specific hypotheses. The final model in this study along with its paths should thus be seen as a revised overarching substantive research hypothesis and a revised array of path specific hypotheses. The revised hypotheses should be tested by confronting the final learning potential structural mode with new data. The sample limitations of this study should be taken into account when selecting new data.

The fifth and last limitation, of this study has to do with the method of testing the discriminant validity. This study considered the phi matrix which does not hold strong evidence of discriminant validity. The 95% confidence interval was calculated for each sample estimate in Φ utilising Scientific Software International's (Mels, 2009) Excel macro, to assess the discriminant validity. This method is very lenient and does not hold very stringent assumptions like other existing methods. The reason for this is that the range of constructs included in this study are closely related and defined. A more stringent approach to the evaluation of discriminant validity would therefore be an advantage. Such an approach would entail the comparison of the average variance extracted and calculated for each latent variable with the squared inter-latent variable correlation (Diamantopoulos & Sigauw, 2000). The current practices do thus pose a limitation to this study.

## 5.5 PRACTICAL IMPLICATIONS FOR THIS STUDY

The following section will consist of a discussion of the potential practical usefulness of the results obtained in this study.

As mentioned throughout this study, a need exists for organisations to be able to identify disadvantaged individuals who show the greatest potential to be successful in an affirmative skills development programme. The reality of scarce resources for these learning opportunities does exist and these resources should be used optimally. This was motivated by showing the importance affirmative development holds for the future of South Africa. Organisations should be able to identify individuals who would gain maximum benefit from such affirmative development opportunities. The study argued that the level of learning performance that learners admitted to the programme achieve during these developmental opportunities, is not the outcome of a random event, but is rather systematically determined by a complex nomological network of latent variables characterising the learner and his/her environment. An understanding of the factors which determine whether or not a learner will be successful if entered into an affirmative development opportunity is essential to propose a theoretically justifiable selection battery. More specifically the non-malleable learning competency potential latent variables should be combined in a selection battery. From a moral perspective questions could be raised if individuals are screened out of an affirmative development opportunity based on deficiencies that could have been corrected through appropriate remedial action. This would imply that those who show the greatest potential to be successful in an affirmative development opportunity need to be identified, whereafter the malleable determinants of learning performance within the learner as well as in the learning environment need to be manipulated through appropriate human resource interventions to levels of optimal effective classroom learning performance and learning performance during evaluation. Selection can be approached from either a content-orientated logic or a construct-orientated logic (De Goede & Theron, 2010). Under a construct-orientated logic the learning competency potential latent variables would be included in the selection battery. Under a construct orientated logic the learning competencies would be assessed in a simulated classroom learning situation. The former seems to be a preferable approach because it allows an exclusive focus on non-malleable learning comptenecy potential latent variables only. The latter will also reflect the influence of malleable learning competency potential latent variables.

This study undertook the task of taking a step towards understanding and explicating some of the factors which determine whether or not a learner will be successful if entered into an affirmative development opportunity. The results obtained through this study indicated that, *metacognitive knowledge*, , *learning motivation*, *academic self-efficacy* and *learning goal orientation* influence the level of success or competence a learner achieves on the competencies that constitute *classroom learning performance* during an affirmative development opportunity (*time cognitively engaged*, *cognitive engagement, metacognitive regulation* and *academic self-leadership).* Of these learning competency potential latent variables, only learning *goal orientation* can really be considered a non-malleable latent variable. The De Goede (2007) study, and before that the research of Taylor (1989, 1992, 1994), in addition suggested that *fluid intelligence*, *information* or *abstract thinking capacity* and *processing capacity* are two additional non-malleable learning competency potential latent variables that affect *classroom learning performance* and *learning performance during evaluation*. The studies of Burger (2012) and Van Heerden (2013) moreover showed that *conscientiousness* is a further non-malleable learning competency potential latent variable that affects *classroom learning performance* and *learning performance during evaluation*. Therefore, the first practical implication would be to include these four identified predictors in the selection battery used for the selection of candidates into the affirmative development programme. These predictors can thus be used during selection procedures aimed at optimising *learning performance during evaluation* by controlling the level of *classroom learning performance* by controlling the quality of the individuals that flow into an affirmative development opportunity. An actuarial prediction model should ideally be developed and validated.

The second practical implication would include using intervention to develop and enhance the level of the malleable learning competency potential latent variables characterising the candidates selected into the affirmative development programme. The malleable latent variables offer the possibility to affect *classroom learning performance* by manipulating the quality of learners before and after they have been admitted into the affirmative development programme. The du Toit – De Goede learning potential structural model suggested that *learning motivation*, *academic self-efficacy*, *and metacognitive knowledge)*, are learning competency potential latent variables that should be considered in this regard. Suggestions with regards to the enhancements of these malleable variables will be subsequently discussed. At the same time, however, the level of competence achieved in some of the learning competencies that constitute *classroom learning performance* should be considered for assessment and development through targeted exercises aimed at enhancing the level of competence on those learning competency dimensions flagged as development areas. All learning competencies are malleable. Not all of them, however, lend themselves to attempts at direct manipulation. A*cademic self-leadership* and *metacognitive regulation* represent two learning competencies that do lend themselves to this type of development.

*Learning motivation* depends on the expectancy that exerting efforts will result in successful *classroom learning performance* and the instrumentality of high *classroom learning performance* in attaining high *learning performance during evaluation* and the instrumentality of high *learning performance during evaluation* in attaining positive valences outcomes. Motivation is literally the desire to do things and can be seen as the crucial element in setting and attaining goals. It is thus important that a clear link between *learning performance during evaluation* and value rewards exists, and that the expectancy levels are high. For example, good academic results obtained in training programmes should be clearly linked to outcomes that have valence for trainees (e.g. increased autonomy) and should thus be instrumental in trainees obtaining the desired outcomes. In the case of affirmative development programmes that also admit applicants from outside the organisation, as a constructive act of affirming with action that Apartheid policies negatively affected many South Africans, the promise of a job offer (or a promotion) conditional on high *learning performance during evaluation* could be a highly valenced outcome. According to Vroom's (1964) expectancy theory, if learners have high expectations that efforts will translate into learning success, learners should be more motivated. Important points to take note of in an attempt to motivate learners would be to make sure that the learners will find the training valuable; the training should lead to positive outcomes for the trainees; insight on trainees' expectancy of achieving success should be gathered. All these elements should be thoroughly examined and considered in order to make sure that the trainees are motivated to learn.

*Academic self-efficacy* probably affects learning motivation through its affect on the effort – performance expectancy $P(E \rightarrow P)$. *Academic self-efficacy* can be developed prior to, as well as after, admission to an affirmative development programme and thereby also *learning motivation*. Literature provides extensive information on this development. *Academic self-efficacy* is affected by five primary sources: Learning experiences, vicarious experiences, imaginary experiences, social persuasion, and physiological states (Bandura, 1997). *Academic self-efficacy* can therefore be developed through the interpreted results of one's previous performance/learning experience. Individuals use their own interpretations to develop beliefs about their capability to engage in subsequent tasks/activities. Outcomes interpreted as being successful, will raise self-efficacy and failures would lower it. One's self-efficacy can also be influenced by one's observations of other's behaviours and the consequences of these behaviours. According to Snyder (2002) one can influence self-efficacy beliefs by imagining oneself or others behaving effectively or ineffectively in hypothetical situations. Such images may be derived from actual or vicarious experiences with situations similar to the one anticipated, or they may be induced by verbal persuasion. Social persuasion will enhance self-efficacy through the encouragement and/or discouragement from other individuals. Positive persuasions will increase self-efficacy whilst negative persuasion will decrease self-efficacy. Finally, learners base their self-efficacy judgements on their perceived physiological state. Learners commonly exhibit signs of distress during stressful experiences, nausea, sweaty palms, trembles, dizziness etc. A learner's perception of these responses can markedly negatively alter their self-efficacy, as the response might be seen as a sign of their own inability. It can be seen from this model, that *academic self-efficacy* is crucial to an individual's potential to learn, and should therefore be a primary focus during selection and training.

Literature on metacognition suggests that individuals are not born with static levels of metacognition, but rather that it is malleable and can be developed over time (Kuhn, 2000; Paris & Winograd, 1990; Schraw, 1998; Veenman et al., 2004). Metacognitive skills develop at the age of 8 to 10 years, and expand during the years thereafter. Metacognitive knowledge and skills become more sophisticated and academically oriented whenever formal education requires the explicit utilisation of a metacognitive repertoire. Shraw (1998) suggests that metacogntion can be increased in four ways namely, promoting general awareness of the importance of metacognition, improving knowledge of cognition, improving regulation of cognition and fostering environments that promote metacognitive awareness. According to Paris and Winogard (1990) teachers and training instructors can directly promote metacognition by informing students about effective problem-solving strategies and discussing cognitive and motivational characteristics of thinking. These should be utilised to develop a training intervention delivered to the candidates in the affirmative development programme to enhance their levels of metacognition. The malleability of metacognition has powerful implications in the framework of learning potential. Metacognition is associated with a collection of activities and skills related to planning, monitoring, evaluating, and repairing performance. The basic idea is that teaching/training metacognitive skills must be one of the goals of instruction, so that the individuals involved acquire a bundle of strategies that will encourage significant learning. Acquired and developed metacognitive skills will allow them to be more effective in their learning and performance during an affirmative development programme. The results of the current study provided support for the hypothesis that *metacognitive knowledge* affects *metacognitive regulation,* that affects *learning motivation,* that affects *cognitive engagement* and *time at task*, that affects *learning performance during evaluation*. Additional support for this is found in a report of Everson and Tobias (2001) stating that there is a difference in the metacognition of effective learners and ineffective learners, and that the effective use of metacognition has been shown to predict learning performance (Pintrich & De Groot, 1990). Students with higher metacognitive skills outperformed those with lower metacognitive skills in problem-solving tasks, regardless of their overall aptitude. This does not mean that students who do not currently possess high levels of metacognitive skills should be disregarded for training interventions, as these skills can be developed and the probability that these learners will succeed in the learning intervention will be enhanced.

There lies great benefit in training individuals in general *self-leadership* strategies which address an individual's self-awareness, volition, motivation, cognition, and behaviour. *Self-leadership* strategies include behaviour-focused strategies; self-reward strategies; natural reward strategies and constructive thought strategies. *Academic self-leadership* is the key to employees' enthusiasm for, commitment toward and performance in the developmental opportunity and in the organisation and therefore a key foundation of self-managed work teams, participative management and other attempts to improve business organisations. Consequently, the organisation should appraise the level of competence that learners display on the academic self-leadership dimensions and train learners in general self-leadership strategies (especially on those dimensions flagged as development areas) of which the principals could be applied in the affirmative development program and the job thereafter in order for the organisation to reduce the importance of traditional external leadership and to rather rely on employee's self-leadership. The *academic self-leadership* construct is also strongly related to *time cognitively engaged*, and will strongly influence their *learning performance during evaluation* through the influence of this variable.

*Time cognitively engaged* is seen as the most crucial construct as it is the only latent variable that in the current model directly influences learning performance during evaluation. This includes the amount of effort a person is willing to invest in working on the task and how long they persist. Individual differences in the time spent engaged on the learning task contribute to individual differences in skills and abilities required to (Bloom, 1974). As mentioned earlier, *Transfer of knowledge* refers to the adaptation of knowledge and skill to address novel, cognitively demanding problems different from those already encountered. In order for *transfer* to occur the individual must engage with the learning material cognitively. Research suggests that individuals who exert more effort and persist longer at tasks are more likely to learn more and achieve higher levels of academic achievement (Pintrich & Schunk, 2002) as they are more likely to transfer their knowledge in order to create meaningful structure in the novel learning material and to automate that insight. Trainers should be aware of the learner's schedules, level of ability and how motivated they are to learn, as low ability students would benefit more from engagement than their high ability counterparts. This will assist trainers to determine how much instruction time vs self study time is required for a successful training session. Instruction time refers to the proportion of time spent on instructional activities. If *time cognitively engaged* is not high outside the classroom; then instruction time serves as the primary place for transfer of knowledge to occur. Time cognitively engaged can also be enhanced by *learning motivation, academic self-efficacy, regulation of cognition* and *academic self-leadership*.

The final practical implication would have bearing on the design and delivery of the training programme. This study identified certain variables which will allow an individual to achieve higher levels of *learning performance during evaluation*. These identified variables are malleable in nature and therefore open for development, and when these are developed, they would be beneficial to schools, organisations or South Africa as a whole. The training design and delivery should thus be structured in such a way as to encourage learners to engage in behaviours which will positively affect *learning performance*. The design and delivery of the training programme as well as the manner in which consequences following from the training programme are managed will in addition impact on the *learning motivation*. *Learning motivation* should be enhanced if high *learning performance during evaluation* is perceived to be instrumental in the achievement of high valence outcomes and if the design and delivery of the training programme facilitates the likelihood of high *classroom learning performance*. These training opportunities have been proven by previous research to be very advantageous in the developing of these constructs within individuals (Luthans, Avey, Avolio, Norman & Combs, 2006; Luthans, Youssef & Avolio, 2007; Luthans & Youssef, 2004; Toor & Ofori, 2010). Reinforcement and modelling has also enjoyed support for enhancing these constructs within individuals. Research has supported the positive contagion effect that leaders have on their followers (Norman, Luthans & Luthans, 2005; Ross, 2006). Teachers, principals, parents, managers etc could be identified to serve as vehicles for this reinforcement or modelling, from which great advantage could be gained by any learning institution or organisation as it is instrumental in the achievement of high valence outcomes.

## 5.6 SUGGESTIONS FOR FUTURE RESEARCH

Firstly it is recommended that this model and subsequent elaborations thereof be empirically cross-validated and tested on a more representative sample. This will allow a higher degree of generalisability of the results obtained through this study. The paths that were added to the original model, moreover, at this stage should be considered as hypotheses that were suggested by the current study. A more representative sample will also allow the revised overarching substantive hypotheses to be formally and empirically assessed on data which played no role in the derivation of the revised hypothesis. This would make a more significant contribution to the field of Industrial Psychology and Human Resource Management.

As the vastness and complexity of the nomological networks makes it virtually impossible for any one researcher to be able to gain a complete and accurate understanding of the nomological network of variables and the interrelationships between the variables, it would also be recommended that future research with regard to the learning potential structural model be expanded to include other learning competency potential latent variables and learning competencies not included within this current study. With regard to variables which would be included in future research, the following could be considered:

### 5.6.1 AUTONOMY

*Autonomy* refers to the extent to which the learning context provides the individual with the ability to function independently without control by others. It can be described as the capacity to make decisions independently, to serve as one's own source of emotional strength, and to otherwise manage one's life tasks without depending on others for assistance. In simple terms it could be described as being able to do things on one's own.

There is consistent evidence that *autonomy* plays a significant role in students' classroom learning (Deci, 1992; Cordova and Lepper, 1996). Reeve (2004) proposed that there is empirical evidence to support the conclusion that autonomously-motivated students thrive in educational settings and that they would benefit when teachers support their autonomy. There is considerable evidence linking this to positive educational outcomes, such as higher academic achievement (Boggiano et al., 1993; Miserandino, 1996). Deci (1991) suggests that learning environments which promote student *autonomy* and choice increase student's engagement with the task at hand and has a positive effect on interest and engagement because people have an innate psychological need for competence, belonging and autonomy. Being in a position to identify one's own learning goals in collaboration with peers fosters a feeling of autonomy, agency, and empowerment and also has a motivating effect which encourages engagement with the task at hand. Being autonomous from the direct intervention of a trainer/teacher/manager, and feeling in charge of one's own learning is supposed to result in increased cognitive engagement with the topic to be learned, which eventually encourages deeper understanding of it (Rotgans and Schmidt, 2011).

In the learning context, according to Rotgans and Schmidt (2011) *cognitive engagement* has traditionally been operationalised by measuring the extent of a student's homework completion, class attendance, extra-circular participation in activities, or their general interactions with the teachers, and how motivated they seem while engaging in classroom discussions. This description of cognitive engagement suggests that it is considered by most authors a more or less stable trait of students, independent of context. Rotgans and Schmidt (2011), however, suggest that *cognitive engagement* is more or less dependent on the task at hand because the task determines the extent of student's *autonomy*. For instance, working with groups and engaging in discussions, searching for information on the internet, or listening to a lecture is likely to result in different levels of cognitive engagement because of different levels of autonomy. Listening to a lecture is arguably the least cognitively engaging since under such circumstances there is little to no student *autonomy*. On the other hand, when students engage in self-initiated information-seeking behaviours, the level of *autonomy* should be relatively high and thus lead to more cognitive engagement. Rotgans and Schmidt (2011) thus suggest that the level of autonomy is inherently related to an activity or task and largely determines the degree to which students engage cognitively with that activity or task. They also suggest that the higher a student's level of *autonomy*, the more cognitively engaged they will be.

The foregoing argument suggests the importance if this construct, and the necessity to include it in future studies, it is a critical learning potential latent variable without which one cannot really hope to accurately predict *classroom learning performance* and *learning performance during evaluation*. To assist learners to make the most of a new learning experience, educators need to understand the influence *autonomy* has on learning. Rotgans and Schmidt (2011) pointed out that autonomy seems to be dependent on the knowledge a student gains during their learning, and they thus deem this a fruitful approach to investigate the relationship between *autonomy* and factual knowledge.

Consequently it would also be beneficial to perform additional research on the construct of knowledge in the context of the learning potential structural model. The critical role of *prior knowledge* will be discussed in the following sections, as various studies have demonstrated positive relationships between prior knowledge and learning (Beier & Ackerman, 2005; Lipson, 1982; McNamara & Kintsch, 1996; Shapiro, 2004).

### 5.6.2 PRIOR KNOWLEDGE

*Prior knowledge* can be described as familiarity, expertise, and experience interchangeably. Roschelle (1995) suggested that it rather refers to the objective knowledge an individual has stored in their memory. Rochelle (1995) further mentions that *prior knowledge* exists at levels of perceptions focus of attention, procedural skills, modes of reasoning, and beliefs about knowledge. Determining a learner's *prior knowledge* can confound a trainer's best efforts to teach a learner. As mentioned earlier in this study, learning proceeds primarily from *prior knowledge* and only secondary from the presented material. Roschelle (1995) supports this. Learners can only successfully create meaningful structure in classroom learning material if they have adequate levels of *prior knowledge* that can be transferred onto the novel learning material. Since transfer is driven by *abstract thinking capacity* or *fluid intelligence*, what constitutes adequate levels of *prior knowledge* depends on learner's level of *abstract reasoning capacity*. This construct can thus play a highly influential role in a learner's *classroom learning performance*. Dochy, Segers and Buehl (1999) studied the universal effect of *prior knowledge* on learning outcomes and from this concluded that in 92% of cases, *prior knowledge* is strongly associated with learning. The possibility should therefore be considered that *prior knowledge* interacts with *fluid intelligence* to determine *transfer of knowledge*. De Goede and Theron's (2010) theoretical argument that *fluid intelligence* plays an influential role in *classroom learning performance* as well as subsequent *learning performance during evaluation* is persuasive. He suggested that the acquisition of new job-specific knowledge, abilities and insight (job competency potential) can be described as a process during which new attainments have to be built on older ones and these have to be integrated into conceptual frameworks that subsequently become more general and elaborated (Taylor, 1994). *Transfer of knowledge* as a learning competency is in effect *abstract thinking capacity* in action. *Transfer of knowledge* occurs when *fluid intelligence* combines and transforms existing crystallised abilities into a solution to a novel problem. Burger (2012) explains that the distance over which *fluid intelligence* must "leap" in order to turn *prior knowledge* into solutions, increases as the level of *prior knowledge* decreases. This would suggest a *prior learning* x *fluid intelligence* interaction effect on *classroom learning performance* as well as *learning performance during evaluation*. Van Heerden (2013) suggested that the quality of prior learning will determine the adverse influence this construct has on the learner's *classroom learning performance*. *Prior knowledge* consisting of surface level understanding of facts is not related to student achievement, compared to higher levels of *prior knowledge* which correlates significantly with success in the presented course.

This line of reasoning suggests that successful *transfer of knowledge* and subsequent *automisation* supplements the *prior knowledge* and creates *post-development knowledge*. This *post-development knowledge* (in interaction with fluid intelligence) in turn affects the transfer of knowledge that occurs during learning performance during evaluation.

To successfully reflect these arguments in future learning potential structural models creative ways will have to be found to appropriately operationalise the two core learning potential competencies comprising *classroom learning performance* and *learning performance* *during evaluation,* namely, *transfer of knowledge* and *automisation.* The measures provided by the APIL battery (Taylor, 1989, 1992, 1994) are not appropriate since they are based on a simulated learning task unique to the measure. What is required are measures that assess the extent to which *transfer of knowledge* and *automisation* occurs in the classroom with regards to the learning material that constitutes the curriculum. This presents a critically important but extremely daunting challenge facing the development of future learning potential structural models.

### 5.6.3 LONGITUDINAL MODELS

A further consideration for future research in learning potential structural models is to develop and test longitudinal models in which the learning competency latent variables like *(prior) knowledge*, *metacognition and learning motivation*, but more importantly also the learning competencies comprising *classroom learning performance* and the learning competencies comprising *learning performance during evaluation* are modelled at different time points to more realistically capture the structural feedback loops that exist between the learning competencies and the learning competency potential latent variables. Such a longitudinal model could possibly more accurately capture the fact that the learning competencies constituting classroom learning performance and the learning competency potential latent variables that determine the level of performance that is achieved are the same latent variables operating at two consecutive points in time.

## 5.7 CONCLUSION

A significant number of the current challenges which South Africa is facing today are due to having segregated amenities and public services which characterised this country's socio-political past under the Apartheid system. These challenges include issues such as skills shortages, high unemployment and poverty rates as well as inequality in terms of income distribution and racial representation in the workforce. South Africa is furthermore facing social problems such as high crime rates as well as high incidences of HIV/AIDS. These challenges and negative manifestations of a tragic regime not only have a negative influence on the previously disadvantaged group members but also indirectly affect all South Africans, as well as organisations and all spheres of society. An urgent need exists for these challenges to be addressed in an intellectually honest manner that acknowledges the fact that a purposeful denial of access to developmental opportunities lies at the root of the problems. Under-developed job competency potential currently denies too many Black South Africans the opportunity to constructively participate in the South African economy. At the same time South Africa lacks important skills in many sectors of the economy. This situation has the potential for textbook symbiosis. Addressing the fact that Black individuals lack skills, knowledge and abilities due to the consequences of Apartheid, is essential and requires urgent and collaborative attention. The implementation of an affirmative action skill development opportunity provides a direct means in order to alleviate the skills shortages as well as the high unemployment and poverty rates through equipping these previously disadvantaged groups with the skills, knowledge and abilities that are sought after in the marketplace. The study assists in addressing this problem as it attempts to motivate education and skills development in order to achieve self-reliance that stems from employment opportunities and decent wages. This study highlights the importance of the variables which determine learning performance and which can be developed/enhanced in order to achieve better learning performance within affirmative development programmes, which will again lead to self-reliance and a means to discover South Africa's untapped reservoir of human potential.

Future research should be undertaken to build upon this study and also other relevant themes. The available results of studies like this one will not contribute towards solving the challenges the country is facing if they gather dust on library shelves or remain hidden in academic journals. The results should rather be converted through synergistic cooperation between practical scientists and scientific practitioners, in order to obtain practical methods which can be applied by government and the private sector organisations for their practical use.

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# APPENDIX A

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## STELLENBOSCH UNIVERSITY
## CONSENT TO PARTICIPATE IN RESEARCH

---

| | |
|---|---|
| *Title Of The Research Project:* | **Modification, Elaboration And Emperical Evaluation Of The De Goede Learning Potential Structural Model.** |
| *Consent Form addressed to:* | **Parent/Guardian of grade 12 learner.** |

You are asked to participate in a research study conducted by Berné du Toit (master's student, MComm) and Prof Callie Theron, from the Department of Industrial Psychology, Stellenbosch University. The results of this study will contribute to the thesis of Berné du Toit. Your child can be selected as a possible participant in this study because he/she is a Grade 12 learner who has completed his/her second semester (third and fourth terms) of the Grade 11 course with the following subjects: Afrikaans Home language, English First Additional language and Mathematics.

### 1. PURPOSE OF THE STUDY

The objective of the study is to modify and elaborate an existing theoretical model developed by De Goede (2007) with regards to differences in learning performance. The aim is therefore to elaborate on previous research in order to see how non-cognitive variables play a role in learning.

### 2. PROCEDURES

If you give permission for your child to participate in this study, we will ask of them to complete a short questionnaire that will take ± 30 minutes to complete. They will be asked to provide their name, as this will allow us to link your child's academic results (for the three subjects for term 3 and term 4 of grade 11) and their questionnaire results. Your child's academic results will thus serve as a criterion measure for this study. 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

There exist no foreseeable risks, discomforts or inconveniences for your child or their school. If your child does not want to partake in the study, he/she will be allowed to withdraw before participating. They can withdraw at anytime during the study. Even after completion of the questionnaire they may withdraw their input.

### 4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO 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 restricting access to the data to the researchers (Berné du Toit and Prof Callie Theron), by storing the data on a password-protected computer, and by only reporting aggregate statistics of the sample. The results of this study will be distributed in an unrestricted electronic thesis, as well as in an article published in an accredited scientific journal. A summary of the findings will be presented to the teachers of the participant schools. Not one of these publications 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 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, but he/she will not be allowed to do so without your explicit permission.

## 8. IDENTIFICATION OF INVESTIGATORS

If you as parent/guardian have any questions or concerns about the particular research study, please feel free to contact Berné du Toit (083 597 6393 or bernecastelyn@yahoo.com) or Prof Callie Theron (021 808 3009 or ccth@sun.ac.za).

## 9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development at Stellenbosch University.

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

The information above was described to……………………………………………..in English and I understood what was described to me. I was given an opportunity to ask questions, and the questions were answered to my satisfaction. I hereby give consent voluntarily that my Grade 12 child participates in the research study.

________________________________________

**Name of parent/guardian**

________________________________________

**Name of Grade 12 learner**

________________________________________ ______________

**Signature of parent/guardian** **Date**

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**UNIVERSITEIT VAN STELLENBOSCH**
**TOESTEMMING VAN OUER/VOOG**

---

| | |
|---|---|
| ***Titel van Navorsingsprojek:*** | Verandering, Uitbreiding en Empiriese Evaluasie van die De Goede Leerpotensiaal Strukturele Model. |
| ***Toestemming gerig aan:*** | Ouers van Graad 12 leerders |

U word hiermee versoek om toestemming te verleen dat u kind aan hierdie navorsingsprojek mag deelneem. Die ondersoek word gelei deur Berné du Toit (magisterstudent, MComm) en Prof. Callie Theron van die Departement Bedryfsielkunde van die Universiteit van Stellenbosch. Die resultate van hierdie studie sal bydra tot die magistertesis van Berné du Toit. U kind kwalifiseer as moontlike deelnemer aangesien hy/sy die tweede semester (kwartaal 3 en 4) van Graad 11 voltooi het met die volgende vakkeuses: Afrikaans Eerste Taal, Engels Tweede Taal en Wiskunde.

## 1. DOEL VAN DIE STUDIE

Die doel van die navorsingstudie is om 'n reedsbestaande teoretiese model gerig om die verklaring van verskille in leerprestasie soos ontwikkel deur De Goede (2007) uit te brei en/of te wysig. Meer spesifiek poog die studie om die bestaande model uit te brei deur die rol wat nie-kognitiewe veranderlikes in die leerproses van leerders speel te probeer verstaan.

## 2. PROSEDURES

Indien u toestemming verleen dat u kind mag deelneem aan die navorsingstudie sal hy/sy gevra word om 'n kort vraelys te voltooi wat om en by 30minute sal neem. U kind sal sy/haar naam moet verskaf om sodoende u kind se akademiese rekord (in genoemde vakke) en die vraelys se resultate aan mekaar te koppel. U kind se akademiese punte sal dus as kriteriummeting dien vir die studie. Die navorser sal u kind se skool persoonlik besoek en sal daar die vraelyste uitdeel. Voltooiing van die vraelys sal geensins inmeng met die normale skool aktiwiteite van u kind nie.

### 3. POTENSIËLE RISIKO'S

Daar bestaan geen voorsienbare risiko's vir u kind of hul skool, wat verband hou met die deelname in hierdie navorsingstudie nie. U kind is geregtig om hom/haar van hierdie studie te onttrek voor deelname, daartydens of selfs na die voltooing van die vraelys.

### 4. POTENSIËLE VOORDELE

Daar bestaan geen direkte voordele vir u kind nie. Tog sal die uitbreiding van die leerpotensiaal-strukturele model die ontwikkeling van intervensies gerig op suksesvolle studie van leerders bevorder. Daarom sal u kind se skool, u gemeenskap en die algehele samelewing noemenswaardig by hierdie navorsing baat.

### 5. VERGOEDING

Nog u, nog u kind of sy skool sal enige finansiële of ander vergoeding vir deelname aan hierdie studie ontvang nie.

### 6. VERTROULIKHEID

Alle inligting wat tydens hierdie studie bekom word rakend u kind, is vertroulik en sal slegs met u en u kind se toestemming bekend gemaak word. Beperkte toegang tot inligting aan die navorsers (Berné du Toit en Prof. Callie Theron) word verseker deur data op 'n rekenaar, wat 'n wagwoord benodig, te berg. Slegs die gesamentlike statistiek van die groep word gerapporteer en geen individuele statistiek nie. Die resultate sal gerapporteer word in 'n onbeperkte elektroniese tesis en 'n gepubliseerde artikel in 'n geakkrediteerde wetenskaplike vaktydskrif. 'n Opsomming sal ook aan die onderwysers van die deelnemende skole voorgedra word. Op geen van die bogenoemde publikasies sal die identiteit van enige leerder of hul akademiese rekord bekend gemaak word nie. Die naam van die skool van die deelnemende leerders sal ook vertroulik bly.

### 7. DEELNAME EN ONTREKKING

Die deelname van die leerder aan hierdie studie is die keuse van u as ouer/voog. Indien u instem dat u kind mag deelneem, behou u die volle reg om u kind enige tyd van die studie te onttrek sonder enige gevolge. U kind mag weier om enige van die vrae op die vraelys nie te antwoord nie en steeds deel te wees van die studie. Daar word ingeligte toestemming van elke leerder ook verkry (waarvoor hy sy handtekening gee) voor deelname aan die studie mag plaasvind. Geen kind mag ten spyte van sy instemming, sonder sy ouer/voog se toestemming aan die navorsingstudie deelneem nie.

## 8. INDENTITEIT VAN NAVORSERS

Enige navrae in verband met die studie kan aan Berné du Toit (083 597 6393 of bernecastelyn@yahoo.com) of Prof. Callie Theron (021 808 3009 of ccth@sun.ac.za) gerig word.

## 9. REGTE VAN DIE LEERDERS

U of u kind mag ter enige tyd die toestemming kanseleer en die leerder uit die studie onttrek sonder enige gevolge. Deur u kind toe te laat om aan hierdie studie deel te neem verbeur u nog u kind geen wetlike regte, aansprake of voorregte nie. Indien u enige vrae in verband met u kind se regte rakende sy/haar deelname aan hierdie studie het, kontak gerus vir Me. Maléne Fouche (021 808 4622 of mfouche@sun.ac.za) by die Afdeling vir Navorsingsontwikkeling van die Universiteit van Stellenbosch.

## 10. HANDTEKENING VAN OUR/VOOG VAN DEELNEMER

Bogenoemde inligting is aan my……………………………………………..verduidelik in Afrikaans en ek verstaan dit. Ek is die geleentheid gebied om vrae te vra en is bevredigend beantwoord. Hiermee gee ek my toestemming dat my Graad 12 leerder aan hierdie studie mag deelneem.

_____________________________________

**Naam van ouer/voog**

_____________________________________

**Naam van Graad 12 leerder**

_____________________________________ _____________

**Handtekening van ouer/voog** **Datum**

# LEARNING POTENTIAL QUESTIONNAIRE

## [SELF ASSESSMENT FORM]

# LEERPOTENSIAAL-VRAELYS

## [SELFASSESSERINGSVORM]

**CONFIDENTIAL/ VERTROULIK**

## TITLE OF THE RESEARCH PROJECT: MODIFICATION, ELABORATION AND EMPERICAL EVALUATION OF THE DE GOEDE LEARNING POTENTIAL STRUCTURAL MODEL

### What is this research project all about?

The objective of the study is to modify and elaborate an existing theoretical model developed by De Goede (2007) with regards to differences in learning performance. The aim is therefore to elaborate on previous research in order to see how non-cognitive variables play a role in learning.

### Why have I been invited to take part in this research project?

You were selected as a possible participant in this study because you have completed the second half of your grade 11 course and therefore are at the correct NQF level for me to use as a sample.

### Who is doing the research?

You are asked to participate in a research study conducted by Berné du Toit (MComm) from the Department of Industrial Psychology at Stellenbosch University. The results of the study will be contributed to my master's thesis.

### What will happen to me in this study?

If you volunteer to participate in this study, you will be asked to complete a short questionnaire that will take about 30 minutes. You will be asked to provide your name which is required to bring together the results of the questionnaire with your academic performance during the second half of grade 11 (i.e., term 2 and 3). Your academic results will thus serve as a criterion measure for this study. Completion of the questionnaire will not interfere with your normal school activities.

### Can anything bad happen to me?

There are no foreseeable risks associated with participation in this research study. The results of the study will be treated as confidential. Teachers at your school will not have access to the survey of any individual.

**Does this study hold any benefits for me?**

Participation in the research will not directly benefit you. The development of an elaborated learning performance structural model will, however, assist in the development of interventions aimed at facilitating successful learning.

**Will anyone know I am in the study?**

Any information that is obtained in connection with this study, and that can be identified with you, will remain confidential and will be disclosed only with your [and your parents'] permission or as required by law. Confidentiality will be maintained by means of restricting access to the data to me and my supervisor, by storing the data on a password-protected computer and by only reporting aggregate statistics for the sample. The results of the study will be disseminated by means of an unrestricted electronic thesis and by means of an article published in an accredited scientific journal. An anonymous summary of the research findings will be presented to teachers of the school. In none of these instances will the identity of any research participant be revealed nor will any academic results for any pupil be reported. Only aggregated statistics reflecting the proposed structural model's fit will be reported. The identity of the school will not be revealed in any of the publications.

**Who can I talk to about the study?**

If you have any questions or concerns about the research, please feel free to contact Berné du Toit (cell number: 083 597 6393 or bernecastelyn@yahoo.com and/or Prof Callie Theron on 0218083009; ccth@sun.ac.za) both from the Department of Industrial Psychology of Stellenbosch University.

**What if I do not want to do this?**

You may refuse to take part in the study even if your parents have agreed to your participation. You may withdraw your consent at any time and stop participation without getting into trouble. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché (mfouche@sun.ac.za; 021 808 4622) at the Division for Research Development.

**Do you understand what partaking in this research study entails and are you willing to take part in it?**

| | |
|---|---|
| **YES** | **NO** |

**Do you understand that you can pull out of the study at any time?**

| | |
|---|---|
| **YES** | **NO** |

**Biographic information:**

| |
|---|
| **Name & Surname:** |
| **School:** |

| |
|---|
| **Age:** |

| | | |
|---|---|---|
| **Gender:** | **Male** | **Female** |

| | | | | | |
|---|---|---|---|---|---|
| **Race:** | **Black** | **Coloured** | **Indian** | **White** | **Other** |

**Please complete this section if you are 18 years or above**

The information above was described to me in English and I understood what was described to me. I was given an opportunity to ask questions, and the questions were answered to my satisfaction. I hereby give my voluntary informed consent to participate in the research study.

Name and Surname

________________________________________

School

________________________________________

Signature of learner Date

________________________ __________________

# TITEL VAN NAVORSINGSPROJEK: VERANDERING, UITBREIDING EN EMPIRIESE EVALUERING VAN DIE DE GOEDE LEERPOTENSIAAL STRUKTURELE MODEL.

## Waar oor handel hierdie navorsing?

Die doel van die studie is om die bestaande teoretiese model ontwikkel deur De Goede (2007) wat verskille in leerprestasie verduidelik, aan te pas en uit te brei. Die doel van die navorsing is om die leerprestasie van individue wat tot ontwikkelingsgeleenthede toegelaat is te fasiliteer.

## Hoekom is ek gekies om in hierdie studie deel te neem?

Jy is gekies omdat jy klaar is met die tweede kwartaal van graad 11 en dus is jy op die regte NKR vlak om deel te wees van die steekproef.

## Wie doen die navorsing?

Jy word gevra om aan 'n navorsingstudie wat deur Berné du Toit uitgevoer word, deel te neem. Sy is van die Departement Bedryfsielkunde van die Universiteit Stellenbosch.

## Wat sal met my gedurende hierdie studie gebeur?

As jy vrywillig aan hierdie studie deelneem sal jy gevra word om 'n kort vraelys te voltooi. Dit sal omtrent 30 minute duur om te voltooi. Jy sal jou naam moet verskaf om sodoende jou akademiese rekord (in genoemde vakke) en die vraelys se resultate aan mekaar te koppel. Jou akademiese punte sal dus as kriteriummeting dien vir die studie. Voltooiing van die vraelys sal geensins inmeng met jou normale skool aktiwiteite nie.

## Kan enigiets negatiefs met my gebeur?

Daar is geen voorsienbare risiko's wat verband hou met die deelname in hierdie navorsingstudie nie. Die resultate van die studie sal vertroulik hanteer word. Slegs ek, my studieleier en mede-studieleier sal toegang hê tot die data. Onderwysers by jou skool sal nie toegang hê tot vraelyste van enige individue nie. Die noodsaaklikheid om jou opname-response met jou akademiese uitslae in die eerste-semester in verband te kan, bring mee dat die vraelys nie anoniem voltooi kan word nie.

**Kan enigiets positiefs met my gebeur?**

Deelname aan die navorsing sal jou nie direk bevoordeel nie. Die ontwikkeling van 'n uitgebreide leerprestasie-strukturele model sal egter bydra tot die ontwikkeling van intervensies wat gerig is op die fasilitering van suksesvolle leer in individue wat toegelaat is tot bemagtigende ontwikkelings geleenthede. Daar word gehoop dat deur bemagtigende ontwikkeling 'n betekenisvolle bydrae gemaak kan word om ten minste sommige van die misdrywe van die verlede in die opvoeding in Suid-Afrika te herstel.

**Sal enigiemand weet dat ek deel neem aan die studie?**

Enige inligting wat verkry is rakende die studie wat op jou van toepassing is, sal vertroulik bly en sal slegs bekendgemaak word met jou [en jou ouers] se toestemming of soos deur die wet vereis.

Vertroulikheid sal gehandhaaf word deur toegang tot die data te beperk tot myself en my studieleiers deur die data te stoor op 'n wagwoord-beskermde rekenaar en slegs opsommende statistiek van die opname bekend te maak. Die resultate van die studie sal versprei word deur middel van 'n onbeperkde elektroniese tesis en deur middel van 'n gepubliseerde artikel in 'n geakkrediteerde wetenskaplike tydskrif. In geeneen van hierdie gevalle sal die identiteit van enige navorsingsdeelnemer bekend gemaak word of sal enige akademiese uitslae vir enige leerder bekend gemaak word nie. Die identiteit van die skool sal nie in enige publikasie bekend gemaak word nie.

**Met wie kan ek praat oor die studie?**

Indien jy enige vrae of probleme oor die navorsing het bel gerus vir Berné du Toit 0835976393 (bernecastelyn@yahoo.com) en/of Professor C Theron: 021 808 3009 (ccth@sun.ac.za). Hulle is albei van die Departement Bedryfsielkunde van die Universiteit Stellenbosch.

**Wat sal gebeur as ek dit nie wil doen nie?**

Jy kan weier om in die studie deel te neem selfs al het jou ouers tot jou deelname ingestem. Jy kan jou toestemming te enige tyd terugtrek sonder om in die moeilikheid te beland. Jy gee geen wetlike regte of voorregte prys deur aan hierdie navorsingstudie deel te neem nie. As jy enige vrae het in verband met jou regte as 'n navorsingsdeelnemer, kan jy Me Malene Fouche kontak (021 808 4622 mfouche@sun.ac.za) by die Afdeling Navorsingsontwikkeling aan die Universiteit van Stellenbosch.

**Verstaan jy waaroor hierdie studie handel en willig jy in om daaraan deel te neem?**

| | |
|---|---|
| **JA** | **NEE** |

**Het die navorser al jou vrae beantwoord?**

| | |
|---|---|
| **JA** | **NEE** |

**Verstaan jy dat jy enige tyd van die studie kan onttrek?**

| | |
|---|---|
| **JA** | **NEE** |

**Biografiese inligting:**

| |
|---|
| **Naam & Van:** |
| **Skool:** |

| |
|---|
| **Ouderdom:** |

| | | |
|---|---|---|
| **Geslag:** | **Manlik** | **Vroulik** |

| | | | | | |
|---|---|---|---|---|---|
| **Ras:** | **Swart** | **Kleurling** | **Indiër** | **Blank** | **Ander** |

**Voltooi die volgende afdeling indien jy 18 jaar of ouers is:**

Bogenoemde inligting is aan my verduidelik in Afrikaans en ek verstaan dit. Ek is die geleentheid gebied om vrae te vra en is bevredigend beantwoord. Hiermee gee ek my toestemming om deel te neem aan hierdie studie.

Naam en Van

________________________________________

Graad

________________________________________

Leerling se handtekening Datum

__________________________ _____________________

**Directions:** Listed below is a set of statements about your second half of grade 11 (i.e., term 3 and 4). Please react to each statement as honestly and truthfully as possible. There are no right or wrong answers.

**Read each statement carefully and choose only ONE answer!**

**Please respond to all questions as follows:**

Indicate how often you performed the following behaviours or your level of agreement with the statements described by crossing the number that best describes how frequently performed the following behaviours in the first half of grade 11.

| | | | | | | |
|---|---|---|---|---|---|---|
| **0**<br>**Never** | **1**<br>**Almost Never** | **2**<br>**Rarely** | **3**<br>**Sometimes** | **4**<br>**Often** | **5**<br>**Very Often** | **6**<br>**Always** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1**<br>**Strongly Disagree** | **2**<br>**Disagree** | **3**<br>**Slightly Disagree** | **4**<br>**Neither Agree nor Disagree** | **5**<br>**Slightly Agree** | **6**<br>**Agree** | **7**<br>**Strongly Agree** |

**For example: If you <u>never</u> performed the behaviour described in the statement, cross the box with the number 0.**

| | | | | | | |
|---|---|---|---|---|---|---|
| [✓ **0**<br>**Never**] | **1**<br>**Almost Never** | **2**<br>**Rarely** | **3**<br>**Sometimes** | **4**<br>**Often** | **5**<br>**Very Often** | **6**<br>**Always** |

### Time at task and Cognitive Engagement

This section of the questionnaire is to provide an assessment of cognitive engagement. Cognitive (mental) engagement refers to the amount of time spent as well as the effort exerted on academic tasks.

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 1. I spent enough time on my academic work in the first half of grade 11 to reach my learning/academic goals. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 2. I made sure I set aside enough time to study. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 3. I exerted enough cognitive effort on grade 11 learning/academic work to reach my goals. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 4. I actively listened and engaged with what my teachers said in class. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 5. In my grade 11 class I exerted effort to concentrate and understand what my teacher was saying. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 6. I spent time reviewing my grade 11 learning material. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 7. I was intellectually/mentally engaged with what my teacher was saying in my grade 11 class. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 8. I stayed away from school in grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 9. I would make sure that when I had set time aside to study I used mytime efficiently and exerted effort to learn the material. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 10. In grade 22 I had specific times that I set out for myself to study. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 11. I spent more time than most of my class mates on studying in grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 12. When I got down to work with regards to the first half of grade 11, I worked hard. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 13. I forced myself to focus on my work when my mind drifted off while I was studying. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 14. I put enough effort into the first half of grade 11 to reach my grade 11 goals. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 15. I was intellectually/mentally engaged with my grade 11 study material outside of compulsory class times. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 16. I was an active member of my grade 11 class. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 17. I listened intensively/deeply in my grade 11 classes. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 18. I concentrated in my grade 11 classes. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 19. I actively participated in grade 11 academic group activities. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 20. I kept myself focused when I learnt for my grade 11 tests. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 21. In grade 11 I studied long hours. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 22. When I did not understand some aspect of the grade 11 curriculum I struggled with it until it made sense to me. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 23. When I was studying in the first half of grade 11 I really engaged with my grade 11 study material. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 24. I tried not to get distracted in class. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 25. In grade 11 my parents had to reprimand me to spend more time studying. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

## Academic Self-leadership

This section of the questionnaire is to provide an assessment of self-leadership. Self-leadership refers to how you managed and lead yourself with regards to your first half of grade 11.

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 1. I used my imagination to picture myself performing well on important grade 11 learning tasks before I actually did them. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 2. I visualised myself successfully performing a grade 11 learning task before I did it. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 3. I mentally rehearsed the way I planned to deal with a grade 11 learning challenge before I actually faced the challenge. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 4. I wrote down specific learning goals for grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 5. I consciously had my grade 11learning goals in mind when I studied. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 6. I talked to myself (out loud or in my head) to work through difficult learning/academic problems in grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 7. I found I was talking to myself (out loud or in my head) to help me deal with difficult learning/academic problems I faced in grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 8. When I did a learning/academic assignment especially well, I would treat myself to something I liked or activity I especially enjoy. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 9. When I successfully completed a grade 11 task, I would often reward myself with something I liked or activity I especially enjoy. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 10. I evaluated/assessed the correctness of my beliefs and assumptions when I was in difficult situations. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 11. I evaluate/assess my beliefs and assumptions when I had a disagreement with someone else. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 12. I was tough on myself in my thinking when I did not do a grade 11 task well. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 13. I got down on myself when I performed grade 11 tasks poorly. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 14. I felt guilt when I performed grade 11 tasks poorly. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 15. I made a point of keeping on track as to how well I was doing in my grade 11 work. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 16. I was aware of how well I was performing my grade 11 activities. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 17. I kept track of my progress on grade 11 work. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 18. I focused my thinking on the pleasant rather than the unpleasant aspects of my grade 11 learning/academic work. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 19. I surrounded myself with objects and people that brought out the learning behaviours I wanted in myself to help me learn. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 20. I would try to find activities in my work that I enjoyed doing in order to get my work done. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 21. I found my own favourite way to get my work done. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 22. I used written notes to remind myself of the things I needed to get done. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 23. I made lists to remind me of the things I needed to get done. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

## Academic Self-Efficacy

This section of the questionnaire is to provide an assessment of academic self-efficacy. Academic self-efficacy refers to the belief you have in your academic ability.

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 1. I felt that I was able to deal with my grade 11 work. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 2. I believed if I tried hard enough I could solve difficult problems in my grade 11 course. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 3. I needed reassurance during the first half of my grade 11 course with regards to the academic work. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 4. I believed I could handle anything in the first half of my grade 11 course. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 5. I was confident that I could cope efficiently with the first half of my grade 11 course. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 6. I believed I could solve most problems with regards to the first half of my grade 11 course if I put in the necessary effort. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 7. I believed I could handle the first half of my grade 11 course well. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 8. I felt certain I could achieve the academic goals I set for myself in the first half of my grade 11 course. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

| **Statement** | **Never** | **Almost Never** | **Rarely** | **Sometimes** | **Often** | **Very Often** | **Always** |
|---|---|---|---|---|---|---|---|
| 9. I believed I was capable of reaching the goals I set for the first half of my grade 11 course even when times were tough. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 10. I felt secure about my ability to reach the goals I set for the first half of my grade 11 course. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 11. I felt capable of dealing with most problems that came up in grade 11. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| 12. I felt I would get good grades in grade 11 if I tried hard enough. | **0** | **1** | **2** | **3** | **4** | **5** | **6** |

## Learning motivation

This section of the questionnaire is to provide an assessment of learning motivation. Learning motivation refers to the specific desire to learn the content of the curriculum relevant to of grade 11.

| **Statement** | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree Nor Disagree** | **Slightly Agree** | **Agree** | **Strong Agree** |
|---|---|---|---|---|---|---|---|
| 1. I intended to increase my knowledge during the first half of grade 11. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 2. When I didn't understand some part of the first half of grade 11course I tried harder for example by asking questions. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |

| **Statement** | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree Nor Disagree** | **Slightly Agree** | **Agree** | **Strong Agree** |
|---|---|---|---|---|---|---|---|
| 3. I was willing to exert considerable effort in order to enhance my knowledge and understanding during the first half of grade 11. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 4. I wanted to learn as much as I could during the first half of grade 11. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5. I was motivated to learn the work covered in the first half of grade 11. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 6. I intended to do my best in the first half of grade 11. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |

### Goal orientation

This section of the questionnaire is to provide an assessment of goal orientation. Goal orientation defines why and how people are trying to achieve various objectives.

| **Statement** | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree Nor Disagree** | **Slightly Agree** | **Agree** | **Strong Agree** |
|---|---|---|---|---|---|---|---|
| 1. I prefer to do things that I can do well rather than things that I do poorly. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 2. I'm happiest at work when I perform tasks on which I know that I won't make any errors. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |

| **Statement** | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree Nor Disagree** | **Slightly Agree** | **Agree** | **Strong Agree** |
|---|---|---|---|---|---|---|---|
| 3. The things I enjoy the most are the things I do the best. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 4. The opinions others have about how well I can do certain things are important to me. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 5. I feel smart when I do something without making any mistakes. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 6. I like to be fairly confident that I can successfully perform a task before I attempt it. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 7. I like to work on tasks that I have done well on in the past. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 8. I feel smart when I can do something better than most other people. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 9. Even if I know that I did a good job on something, I'm satisfied only if others recognise my accomplishments. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 10. Its important to impress others by doing a good job. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 11. The opportunity to do challenging work is important to me. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |

| **Statement** | **Strongly Disagree** | **Disagree** | **Slightly Disagree** | **Neither Agree Nor Disagree** | **Slightly Agree** | **Agree** | **Strong Agree** |
|---|---|---|---|---|---|---|---|
| 12. When I fail to complete a difficult task, I plan to try harder the next time I work on it. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 13. I prefer to work on tasks that force me to learn new things. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 14. The opportunity to learn new things is important to me. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 15. I do my best when I'm working on a fairly difficult task. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 16. I try hard to improve on my past performance. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 17. The opportunity to extend the range of my abilities is important to me. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 18. When I have difficulty solving a problem, I enjoy trying different approaches to see which one will work. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 19. On most jobs, people can pretty much accomplish whatever they set out to accomplish. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 20. Your performance on most tasks or jobs increases with the amount of effort you put into them. | **1** | **2** | **3** | **4** | **5** | **6** | **7** |

## Metacognitive Awareness

This section of the questionnaire is to provide an assessment of the two components of metacognition namely knowledge of cognition and regulation of cognition. Metacognition is our capacity to monitor our own thoughts and can be referred to as a person's knowledge about the cognitive processes necessary for understanding and learning.

| **Statement** | **Never** | **Seldom** | **Sometimes** | **Often** | **Always** |
|---|---|---|---|---|---|
| 1. I know when I understand something. | **1** | **2** | **3** | **4** | **5** |
| 2. I can make myself learn when I need to. | **1** | **2** | **3** | **4** | **5** |
| 3. I try to use ways of studying that have worked for me before. | **1** | **2** | **3** | **4** | **5** |
| 4. I know what the teacher expects me to learn. | **1** | **2** | **3** | **4** | **5** |
| 5. I learn best when I already know something about the topic. | **1** | **2** | **3** | **4** | **5** |
| 6. I draw pictures or diagrams to help me understand while learning. | **1** | **2** | **3** | **4** | **5** |
| 7. When I am done with my schoolwork, I ask myself if I learned what I wanted to learn. | **1** | **2** | **3** | **4** | **5** |

| **Statement** | **Never** | **Seldom** | **Sometimes** | **Often** | **Always** |
|---|---|---|---|---|---|
| 8. I think of several ways to solve a problem and then choose the best one. | **1** | **2** | **3** | **4** | **5** |
| 9. I think about what I need to learn before I start working | **1** | **2** | **3** | **4** | **5** |
| 10. I ask myself how well I am doing when I am learning something new. | **1** | **2** | **3** | **4** | **5** |
| 11. I really pay attention to important information. | **1** | **2** | **3** | **4** | **5** |
| 12. I learn more when I am interested in the topic. | **1** | **2** | **3** | **4** | **5** |
| 13. I use my learning strengths to make up for my weaknesses. | **1** | **2** | **3** | **4** | **5** |
| 14. I use different learning strategies depending on the task. | **1** | **2** | **3** | **4** | **5** |
| 15. I occasionally check to make sure I'll get my work done on time. | **1** | **2** | **3** | **4** | **5** |
| 16. I sometimes use learning strategies without thinking. | **1** | **2** | **3** | **4** | **5** |

| **Statement** | **Never** | **Seldom** | **Sometimes** | **Often** | **Always** |
|---|---|---|---|---|---|
| 17. I ask myself if there was an easier way to do things after I finish a task. | **1** | **2** | **3** | **4** | **5** |
| 18. I decide what I need to get done before I start a task. | **1** | **2** | **3** | **4** | **5** |

**Thank you**