THE POTENTIAL OF THE COMET COMPETENCE DIAGNOSTIC MODEL FOR THE ASSESSMENT AND DEVELOPMENT OF OCCUPATIONAL COMPETENCE AND COMMITMENT, IN TECHNICAL VOCATIONAL EDUCATION AND TRAINING

by

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DECLARATION OF AUTHENTICITY

I, Patricia Ammarenthea Jacobs declare that the thesis submitted by me for the Doctor of Philosophy degree at the Bremen University in Germany, is my own, original work and that information and resources used have been referenced and acknowledged according to APA style of referencing. I have not previously submitted this Thesis to another University.

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Table of Contents

List of Tables

List of Figures

GLOSSARY

ABET	Adult Basic Education and Training
AIDS	Acquired Immune Deficiency Syndrome
ANA's	Annual National Assessments
BRICS	Brazil, Russia, India, China and South Africa
CHE	Council on Higher Education
CPD	Continuing professional development
CWP	Community Works Programme
DHET	Department of Higher Education and Training
DoE	Department of Education
DOL	Department of Labour
DST	Department of Science and Technology
ELRC	Education Labour Relations Council
FET	Further education and training
ESD	Education for Sustainable Development
GETC	General Education and Training Certificate
GIZ	German Technical Cooperation
HEDSA	Higher Education Disability Services Association
HEQF	Higher Education Qualifications Sub-Framework
HEQC	Higher Education Quality Committee
HIV	Human Immunodeficiency Virus
HRDS	Human Resource Development Strategy
HSRC	Human Sciences Research Council
ICT	Information and communications technology
ILO	International Labour Organisation
ISCO	International Labour Organisation
MDG's	Millennium Development Goals

N-programme NATED/Report 191	National Accredited Technical Education Diploma
NAMB	National Artisan Moderating Body
NARYSEC	National Rural Youth Services Corps
NASCA	National Senior Certificate for Adults
NCVER	National Centre for Vocational Education Research
NCV	National Certificate (Vocational)
NDP	National Development Plan
NEDLAC	National Economic Development and Labour Council
NEET	Not in employment, education or training
NGO	Non-governmental organization
NGP	New Growth Path
NQF	National Qualifications Framework
NSA	National Skills Authority
NSC	National Senior Certificate
NSDS III	Third National Skills Development Strategy
NSF	National Skills Fund
NSFAS	National Student Financial Aid Scheme
OFO	Organising Framework for Occupations
QCTO	Quality Council for Trades and Occupation
QLFS	Quarterly Labour Force Survey
OECD	Organisation for Economic Co-operation and Development
OQSF	Occupational Qualifications Sub-framework
OBET	Outcomes-Based Education and Training
PISA	Program for International Student Assessment
RPL	Recognition of prior learning
RSA	Republic of South Africa
SASCO	South African Standards Classification of Occupations
SAQA	South African Council of Educators

SADC	Southern African Development Community
SAIVCET	South African Institute for Vocational and Continuing Education and Training
SAQA	South African Qualifications Authority
SDA	Skills Development Act
SETA	Sector Education and Training Authority
TIMSS	Trends in International Mathematics and Science Study
TVET	Technical and vocational education and training
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UKTI	United Kingdom Trade and Investment
USAID	United States Agency for International Development
VI	Vocational Identity
WEF	World Economic Forum
WICS	Wisdom-Intelligence-Creativity-Synthesized
WIL	Work-integrated learning
WSP	Workplace skills plan
WPLC	Work process oriented learning context

ABSTRACT

This study sets out to examine the potential of COMET occupational competence diagnostic model to assess and develop occupational competence in TVET. Holistic problem solving competence grounded in the COMET three-dimensional model, eight COMET criteria and Work Process Knowledge is a key element in this study. TVET is frequently seen as an instrument to address socio-economic and political challenges at a national and global level. The significance of a well-defined occupational competence assessment tool to advance quality assurance in TVET is accentuated by the high expectations of TVET to mitigate global concerns. Central to the debate around high youth unemployment is the issue of student occupational competence and workplace readiness to access the opportunities created by government policies and strategies.

A mixed methodological approach consisting of qualitative and quantitative research methods was adopted. Cross-sectional data as well as elements of longitudinal data was collected from 715 participants comprising of students and artisans from six Public TVET Colleges, two Private TVET Institutions and three Industry Academies. The highest percentage of students (34,4%) ranged between ages 21-24.

COMET Large-Scale Open-ended Test Tasks were conducted in measuring the occupational competence of TVET students to solve domain specific, complex problems, holistically. Four context questionnaires and semi-structured focus group interviews complete the assessment methods for data collection. COMET psychometric model and IBM SPSS version 22 were predominantly used to analyse the data collected.

Findings of this study provide strong evidence that qualifications do not guarantee the development of occupational competence amongst students. The typical applied curriculum appears to be insufficient in preparing TVET students for the 21st century, modern work where reflective, divergent thinking and holistic problem solving competence has become the norm. 60.4% of students are at risk at Nominal Competence level and merely 11.4% achieved Holistic Shaping Competence. Functional Competence was achieved by 14.9% and 13.1% of students achieved Processual Competence. Students in the pilot dual system apprenticeship programme (DSAP) exposed to a real work situation, acquired higher occupation competence levels in comparison to sole College based peers. Stagnation in the development of occupational competence over three years of training is a major finding. Occupational commitment and motivation of students was high contrary to poor holistic problem solving competence.

Arising from these findings, COMET occupational competence diagnostic model is proposed to position TVET to assess and develop value related occupational competence in TVET. This study supports COMET pedagogy of accumulative occupational competence in developing students from a novice to an expert, skilled professional.

THE POTENTIAL OF THE COMET COMPETENCE DIAGNOSTIC MODEL FOR THE ASSESSMENT AND DEVELOPMENT OF OCCUPATIONAL COMPETENCE AND COMMITMENT, IN TECHNICAL VOCATIONAL EDUCATION AND TRAINING.

Das Potenzial des Comet Kompetenzdiagnosemodells für die Bewertung und Entwicklung beruflicher Kompetenz und beruflichen Engagements in der technischen Berufsbildung.

ZUSAMMENFASSUNG

Die Dissertation zielt darauf ab, das Potenzial des COMET-Kompetenz- und Messmodells zum Messen und Entwickeln berufliche Kompetenz im der südafrikanischen Berufsbildungssystem zu ermitteln. Das zentrale methodische Instrumentarium ist dabei das dreidimensionale COMET-Kompetenzmodell, basierend auf dem Konzept der ganzheitlichen Gestaltungs-/Problemlösungskompetenz mit seinen acht Teilkompetenzen und dem in die Anforderungsdimension inkorporierten Konzept des Arbeitsprozesswissens. Berufliche Bildung wird häufig als Instrument zur Lösung sozio-ökonomischer und politischer Herausforderungen auf nationaler und globaler Ebene gesehen. Die Bedeutung eines wirksamen Instrumentariums zum Messen berufliche Kompetenz und zur Steuerung der Qualitätssicherung in der beruflichen Bildung wird von hohen Erwartungen an positive Auswirkungen an die Wettbewerbsfähigkeit der Unternehmen und die Reduzierung der Jugendarbeitslosigkeit begleitet. Daraus ergibt sich die bildungsplanerische und -politische Relevanz der Dissertation.

Der Bezugspunkt für die Begründung der zentralen Fragestellung der Dissertation sind die Ergebnisse einer COMET-Vorstudie in Südafrika. Danach stagniert die Kompetenzentwicklung der Auszubildenden/Studierenden im Verlaufe ihrer drei- bis vierjährigen Ausbildung. Gemessen wurde lediglich eine horizontale Erweiterung funktionaler modularer Teil-Qualifikationen. Die vorläufige Interpretation dieses überraschenden Phänomens war der Ausgangspunkt für die Entwicklung der Forschungsfrage. Im Kern geht es um die Hypothese, dass die entscheidende Determinanten für die Stagnation der Kompetenzentwicklung nicht das durch die Lehrer geprägte Lernmilieu in den Colleges ist (s. dazu den Stand der Lehr-Lernforschung), sondern die charakteristische Struktur der in der südafrikanischen Berufsausbildung implementierten Formen beruflicher Curricula und Assessmentverfahren.

Es wurde ein mixed-methods Forschungsdesign, bestehend aus qualitativen und quantitativen Methoden, angewandt. Dabei wurden mit einer Querschnitts- und Längsschnittuntersuchung Daten von 715 Testteilnehmern (von vier Berufen) von sechs öffentlichen berufsbildenden Schulen, zwei privaten

Berufsbildungszentren sowie drei Wirtschaftsakademien erhoben. Der größte Anteil der Auszubildenden/Studierenden (34,4 %) war zwischen 21 und 24 Jahre alt. Zum Messen der beruflichen Kompetenz der Auszubildenden/Studierenden wurden für diese Large-Scale Untersuchungen offene Testaufgaben entwickelt und eingesetzt. Vier Kontext-Fragebögen und halbstrukturierte Gruppeninterviews vervollständigten die Methoden zur Datenerhebung. Dieses Forschungsdesign erforderte eine Erweiterung des COMET-Kompetenz- und Messmodells. Die Erweiterungen beziehen sich auf das Erfassen sozialer Kompetenz sowie auf den Transfer konzeptuelle Kompetenz auf das berufliche Können (berufliche Handlungskompetenz.

Die Ergebnisse der Untersuchung erbrachten den Nachweis dafür, dass die in den beruflichen Rahmenlehrplänen definierten Qualifikationen keine Voraussetzung für die Entwicklung berufliche Kompetenz bei Auszubildenden/Studierenden darstellen. Die Stagnation der Kompetenzentwicklung kann vor allem darauf zurückgeführt werden, dass die Vermittlung des beruflichen Wissens nicht über das Niveau des handlungsleitenden Wissens hinausreicht. Durchgängig sind das reflexive Arbeitsprozesswissens sowie eine darauf basierende Problemlösungskompetenz bei der Mehrzahl der Testpersonen unterentwickelt. 60,4% der Testteilnehmer wurden als Risikogruppe (nominelle Kompetenz) eingestuft. Nur 11,4% erreichten das höchste Kompetenzniveau (ganzheitliche Gestaltungskompetenz). Das Niveau der funktionalen Kompetenz wurde von 14,9 %, das Niveau der prozessualen Kompetenz von 13,1% der Testteilnehmer erreicht. Auszubildende einer dualen Ausbildung (DSAP), die in ihrer Ausbildungspraxis mit realen Arbeitssituationen konfrontiert waren, erreichten ein höheres Kompetenzniveau als Auszubildende/Studierende, deren Ausbildung lediglich in schulischen Bildungsgängen vermittelt wurde. Anhand der umfangreichen Untersuchungsergebnisse kann die der Dissertation zu Grunde liegende Forschungsfrage zu einer detaillierten Forschungshypothese verdichtet werden: die Curriculum- und Assessmentstrukturen sind die im südafrikanischen Berufsbildungssystem die entscheidende Determinanten für die Stagnation der Kompetenzentwicklung im Verlaufe der Berufsausbildung. Die Erweiterung des Kompetenzmessverfahrens um zwei Komponenten: das Messen beruflichen Könnens sowie sozialer Kompetenz hat zu neuen Erkenntnissen in der Kompetenzdiagnostik beigetragen. Die Ergänzung der quantitativen Untersuchungsmethode um die qualitative Methode der halbstrukturierten Gruppendiskussion hat eine größere Tiefe der Interpretation der Untersuchungsergebnisse ermöglicht. Die Forschungsergebnisse lassen die Begründung vielfältiger Anregungen für die Modernisierung der Berufsausbildung in Südafrika zu.

CHAPTER ONE

CONTEXTUALISATION, BACKGROUND AND RESEARCH RELEVANCE

1.1 INTRODUCTORY OVERVIEW OF THE RESEARCH

This study aims to examine the impact of competence diagnostic assessment and development on occupational competence and commitment in Technical Vocational Education and Training (TVET) students. The potential for a competence diagnostic model to navigate TVET practice in defining and positioning itself in education and socio-economic sectors needs to be investigated.

For students to be relevant in a rapid changing world of work where innovation and life-long learning phenomena have become the rule, it is inevitable to assess whether the existing quality assurance practice for qualifications and certification in TVET is sufficient. The search for a more universal approach to the domain of quality assurance as a regulatory mechanism is complex and ongoing. It can be seen as an overarching term referring to assessing, monitoring guaranteeing, maintaining, and improving the quality of a higher education system, institutions or programmes for the purpose of accountability and improvement (Vlasceanu, Grunberg, & Parlea, 2007, p. 74). The TVET assessment landscape is confronted with similar quality assurance and systemic challenges.

In South Africa, the government, educators and officials in TVET are seeking ways to develop a system that will engage and effectively capacitate students to address the technical skills challenges as outlined in policy and strategy documents such as the National Development Plan (NDP), National Skills Development Strategy 3 (NSDS III) and Millennium Development Goals (MDG's). Very little has been done thus far to examine the connection between the implementation of competence diagnostic assessment and its potential in initiating competence development in TVET, resulting in students being empowered to address the challenges of modern society as outlined in the directive policies and strategies.

Further Education and Training (FET) Colleges are seen as the vehicle to execute the government's NSDS III strategy to accelerate skills development in South Africa. (ACHIEVER SKILLS SUMMIT, 2013) "Promoting the growth of a public FET College system that is responsive to sector, regional and national skills needs and priorities" (NSDS III 2011-2016, p. 16). However, Adcorp's latest research according to Sharp, on 15 April 2013 revealed that Higher Education Institutions, especially FET Colleges are failing to produce the appropriate skills and mentioned that government's approach to up skill the labour market and alleviate unemployment is doomed to fail (Payle, 2013). FET Colleges are now renamed as TVET Colleges (DHET, 2013, p. 5). The implementation of lean production in companies poses an even bigger risk for employment prospects for these students. Lean production involves processes that are simplified by the elimination of costly and burdensome waste throughout the system. Everyone is expected to participate in these process improvements in a meaningful manner. Recently there is a focus on linking lean-oriented improvements directly to the operational management of the production process in a holistic organisational approach. This holistic company approach is necessary to remain competitive in the fast changing global business dynamics of today (Armstrong & Diehl, 2015, pp. 26-30). The question arises whether the lack of well-defined measurement of competence diagnostics and development could be the contributing factor to the occupational competence predicament in South Africa.

"As markets become increasingly global and competitive, governments are intensifying pressure on national VET systems to produce more highly skilled and employable workers. '*Jobs and growth'* is now the universal mantra of policy makers and the taken-for-granted *raison d'etre* (reason for existence) of VET" (Anderson, Searle & Roebuck, 2002, pp. 61-68). Anderson argues that the race for global economic competiveness risk VET being practiced at the cost of ecological sustainability and the increasing irrelevance of skills-for-work perception. The very complex position of TVET is illustrated in this statement. The Millennium Development Goal 7 (Ensure environmental sustainability) accentuates the importance of ecological sustainability. The COMET competence diagnostic model will be tested for its potential to measure the criteria for the development of holistic competence in TVET (Rauner et al. 2013).

Zhou and Yan claim that it is evident that TVET teachers' professional competence structure should consist of five dimensions of competence relevant to TVET, namely cognitive competence, functional competence, social competence, transferable competence and meta-

competence (Zhou & Yan, 2011, pp. 167-170). This will result in TVET educator competence development and not only student competence development. If there is a disjuncture between educator and student competence development the materialising of occupational competence will be derailed. An article by Kurnia and Ilhamdaniah emphasises this fundamental element of TVET stating that the quality of teachers determines the quality of education in general and occupational competence in particular (Kurnia & Ilhamdaniah, 2013, p. 1). A study done by Zhao, Zhang and Rauner on KOMET-Based Professional Competence Assessment for VET Teachers in China provides an empirical measurement tool to verify these very general hypotheses. This study measures professional competences of TVET Teachers to seek holistic solutions for education and training, focusing on real work problems rather than professional aptitudes. The three COMET competence levels are measured within nine COMET criteria, namely:

- Functional Competence informed by the criteria of functionality in a specialised domain, objectives and content of teaching, approaches and methods of teaching and learning.
- Processual Competence informed by the criteria, namely, organisation of the teaching process, quality control of teaching and the efficiency and effects of teaching.
- Shaping Competence informed by the criteria of acceptability, social and cultural background as well as creativity.

These nine criteria are further qualified by 45 items to ensure content validity of the measuring tool. Professional identity, Organisational identity and Achievement motivation of Staff as equally important indicators for quality assurance in TVET, were also empirically measured (Zhao, Zhang & Rauner, 2013-2016).

Although the emphasis of this research study is predominantly on the assessment and development of occupational competence amongst TVET students, educator competence remains a critical element in the development of occupational competence. Several policy and strategy documents raise the concern regarding TVET Educator competence as echoed in the White Paper for Post-School Education and Training: *The most important indicator for the success of a (TVET) college is the quality of education offered by a well-educated, capable and professional teaching staff* (DHET, 2013, p. 16).

The infusion of a competence diagnostic model in the current assessment in TVET will be investigated. Feuerstein & Falik (2010) referred to the infusion of the thinking process into curriculum content and the consequent benefits such as improved thinking skills, behavioural regulation and transfer of learning (Feuerstein & Falik, 2010, pp. 4-20). This need to surpass the traditional method of curriculum delivery and assessment is further supported by the WICS (Wisdom-Intelligence-Creativity-Synthesized) model of Robert Sternberg. Sternberg recognises the necessity of knowledge and basic skills but argues very strongly that it is not sufficient for critical, creative, practical and wise thinking to equip learners for "a world whose inhabitants are not lacking so much knowledge as in how to employ it for good ends" (Sternberg, 2010, pp. 36-47). Numerous authors and organisations acknowledge and support competence assessment as an imperative for the development of occupational competence and commitment (Jaros, 2007, pp. 7-24; Bagraim, 2003, pp. 6-9; Cohen, 2007, pp. 1-18). There are, however, many gaps on how to be responsive to the extent where occupational competence and commitment can be empirically measured, which particular competences are to be assessed and which mode of assessor function will be most effective. Mulder, Weigel and Collins, however, also highlight the criticism regarding the implementation of competence and specifically refer to the assessment of competence in VET, the definition of competence and practical problems (Mulder, Weigel & Collins, 2006, pp. 65-85). The authors determined that a holistic approach is the most suitable driver for their definition of competence, being the ability to perform, to use knowledge, skills and attitudes in an integrated manner in the professional repertoire of the individual. McClelland's paper, *Testing for competence rather than for intelligence,* in as early as 1973 launched the modern competence movement (McClelland, 1973, pp. 1-14). It is, however, evident that research central to competence diagnostic models such as COMET is indispensable to address the gaps. The identified gaps form the basis for this research.

The inadequate emphasis on occupational competence development in the current system and qualifications criteria as a possible contributing factor to the areas for development in TVET, should be investigated. This investigation should take cognisance of the fact that research in TVET indicates that there is a close relationship between the development of vocational identity and the development and occupational commitment (Rauner, Heinemann, Maurer, Haasler, 2013, p. 31).

The National Development Plan (NDP) 2030 has as one of its objectives the decreasing of unemployment rates from 24,9% in 2012 to 14% by 2030. The specific practical implementation of a competence diagnostic model to achieve the envisaged outcomes must be investigated. “In particular the impact of the Global Financial crisis has raised the profile of apprenticeships as it is seen as a way to combat youth unemployment” (ILO, Nov 2012). Statistics South Africa reported the Not in Education, Employment or Training (NEET) rate amongst youth at 33,5% in June 2013 (Statistics South Africa, 2013). In 2009, G20 leaders debated a recovery strategy to address the establishment of quality jobs and improved employment prospects that was supported by a framework that promotes strong, sustainable and balanced growth. The International Labour Organisation presented the strategy to the G20 Labour Ministers in April 2010 at a summit in Toronto (ILO, 2011). Furthermore, the OECD action plan for addressing youth unemployment adopted the slogan *Giving Youth a Better Start* at the Ministerial Council meeting in Paris on 6 to 7 May 2014 with the focus on youth unemployment as a crisis and the strengthening of long term employment prospects for youth. Concerns regarding youth unemployment at 14,5% for the fourth quarter of 2013 in OECD countries were raised. This paper however indicates the huge discrepancies among the individual countries in terms of NEET and youth unemployment. Youth unemployment for Japan, Germany, Switzerland Korea and Austria was for example, below 5%. These countries are known for implementing a robust dual education apprenticeship system. The question therefore is whether such an educational system can solve the youth unemployment crisis. OECD identified key imperatives:

- *Increase demand and stimulate job creation.*
- *Support unemployed youth financially* until employed with the mutual agreement of self-efficacy in terms of finding a job and employability.
- *Maintain and where possible expand cost-effective active labour market measures with more emphasis on disadvantaged youth.*
- *Tackle demand-side barriers to the employment of low-skilled youth*, such as high labour costs.
- *Encourage employers to continue or expand quality apprenticeship and internship programmes*, including, for example, additional financial incentives if necessary.
- *Strengthen the long-term employment prospects for Youth.*

- *Strengthen the education system and prepare all young people for the world of work* – address premature drop-out; provide alternative pathways where needed; ensure quality, work related education and training.
- *Strengthen the role and effectiveness of Vocational Education and Training* to provide programmes that are responsive to labour market needs and are inclusive of work-based learning; address foundational skills (OECD, 2014).

The high policy impetus on the NCV (National Certificate Vocational) programme to address this dilemma appears to be insufficient to deal with NEET amongst South African Youth. The possibility of competence development and commitment as a key driver to improve the success rate of this programme must be argued against the principles of the COMET model. Modern occupations need to be responsive in terms of innovative thinking skills and prospects that lead to the development of divergent thinking in solving complex problems holistically.

Furthermore, in the Organisation for Economic Co-operation and Development (OECD) countries, more than one in eight of all 15 to 24-year-olds are not in employment, education, or training (NEET). Around the world, the International Labour Organisation estimates that 75 million young people are unemployed" (Mourshed, Farrell, & Barton, 2013, p. 11).

Job-man-fitness appears to be a significant barrier to youth employment prospects. "Across the surveyed countries, nearly four in ten employers who had vacancies reported that a driving reason behind these vacancies remaining unfilled is the lack of the right skills in new graduates" (Mourshed et al. , 2013, p. 44). The modernisation of assessment practice in TVET towards occupational competence has become a primary necessity. Wyman stated that approximately thirteen million Americans are unemployed while three million positions remain vacant. Likewise, a quarter of American businesses say that they experience difficulty in finding people with the practical, technical, job-ready skills that they require. He ascribes this imbalance to the dilemma of too many job seekers inclusive of numerous college graduates completing their education without practical work experience or the soft skills needed to find a job (Wyman, 2015, p. 2). Reflective work experience as described by Schoen as *the reflective practitioner* (Schoen, 1983, pp. 21-69), is a fundamental didactic concept in COMET diagnostic assessment and development of shaping occupational competence as researched in this work.

A dual TVET system implies the cooperation between learning venues and is based on the insight that each occupation has to be learned in theoretical as well as real work processes.

Deitmer et al. alluded to the fact that learning entails much more than the mere "scholification" where it is primarily connected to theoretical studies (Deitmer et al. 2013). Learning is also related to the development of a vocational identity, acquiring of responsibility and coping effectively with work tasks. The authors refer to the terms "spectator" skills provided by schools and "participant" skills provided by the workplace. These two skills need to complement one another in a competence-based model and this research seeks to investigate how this gap can be addressed by a dual TVET system. This paradigm is supported by the NSDS III as a pivotal matter: "The term 'PIVOTAL' aggregates the traditionally divided realms of the professional, the para-professional and the artisan and focuses instead on the fact that they all constitute institutional and workplace learning, albeit it in different ways. This bridging between the two worlds is a defining feature of PIVOTAL programmes" (Department of Higher Education, RSA).

"In any country where policy makers are considering the need for radical restructuring of TVET, there is a clear need for policy making to be informed by research on these matters, and such research should also show cognisance of the controversies which exist" (Lauglo, 2006, pp. 3-26). This is a typical situation in South Africa and given the high emphasis on TVET Colleges to execute TVET policy, as stated in for example, NSDS III, the COMET competence model needs to be tested in terms of the potential to inform policy makers regarding the improvement of competence development and quality return on investment. This is crucial to attract more students to TVET Colleges but equally so, for the provision of quality education and training. The DHET has as one of its goals for post-school education and training to have 2.5 million head-count enrollments in TVET Colleges by 2030 and 1.6 million, in Universities (DHET, 2013, p. 7). Universities however, remain the institutions of choice with 899 120 students enrolled in 23 Universities in comparison to 400 273 students enrolled in 50 FET (TVET) Colleges (MDG Country Report, 2013, pp. 41-42). This endeavor is equally crucial to address the public perception of TVET as second-class education. "TVET has suffered from being considered as the fallback position for those who did not succeed in the more academic streams (Kingombe, 2011). The impact of the revolutionary but highly contested principles of Donald Schoen's *learning society* appears to be a contributing factor (Shoen, 1983).

The COMET-Pilot Test- South Africa 2012 indicated that 59,3% of respondents function at nominal level, 37, 9% at functional competence and 1,1 % at processional level with merely 1,6% at holistic shaping competence level.

This high nominal functioning group is identified as high risk and in jeopardy of not being able to achieve the required level of skilled worker competence according to international standards (Project Report COMET –Pilot Test South Africa 2012). The reasons for the poor competence levels need to be further researched. Thus, the need for this comprehensive Research Study to investigate the understanding of the potential of competence-based measurement in developing effective assessment and learning tasks to improve quality assurance practices in occupations.

1.2 THEORETICAL FRAMEWORK

"Assessment can help you identify strengths and weaknesses, map development or progress, make decisions regarding suitability for a job or a field of study, identify training and education needs or it can assist in making a diagnosis" (Foxcroft & Roodt, 2009, p. 3). Assessment is an integral part of the curriculum and as described by Foxcroft and Roodt, a defining factor in curriculum delivery. It is, however, crucial that assessment measures meet the intended purpose. COMET assesses domain specific content with wider application value and not narrow, applied curriculum specific knowledge. For competence diagnostics and measurement, COMET competence model provides the dimensions to quantify competence to an extent where a competence profile analysis can be done and plotted on a graph. COMET psychometric model allows for the profiles to be scientifically analysed.

For the purpose of this study the focus will be on a formative and summative assessment approach. "Summative assessment is concerned with the outcome of a process or the current status of a phenomenon" (Moerdyk, 2009, p. 6). Formative assessment can be seen as a process that forms the learning, rather than a single event. Both the educator and the student as a significant partner are involved in the assessment process (Box, Skoog, & Dabbs, 2015, pp. 956-983).

COMET Competence-based assessment is a large-scale process similar to the OECD Program for International Student Assessment (PISA) but differ fundamentally in the sense that COMET assessment accentuates content validity in contrast to PISA where the valuing of different educational contexts is overlooked (Schleicher, 2013; Kaplan & McCarty, 2013). The COMET assessment model allows for the reinvention of benchmarking as a quality assurance tool applicable in individual up to large-scale international comparisons.

“With the (COMET) tool, required and existing competences are contrasted in order for the qualification deficits to become visible. Thus, the tool provides a quick and comprehensive overview of the employees’ competences” (Berufsfoerderungswerk Nuremberg). The alarmingly high unemployment rate in South Africa accompanied with major social challenges raise the question whether the qualifications achieved are adequate for equipping students implicitly for these challenges.

The COMET competence model as discussed in 2.8, is based on the four-stage scientific and technical literacy model proposed by Bybee (1997).

- Nominal Competence
- Functional Competence
- Procedural Competence
- Multidimensional Competence

(Rauner, Heinemann, Maurer, Haasler, Erdwien & Martens, 2013, pp. 42-43)
This accumulative development of competence is a fundamental didactic principle and should be reflected in assessment planning and procedure.

It is crucial for the validity of this study to take cognisance that the initial COMET studies by Rauner et al. assumed that competences that cannot be assessed by large scale competence diagnostics tests are:

- Tacit knowledge
- Occupational aptitude
- Social skills
- Abilities that come into play in interactive work processes
- Manual dexterity

Developments in COMET, introducing the COMET practical test tasks in a real workplace setting as well as the assessment of social competence, however, modified this observation. These findings will be discussed in detail in Chapters 4 and 5. It is important to notice that the 40-item rating sheet used for the conceptual COMET open-ended test tasks, has since been adapted to integrate items required for the assessment of COMET practical tasks. A prominent focus is on the quality of the presentation in terms of adequacy, skilled professional level and customer focus. Referring to the functionality of the task, practical feasibility of the solution, the transfer from conceptual to practice, the justification of the solution and the approach towards the task comprise the main focus (Rauner, 2015).

Not all competencies can be directly observed. Related, indirect behaviours can also be used, along with directly observable behaviours" (Griffin, Gillis & Calvitto, 2007, pp. 19-38).

Maag Merki refers to cross-curricular competencies as all competencies that are not specific to an individual subject or occupation but transversal in nature, spanning diverse fields and professions and are crucial for school or job success (Maag Merki, 2008, pp. 517-522). This will be useful in the move towards core occupations where the principle of specialisation was replaced with the principle of exemplarity (Deitmer, Hauschildt, Rauner & Zelloth, 2013, p. 5).

The criteria as outlined in Table 1 will be a guide for the assessment of competence that can be measured by large-scale competence diagnostic tools such as COMET diagnostic model

Tab. 1: Criteria for measuring occupational competence

Clarity/ Presentation	The outcome of occupational tasks is anticipated in the planning and preparation process and is documented and presented in such a way that the task-setters (superiors or customers) can communicate and assess the proposed solutions. That is why this is a basic form of occupational activity and vocational learning.
Functionality	This criterion relates to instrumental specialised competence and hence to non-contextual specialised knowledge. The ability to perform a task functionally is basic to all other requirements in the realm of occupational problem solving.
Sustainability Focus on utility value	Occupational work processes and assignments always relate to customers, who are interested in high utility value and sustainable solutions. In work processes with extensive division of labour, the aspects of utility value and sustainability often fade from the minds of employees as they go about their tasks. By emphasising sustainable solutions, vocational training helps to counteract this phenomenon.
Cost-effectiveness/ Efficiency	Occupational tasks must, in principle, be performed economically. The competence of skilled workers is reflected in their consideration of cost-effectiveness in the context of their occupational duties.
Business and process orientation	This criterion covers aspects of task performance that take account of the higher and lower tiers of the company hierarchy (the hierarchical aspect of the business process) and of the upstream and downstream links in the process chain (the horizontal aspect of the business process).
Social acceptability	This criterion primarily relates to the ergonomics of the work process and workplace organisation, to health and safety and, where appropriate, to the social aspects of working life that transcend life on the shop floor.
Environmental Compatibility	This is a criterion which is relevant to almost all work processes. It is not a question of general environmental awareness but of the environmental requirements specific to particular occupations and specialisations in so far as they affect work processes and their outcome.
Creativity	This is an indicator that plays a leading role in the performance of occupational tasks. One reason for this is the extreme variations in the scope for creativity in the performance of occupational tasks in different situations.

(Rauner , 2010)

As opposed to the original approach where it was decided to exclude certain indicators from the model based on practical reasons, this study intends to explore the possibility to integrate Social competence in the COMET competence diagnostic model as a measurable competence diagnostic dimension. “Auch aus forschungsökonomischen gründen wird im KOMET-Project darauf verzichtet, die überfachlichen Kompetenzen nach dem Indikatorensystem von Grob und Maag Merki zu erfassen.” (Rauner, Haasler, Heinemann, & Grollmann, 2009, p. 20). The validity of this position had to be verified. Chapters 4 and 5 provide a detailed report regarding the assessment of Social Competence in this research study. The model is evolving to assess the areas initially referred to as *not assessable*.

The COMET competence model for large-scale competence diagnostics can be used as the basis for comparative assessments between current assessment strategies in South Africa and occupational competence based assessment and quality assurance as researched in this study.

Another study on assessment dynamics conducted in Australia across fifty colleges for Year Twelve VET subjects argued in favour of Standard-referenced assessments in VET schools, where performance indicators were rated using a series quality ordered criteria (Griffin, Gillis, & Calvitto, 2007, pp. 19-38). A collective approach towards the assessment of quality and competence is a central element in this research. It is however curriculum based. The quest for efficacy of competence assessment in TVET is clearly illustrated in this article. “The lack of rigorous research and theoretical models has been detrimental to the development of the field” (Griffin et al. , 2007, pp. 19-38). Valuable scientific contributions were made in the field of assessment in TVET, such as defining the important role of the quality of performance in competence assessment. However, this research is limiting the enormous potential of competence diagnostic assessments to a large extent, to access to a University. There is no evidence of a competence model where work related competence is measured. Units are broken down into tasks and eventually elements. Elements are assessed, which in comparison to COMET, does not focus on overall problem solving. Content validity of COMET and vocational action are also lacking.

Studies by KNAPP and Assessment Certification (ACE), New South Wales support the fundamental principles of COMET: “It is not necessary, nor is it desirable, for individual performance criteria to be demonstrated separately for assessment purposes. Rather, assessors should adopt an integrated or holistic approach to assessment.

This means that a number of elements of competency or even several units of competency are assessed together. This method of assessment is strongly recommended because the concept of competence involves the integration of a wide range of skills, knowledge and attitudes" (ACE, 2011). "Typically incorporates performance of several related tasks and/or requires the use of a variety of knowledge domains" (KNAPP, n.d.).

"Competence is not something that is directly observed. Rather, competence is inferred from performance. In this respect assessment of competence is similar to other kinds of assessment in a sense that procedures are used to test the validity and reliability of the inference. If these procedures are followed, then assessment of competence is as objective as any of the alternatives" (Hager, Gonzi, & Athanasou, 1994, pp. 3-16). The authors referred to critique against competence-based assessment on the grounds of inference and concluded that they are apparently unaware that this is the case for all typical assessment methods. "Tests of knowledge, for example, usually sample only a fraction of the required knowledge. On the basis of a score that is typically well below 100%, an inference is made as to whether or not the student knows enough to be assessed as satisfactory" (Hager, Gonzi, & Athanasou, 1994, pp. 3-16). The relevance of research in competence diagnostic assessment is further supported by Botha referring to the South African examinations system as examination factories (eksamenfabrieke) with too little emphasis on holistic development of learners, their character and critical thinking (Botha , 2013).

1.3 BACKGROUND AND SCIENTIFIC RELEVANCE

This study is based on the assumption that the development of *readiness to act* in a domain specific disposition is inevitable for the accomplishment of occupational competence and commitment. COMET competence diagnostic tool's potential to measure processional knowledge in terms of the *know that, know how and know why*, will be tested for the advancement of a competence based paradigm in TVET assessment. Scholz and Heinemann refer to these dimensions as "work process knowledge where *know that* refers to knowledge to guide action, *know how* refers to knowledge to interpret action and *know why*, refers to knowledge to reflect action" (Scholz & Heinemann, 2013, pp. 107-110).

Literature studies over more than five decades illustrate the chaos of competence theories and terminology in various contexts. The thinking and conceptualisation has some commonalities but differ distinctively as explained in the different approaches below.

Ennis refer to McClelland who in the early 1970's acknowledged competencies, or individual characteristics as significant predictors of employee performance and success (Ennis, 2008, p. 4). Norris argues that competence has become a modern term associated with the drive towards more practical Education and Training, accompanied with greater emphasis on assessment of performance than on knowledge. He alarms against the apparent simplicity and tacit understanding of the defining and operationalisation of the concepts of competence and standards (Norris, 1991, pp. 331-341).

The Australian TVET model identified six intrinsic features used as a baseline: governance, industrial engagement, competency-based standards, qualifications framework, quality standards for providers and assessment. This model describes competency-based standards as being nationally endorsed skills aligned to specific occupations and skills aligned to levels of competence (Kazmi, 2012/13, p. 235).

Social construct and conceptual pragmatism in defining concepts are central to the *Holistic model of Competence* of Rychen and Salganik. A demand driven or functional approach is adopted in this model. "The notion that context is an integral element of competent performance raises the issue of whether an individual who is competent to meet a demand in one context or situation would be able to meet a similar demand in another context. Frequently, this topic is addressed in terms of *transfer,* alluding to the value of previous experience in acquiring a new competence or performing successfully in a new situation (Rychen & Salganik, 2003; Weinhart, 2001; Gonczi, 2003).

Haasler and Erpenbeck further explain the divergent attempts to classify competence. They referred to work done by Rychen and Salganik (2001) on Key competencies, Benner (1995) and Haasler (2004) on Practical or Implicit knowledge, Action oriented and reflective knowledge by Hacker (1996) and Work Process Knowledge by Fischer (2001) (Haasler & Erpenbeck, 2009, pp. 766-774).

"As countries in Asia-Pacific strive for economic development, TVET is increasingly gaining importance on education agendas. Doubtlessly, skilled youth play a key role in developing a competitive labour force. Technical skills, however, are not the only skills needed in today's work places. Increasingly young people are required to show teamwork, problem solving and

communication skills, as well as leadership, creativity, conscientiousness and so on.
All these skills are combined under different names – ranging from transferable, transversal and non-cognitive to 21st century skills. Nevertheless, each one of these terms implies the need to develop young people's capabilities beyond academic knowledge and technical skills" (Chang, 2013, p. 138).

All these contemplations on competence demonstrate the diverse conceptualisation of the concept and outlines the measure to which research is needed towards a more common understanding of competence and specifically occupational competence in a global village.

KNAPP, an International Company that focuses on the business of competency-based certification, indicated that ignorance towards competency-based assessment could have detrimental implications such as loss of public confidence and additional regulation in professions. The British Council and the United Kingdom Trade and Investment (UKTI) profoundly express their commitment to TVET stating that it is the key to developing a skilled and motivated workforce needed to maintain workplace standards, boost commercial success and promote social cohesion (British Council and UKTI, 2012). Furthermore, it is crucial to elevate the quality and relevance of TVET in eradicating the perception of a second-class schooling as well as misalignment between education and the workforce (Mar, 2011).

The need for Research in the assessment and development of occupational competence in TVET is endorsed by the proposed indicators for assessing TVET, as outlined by the inter-agency group comprising of United Nations Education, Scientific and Cultural Organisation (UNESCO), the World Bank (WB), the International Labour Organisation (ILO), the European Commission (EC), the European Training Foundation (ETF) and the Asian Development Bank (ADB). "This joint work comes at a significant time of challenge and opportunity for TVET" (Inter-Agency Working Group on TVET Indicators, 2012, p. 3).

Urgency for investigation in competence assessment and development is substantiated by the revised TVET strategy of Palestine, supported by GIZ (German Technical Cooperation) who argues strongly for TVET to respond to the competence needs of the labour market and its fundamental role to create a competent, motivated and adaptable workforce capable of driving economic growth and development (Palestinian National Authority; Ministry of Education and Higher Education; Ministry of Labour, 2010, p. 5). Evidence for the enormous development guided by empirical research required to transform TVET is further verified by the

recommendations of the third International Conference on TVET in China namely: Enhancing relevance of TVET; Expanding access and improving quality and equality; Adapting qualifications and developing pathways; Improving the evidence base; Strengthening governance and expanding partnerships; Increasing investment in TVET and diversifying financing and Advocating for TVET (UNESCO, 2012, pp. 2-5).

Leung points to the critique against a competence approach as "firstly, functional analysis of occupational roles is problematic; secondly, the assessment of competencies is by no means value free and thirdly, the competency approach is based primarily on the behaviourist framework, which attempts to break down roles into small discrete tasks" (Leung, 2002, pp. 1-5). The critics, however, need to take into consideration the cost-benefit factor. The financial investment in the current TVET sector in South Africa - R1.988 billion in 2013 for student bursaries is not reflected in the results as previously stated (Skillsportal; Payle, 2013). Competence measurement on COMET diagnostic model allocate specific, measurable criteria to levels of competence, which is fundamental in assessing real performance on occupational tasks. "Complex open-ended test assignments, serve to measure occupational competence and, in the case of longitudinal studies, the development of occupational competence in realistic conditions" (Heinemann & Rauner, 2011, pp. 221-224; Maag Merki, 2008, pp. 517-522).

Moreover, the Department of Higher Education (DHET) was formed in May 2009 to incorporate all post-school education and training institutions. It includes all higher education institutions, colleges, adult education institutions and the skills levy institutions. In 2013, FET Colleges were still not completely arranged in this structure. The DHET Green Paper for post-school education and training alludes to the envisaged Institute for Vocational and Continuing Education and Training (SAIVCET) to address the need for institutional support in the FET (TVET) sector. One of the proposed activities is to "undertake and promote cutting edge research for the progressive development of vocational and continuing education as a whole". The conceptualisation of a competence diagnostics assessment model will be a fundamental tool in the establishment of FET (TVET) competence indicators responsive to real-world socio-economic challenges. An effective Technical and Vocational Education and Training system within a country is a critical pillar of any successful economy. It can serve as the impetus to boost the value of the nation and its GDP in the global marketplace (MacDonald, Nink, & Duggan, 2010, p. 2).

Cabinet approved the DHET White Paper for Post-School Education and Training on 20 November 2013. This policy document has as its main objectives: Education and Social justice; A single coordinated Post School education and training system; The expansion of access and the improvement of quality and increased diversity; a stronger relationship and cooperation between education and training institutions and the workplace; Responsiveness towards the needs of individual citizens and employers in both public and private sectors. TVET Colleges are officially incorporated in this White Paper (DHET, 2013, pp. 4-10).

The competence profiles of staff are an important factor for effective and efficient education and training to develop holistic occupational competence as stressed by the DHET. "While expanding…stepping up the training of College managers and academic staff are particularly important" (DHET, Green Paper for Post-School Education and Training, p. xi; DHET, 2013, p. xii).

This study presents a new perspective of assessment in the FET /TVET sector; it reviews trends of the traditional assessment and proposes strategies to foster the implementation of a competence model as a tangible tool to anchor occupational competence assessment and development in national policy and strategy documents. It will increase measurable and directional information to ascertain the relationship between competences certified in final examinations and verified competences measured holistically.

The timing of this research is ideal: The policy on professional qualifications for lecturers in TVET announced in 2013 requires input on training programmes; The Institute for Vocational and Continuing Education and Training (SAIVCET) announced in the Green Paper for post-school education and training, will gain from research of this nature; New Growth Plan (NGP), Industrial Action Plan 2, Human Resource Development strategy for South Africa 2010-2030 and South Africa's Ten-year Innovation Plan amongst others will benefit from a competence model to assess and develop occupational competence and commitment in TVET students.

1.4 EXISTING KNOWLEDGE REGARDING THE RESEARCH QUESTION.

The McKinsey survey, August-September 2012, conducted in Saudi Arabia, Brazil, India, Germany, Turkey, Morocco, United States and United Kingdom revealed that only 50% of Youth believed that their post-secondary studies improved their employment opportunities. In

the same study, 39% of employers sited skills shortages as a leading reason for entry-level vacancies and 36% pointed out the significant problems in terms of cost, quality and time caused by the lack of skills (Mourshed et al., 2013). These research findings affirm the importance of competence diagnostic assessment to inform the development of occupational competence.

The McKinsey survey (2012) stresses that employers, education providers and youth need to work integrated to ensure a more collective perception of graduate readiness for work. In the study stakeholders' perception showed significant discrepancies – Employer rated work readiness at 42%, Education provider, 72% and Youth, 45% (Mourshed et al., 2013, p. 19). These findings support the importance for research of the impact of a dual-education and training system on comprehensive competence development. The importance of examining implicit and explicit knowledge as a key driver in assessing occupational competence and development is endorsed by this finding.

The COMET pilot TVET research conducted in South Africa in 2011, revealed content fragmentation as a central disadvantage in the development of relational understanding of complex work tasks. "The need for integration and connection between these silos of specialised knowledge becomes very apparent, when we try to apply knowledge to solve human problems. It is then, that we realise, that although we have reached an advanced level of specialisation in a particular field of knowledge, it is the ability to holistically combine and apply all the relevant fields of knowledge that really results in effective solutions" (Stuart , 2010/2011, p. 237). Schoen made the assumption that competent practitioners know more than they can express and exhibit a *knowing-in-practice* that is predominantly tacit of nature. The major quest here is to determine the correlation between professional knowing and academic applied knowledge. A critical statement is that professional practice involves finding and not merely solving the problem. Problem setting is therefore an inherent professional activity. The applied knowledge paradigm poses a risk for complexity, instability and uncertainty in problem setting and problem solving. The reality of the real world where problems do not present themselves to practitioners but must be constructed from complex and challenging material of problematic situations requires a certain kind of operation where a conflict of ends cannot be resolved by applying techniques of applied research. The shift from the Technical Rationality model, advocating the application of scientific theory and technique in problem solving that result in a hierarchy where general principles are pitched at the highest level and concrete

problem solving at the lowest to Reflection-in-Action is proposed.

Fundamental to Reflection-in-Action which is the core of the *art* in dealing well with situations of uncertainty, instability, uniqueness, value-conflict and unpredictable ends is reflection on *knowing-in-action.* Reflection should focus interactively on the outcomes of the action, the action itself and the intuitive knowing in the action (Schoen,1983, pp. 21-69). Knowledge production and knowledge management however remains inevitable for the development of occupational competence. Knowledge should however be value related with good use-value for the betterment of individuals and communities at a local, national and global level, as opposed to value free, theoretical knowledge. This is an area for development in South Africa given that in 2012 only 34% of South African academics had a PhD qualification (Cloete, 2014, pp. 1355-1368). Thinking and meta-cognition constitutes the basis for reflective practices that are essential for innovation and development. The risk of an applied science philosophy as indicated in the OBE curriculum is that students may not be suitably equipped to reflect and know in action when confronted with complex, peculiar and innovative problems beyond the curriculum content.

This problematic statement resulted in the research question relating to the impact of holistic competence based assessment in TVET as a potential strategy to address the identified challenges of the South African TVET practice. Research studies of assessment practices in dual Vocational Education in countries with developed dual systems will serve as a reference for this study.

1.5 INTRODUCTION TO RESEARCH QUESTIONS

The challenges identified in investigating occupational competence in TVET resulted in the founding of the main question:

1.5.1 FOCAL RESEARCH QUESTION:

Would the implementation of the COMET competence diagnostic model in TVET effect higher quality assessment for the development of occupational competence and commitment?

The main research question and the three sub-questions formulated in order to generate data to answer the main question will be interrogated in Chapter Three.

1.6 OVERVIEW OF METHOD OF INVESTIGATION

The research project aims to advance TVET sector understanding and capacity in applying the COMET model for the examination of occupational competence and occupational commitment, by addressing the question: Would the implementation of the COMET competence diagnostic model in the TVET system, effect higher quality assessment for the development of occupational competence and commitment? Johansson stated that research is about creating new knowledge and the raw material is evidence (Johansson, 2004, p. 2). A brief overview of the research methods and methodology is provided below in anticipation of the comprehensive description thereof presented in Chapter Four.

A quantitative approach of data gathering and analysis, including the analysis of existing forms of learning and measuring of competence in comparison to COMET competence diagnostic criteria will be conducted. This research study focuses on the 2014 large-scale occupational competence assessment.

A psychometric model will be applied for the analysis of results. The measurement of competencies should be based on a solid theoretical and psychometric basis. This is crucial in terms of inferring quantity and quality (Koeppen, Hartig, Klieme & Leutner, 2008, pp. 61-73).

Observation, COMET psychometric model and student interviews will be used in the work-based scenario to assess occupational competence and commitment in a practical set-up.

Qualitative research will be implemented to explore TVET students' understanding of the COMET model using the assessment-interviewing method. Qualitative research in the form of semi-structured focus group interviews will be applied to explore levels of occupational competence achieved as well as gaining a complex, detailed understanding of the issue (Creswell, 2013, p. 48).

A comprehensive discussion of the research design and methods is unpacked in Chapter Four.

The research will be conducted in six public TVET Colleges in South Africa, situated in the Western Cape, Eastern Cape, Gauteng and Kwa -Zulu Natal. Two private TVET Institutions and three Industrial companies form part of the research participants. The target groups are students in Electrical, Mechatronics, Millwright and Welding Courses. These respondents were included after being exposed to COMET philosophy and on the basis of the respective academic staff accepting the validity of the test tasks. A pre-test, comprising of an alternative set of test tasks, to expose students to the nature of the assessment were conducted. Test tasks were validated and adapted where necessary to ensure content validity.

The collection of data to analyse occupational competence and commitment will be done using the COMET large-scale occupational competence diagnostics model (Heinemann, Maurer & Rauner, 2010).

COMET test tasks and context questionnaires will enable the researcher to collect a significant amount of diverse data. Context Questionnaires encompass a Lecturer Feedback as well as a Student Social competence measurement scale. Qualitative interviews will be conducted to gain additional insight in student implicit knowledge and experiences regarding assessment in TVET. "Structured interviews can be used to assess a trait or a person's articulation of ability" (Lankshear & Knobel, 2004, p. 35).

The dimensions of COMET will be used to analyse and interpret competence and competence development. COMET psychometric model, Context questionnaires for students and lecturers will be empirically analysed (Rauner, Haasler, Heinemann & Grollman, 2009)**.** Statistical Package for the Social Science (SPSS) will be applied for the statistical analyses and graphic illustrations of data. The semi-structured interviews, which have been coded, were interpreted. The main themes, which arise, are discussed. Inter-rater reliability, where raters will come to an agreement regarding a rating on what has been observed was be applied. COMET tasks are open ended and therefore more challenging to score. Proper Rater training is therefore essential for the standardisation process.

1.7 DELIMITATIONS OF THE STUDY

This study focuses only on diagnostic assessment and development of occupational competence and commitment in TVET institutions that participated in the COMET project

2013-2015. A number of TVET Colleges were not open to participation and voluntary participation was seen as the best option for obtaining valid and reliable data. Industries included in the study are chosen because of their location of close proximity to the TVET Colleges as well as openness to participate. All nine provinces in South Africa (SA) could not be included due to logistics such as cost and time factors. Four provinces are represented.

1.8 SUMMARY

The foundation for analysing the potential of COMET to assess and develop occupational competence and commitment in TVET has been established in this chapter to present a different dimension of equipping TVET students with job related attributes than previously offered. For this reason, investigating the possibilities of applying the three-dimensional COMET occupational assessment model in conjunction with the Motivational and the Occupational Commitment Questionnaires in promoting occupational competence and commitment in TVET is essential. The research proposes that should COMET be applied and implemented meticulously, it holds the potential to develop holistic competence in TVET students, equipping them for the complex world of work as well as the comprehensive socio-economic and political expectations of TVET. Occupations have become a fundamental element of modern society and it impacts on nearly every aspect of our daily lives and holistic wellness. It is therefore critical to examine what occupations are but even more so, what is needed for effective and efficient occupational competence training. Chapter One provided a general overview of the study where the background, the purpose, problem statement, research questions and significance of the study were described. The purpose for the research was validated to an extent where the need for a detailed research study was justified. Chapter Two presents the literature review on the assessment fundamentals, inclusive of assessment challenges and quality assurance strategies, as well as the different policies and strategic guidelines impacting TVET. Chapter Three outlines the research questions. Chapter Four unpacks the methodology and methods used to collect and analyse data. Chapter Five gives a comprehensive analysis of the results of the research. Chapter Six presents the summary of findings, conclusion and recommendations for future research.

CHAPTER TWO

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 INTRODUCTION

This chapter outlines the theoretical investigation by cross-examining the capacity of the current TVET assessment system to respond in a tangible manner to National and International socio-economic and political imperatives captured in TVET policy principles. To achieve the desired outcomes for these global imperatives, a competent TVET student corps is vital. This research is of particular importance given the increase in youth unemployment in spite of numerous policies and strategies, from 32.7% in 2008 to 36.9% in 2015 as reported by Statistics South Africa's Youth Labour Market Survey 2008-2015. Furthermore, the gender unemployment for Males in 2008 was at 28.4% and in 2015 at 33.8% while Female unemployment rates pitched at 38% in 2008 and 40.75% in 2015. This predicament is ascribed to a structural weakness in the labour market due to a mismatch between skills and jobs. The Youth working age population amounts to 19.7 million, which is 55% of the total working age population (Statistics South Africa, 2015). It is evident that the current TVET delivery does not suffice in alleviating these challenges. A more effective and efficient workforce is needed to counteract the detrimental effect of the poor state of affairs in youth employment, social equity and livelihoods. An innovative thinking archetype to vigorously enhance occupational competence required for the 21st century workplace is researched in this study. The potential of the COMET diagnostic model to develop holistic problem solving competence in TVET, which extends beyond technical training to the development of professional competence needed to activate these global developmental priorities will be tested. Luthans stated that the major environmental context impacting organisational behavior, is globalisation and he identified the lack of competent human resources as a major concern (Luthans, 2011, p. 5).

The implications of globalisation on the world of work are immense and necessitate skilled worker competence extending beyond the mere application of knowledge and skills. Globalisation imposes increased pressure on local producers to be globally competitive and yet remain abreast of new technologies (Government Gazette Vol.599, No. 48796, 2015). Finding the balance between responding to socio-economic demands and innovation requires a vibrant, comprehensive TVET system. Employees are confronted with complex problems in a constant changing global occupational environment. This research is essential for quality assurance processes in TVET to respond coherently to the national and global imperatives entrusted on the sector.

While Chapter One focused on the Research Literature aiming to describe current knowledge to summarise evidence about the research questions, this chapter on the Theoretical Literature aims to critically asses the overall state of knowledge, thinking and theorising of the topic. The emphasis will therefore be on key sources, issues and debates on the topic, political stances, definitions, conceptualisation as well as epistemological and ontological grounds for the discipline (Punch, 2009, pp. 95-98).

The concept of assessment in this study is presented in a framework covering the basic assessment principles to ensure quality, the various types of assessment in TVET and the impact of assessment as a catalyst for equipping students adequately for the world of work. The role of TVET in addressing socio-economic challenges as mandated by Government policies, increasingly compels a paradigm shift towards assessment and development of occupational competence and commitment underpinned by reflective thinking. The rapid change in socio-economic sectors poses a major challenge for TVET delivery to remain relevant. Jobs and organisations are confronted with flatter organisational structures in a rapid changing and evolving work environment (Riggio, 2009, pp. 11-15). The first section of this chapter aims therefore to establish the aspects needed for effective and efficient assessment by means of a critical analysis of the challenges and potential to transform current assessment structures in TVET. The incorporation of altered insights regarding TVET delivery to include complex, flexible, holistic problem solving is a prerequisite for transforming TVET. Embedded in this framework is the need for the development of a public TVET College system responsive to sector, local, regional and national skills need and priorities (Department of Higher Education, RSA). The second part of the chapter offers firstly, an overview of literature related to assessment policy and the fundamental principles in TVET assessment. Secondly, it

examines the impact of National and International policy guidelines and thirdly, perceived opportunities and challenges for TVET to develop occupational competence are explored. After that, I will explain the dimensions of an occupational competence model and focus particularly on the framework thereof. Education and Training are the two most critical factors that can impact economic growth in a positive manner, create political stability and social success (Erasmus, Loedolff, Mda, & Nel, 2010).

2.2 ASSESSMENT CHALLENGES IN TVET

2.2.1 Defining Assessment

Assessment is defined as the process to identify, gather and interpret information against the required competencies in a qualification, part qualification or professional designation to judge the leaner's achievement. Assessment can be informal, formal or non-formal. Recognition of Prior Learning (RPL), credit accumulation and transfer must be included. Assessment must be integrated in the learning process (SAQA, 2013, p. 4). Assessment tools are required to gather and interpret the evidence of competence and the instrument refers to the activity or specific questions used while the procedure entails the instructions on how the assessment must be conducted, analysed and presented (Department of Education and Training Western Australia, 2008, p. 3). Two basic approaches are adopted for assessment namely Criterion referenced and Norm referenced. Criterion referencing occurs when performance is measured against a defined standard and Norm referencing assess a performance against that of other test takers doing the same assessment (Fretwell, Lewis, & Deij, 2001, p. 29). On the basis of these studies, it is recommended to develop a clear understanding of assessment concepts. For this particular research on the assessment and development of occupational competence and commitment, Norm referencing may pose a serious risk for the performance and safety of the occupations being assessed. Criterion referenced assessment is more applicable, particularly because open-ended context specific test tasks will be implemented. The complicated nature and high level of competence required to ensure that assessment, which is inevitable for effective and efficient learning, is clearly illustrated by these statements.

The concept of Assessment is widely debated in literature and such information is necessary but not efficient for informing successful development of occupational competence in TVET. It is found to be stagnant and not adequately reflective in terms of the complex socio-economic,

political and innovative imperatives needed for equipping students to develop multifaceted problem solving competence. The methodology of large-scale competence diagnostics based on a pedagogically sound and psychometrically tested competence model, enhance the possibility to explore the correlation between the practice of vocational education, inclusive of examinations and the development of professional competence (Rauner et al., 2013, p. 111). This large-scale diagnostic assessment method is tested within four TVET occupations and forms the foundation for this research study.

This research introduces TVET to a new range of concepts and vocabulary within the context of assessing and developing occupational competence in TVET. The eight COMET criteria discussed in Table 1, activated within the three didactic oriented dimensions as illustrated in Figure 8, promise to enrich TVET vocabulary at an implicit and explicit level. In essence, this study offers a new TVET language needed for modern work.

2.2.2 Concepts in TVET assessment

Assessment in TVET is often intertwined with concepts such as skills, competence, competency, qualification, knowledge and outcomes-based education (OBE) and therefore requires any assessor to have an in depth understanding of these constructs. Meyer and Orpen emphasise the importance of competence in Outcomes-Based Education and Training (OBET) as instrumental in an OBET approach. They define competence as the ability to perform according to performance standards. Knowledge, skills and values are identified as a prerequisite for the attainment of competence (Meyer & Orpen, 2012, p.13).

De Bruler refers to Jessup (1991) stating that according to the National Vocational Qualifications (NVQ), competence can be seen as a statement of what an individual has achieved. It involves competent performance underpinned by skills, knowledge and understanding to increase systematic and comprehensive assessment and the integration thereof within learning (De Bruler, 2001, p. 9) Learning is guided by a curriculum, a concept stemming from the Latin word *currere*, meaning to run. It must be reflective of nature to guarantee that conventional thinking and work patterns, as well as the correlated justifications are regularly scrutinized and continuously improved to deal with emerging difficulties (Lasonen, 2010, p. 157).

Skills development is the learning process leading to occupational competence. Occupational competence requires application in context, with reference to work experience in a real-life, real-time working environment (De Jager & Vorwerk, 2006). Competence is furthermore ascribed to an internal view focusing on skills, knowledge and other factors enabling individuals to act competently and an external approach claiming to be more holistic of nature, utilizing these attributes to achieve the desired results (Lester, 2014, pp. 276-286).

Literature frequently uses the term, competency. The question arises around the existence of a substantive difference between the concepts of competence and competency. Aguinis (2009) describes competencies as measurable clusters of knowledge, skills and abilities that are critical in determining how results will be achieved. Assessment is integrated in this approach. Customer service, written and oral communication, creativity and dependability are identified as possible competencies. Measurable indicators are formulated to provide information towards determining competencies (Aguinis, 2009, pp. 100-101). Competences focus on organisation or job requirements and competencies on personal attributes and the related behaviour (Williams, 2002, pp. 154-159). Competencies describe behavior influenced by underlying individual characteristics, which can be job specific, or of a general nature (Heneman & Judge, 2009, pp. 174-175), while competence is indicative of the level of performance (JBS International, Inc., Aguirre Division, 2012). Competence relates to an overall job well executed, measured against minimum standards and demonstrated by performance and outputs (Sultana, 2009, p.19).

Competencies are context specific and have to be acquired by learning and experience in relevant, domain- specific situations. In the construction of competence models, it is therefore important to consider and empirically examine the connections between specific competencies and basic cognitive abilities (Koeppen, Hartig, Klieme & Leutner, 2008, pp. 61-73). The fact that the TVET College student completed the General Education and Training phase often lead to the assumption that the basic cognitive abilities are sufficient for the demands such as acquiring occupational competence in a specific domain. The authors argue that competence needs to be based on theoretically sound and empirically tested psychometric competence models that allows for interpretation based on a theoretical model of competences. The outcomes of the measured competences must serve the purpose of informing individual and collective education related decisions and policy.

Based on this review these two concepts need to be debated much more and the question arises whether it is merely a matter of semantics or is there a concrete difference between the two.

Competence is the ability to perform according to performance standards and should be attained by acquiring knowledge (What you need to know), Skills (Practical performance) and Values (What you need to believe and live). In defense of Skills being compromised to serve knowledge in the traditional education system in South Africa, the term *Applied competence* was initiated. Three distinctive elements are identified being: Practical competence (What should be done and why), Foundational competence (How should the job be done) and Reflexive competence (What was learned) (Meyer & Orpen, 2012, pp. 13-15). It is however clear that there is a shift from the reductionist and behaviourist concept of competency to a growing acceptance of a multi-dimensional, analytic concept in the form of measurable, holistic competence (Kodiappan, 2011). Moreover, occupational competence should be distinguished from intelligence and equally so, qualifications. It can be defined as professional competence to act in a domain specific cognitive disposition. Qualifications are based on the requirements for executing a professional task (Rauner et al., 2013, p.7). A qualification implies that a learner has successfully completed a coherent and purposeful programme of learning, has been assessed at exit level outcomes as qualified at a particular level on the NQF resulting in certification by the relevant quality assurance body (Government Gazette, 2013). Rauner et al. refer to the criteria for the conceptual distinction between qualification and competence as illustrated in Table 2 below:

Tab. 2: Comparison of conceptual qualities of qualification and competence

Criteria	Qualification	Competence
Object-subject relation	Objectively defined by the work tasks, processes and the related demands.	Domain-specific abilities and strategies in cognitive performance dispositions accompanied with open applicability.
Learning	The human being is a holder of qualifications, a (human) resource trained to perform specific activities.	Personal development inclusive of skills defined by educational objectives.
Objectification (Objectification)	Skills and abilities not yet objectivised or mechanised described and define the human being as a holder of qualifications derived from work processes.	The focus is on skills that are complex or impossible to objectivise. It is futuristic of nature and extends beyond current professional tasks to the mastering of future tasks.

(Rauner et al., 2013, p. 7)

These assessment constructs need to be tested for its relevance for scientific diagnostic assessment, and the role thereof in preparing students for meaningful employment and a

positive orientation towards TVET related occupations. Many reviewers as indicated above have explored and defined assessment concepts predominantly based on theoretical curriculum considerations. This investigation aims to actually measure occupational competence and offer a new perspective on assessment in TVET.

2.2.3 Vocational Identity and Occupational Commitment as key constructs in the assessment of occupational competence.

The conceptual framework needs to critically differentiate between the perceptions of organisational and occupational commitment. Every organisation, irrespective of size, has a "personality" reflected in its rituals, language, traditions, symbols and unwritten rules. Job satisfaction referring to the quality of working life appears to be influenced by productivity, meaning that employees are capable of achieving goals and overcoming work-related challenges while they experience higher job satisfaction (Weiten, 2007, pp. A23-A25). Occupational competence therefore becomes essential for productivity, problem solving capacity and the overall organisational climate. It is of particular importance for managing change in a world comprising of complex, interrelated systems. The Meyer and Allen model of Organisational Commitment, is extensively applied in workplace commitment studies with the focus on three dimensions namely; Affective commitment resulting from positive work experiences, Normative commitment established by perceived obligations to the organisation and Continuance commitment based on perceived economic and social costs of leaving the organisation (Jaros, 2007). The inherent motivational aspect of occupational commitment is a dimension of the analysis and organisation of the vocational learning processes (Rauner et al. , 2013, pp 65-70). Cohen (2007) refers to the local versus cosmopolitan continuum of Gouldner (1957, 1958), identifying three variables positioning a person on the continuum as:

- Commitment to professional skills and values;
- Organisational loyalty and
- Reference group orientation.

Locals primarily identify with and are committed and loyal to institutions. They use internal groups as their reference and portray a typical weak identification with their profession. Cosmopolitans are committed to their profession and professional qualifications and use external groups as a reference (Cohen, 2007, p. 8). The interconnectedness of Occupational

commitment and Organisational commitment is clearly illustrated here. The development of Vocational Identity (VI) requires adequate self-knowledge, career decision-making skills and understanding of the world of work. Congruence between knowledge of personality, environment and awareness of the world of work support the establishment of VI (Khasawneh, Khasawneh, Hailat, & Jawarneh, 2007, pp. 27-42). Smitina explored the relation between risk for student drop out and VI. Drop out, a familiar concept in TVET Colleges, refers to students who quit without graduating from a first qualification. She noted that students who drop out from studies probably lack a clear perception of their skills, talents, interest and goals. This result is a high-risk student and a corresponding significant lower VI (Smitina, 2009, pp. 1-10). This can be an indication of insufficient or ineffective career guidance. The impact of career guidance to students by suitably qualified and competent staff, registered at a professional body, cannot be over emphasized as a critical indicator of student success.

The impact of vocational identity and the effect of the socio-political environment is clearly illustrated in the Artisan training domain in South Africa. A huge decline in Artisan training and numbers is observed since the mid-80's as a result of the negative connotations attached to skills related occupations, as well as a serious collapse in the economy in the 1980's resulting from the Apartheids era dynamics in South Africa. The new democratic government elected in 1994, implemented urgent legislation, programmes and strategies to revive the system. A poor understanding of underlying issues with regard to quality and success in artisanal training however, remains a concern (LMIP Report 2, 2014). The G20 Labor and Employment Ministers accentuated apprenticeship programmes in 2012. Subsequently the ILO and World Bank initiated an investigation in international experience of apprenticeships in a search for identifying best practice. These studies confirmed that good quality and increased accessibility to apprenticeships could reduce youth unemployment (Smith & Kemmis, 2013). Valuable information that TVET can draw from is provided but no specific focus and method on the assessment and development of occupational competence beyond technical skills is noticed. This gap can seriously compromise workplace readiness for the 21st century, conceptual age qualities needed.

It is of practical significance for TVET to actually measure Vocational Identity and Occupational Commitment levels in the new democratic South Africa, to inform processes such as career guidance and the creation of career paths.

2.2.4 The role of Assessment in occupational competence in relation to the 21st century demands.

The 21st century workplace requires workers that can deliver beyond mere functionality. Pink refers to the demands of the Conceptual Age workplace in terms of six high-concepts impacting the mind: 1. Not just function but Design – referring to creativity and being emotionally engaged; 2. Not just argument but Story – referring to attributes of persuasion, self-understanding, communication; 3. Not just focus /specialisation but Symphony – to be able to see the big picture and pursue holistic solutions; 4. Not just logic but Empathy – to embrace social wellness and foster healthy relationships; 5. Not just seriousness but Play – to value humor and fun in improving overall wellness; 6. Not just accumulation but Meaning – to experience significance, transcendence and spiritual fulfillment (Pink, 2005, pp. 65-67). The COMET dimensions speak to these attributes needed to survive the transition from the Information Age to the Conceptual Age workplace. These high concepts identified for the conceptual age are indispensable for companies and business to maintain relevancy and viability in the 21st century environment characterised by global competitiveness, abundance and an overload of knowledge.

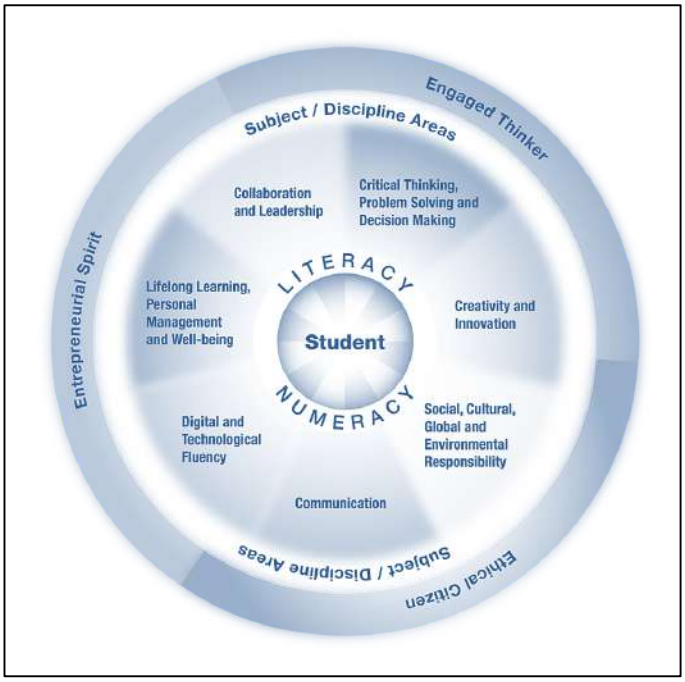
Voogt and Roblin identified eight frameworks describing competences needed for the 21st century. A common set of competences incorporates collaboration, communication, ICT literacy, social and/or cultural competences. These frameworks indicated that there is a large extent of alignment regarding what 21st century competences are and their relevance but intentions and practice differed. Assessment of these competences is identified as a challenge, specifically where opportunities must be provided for students to apply and transfer their understandings to real world situations, to solve problems, to think critically and to work in a collaborative way (Voogt & Roblin, 2012, pp. 299-321).

Wyman summarises the job-man fitness predicament in a statement: *People without Jobs and Jobs without People.* He attributes this phenomenon to a lack of skills that he refers to as *soft skills*. He continues by stating that people remain unemployed because they do not have the skills needed by companies (Wyman, 2015, p. 20). This is of particular significance for creating a new thinking paradigm to initiate the development of holistic professional competence as proposed by this study.

2.2.5 Curriculum learning and assessment

Learning and assessment are inseparable processes for the development of occupational competence. The Government of Alberta in Canada projects the crucial elements for student learning in the development of engaged thinkers and ethical citizens with an entrepreneurial spirit in Figure 1 (Alberta Education, 2011, pp. 1-2). These attributes are essential for preparing students for the complex world of work and responsible citizenship. The challenge in such ideologies lies in translating these elements into measurable variables within a scientific model.

Figure 1: Crucial elements for student learning



(Alberta Education, 2011, p. 2)

In South Africa, psychometric tests are often applied to assess readiness for an occupation. This is often controversial in terms of cultural differences, politics and test bias. A number of legislative acts govern the use of psychological tests in South Africa (Claassen, 1997, pp. 297-307). COMET competence model can serve as a possible solution to this dilemma given the universal nature of the competence criteria. Psychological tests are norm oriented and cannot measure competence for the reality of work.

The continuous changes in the Education Curriculum since 1994, the world shrunken by modern technology and the commotion in the world of work pose distinctive challenges for the design and development of relevant assessment models for TVET. Conservatism and

resistance to change amongst educators and their unions is often quoted as a barrier to the implementation of innovative policy measures, hindering the complete development of a dynamic and change oriented prospect for the teaching profession. This result in maintaining the traditional, known methods and techniques and in the process, discarding innovative ideas that could serve a futuristic education. The Centre for Educational Research and Innovation (CERI) however indicated that countries with limited innovative structures, characterised by the *catch-up- effect*, shows the highest innovation oriented change contrary to countries with already high levels of innovation in education. Change in itself seems not to be the culprit but how the process of change is managed. Educator satisfaction, capacity building and autonomy are key drivers to ultimately improve teaching and learning (Ntia, 2014). Outcomes Based Education and Training (OBET), focusing on evidence produced, require valid and reliable measurement. The dilemma for Education in South Africa is that the process is often fragmented in terms of the actual processes of teaching, learning and assessment. Assessment should be seamlessly integrated in the fiber of teaching and learning. The opportunity for evidence-based change in assessment practices, particularly assessment of occupational competence and commitment is immense given the limited innovative structures and measurement tools in TVET.

TVET College assessment, accreditation and quality assurance policies are debatable. QCTO regulates Occupations and the National Accredited Technical Education Diploma (NATED)/ Programme 191 Part 2(N3-N4) while the COUNCIL FOR QUALITY ASSURANCE IN GENERAL AND FURTHER EDUCATION AND TRAINING – UMALUSI, the NCV and NATED/Programme 191 Part 1(N1-N3) qualifications (QCTO, 2015). In our search for a model to promote occupational competence in TVET, the correlation between the perception of occupational and theoretical instruction will be re-looked. Quality assurance in Assessment is confronted with key challenges on how to ensure being on target and strategic and yet not to suppress initiative, responsiveness and ability of providers in the provision of education (DHET, 2013, pp. 16-17). To obtain this balance a holistic problem solving approach is required, where functionality remains crucial but ultimately, the development of occupational competence required in generating comprehensive solutions to solve complex problems.

2.2.6 Validity and Reliability as quality assuring agents in Assessment.

Accountability and the trustworthiness of the assessment process is critical for the development of competence and risk factors should be acknowledged and minimized as far as possible. The processes of moderation and validation form an inherent part of quality control in Assessment. Halliday-Wynes and Misko refers to Maxwell (2001), defining Moderation as the monitoring and approval of assessment procedures and judgments to ensure consistency in the interpretation and application of performance standards. Validation is a quality review process, ensuring that the assessment tools meet the requirements to produce valid, reliable, sufficient, current and authentic evidence to enable reasonable judgment (Halliday-Wynes & NCVER, 2013, pp. 15-26). The high-risk disposition of assessments necessitates assessment providers to be accountable and responsible for developing and revising examinations, scoring, interpreting and reporting results, striving for and enhancing fairness and providing feedback to test takers regarding the test process and what their scores mean. This gathered evidence for validity to support the interpretation of test scores and its relevance to the proposed use thereof, can be described as validation. In the gathering of validity evidence as a defining component of quality assessments, critical validation questions should be posed:

- Do the test tasks elicit performances/actions that reflect the intended constructs?
- Are the scores/grades/ratings dependable measures of the intended constructs?
- Do the test tasks adequately sample the constructs that are set out as important in the syllabus/curriculum?
- Are the constructs sampled, representations of competence in the wider subject domain?
- Are guidance and feedback procedures in place to inform stakeholders what the scores mean and how the outcomes should be used? (Shaw, Crisp, & Johnson, 2012, pp. 159-176).

COMET occupational diagnostic model has a built-in mechanism to ensure test task validity and in conjunction with the inter-rater reliability component, it is a model to be explored for the purpose of quality assuring occupational competence assessments.

The public interest in the reliability of educational assessment (Gardner, 2013, pp. 72-92) and the complex nature of understanding error in assessment that can range from systemic factors to personal circumstances is often a challenge in assessment. Large-scale National and

International tests such as International PISA, Trends in International Mathematics and Science Study (TIMSS) and Annual National Assessments (ANA's) has drawn significant public interest, specifically because of the media coverage and government response to the outcomes.

It is therefore imperative to apply effective and efficient Quality Assurance practices (QA) in TVET. QA is the process of monitoring and assessment in line with stipulated requirements and benchmarks to assist institutions in gaining confidence in its quality processes and at the same time, increase public trust. This allows for the identification of strengths and weaknesses as well as opportunities for improvement within institutions. This QA process should establish the quality standards (components), indicators (criteria), conducting the assessment and applying the results (outcomes) in a reflective manner. TVET can improve QA by applying the Plan, Do, Check, Act (PDCA) cycle in conjunction with Total Quality Management (TQM) (Ministry of Education Lao PDR, 2011, p. 4). Reforms in assessment gain impetus for change deriving from the analysis of performance on National and International surveys and the critical realisation that provision of quality education is dependent on accurate student assessment and vigorous monitoring of systems (Murchan, Shiel, & Mickovska, 2012, pp. 487-502). As for the assessment of occupational competence in TVET, the lack of accurate student assessment and monitoring as an opportunity to improve the quality of teaching and learning is an area for development. Urgent reform is needed to foster improved prospects for students to survive socio-economic global competitiveness. Quality Assurance and development is of particular importance for the effective and efficient use of limited financial means in education efforts and must be prioritised and set as a main goal (Van Buer & Samier, 2009, pp. 819-825). Isaacson boldly illustrate the concept of quality assurance and innovation in the bibliography of Steve Jobs, describing him as the greatest business executive of our era, a genius whose imaginative leaps were instinctive, unexpected and at times magical. Jobs stated that his passion has been to create a great company where people were motivated to build great, quality products supported by a deep current of humanity in their innovation (Isaacson, 2011, pp. 560-571).

Quality assurance, quality improvement and the strengthening of quality standards are a major challenge for education under the ever-changing socio-economic conditions. Benchmarking as a continuous systemic monitoring of the quality of products, services, internal processes and methods of the organisation in comparison to other organisations is essential for the effective and efficient functioning of organisations. It allows for the collection and analysis of data, target setting and the identification of best practice (Seeber, 2009, pp. 851-857). The

assessment of domain specific professional competence unlocks a new dimension for quality assurance in TVET.

A diagnostic model where quality assurance in terms of student occupational competence can be empirically measured across pertinent criteria and equally so, mechanisms to improve quality in empowering all stakeholders accordingly, is lacking in the TVET curriculum design. This identified gap has the potential to result in poor standards and subjective responses to quality assurance and management practices in TVET. It should therefore be addressed by means of evidence-based scientific research.

2.2.7 Managing Diversity in Assessment.

Assessment in countries such as South Africa is often challenged by diversity realities for example, language (Official languages being Sepedi, Sesotho, Setswana, siSwati, Tshivenda, Xitsonga, Afrikaans, English, isiNdebele, isiXhosa and isiZulu) and socio-economic disparities. The Bill of Rights, section 29 in the Constitution of South Africa referring to language of instruction stating that every learner has the right to receive education in the official language or languages of their choice in public education institutions where reasonably practical (Botha, Kiley, Truman & Tshilongamulenzhe, 2013, pp. 3-17), is illustrative of this complex situation. Numerous additional insight is needed such as understanding the process of attribution and the corresponding possible errors for example self-serving bias where favourable outcomes are attributed to internal factors and failures to external factors and self-fulfilling prophecy where people's performances are influenced by the perceptions of others (McShane & Von Gilnow, 2009, pp. 50-54). This is of particular relevance in TVET Colleges being attributed as second-class education and training institutions. The attribution theory attempts to analyse the thinking process used by people to account for the reason why an event occurred (Chodkiewicz & Boyle, 2014, pp. 78-87). Attribution retraining and its impact on learning, emotions, thinking and conduct must be seen as a key factor in student success. The challenge for assessment for learning and development is to focus on the whole person.

Diversity in terms of ability poses a further challenge for assessment. Inclusive education as outlined in SA Education White Paper 6 on Special Needs Education, allows for alternative assessment strategies for example, scribing, amanuensis and the use of assistive devices (DoE, 2001).

Implicit and explicit knowledge and learning must also be taken into account during assessment. Implicit knowledge refers to knowledge people use daily in an automated manner but cannot describe how it was obtained while explicit knowledge requires conscious and deliberate thought and effort involving memorising, problem solving and comprehension, as offered in Educational institutions or settings (Botha et al., 2013, pp. 3-17).

An applied curriculum assessment arrangement limits the potential to effectively assess the nature and extent of diversity components as a result of situated performance within a specific response territory. The open-ended test tasks implemented in this research allowing for diverse responses within a broad solution space, accompanied by the possibility to perform at different levels of complexity, offers a new way of assessment to be explored for a more in depth analysis of diversity dynamics in TVET.

2.2.8 The impact of Workplace-based learning on the assessment and development of occupational competence.

Incorporating an Apprenticeship in TVET college programmes as part of a dual system is being investigated in this study. An apprenticeship refers to a programme aiming at equipping participants with domain specific occupational competence and hands-on skills (Wyman, 2015, pp. 113-114).

The White Paper for Post-School Education and Training emphasises a combination of theoretical knowledge and practical experience in TVET. Workplace training and work integrated learning (WIL) is stated as a central part of TVET and is endorsed by the National Skills Accord signed by all partners in the National Economic Department and Labour Council (NEDLAC) (DHET, 2013, pp. 16-17). Smith and Worsfold investigated the effects of a WIL curriculum design related to student learning on student satisfaction. A six-dimensional framework by Smith (2012) of the WIL experiences were implemented:

- Authenticity – real work, with real (authentic) meaning and real consequences;
- Alignment of Teaching and Learning activities with integrative outcomes;
- Alignment of assessment with integrative learning outcomes;
- Integrated learning support – for example health and safety, counseling services and access to resources such as libraries;

- Supervisor access – access to academic supervision during placement;
- Induction and preparation – action plans and resources for preparing students for work (Smith & Worsfold, 2014, pp. 1070-1084).

The study concluded that good curricula design, authentic workplace experiences as well as the provision of a supportive learning environment are imperative for a successful WIL curriculum experience, good learning outcomes and student satisfaction (Smith & Worsfold, 2014, pp. 1070-1084). Valuable direction on the implementation of WIL is provided but it fails to address the assessment and development of occupational competence as an integral part of WIL as a work readiness initiative. WIL as a dual apprenticeship TVET curriculum model offers a combination of workplace learning and classroom teaching and learning. Proposed objectives are:

- Facilitating transition from school to work for young people to promote employment opportunities.
- Stimulating competitiveness among companies.
- Expanding access to rewarding careers for a larger proportion of the population (inAP, 2012, p. 4).

In the dual system, workplace trainers often find themselves in a predicament of adhering to Company mandate as an employee and yet serve as the employer for the apprentices in its care, which can benefit or jeopardise assessment and development. The corporate culture and overall relationships will be the decisive factor (Bahl, 2013, pp. 157-160). Absolute commitment from TVET colleges, workplace trainers and social partners is needed and should be formalised in the coordination of labour market, economic and education policies (inAP, 2012, p. 4).

Learning outcomes inclusive of occupational competence and commitment and student perceived learning in TVET, are profoundly influenced by work process oriented learning context (WPLC) and involves instructor support, variety of work, work process orientation, challenge of work, complexity of work and autonomy of work (Zhou & Zhao, 2013, pp. 169-172). It is described as a pivotal factor in the design of vocational curricula and processes (Rauner, 2007). Work process learning stresses that modern work, referring to holistic and process-oriented work requires new qualifications and competence and even more so, *reflective action competence* to address the quality and authority of the actual ability to perform competently. This type of learning is known for process orientation, subject-relatedness, self-

direction, demand orientation, enhanced experiential learning and the combination of formal and informal learning. Learning at work is an integral part of competence development (Dehnbostel, 2008, pp. 444-452). The poor throughput rate of 56 % of artisan learners who successfully complete the trade test can amongst others be ascribed to challenges in work placements (Stuart, 2015, p.21).

The challenge for assessment in TVET is to re-think the current traditional instructional and assessment concepts towards WPLC assessment strategies and development. Developing occupational competence and commitment in TVET students can serve as efficacy towards finding meaning in their work.

The need for Workplace-based learning is widely acknowledged in literature. A measurement tool for the criteria needed to equip students for real work is essential to develop holistic problem solving competence needed for the 21st century workplace as discussed in 2.2.4 and managing diversity as outlined in 2.2.7.

2.2.9 Assessment of Educator occupational competence.

The assessment of Educator occupational competence and commitment poses a further challenge but even more so an opportunity for the development thereof. A study in China conducted anonymously on Educator/Trainer competence involved the administering of VET test tasks to measure vocational competence as cognitive dispositions in the shaping of vocational teaching. The results reflected learner profiles mirroring that of their Educators (Rauner, 2013 pp.181-184). Schoen argued that educational design, as a *reflective conversation with the situation* should be contemplative of nature and not merely rational problem solving. Educators should be reflective practitioners that can reflect on prior knowledge of similar situations and solutions, their thinking and actions in these situations and solutions as well as the current problem situation (Holmberg, 2014, pp. 293-310). This is pertinent, bearing in mind that the era of vocational training being concluded by an apprenticeship has been complicated by on-going societal and economic change where the need for lifelong learning and adaptability has become the norm for workers. To the contrary, less emphasis is placed on the effects thereof on educators in TVET (Harteis, 2009, p. 1351). The quality of education as the most important indicator for success necessitates a well-educated, capable and professional TVET teaching staff.

The *reflection-in-action* problem solving approach should be strengthened by sound scientific research studies. SAIVCET will be mandated to fulfill this role in ensuring a capable workforce inclusive of workplace experience required by lecturers (DHET, 2013, pp. 16-17). Quality assessment and feedback of occupational competence prospects in TVET can serve as a navigator for the development of effective and efficient intervention strategies.

James identified two major questions to be asked in dealing with assessments (James, 2008, pp. 20-35):

- To what extent do the assessments available to me, or which I create, reflect the kind of learning that I aim to promote?
- If assessments lack congruence with learning, how can I try to bring them into closer alignment?

These reflective questions are relevant for TVET and the question arises whether the current assessment scenario reflects the learning required to prepare students for the dynamic world of work.

Various studies in the assessment and development of occupational competence encompass vital dimensions:

- Disjuncture between labour market and the education and training system.
- TVET curricula to be current and relevant to industrial needs.
- The need to develop competences broader than your current occupation.
- Lifelong Learning.

The effectiveness of lecturers at TVET Colleges is a prominent factor in the transformation of TVET Colleges. Lecturers must be capacitated to deal with new challenges and flexibility on the timing, mode and location of services offered (Government Gazette Vol.599, No. 48796, 2015).

Literature in South Africa refers to lecturer qualifications but no study is detected to report scientifically and empirically on lecturer occupational competence. The Rater Training, which forms an integral part of this study, starts to address the assessment of occupational competence of TVET Staff.

2.2.10 Feedback as an essential element of Assessment and Development.

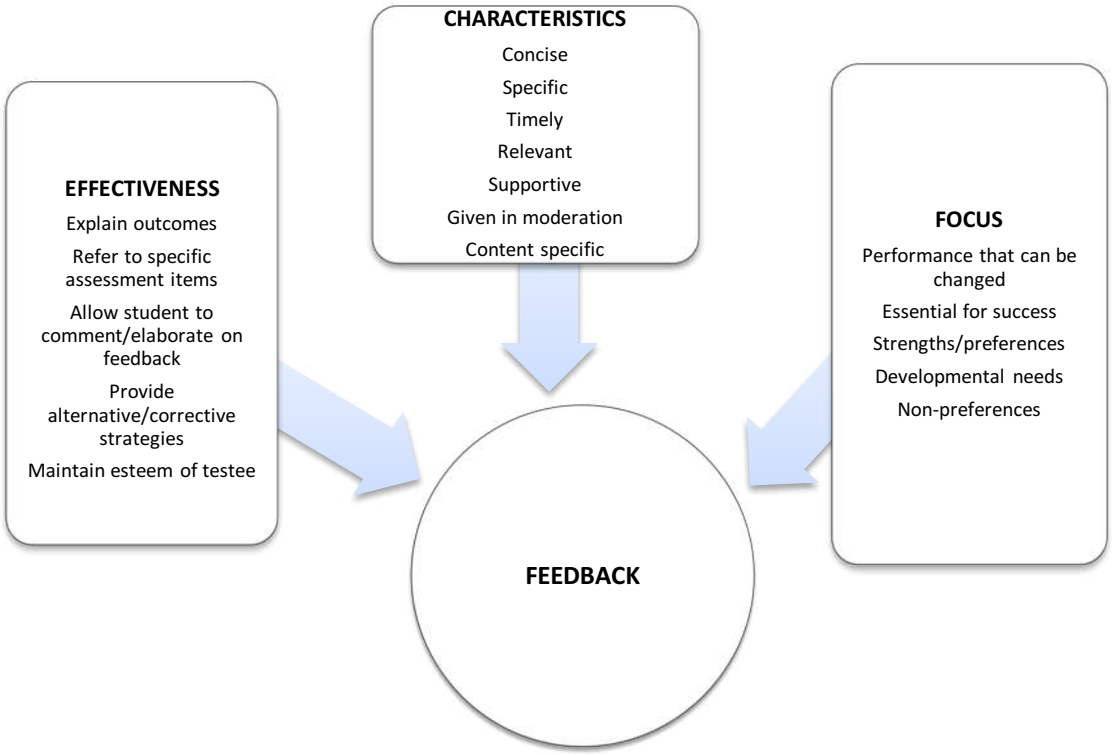
Assessment in TVET encompasses formative (continuous) and summative (end of learning programme) assessment according to course specific assessment unit standards. It is qualification driven and has limited transformative learning potential. The first priority of assessment should be to serve the purpose of advancing and facilitating student learning – *assessment for learning*. Assessment can positively inform learning when feedback by educators and by students engaged in self-assessment, assist in modifying teaching and learning activities accordingly. This feedback should focus on what needs to be done and not on ability as projected by *feedback by grades* (Black, Harrison, Lee, Marshall, & William, 2003, p. 2). Pedder and James argue that when teachers and students use assessment information for supporting improvements in learning, the educational purpose of assessment is achieved. They refer to the process as Assessment for Learning (AfL) where autonomous learning is seen as a fundamental principle (Pedder & James, 2012, pp. 33-48). Assessment for Learning moves the focus of assessment from being solely a method of grading to assessment as a learning process instead of end-point testing (Webb & Willis, 2010, p. 2).

Assessment processes involve planning and preparation, conducting assessments while focusing on:

- Foundational competence: knowing,
- Practical competence: doing, and
- Reflexive competence: understanding and feedback (NETWORX, n.d., p. 59).

Assessment for learning and development requires quality feedback. Feedback can serve as a compass for developmental actions following assessment and is an integral part of the assessment practice. Timing, relevance and specificity of feedback is crucial (McShane & Von Gilnow, 2009, pp. 50-54) and should be provided to all role-players (NETWORX, n.d., p. 97). Recognition or corrective strategies must be communicated soonest possible after the assessment. Williams (2002) suggests it should however also focus on criteria such as the effectiveness, characteristics and the focus of the feedback process (Williams, 2002, pp. 154-159). Figure 2 adapted from Williams outlines these criteria.

Figure 2: Feedback Criteria



These feedback criteria will be assessed as part of this research study, to determine its value for diagnostic feedback to an extent where the impact on TVET learning can be identified and elaborated on. Diagnostic findings are fundamental for further occupational competence development and curriculum planning responsive to pivotal strategies such as the NSDS III Goal 3: Promoting the growth of a public TVET College system that is responsive to sector, local, regional and national skills need and priorities (Botha et al., 2013, pp. 46-50; (DHET, NSDS III, 2011-2016, p. 15).

It is of particular relevance to examine a feedback model that exceeds the traditional feedback processes to provide the opportunity for comparative studies among, for example, holistic problem solving competence levels in occupations and tangible data to inform intervention processes and policy.

Harlen identified the purpose of summative assessment to ensure that what is assessed and how it is assessed have positive impact on learning. Feedback assists in regulating teaching and positioning it as a mechanism for the implementation of effective operational actions that will lead to new experiences that are pitched at the level of student functioning.

He further argued that feedback is most effective in promoting learning if it involves students in the process of deciding what the next steps should be. Feedback therefore allows students to play a role in the collection, interpretation and use of the evidence of their learning (Harlen, 2012, pp. 87-102).

Finding a healthy balance between positive feedback that is optimistic, encouraging and affirming and negative feedback, being critical and corrective of nature can be challenging. Feedback without any critical content can be unrealistic and untruthful and detrimental to student development, while oppressive, relentless and critical comments may discourage and de-motivate the student. (Webb & Willis, 2010, p. 6).

There is a global trend to reform TVET to a sector that is accountable and competence based. Transnational forces affect people globally and impact on national education policies (Akiba & LeTendre, 2009, p. 3). This is equally so for TVET. Effective feedback discussions with students that can provide focused and quality information to develop coherent policies to improve TVET delivery is a major focus in this investigation.

Chappuis highlights the fact that marks do not serve as effective feedback. He emphasises that acting on the feedback determines how much students learn contrary to the practice of merely giving the feedback. He further guards against providing students with more guidance than needed which will jeopardise in depth learning because students do not need to think (Chappuis, 2012, pp. 36-41). This is evident of the skills needed for effective and efficient feedback for the development of occupational competence. *Feed-forward* is a concept that strengthens the assessment for learning principle by building upon other learning opportunities and may be informed by experience gained from previous student cohorts (Webb & Willis, 2010, p. 3).

Feedback during active learning and doing can shape student occupational competence. Meta-cognition that leads to self-regulation and giving more feedback on students' social learning is critical for active learning but are often disregarded by educators resulting in the inability to construct active learning environments that genuinely demand the student's individual planning, elaboration and evaluation (Van den Berg, Ros & Beijaard, 2014, pp. 772-809). These two factors that can enhance reflective learning, knowing and doing which is required for innovation in a competitive world of work is a strong focus of this study.

Feedback is essential for successful learning and development. Feed up and Feed forward are equally important and often overlooked. Feed up refers to – *where am I going*, Feed forward – *where to next* and feedback – *how am I doing* (Chan, 2015, pp. 113-117).

Feedback is regarded as part of assessment in numerous literature studies. It is however predominantly narrow, curriculum based of nature. The alternatives to this feedback scenario should be looked into. This investigation on an occupational competence diagnostic model in TVET to shape all areas of meaningful systemic and individual feedback for an improved response to economic and social goals of modern work, is indispensable.

2.2.11 Contextual and systemic challenges for Assessment.

UMALUSI acknowledges the contextual issues that colleges and their staff must deal with on a daily basis. Concerns regarding a mismatch between NCV demands and the student profile require rethinking the compatibility between the purpose and scope of the qualification and recruitment in relation to the entry requirements for learners. It may well be that the poor results achieved to date are strongly influenced by these and other contextual issues that characterise the college sector. The implications thereof for the current learners seriously need to be addressed. If such learners are in the majority, another variable is added to any analysis of the assessment system or assessment results: are poor achievements the result of unfair assessments, an inappropriate assessment system, inadequate teaching, or a low-level baseline (UMALUSI). In 2014, six years later, TVET colleges are still battling with the very same challenges. Whilst focusing on student assessment for learning, the level of educator competence remains a controversial factor in the quality of student learning.

Currently no structured assessment model for occupational competence and commitment is implemented. Government Policies, shaping the TVET mandate extensively propels occupational competence, yet no concrete assessment model is applied. Diverse conceptualisation of assessment constructs such as occupation, competence, knowledge and skills complicate the assessment process. The QCTO, for example, describes an Occupation as a cluster or group of similar jobs that share many occupational tasks of similar complexity and require similar performance across different processes and industries (QCTO, 2011, pp. 3-4).

Though COMET measurement has been applied successfully in other countries, it is imperative for Test Tasks to be customised for TVET in South Africa. The large-scale competence measurement project done in China affirms that even though large–scale assessment should be applicable internationally, discrepancies in national VET system conducts, societal organisation of labour and conceptualisation of the role and nature of VET in occupations can be possible barriers (Heinemann, Maurer, & Rauner, 2010, pp. 139-142). This is a scientific process, which can be challenging, as it is not viable to merely replicate a model for a different contextual environment. It is however a stimulating process for the advancement of educator development and evolution. The risk of the possible derailing of comparability in occupational competence studies amongst international studies which is a primary function of COMET should be mitigated by means of sound quality assurance practices. Literature predominantly refers to competence models in terms of Human Resource development and appraisal and are implemented to identify knowledge, skills, personal and professional abilities needed to successfully perform critical work functions in industry or an occupation (Krcmarska, Cerny, & Vanek, 2013, pp. 60-70). Despite the valuable research contributions to the establishment of assessment criteria and models an occupational competence diagnostic measurement tool that is valid in terms of the test tasks and scope, underpinned by holistic problem solving in an occupation, is lacking.

2.3 THE ROLE OF COMPETENCE ASSESSMENT TO DEFINE AND QUALITY ASSURE THE POSITION OF TVET IN EDUCATION AND SOCIO-ECONOMIC DOMAINS.

"TVET is seen as an important public policy tool to support economic growth and poverty alleviation. It is instrumental in the transition from school to decent work and adulthood; increasing productivity of existing workers and steering the unemployed into work; assist in reconstruction after conflict and disasters and promote social inclusion" (UNESCO, Status of TVET in the SADC Region, 2013, p. 11). The urgency for a well-defined occupational competence assessment model to quality assure TVET is underscored by this statement of the Southern African Development Community (SADC) region and the United Nations Educational, Scientific and Cultural Organisation (UNESCO). This study indicated the following elements as critical in transforming TVET:

- A qualifications framework- such as the NQF in South Africa.

- Quality assurance – evidence based effectiveness to be demonstrated.
- Policy coherence concerns – TVET often resorts under different government ministries causing fragmented policy mandates. A national vision for TVET will enhance coherence.
- National governance reform – good national models to be developed.
- Employer involvement – must be valued as one of the most important stakeholders to ensure relevant learning in the workplace.
- Public provider governance reform – QA systems and performance indicators to ensure accountability.
- Quality assurance and qualifications frameworks must revisit the role of private sector providers in terms of its potential to contribute to TVET achieving its goals.

TVET colleges need to develop the mechanisms to translate into centres of excellence, responsive to socio-economic needs to strengthen economic and human capacity (Jacobs, 2015, pp. 161-166). One of the aims should be to critically assess current education processes and procedures. In this instance, the occupational competences needed to equip TVET students for the dynamic world of work, which requires holistic problem solving, and total quality management. Policy, such as the curriculum and assessment statements should relate to real workplace socio-economic practice. Research on TVET Colleges and particularly the role of occupational competence, in South Africa is limited. Numerous challenges regarding workplace readiness are acknowledged and discussed in everyday talks and even formal meetings but the empirical evidence needed to inform policy is lacking. A much stronger TVET research mandate and capacity are critical to explore the feasibility of alternative models such as COMET occupational competence diagnostic model to measure and equally so, serve as a catalyst for the attainment of occupational competence and commitment.

The vital role and potential of TVET to transform societies is emphasized in various literature and policy documents. Technical/Vocational Education as a fundamental element in development allows for individuals and societies to be responsive to local and global demands in terms of unlocking potential, expand horizons and adapt to changes in global dynamics (Anane, 2013, pp. 117-127). There is an increasing demand for adaptability to new demands, responsibilities and technologies in the workplace. The traditional approaches that narrowly focus on one mode of production are of limited value. TVET should aim to provide a sound foundation in particular skills while inculcating the skills of responding to new production

modes (Government Gazette No. 38796, Vol. 599, 2015). The didactic principle of transforming students throughout their course from a novice worker, working in an abstract manner according to rules to an expert worker, who respond to complex problems and change in a reflective, intuitive and practical manner is vital in bridging this gap in the current TVET system.

Koeppen et al. describe the outcomes of Education as being the knowledge acquired, the abilities, skills, attitudes and dispositions developed and the qualifications attained. They further refer to large-scale domain specific assessments such as TIMSS and PISA as a trigger for the increased deliberation on educational outcomes and the assessment thereof. They draw attention to the discrepancies identified between competencies attained and the goals of the education system (Koeppen, Hartig, Klieme & Leutner, 2008, pp. 61-73). This article emphasise the shift from a fixed set of specialised skills cherished for years to the development of competences that are applicable in various settings that might be novice or complex. Education and Training must foster a paradigm of assessment practices that will equip students with transferable competences. The strategic question to be asked is: Why do we assess?

The emphasis on TVET to transform Education for Sustainability Development (ESD) goals demonstrate the socio-economic expectation to develop the necessary skills, knowledge and attitudes for living in a complex, sustainable society which requires sustainable, complex solutions. TVET for ESD needs to be inclusive and accessible while adopting a holistic approach which promotes life-long learning, social collaboration, holistic problem solving, experiential, transformational and dialogue learning, a constructivist approach as well as a human centred development agenda such as its vital contribution towards achieving the MDG's (Gu, Gomes & Brizuela, 2011). Divergent, creative thinking that is fresh, innovative and inventive is an essential competence required in addressing these challenges. Divergent thinking allows for an expanded range of alternatives by generating numerous possible solutions that will enhance creativity as opposed to convergent thinking narrowing down the list of alternatives to arrive at one single correct answer as typically seen in a school practice (Weiten, 2007, pp. 366-367). Innovative thinking is an indispensable component of creativity. The Technology Top 100 (TT100) awards focusing on industry sectors of Automotive, ICT, Retail, Health, Financial Services, Mining and Agriculture as well as Energy see innovation as central to the prosperity of the continent, stating that without harnessing the power of innovation at the essence of modern society, it will be impossible to create healthy, educated or inclusive societies.

They urge for greater partnership and cooperation among government, private sector, civil society, academia and philanthropic organisations to inculcate a culture of innovation for sustainable development in Africa (TT100, 2014).

Ethics and social responsibility relating to ecological sustainability and the expectation to act upon these challenges are becoming increasingly important (Daft, Murphy, & Willmott, 2010, pp. 6-9). The holistic problem solving methodology asserted by COMET competence model shows potential to prepare students for globalisation, diversity and social responsiveness as well as economic volatility in organisations. Adaptability has become a determining factor in the ever-changing world economy that leads to continuous change in the dynamics of the world of work.

It is clear that TVET has a distinct socio-economic-political agenda but equally so, an innovation agenda. The qualities and attributes needed to realise these obligations cannot emerge in a vacuum. This investigation proposes a model within which the current situation can be empirically measured but even more so, be transformed in terms of understanding how holistic problem solving suits a modern 21st century TVET.

Opportunities for competence assessment in TVET to quality assure the socio-economic domain pertaining to socio-economic inclusion of Youth is illustrated by the New Growth Path (NGP) Accord 6. This Youth Employment accord, signed on 18 April 2013 in Soweto, Johannesburg, South Africa by representatives of Government and Social partners intend to assist with job creation for youth. It envisages five million jobs by 2020. The focus areas will be on Education and Training (TVET College programmes highlighted here), work exposure for graduates in the form of internships, more young people employed in the Public sector, youth targets for certain industries, enhanced youth entrepreneurial support and incentives to encourage the private sector to employ more youth (www.dhet.gov.za/Booklets/youth employment accord, 2013). These socio-political and economic intervention strategies are critical given the high unemployment rate amongst South African youth. The good intentions however require intensive strategies based on sound research supported by empirical evidence as initiated in this research. The state of the art regarding occupation competence that can be applied in a variety of domain specific environments, required to access the job opportunities negotiated and created for Youth, must be investigated.

Pitfalls such as the impact of economic viability can pose a risk to South Africans' perception of democracy and overall conducive citizenship. Results from the South African Social

Attitudes Survey (SASAS), conducted in 2013 concluded that the decrease in democratic satisfaction appear to be linked to national and personal economic unhappiness (Roberts & Struwig, 2014, pp. 12-13). Given the fact that the average age for South Africans was 25 years in the 2011 national census, with just over one third being under the age of 15, is an alarming factor in terms of establishing sustainable employment. This census 2011 pitched the unemployment rate for the working age group, 15-64 at 29,8% (Jordaan, Ngcobo, Motloutse & Tala, 2012, pp. 59-65). A rapid growing population with a high corresponding unemployment rate causing severe poverty is a major threat for socio-economic and political stability and governance of a country. (Pongo, Effah & Osei-Owusu, 2014, pp.185-192). Critical attributes such as reflective thinking to enable students to actually function in the global village is a social skill that is often underplayed. Comprehensive peace education in addressing structural and cultural violence to promote local and global peace is needed for responsible global citizenship to ensure individual and societal transformation (Reilly & Niens, 2014, pp. 53-76). Two decades after the abolition of apartheid in South Africa, numerous incidents of hate speech and racism is still documented, accompanied by racial segregation and symbolic encounters amongst people of diverse descent (Du Preez, 2014, pp. 117-135). This is of particular relevance on post conflict societies. A typical example is the South African apartheid era, characteristic of segregation, inequality and socio-economic injustice that needs to be transformed to a state of unity in diversity.

Furthermore, a study by the British Council's Skills for Employability affirms the necessity for quality assurance in TVET towards occupational competence. This programme focuses on international partnerships with countries such as China and Bangladesh. It aims to develop knowledge, skills and competences to access the labour market and extends beyond technical and vocational skills to include soft skills such as entrepreneurship, problem solving, teamwork, ICT and communication. 75 million young people worldwide are unemployed and the paradox is that 57% of employers report that they cannot find entry-level position employers. This may lead to social and political tension and is indicative of the serious mismatch between TVET training and Industry needs. The focus is on creating progression pathways where students go through succeeding stages of the education system into workforce, equipped with market ready skills and qualifications.

Employers play an important role in ensuring that learning is knowledge and experienced based as well as forward-looking. A demand driven TVET system seems to be imperative (British Council Skills for Employment Programme, 2013). QA should address aspects of programme

and qualifications mix at institutions to ensure realistic employment opportunities for students. DHET Headcounts of Enrolments in TVET colleges for 2012 revealed that NCV student numbers for Business and General Studies (85,236) is significantly higher than that of Engineering studies (46,272). The discrepancy between N4-N6 Business studies (73,276) and Engineering studies (27,288) reflects an even bigger gap (Mgijima & Morobe, 2012, p. 10). This situation at TVET colleges may pose a potential risk for the TVET mandate and student livelihoods.

Moreover, 22.3 million young people were neither in education nor in employment in the fourth quarter of 2010 according to the United Nations, 2011 report (Zhao, 2012). International partnerships embedded in globalisation such as the African Growth and Opportunity Act (AGOA) and Trade Investment Framework Agreement (TIFA), a United States (US) Trade Act to enhance market access to US for Sub-Saharan African Countries (SSA), BRICS (Brazil-Russia-India-China-South Africa) aiming to establish a multilateral development bank to ensure fair and equitable representation for Developing countries – to raise the African voice (Narnia, 2014, pp. 16-17), the European Union (EU) for a significant percentage of SA's exports and the South African Custom Union (SACU) amongst SA, Botswana, Lesotho, Namibia and Swaziland, require a socio-economic sustainable workforce (MDG Report, 2013, pp. 16-17). The challenge and opportunity for TVET to respond to socio-economic and political needs of a country and globally is highlighted here. Whilst competence is mentioned, the focus is more on employability skills and not specifically on occupational competence and commitment acquirement. The actual measurement and development of occupational competence is lacking. A pure market driven approach can be risky given the dynamics of global markets.

The development of shaping competence in conjunction with students evolving from novice to expert, researched in this study, holds the potential to equip students for the complex, dynamic and inter-connected world of work.

It is however critical to acknowledge the risks of a standardised curriculum driven by a socio-political agenda as a possible barrier and contributing factor in hampering the translation of creative ideas into action. This is seen as a key competence and a critical 21st century survival skill.

A study conducted on international tests such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS)

shows that countries that perform well on these international tests indicated a low level of performance on entrepreneurship as indicated by the Global Entrepreneurship Monitor Survey (GEM) of 2011. This decline in creativity is ascribed to various factors such as standardised testing with the focus on rote learning instead of critical, creative thinking and consequently subduing natural curiosity of learners. Curriculum narrowing can occur when the emphasis is on core subjects that are based on internationally benchmarked standards. Whilst acknowledging that education should go beyond these core subjects the reality shows that because of the international comparison and what is at stake, these core subjects tend to receive priority at the cost of a broad, balanced and rich curriculum (Zhao, 2012). The impact of PISA on scientific research is immense given the magnitude of the publications after 2007 and affirms concerns raised by Zhao. Furthermore, high risk testing may cause negative effects such as teaching content narrowing resulting in a *teaching to test (*TTT) approach, as an attempt by Governments worldwide to reform educational policies to improve student performance (Jager, Maag Merki, Oerke & Holmeier, 2012, pp. 451-467). The pressure on educators regarding accountability in preparing students for examinations and certification resulting in TTT, ask for educational policies to be reconsidered (Black, Harrison, Lee, Marshall & William, 2005). This is a typical scenario in TVET Colleges where the preparation for students to pass the national examinations receives preference over the development of creative, holistic problem-solving paradigm for students.

The concepts of ability and competence need to be examined. The VIENNA TEST SYSTEM HR, an online psychological assessment for personnel selection, personnel development and career counseling, identifies Attention (Work accuracy vs. work speed; Vigilance), Cognitive abilities (Anticipation of movement; Knowledge of English; Memory; Logical reasoning; Multi-tasking; Numerical ability; Spatial ability; Technical comprehension; Verbal ability), Reactive behavior and Visual functions (Stress tolerance, reactive; Peripheral perception; Reaction time; Overview; Visual perception), Sensomotor functions (Eye-hand coordination; Eye-foot coordination; Fine motor skills) and Work-related aspects of personality (Resilience; Emotional stability; Extraversion; Frustration tolerance; Leadership; Conscientiousness; Interest; Customer orientation; Motivation; Openness; Stress and burnout; Agreeableness) as measurable dimensions (SCHUHFRIED). These are personality and ability attributes.

As argued in these tests, these are crucial factors in the workplace but furthermore it is important to realise that assessment of ability as in many psychological assessments is merely a contributing aspect in the assessment of occupational competence. Additional contributing

factors to consider are student innate abilities, learned competencies and potential success in a defined domain. Modular and Integrative qualitative human abilities that correlate with corresponding modular tasks and integrative situations respectively impact on the individual's response to the distinctive organisation and roles within specific domains where particular individual abilities are demanded. Tasks for example require specific abilities while situations being complex sets of problems require the integration of complex actions and responses (Connel, Sheridan & Gardner, 2003, pp.127-155). Instituting a well-formulated career guidance programme, executed by suitably qualified staff is an essential function to guide students towards activating this potential/ability to develop occupational competence and commitment and equally so overall career success. Abilities can be seen as the potential that define a space for the development of possible competences. It is evident that ability per se will not lead to occupational competence and that the interaction within the domain is vital.

The question therefore is, what is needed to translate ability to domain specific competence. Rauner et al refer to Hartig and Klieme's distinction between the concepts of competence and intelligence, illustrated in Table 3 below.

Tab. 3: Competence versus Intelligence

Criteria	Competence	Intelligence
Ability	Contextualised ability to adequately respond to specific situations and demands.	General ability to solve new problems.
Acquisition	Can be learned and is acquired through experience with specific situations and demands.	Stable over time and determined by biological factors to a significant extent.
Internal structure	Determined by situations and demands.	Determined by fundamental cognitive processes.

(Rauner et al. , 2013, pp. 8-11)

A literature study conducted by Toohey, Ryan, McLean and Huges focusing on issues related to the assessment of competency based education and training affirms the complicated nature of assessment of competence and the need for an authentic measurement tool. The dynamic nature of competence assessment is evident in this study. The predominant themes are underpinned by competence-based assessment criteria inclusive of identifying the aspects of performance that should be assessed; how competence should be assessed; which assessment methods are appropriate; the grading of competence assessments; should these assessments be conducted in the workplace or at training institutions and by who. They also highlight the need for a broad definition of competency that will encompass competences beyond technical skills

such as self-management, work-management, effective interpersonal interaction and to respond to environmental pressures (Toohey, Ryan, Jan & Huges, pp. 86-117).

Occupational competence assessment should be linked to the 21st century competences, which provoke vigorous debates and deliberations at various forums. Literature reviews revealed various frameworks for 21st century competences as introduced in 2.2.4. Prominent frameworks encompass the 21st century skills and competences for new millennium learners of the OECD with the aim of impacting policy. An interesting finding is that apart from the competences associated with modern technology, traditional beliefs such as that subject expertise can only be developed from sustained practice over months or even years, is acknowledged (Ednews, 2012, pp. 1-6). The Definition and Selection of Competences (DeSeCo) for the identifying of key competences is fundamental in this framework. Another distinguished framework is Key competences for lifelong learning, a European reference framework that supports OECD-DeSeCo programme.

The themes of these frameworks involve Skills/Competences, Implementation issues and Assessment. The predominant skills and competences were identified as Collaboration, Communication, ICT literacy, Social and/or Cultural skills and Citizenship, followed by Creativity, Critical thinking, Problem solving and Productivity (Voogt & Roblin, 2012, pp. 299-321). Given the demands of the 21st century, complex problem solutions, which are holistic of nature, are essential. The quest is therefore for a thinking paradigm to integrate these competences to better understand and respond to the interconnectedness of the 21st century encounters.

Key competencies outlined in the European Union documents are Personal competencies (psycho-affective satisfaction), Social competencies (Integration, Co-existence, Citizenship and Professional competencies (labour related) (Valle, 2004). Key competences can be defined as a transferable, multi-functional bundle of knowledge, skills and attitudes needed for personal development, inclusion and employment. (Van Woensel, 2004, pp. 87-94).

These key competences can be regarded as being relevant to all employment needs but competence models should also integrate domain and context specific assessments and developmental possibilities needed in different occupations.

The expectations and attention paid to TVET in global debates and government priorities for education and national development are immense. TVET features boldly on strategic and

regional economic forums such as the African Union (AU), the European Union (EU) as well as multinational groups such as the G20, the OECD and equally so, in multilateral organisations such as the International Labour Organisation (ILO) and UNESCO. TVET is seen as a source for the skills, knowledge and technology needed to enhance productivity for the knowledge based and transitional societies of the 21st century (Marope, Chakroun & Holmes, 2015, p. 11). This stance may pose a risk for TVET in a sense that the 21st century requires more than knowledge. There is a significant focus on conceptualisation in what Pink describes as a Conceptual age characterized by a move from the typical *Knowledge-worker* to an economy and society built on inventive, empathic and big-picture capabilities (Pink, 2005, pp. 1-2).

The assessment of competence in the workplace is essential for quality assuring TVET in this socio-economic domain. The design of work systems requires specific operations to be conducted by workers and will therefore impact on the limits and possibilities of competence development. The structural and process organisation of the company will impact on organisational learning, work tasks, positioning of workers in the company and the promotion of learning towards professional competence development. Competence development however extends beyond the objective working conditions to include subjective professional competence development manifested in preconditions, attitudes, motives and interests of individual workers, projected in work process knowledge (Fischer & Boreham, 2008, pp.439-444). Work Process Knowledge constitutes the understanding of work processes in the organisation as an interrelated holistic system serving as a guide for practical work and is driven by key factors:

- The shift from highly, narrow defined job specifications to address global economic competition to the development of more organic ways of organising work resulting in flatter management hierarchies, integration of functions, multi-skilling and delegation of more autonomy to self-managing teams. Employees have to be skill-full, versatile, thinkers and significantly more knowledgeable to function effectively in this new organisational structure.

- A TVET system steering away from a highly specialised qualification focus to the assimilation of theory and real work based learning in organic organisations.

- The understanding that the knowledge-base that supports the work of intermediate level employees includes the knowledge they construct from experiences within the

community of practice in the context of their work (Fischer & Boreham, 2008, pp. 466-475).

The National Centre for Vocational Education Research (NCVER) identified the role of workplace assessment and that of employers in the design and application of assessment tools as a crucial function to be performed by industry in establishing consistency and quality in assessment. They mention that VET (TVET) graduates do not always have the skills, knowledge and job-readiness proclaimed by their qualifications, triggering a risk to quality assessment and the credibility of VET/TVET qualifications. They stress that perceptions of quality assessments changed significantly over time and that clarity is essential in a competence based training system. The following risks are identified:

- Impaired competence amongst trainers and assessors to conduct valid and reliable assessments.
- Insufficient time for repeated practice required for the demonstration of competence.
- Inadequate access to work placement as well as inadequate supervision during work placement.
- Not enough attention to RPL.
- Unclear role of employer or industry role in assessments.
- Course duration.
- Language and Literacy concerns.
- Student versus occupation suitability.
- VET (TVET) educator suitability.
- Lack of systemic processes within or amongst training institutions for the moderation and validation of assessments (Halliday-Wynes & NCVER, 2013, pp. 15-26).

These risks may cause a barrier in quality assuring the position of TVET in Education and Socio-economic domains. It however suggests no concrete solutions to these risks. The opportunity to investigate the impact of a model in TVET that incorporate professional competences that are domain specific with open applicability, that extends, beyond the professional tasks at hand to the mastering of future tasks (Rauner, Heinemann, Maurer & Haasler, 2013), is ideal for the challenges identified.

Work Process Knowledge is imperative for the shaping of work and education. It serves as a tool to address the fundamental directives of TVET: Knowledge incorporated into practical

action – the actual performance of work; Knowledge to serve as a guide for practical action in novice situations; Knowledge that can be abstracted from the given situation to transcend assumed reality and involve the notion of a different design of the world of work (Fischer & Boreham, 2008, pp. 466-475).

Several authors suggest that assessment in the workplace has some difficulties and is not always desirable or possible. Debling (1992) identifies the following difficulties:

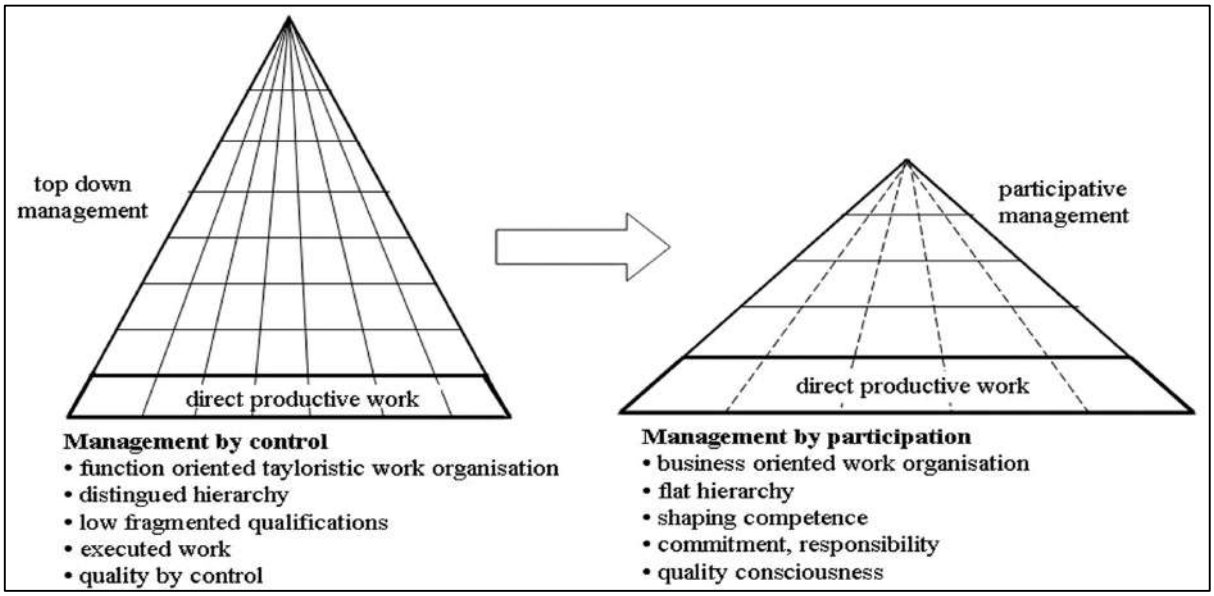
- the burden placed on supervisors and the priority they afford production over assessment because of remuneration incentives etc.;
- the limited time that some supervisors have with staff, leading to 'formal' testing when the supervisor can spare the time;
- some staff working on different shifts and sites can have a number of supervisors which, if all are involved in assessment can lead to standardisation and record keeping problems;
- some competencies are only rarely exercised at work, are not able to be performed without certified competence or a license, use material or equipment that is too expensive to risk waste or damage, or are only exercised in emergency situations. .

It is important to acknowledge the identified assessment risks in the workplace. This information is valuable for future planning and policies with regard to workplace based learning. It is however critical for TVET students to learn their occupation in a dual system consisting of college/institution learning and real-work apprenticeship.

The nature of work is changing rapidly and organisational designs are becoming flatter with fewer levels in the hierarchy (Riggio, 2009, pp.11-15). This in conjunction with the virtual office concept inflicts increased demands on the competence levels of TVET students to cope in this environment. A flatter organisational structure is a defining feature of modern occupations/professions for the development of vocational identity as well as for the development of productive and competitive work organisations (Rauner, 2013).

The direct production layer is strengthened in this management model. This transformation from management by control to participative management is illustrated in figure 3.

Figure 3: From Management control to Participatory management



(Rauner, 2013; Rauner et al., 2013, p. 32)).

This study is essential to ascertain student professional readiness for the management by participation workplace and in doing so combat potentially higher youth unemployment rates and ultimate socio-economic exclusion.

2.4 ASSESSMENT POLICY GUIDELINES IN TERMS OF NATIONAL AND INTERNATIONAL GOVERNMENT POLICY STRATEGIES.

Assessment is tightly regulated by the National Qualifications Framework (NQF) Act (Act 67 of 2008). The South African Qualifications Authority (SAQA) is mandated to develop policy and criteria, in consultation with the Quality Councils. The National Policy and criteria for designing and implementing Assessment is mandated to set minimum criteria and to provide guidance for effective, valid, reliable and consistent, authentic, fair, transparent and appropriate assessment in line with the NQF (SAQA, 2013). The Higher Education Qualifications Sub-Framework was revised in January 2013 with the purpose of considering access to new qualifications inclusive of responsiveness to the HEQF in addressing skills and knowledge needs as well as creating coherence of the higher education system (CHE, 2013).

TVET revolves around the acquisition of knowledge and skills for the world of work ranging from formal, non-formal to informal learning in the development of skills and knowledge from basic to advanced levels, whilst shaping people's attitudes (UNESCO, 2013).

TVET policy frameworks in the SADC region predominantly resonate government strategies addressing skills development, poverty alleviation, employment, employability, economic growth and competitive market engagement. This awkward position of TVET finding itself in a space between schooling and occupational training, whose functions are located in different government ministries need to be addressed to combat elaborate TVET policies remaining merely a paper document (UNESCO, Status of TVET in the SADC Region, 2013). TVET is essential for the formation of orderly and compassionate civil societies, peace building, social justice and equality. Government policies must therefore be based on reliable, research-based evidence with the potential of acknowledging the important contribution of educational research. (Maclean, 2011, pp. 125-127).

Skills development scenarios of countries are situation specific and unique but there are certain global commonalities and interconnectedness. Three major global skills development models are discussed in Table 4.

Tab. 4: Global Skills Development Models

Models	Anglo-Saxon Model	Asian Tigers Model	Germanic model
Countries	Australia, New Zealand, Canada, USA and UK	Singapore, South Korea and Taiwan	Germany, Switzerland, Austria and Denmark
Main Characteristics	Primary focus is on the labour market to balance the supply and demand of skills in the economy.	Supply and demand controlled by Government. Active labour market policy including all social partners.	Market driven skills development. Integrated approach among Government, Trade Unions and Employers.
Role of Government	Limited Government interference.	State Authoritarianism.	Governmental legal framework for industrial relations. Integrates levels of government and social partners and links structures of TVET with the economy.
Trade Union role	At the level of managerial discretion.	Important partner.	Legal rights to participate in training decisions.
Weaknesses	Focus on job-related skills at the cost of soft skills development Fragmented approach.	Limited applicability in a diverse economy and liberal democratic socio-economic political climate. Expensive, difficult to administer. Not sensitive to individual enterprises.	Lacks flexibility in types and location of skills. Complex multiple planning functions. The development of higher order and generic skills are at risk.
Strengths	Voluntary approach to skills development. Major advantages for highly skilled employees	Skills levels demanded can be increased. Comprehensive national system. Strong skills-base across economic sectors.	Large volume of intermediate skills produced. Shared training culture. Enforced apprenticeship system

(Botha et al., 2013, pp. 3-17)

The training and development landscape in South Africa is affected at various levels by global models. The disparity between skills needs of industry and skills provided by training institutions makes the Anglo-Saxon model highly unlikely for the South African economic

context. A combination of the Asian Tigers model and the Germanic model appears to be a more viable and realistic option (Botha et al., 2013, pp. 3-17).

The 21st century competences are portrayed in various models and outlined in numerous frameworks and impacts strategic thinking with regard to the development of assessment policies. Assessment is a prominent theme in these documents and sub-themes involves:

- Arguments for new assessment models – is there a need and why?
- Types of assessment – identification of more appropriate assessments for 21st century competences
- Assessment instruments – How can these competences be assessed.
  (Voogt & Roblin, 2012, pp. 299-321)

Val Klenowski refers to the work of Paul Newton (2007, 2010) to address the intention of assessment where three stages are categorized as indicated in Table 5 below (Klenowski, 2013, pp. 36-51).

Tab. 5: Purpose of Assessment

Level of Assessment purpose	Characteristics
Judgment	Technical aim of the assessment which includes standard-referenced judgments
Decision	The use of assessment judgment for enacting a decision, action or process
Impact	Related to the intended impact such as that the students are motivated to learn.

The predicament of sound judgment, informed decision making and the desired impact is evident in the newspaper article, *Die Burger* dated 2 June 2014 that reflected the views of educationists on the alarming poor performance of South African students in Mathematics and Science. They refer to various contributing factors such as curriculum concerns, the status of educators, educator competence, discrepancies in the standard of tests internationally and socio-demographic factors. A key issue concerning the implementation of effective measurement and authentic measures for competence (*doeltreffendheid*) was expressed. Crucially important is the statement, that if something can be measured, it can be improved (Maree, 2014, p. 2). The emphasis placed on revising policy statements appears to be failing education and such changes are not the basis for educational transformation in practice.

Policies are often jeopardised by the hidden curriculum (actual classroom practice and routine), steered by an overall low –order thinking, everyday knowledge and teacher-led repetition

despite policy changes (Ramani & Joseph, 2014, pp. 24-25). This is an indication of a lack of understanding in the Education system of the extent of the need for effective and efficient measuring models to serve as mechanisms to assess and develop student and educator competence to become confident in implementing good policy and equally so, inform the continuous improvement of policies.

Standard-referenced assessment is a central aspect of assessment policy guidelines and the norm in many countries. Australia developed a National Curriculum and Achievement Standards, New Zealand adopted National Standards for Literacy and Numeracy up to the end of primary school, Canada engaged classroom assessment standards and in South Africa assessments are designed according to Unit Standards stating the outcomes to be achieved. The risk of these standard driven reform in Education is that unintended effects are not taken into consideration or are misinterpreted, resulting in a precarious understanding by policy makers or the public in general. The vital impact of the Educator judgment in critically analysing assessments, is often overlooked (Klenowski, 2013; Networx, n.d.). The intensity in the pursuit for assessment transformative power is clearly illustrated by the influence of test scores on the United States public policy timeline: Minimum competency testing movement (1960's/1970's) driven by public concern over declines in standardised test scores resulting in a back to basics movement supported by plubic attitudes survey results; The Standards-based reform movement(since end of 1970's) requiring higher standards of assessment in correlation with high-order skills and complex actions - public opinion viewed the main usefulness of assessment as an input for instruction rather than an outcome; The *No Child Left Behind* (NCLB) era Act of 2001 added student testing, high quality teachers and research-based programmes effected in annual testing for all students from grade 3 to 8 and once in High School. Issues such as validity, accountability and competition are prevalent (Brookhart, 2013, pp. 52-71). Assessment must serve a purpose which is relevant locally but also globally given the interconnectedness of the world. Finding this balance is the true challenge for an assessment model in emphasising the transfomative power of assessment.

2.5 CHALLENGES AND OPPORTUNITIES IN TVET FOR COMPETENCE DIAGNOSTIC ASSESSMENT AND DEVELOPMENT TOWARDS THE DEVELOPMENT OF OCCUPATIONAL COMPETENCE AND COMMITMENT.

Occupations can be seen as goal-oriented activities in the context of living to help people develop and express their identities. These identities serve as pathways by which people through their daily occupations and relationships with others are able to derive meaning from their lives. Competent performance of occupations serves as a motivator for people to explore and engage with the world in a manner that translates into a sense of autonomy and selfhood. This experience of being competent triggers acceptance of more challenging tasks in a controlled mode, identified by efficacy as well as choice distinguished by autonomy (Christiansen, 1999, pp. 547-558). This statement heightens the advantages of effective and efficient diagnostic assessment procedures for the development occupational competence and commitment. TVET is however challenged with obstacles that complicate the implementation of national and international policies intended to promote occupational competence.

In identifying a challenge posed by the disconnection between research and practice, Heritage refers to the arguments of Garfinkel around *social scientists failing to depict the core practices of the occupational world that they have studied.* This results in a disconnection between occupations as domains of accountable activities and the idea of social science research to translate and represent the accountable organisational objects of social science research and theory. The essence is about portraying accountable competent work practice endorsed by practitioners. Occupations are therefore primarily self-organising domains of visible competent work practice that resemble a unique preoccupation with *local productions and with worldly observability of reasoning* (Heritage, 1984, pp. 298-311). The Scientific oriented approach is disciplinary based, value free and analyzing of nature whilst occupational competence approach involves mastership, multi-competence associated with values and is shaping of nature. These two processes are however constitutive for each other and a dialectical interaction of diffusion and assimilation should be established.

According to Chipunza and Berry (2010) the biggest business challenges posed to South African organisations today range from increased oil prices, political instability, HIV/AIDS and economic recession. They emphasise the need for strategies to reduce expenses but also enhance performance to maximize productivity. Downsizing has become a reality for businesses as a result of the challenges mentioned and the remaining staff can be seen as

survivors who need survivor qualities to cope with the increased workload. For TVET students to survive in this business jungle they will have to be competent in their occupations. The competence must be of such a nature that it is transferable and more flexible to move amongst jobs. The survivors in the company need holistic competence to deal with the added pressure and survivor qualities post downsizing such as attitude, commitment and motivation must be prepared for. Lifelong learning is crucial for the development of adaptive ability within a changing environment (Chipunza & Berry, 2010, pp. 604-613).

The Quarterly Labour Force Survey released for Quarter 3 of 2015, by Statistics South Africa affirms the challenges regarding an increasing unemployment rate, which is now at 25.5% for the working-age population (36.1 million) in South Africa. An interesting finding of this survey is that while employment increased in Elementary, Craft and related trade and Professional occupations, a decline in employment is recorded for Plant and machine operator, Sales and services as well for Technician occupations. An increase in employment in the informal economic sectors is observed since Quarter 2 of 2014 until Quarter 3 of 2015 (Statistics South Africa, 2015). The opportunity for TVET to equip students for entrepreneurship has become essential given the high unemployment rate in conjunction with the deceleration of economic growth rate since 2008, influenced by global economic recession (Statistics South Africa, 2015). For a successful occupation in an entrepreneurial field to contribute meaningfully to the socio-economic conditions, people typically prefer situations where they are allowed to develop practical solutions and divergent interventions (Moerdyk, 2009, pp. 183-184). The country is challenged with high unemployment rates reflected in the low absorption into the formal economy. This dilemma often results in a forced participation in the informal sector as a means to survive (Government Gazette Vol.599, No. 48796, 2015). The manifestation of these qualities needed for the establishment of an economically viable informal sector, is researched in this study. A model in TVET to incorporate the development of well-rounded, occupational competence is essential to equip students professionally for the informal sector as an additional employment route to the formal economic sector in addressing the persistent challenges of youth unemployment and poor job creation.

The concept and notion of competence-based education is widely acknowledged in policy documents but the know-how on implementation, which must be anticipated by diagnostic assessment, is a major gap. The concept is bolder in policy documents and educational handbooks than in regular schools (CIDREE/SLO, 2004). The lack of internationally accepted

measuring tools or models to measure the impact of TVET programmes is a concern that needs to be addressed.

Technological advancements and globalisation afforded education an abundance of opportunities to thrive and excel. The excessive focus on standardisation, assessment, global competitiveness and accountability cripples this opportunity and resources to re-imagine and re-create education. “We have been so busy fixing the horse wagon in order to get to the moon instead of spending time and resources on inventing rockets” (Zhao, 2012, p. 253).

Central to the global sustainability challenge confronting humans today is Education for sustainable development. Education for Sustainable Development (ESD) is critical for TVET (Gu, Gomes & Brizuela, 2011). TVET needs to respond to the demand for skilled labour required to address the pressure associated with globalisation where local producers need to be globally competitive and yet remain abreast of new technologies and production processes (Government Gazette No. 38796, Vol. 599, 2015).

United Nations Educational, Scientific and Cultural Organization (UNESCO) provide amongst others, gender equality and sustainable development, global citizenship and the world of work as key imperatives in the Position Paper on Education Post-2015 (UNESCO, 2014, p. 3). The proposed overarching goal is to ensure equitable quality education and lifelong learning for all by 2030. Priority areas and corresponding targets supported by qualifying, measurable indicators are proposed. All priority areas encompassed impact on TVET but central to TVET is Skills for Work and Life as well as Quality and Relevant Teaching and Learning. Target 8 is of particular relevance with the emphasis on acquiring skills and knowledge within safe, gender-responsive and inclusive learning environments to facilitate personal fulfillment, contribute to peace and an equitable and sustainable world (UNESCO, 2014, pp. A1-2). This is a huge challenge for TVET in South Africa. The theme of gender equity, particularly at TVET Colleges demands strategic intervention and recruitment. Engineering studies are Male dominated and Business studies Female dominated. Numerous policy documents regulate gender equality and promote equal representation in the workplace but gender inequality persist in Artisan employment in South Africa. In 2011, 88,71% of Artisans were Males and 11,29%, Females (Meyer & Widschut, 2014, pp. 6-8). The ripple effect is that Male students have better prospects of finding work in the field of science and technology, which dictates the Economy.

The 2013 HSRC conference theme was *Inequalities and Justice*. The rethinking of the way the world has developed and is developing was urged referring to the environmental systems at crisis caused by the current mode of production and consumption (Maharajh, 2013, pp. 3-4). The South African policies and strategies correspond with MDG 7: Ensure Environmental Sustainability and reported that some strides have been made, yet cautions about the challenges as a result of climate change and the potential negative impacts on the climate (MDG Report, 2013, pp. 17-18). Sustainability of the environment is a key concern. It is evident that the co-existence of technology and sustainable development must be established. Models such as COMET for the measurement and development of occupational competence and commitment can transform the paradigm of fragmented development to holistic thinking and problem solving to contract the equilibrium between technological developments and conserving the environment.

Moreover, students dropping out of school compose an international challenge at various levels. Graduation from secondary school is viewed as the minimum level of educational attainment required for young people to meaningfully participate in further studies and work in most OECD countries. Students failing to complete minimum school education have poorer labour market outcomes and are more likely to become unemployed, remain unemployed for longer and have lower financial income. Countries such as Germany divert students at the end of primary school, based on interest and aptitude, into academic, university preparatory stream (*Gymnasium*), specialist technical training (*Realschule*) or a vocational stream (*Hauptschule*). Japan, Austria and the Netherlands follow a similar distinctive school organisation informed by a selection process. In Sweden, Canada and the United States, Norway, Scotland and England students remain in the same school system for both lower and upper secondary phases and have access to a variety of programmes in the same institution. A mixed dispensation of the two streams is seen in Spain, Italy, France and Denmark (Lamb & Markussen, 2011, pp. 1-18). In South Africa, a mixed school organisation is followed with the majority of learners progressing from primary school to comprehensive high schools and a few technical high schools. After completion of Grade Nine, learners have the option to access the NCV or NATED programmes at TVET Colleges. Students enrolled in a TVET programme at secondary school level open the opportunity to inculcate learning pathways for competence based learning at a young age. Quality, problem-based learning programmes can lead to improved occupational competence prognosis.

The risk involved is that TVET programmes are still seen as diversion programmes (alternative pathways) for learners with learning difficulties in many countries. This often leads to a mismatch between student competence and TVET programme requirements, resulting in a high student dropout rate as evident in TVET Colleges in South Africa.

Alternative pathways mainly involve technical and vocational education. These programmes must be of high quality to ensure commitment to learning and personal development. This is critical because it is often the students who are not achieving well and are disaffected with formal academic schooling that are attracted to these programmes (Lamb & Markussen, 2011, pp. 1-18).

Increasing levels of specialisation result in fragmentation of knowledge and the need for integration and connection between silos of specialised knowledge become very clear when we try to apply knowledge to solve human problems. It has become evident that the ability to holistically combine and apply all the specialised knowledge is the key to effective problem solving. An in-depth understanding of occupational competence is needed to optimise the placement of students in TVET programmes. The opportunity is there for diagnostic assessment and development of occupational competence and commitment research and model to mitigate this risk by informing policy that will ensure a quality TVET delivery to all students.

2.6 PRINCIPLES OF TRANSFORMATIONAL COMPETENCE DIAGNOSTICS ASSESSMENT IN TVET.

The potential of a modern perspective on apprenticeships as an integral part of TVET to introduce students to the world of work was initiated decades ago by Georg Kerschensteiner's and John Dewey's concept of activity schools (Gonon, 2011, pp. 33-42). To date TVET still battles with the integration of the two fields of learning where theory and practice are transferred to one another in a well-structured dual system. Gonon illustrates the significant correlation between apprenticeship and the acquiring of implicit knowledge, which involves active participation of the learner beyond ordinary communication or written work. It is however important to find a healthy balance between the application of theory and practice.

In Germany, since the end of 1990 the school-based curriculum was reorganised in learning fields in relation to working areas and defined occupational competence (berufliche

handlungskompetenz), as the overall goal of learning (Frommberger & Krichewsky, 2011, pp. 59-62). Training standards should be linked to occupational standards to be of relevance in the actual workplace and a discord resulting from an "employment logic" (what needs to be done, how it will be done and how well will it be done) and an 'educational logic" (what is learned, how learning take place and how to assess the quality and content) can jeopardize the translating of occupational standards into training standards (Fretwell, Lewis & Deij, 2001, pp. 31-32).

Strategic principles are needed for a successful TVET system, signifying: Relevance to the labour market, Access for trainees, Quality of delivery, Standardisation, Inclusion of soft skills and Sustainable Government funding (MacDonald, Nink & Duggan, 2010, pp. 2-8). The collaborative operations between industry and its impact on the quality of TVET and the Government support and funding policy are acknowledged as an important strategy for success. Student readiness to be receptive in terms of having fundamental education to benefit from TVET opportunities is seen as essential. Curriculum transformation is of high importance and the possibility is exemplified in research conducted on the application of COMET model in automotive maintenance technician personnel training in China by Gu and Cai. They concluded that, irrespective of challenges manifested in the queries on how to develop professional ethics, self-identity and career planning based on COMET, students could excel beyond merely compiling a maintenance plan but also show ability to solve problems and improve comprehensive vocational competence (Gu & Cai, 2013, pp. 207-210). Stuart, author of the South African National Skills Handbook, reported that graduates in the field of engineering and science, predominantly from TVET colleges are provided with the knowledge and some practical training but then left without work experience and ultimately unemployed (Stuart, 2010). The interrelatedness of theory and workplace practice is vital for the development of occupational competence and subsequent improved employment prospects.

Urbanisation contributes to the unemployment and subsequent challenges. The rural development plan initiated in 2009 aimed to transform the rural landscape. One of the focus areas of the programme is on youth skills development and employment that is predominantly situated in the National Rural Youth Services Corps (NARYSEC). Hart and Jacobs pointed out that the budget spent from 2009 to 2013 increased almost ten-fold without a clear picture on exactly what the money was spent on (Hart & Jacobs, 2013, pp.19-21). Whilst the intentions of the government are good as proven by the impetus on rural development, particularly Youth employment, the dire need for well researched programmes and models to steer towards

occupational competence, and particularly transformational competence, is clearly demonstrated.

The potential of sound research to inform TVET policy and decision making to position the sector in promoting economic growth, socio-economic development and improving education for the world of work, is still very controversial and underscored (Maclean, 2011, pp.125-127). The transitional potential of TVET is endorsed by Maclean. Given the huge challenges in developing countries such as South Africa with enormous economic and societal illness manifested in high crime rates, high unemployment and labour unrests and inequalities, it is crucial that policies be supported by research.

For an Occupational Competence measurement and development model to transform TVET, policy must be grounded in public support programmes. These programmes are often founded in revised curricula, additional physical and human resources targeting a specific group such as Students. The success rate in such projects will impact the nature of transfer to other institutions. Evidence based evaluation in such attempts to transform TVET effectively towards a sustainable delivery is essential (Deitmer, 2009, pp. 858-870). Research indicates that there is a significant correlation between substantive empirical evidence and the transformational potential in implementing such models. An evidence based model for the assessment of occupational competence in TVET is lacking and in doing so, hinders the transformational capacity of TVET.

The conversion from a curriculum subject centered assessment to the empirical measurement of occupational competence that is domain specific, is inevitable for filling the gap in research regarding the true state of affairs regarding the potential of TVET to produce education that is not just good for the individual but equally so for the society and the economy, as stated in the Government Gazette dated 15 May 2015 (Government Gazette Vol.599, No. 48796, 2015).

The transfer of knowledge in Vocational education is a crucial element in Knowledge Management (KM). This is of particular importance in this time of employment insecurity where isolated domination in partial steps in a strong division of labour can hinder the acquirement of cross-functional and holistic learning and knowledge communication as key competences (Deitmer, 2009, pp. 858-870).

Central to this study is the assessment for learning paradigm. The transformation from being unconsciously incompetent (Do not know that you do not know) to consciously incompetent

(aware of shortcomings and trying to improve) to consciously competent (thinking about steps) to unconsciously competent (automated responses) must be acknowledged (Kinnear, 2009, pp. 81-85).

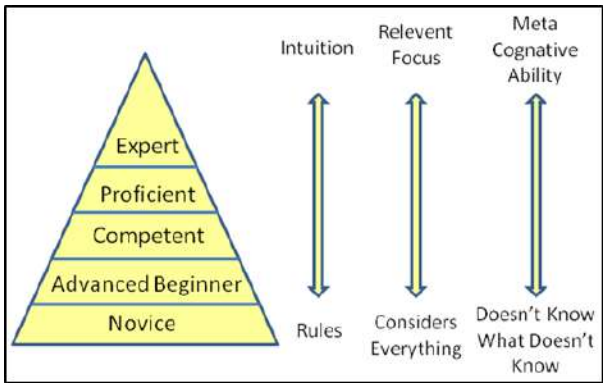
The Novice to Expert concept as illustrated in Figures 4, 5 and 6, is a fundamental principle in the transfer of occupational competence within and beyond the specific occupation. Benner (1982), accentuates the importance of life-long learning, the role of practical experience and career development underpinned by thorough comprehension of the evolution from Novice to Expert as a prerequisite for addressing the complexities and responsibilities in Nursing (Benner, 1982, pp. 402-407). This model, founded by Dreyfus, involves five levels of proficiency and can be implemented in all occupations. Imbedded in the levels are three main paradigms:

- The shift from relying on abstract principles to solve problems and guide actions to the implementation of past, concrete, real work experience.
- Effected change in the perception of complex, challenging situations resulting in the situation being addressed holistically, focusing on the relevant parts.
- Move from detached observer to an involved, actively engaged performer. (Benner, 1982). This involves critical content related thinking skills, which can be developed by exposure to the didactic principles within the Novice to Expert model.

Figure 4: Novice to Expert Level Descriptor

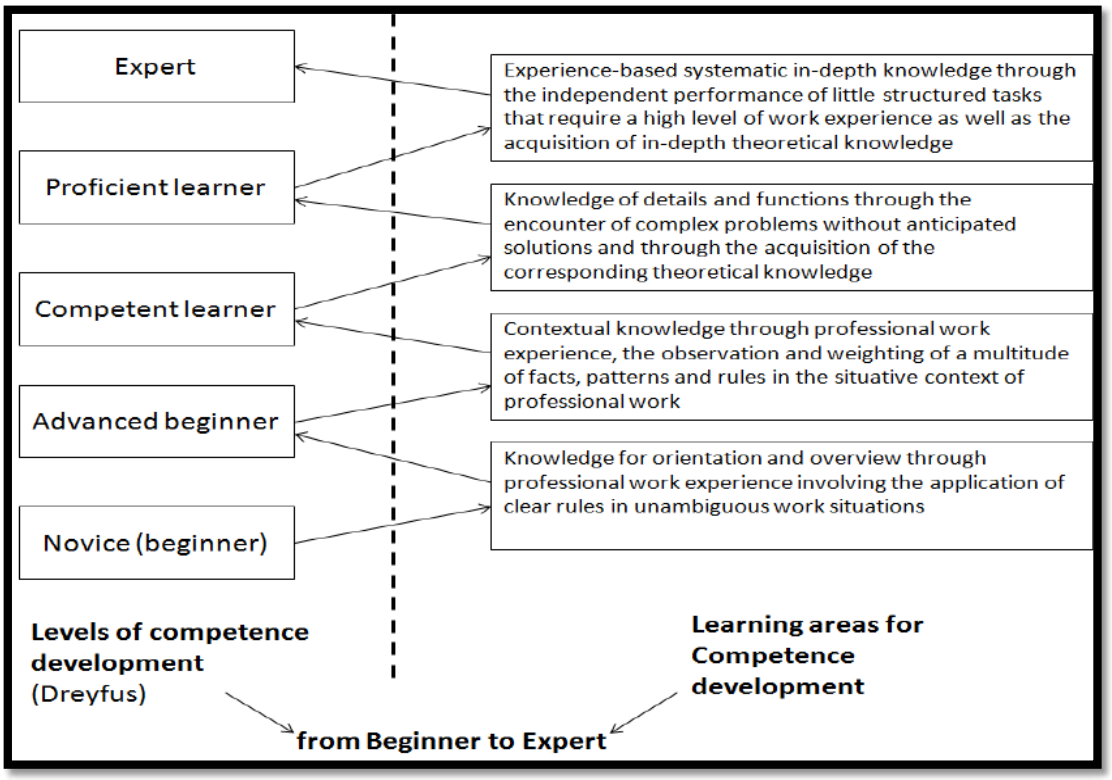
Level	Descriptor
Level 1 Novice	Beginners with no experience of the expected tasks. Exposure to aspects of the task that can be recognised without situational /occupational experience. This is a context free, generic and universally applied rule and regulation orientation phase.
Level 2 Advanced Beginner	Marginally acceptable performance demonstrated. Sufficient experience of real situations to identify recurrent aspects, having the acquired experience in actual situations to recognise overall, global characteristics. Principles based on experience are starting to steer actions/doing.
Level 3 Competent	See actions in terms of long-term goals and plans based on the establishment of a perspective of a conscious, abstract, analytic reflection/thinking in solving and coordinating complex demands. This meta-cognitive approach results in improved efficiency and organisation.
Level 4 Proficient	Holistic problem solving. Evolved from working according to aspects. Pro-active and flexible problem solving approach. Experience-based ability allows for innovative thinking and effective decision-making in abnormal situations, focusing on an accurate area of the problem. Uses past concrete experiences
Level 5 Expert	Advanced experience lead to an intuitive understanding of the situation, zooming in accurately on the problem area by eliminating fruitless problem solving possibilities. Significant background experience allowing for performance to be flexible, fluid and highly proficient.

Figure 5: Novice to expert illustration



http://moleseyhill.com/blog/2009/08/27/dreyfus-model/

Figure 6: Learning areas for competence development



(Rauner, n.d.)

Transfer from school to work is a neglected area and often seen as an automatic process which is often a misconception with disastrous consequences as reflected by a study conducted by Mabotja and Mangalaza in 2012 on unemployed graduates via the very popular social media, Facebook.

Students in this study affirmed the concerns regarding the current education system and its disjuncture to the labour market. They emphasized the youth's willingness to participate in issues regarding their own development but their findings also showed that the South African Youth perceived the current education system as poor, corrupt and misaligned to labour-market demands (Mabotja & Mangalaza, 2013, pp. 28-29).

A dual-system, one of the strategic goals of DHET (DHET, 2013, p. 64), provides students with vital practical experience that cannot be acquired during institution-based lectures but must adhere to quality criteria to be effective:

- Students must acquire high quality and holistic competence of professional knowledge and skills according to the standards of the relevant occupational profile but also contextual work process knowledge.
- The development of Shaping competence and ability to independently control and manage professional tasks to equip students to shape new structures for the world of work responsive to economic, social and environmental challenges in not merely finding the right solution but an effective and efficient one.
- Work context, meaning a specific area identified by complex, integrated work tasks, must be seen as a critical feature of professional work, enabling students to master contexts.
- Flexibility of labour markets and mobility of workers as well as the implementation of the principle of exemplarity opposed to the principle of specialisation must be advanced by embracing the concept of core occupations contrary to a functional, specialised orientation resulting in fragmented work tasks in organisations.
- Sustainable occupation profiles, considering work contexts as an indicator for the life cycle of occupations, must be created to promote the attractiveness of the occupation and support for career guidance processes and relevance for TVET occupations.
- Occupational profiles should be open and dynamic, allowing for mobility amongst related areas of application in adherence to professional standards and the upkeep of a sense of professional identity.
- Occupational Identity interlinked with occupational competence in a constitutive dynamic is critical for work commitment and impact on career choice.
- Competence in an occupation need sufficient time, on average three to four years, to incorporate immersion of an occupational culture and vocational socialisation that will

lead to the acquisition of relevant qualifications and competences as well as vocational identity transforming students from novice to expert occupational competence.

- Continuous professional development, applying the learning enterprise concept to facilitate learning through work processes by maintaining and updating professional competence is essential as opposed to only focusing on external training.
- Cooperation between learning venues is at the heart of a dual TVET system and is based on the principle that each occupation has to be learned in live work processes, ideally when school-based learning and work-based learning alternate at short intervals.
- The legal status of Apprentices implies that students have the same status of prospective skilled workers within the company and are subjected to mandate regulations formulated in a training contract concluded between the apprentice and the company.
- Cost-Benefit of In-Company training need to be determined but the tendency is that the benefit of training is linked to the quality of training.
- The articulation of TVET into Higher Education (HE) is limited and a dual track system with successive qualification levels can serve as a solution to this challenge (Figure 12).
- Governance of a dual system in cooperation with all role-players, culminated in a consistent legal framework, requires manifold governance structures such as government departments of education, economic, labour and the private business sector for the allocation of strategic and operational functions, including Curricula matters.
- TVET research is imperative for the development of innovative strategies. (Dietmer, Hauschlidt, Rauner & Zelloth, 2013, pp. 3-19).

The transfer of training is dependent on the extent of retention and application of knowledge, skills and attitudes originating from the training environment bridged to the workplace. The process of transfer is complicated and complex and is impacted by trainee characteristics, workplace environment and the job relevance of the training programme. Successful transfer must therefore be planned and supported by definite strategies which require active learning where the learner makes a conscious effort to learn. It furthermore must be supported by case based learning which involves psychological processes of logical thinking and reasoning to recognise and solve problems in new contexts by applying the solutions or analogy from the acquired knowledge and skills. The adaptation to a changing environment is influenced by the nature of the transfer. *Near Transfer* is procedural of nature whereby operations are executed in a sequence of steps.

Skills and knowledge are transferred in similar scenarios. *Far transfer* happens when new tasks are performed in situations that differ significantly from the original learning and it requires the ability to adapt, intensive analogy and cognition (Subedi, 2011). This logical, critical and analytic thinking is inevitable for all occupations as stressed in the article on medical students stating that 20-30% of medical costs in the United States of America are linked to complications and side effects stemming from received medical treatment. Pienaar, surgeon and senior lecturer at University of Pretoria says it appears as if most medical students lack thinking skills and do not acquire sufficient investigating thinking and problem solving skills (Myburgh, 2014, p. 6).

Human Resource Development strategies should generate ongoing, comprehensive learning and development to enhance relevant, up to date occupational competence beyond current market related demands in order to stay abreast of the dynamic nature of the world of work. Concentrating only on company specific business skills may put the company at risk. TVET colleges pursuing research in transferrable skills and models to acquire holistic occupational competence can play an integral role in a partnership with industry and business sectors to find long-term solutions for sustainable economic growth. Development and growth are equally necessary for all three main contributors in a dual system, namely, the Student, Educator and Employer. The CIPD/ConerstoneOnDemand 2014 survey on Learning and Development in 1081 organisations in the UK, reported on finding this balance between alignment to business and being responsive to industry trends, new learning insights and new technology (Stuart, 2014). The quest for innovative, creative and lifelong learning and development in a demanding world of work is noticeably captured here.

Retention, throughput and occupational competence remain a major concern across TVET Colleges posing a subsequent risk for socio-economic policy and accord strategy execution. The systemic factors such as the quality of Education, inclusive of Leadership and Educator quality are major barriers to the development of occupational competence in students. La Velle refers to the work of Rowe and Hill (1998), Muijs Reynolds (2005) and Fallon (2006) amongst others, stating that the single most important factor in achievement is the quality of teaching, which is captured in the term *Masterliness.* It encompasses advanced professional thinking linked to action, informed by research and evidence, effected in excellent skills, very accomplished, comprehensive subject or activity knowledge and skills (La Velle, 2013, pp. 2-8).

Education systems need to be sensitive towards diversity issues that often require social support and skills that are vital for Education and life beyond the Education system. Knowledge must be employed as a transformative tool as described by the German concept, *Bildung*, referring to the holistic aspect of pedagogy (Tirri & Ubani, 2013, pp. 21-29). This is of particular significance and an enormous challenge in South Africa being a very diverse country accompanied by major socio-economic and educational inequalities. The National Development Plan (NDP), aims to reduce the level of inequality in poverty levels as measured by the Gini coefficient to 0.6 by 2030. It remained at 0.7 since 2000, which is indicative of South Africa being one of the most unequal countries in the world (MDG Report, 2013, p. 28).

The international trend towards standardisation in education needs to be scrutinised for its effectiveness in addressing complex educational mandates and anticipated outcomes. Letschert refer to Ogawa et al., 2014, illustrating the effects of standards to be rather of symbolic, instead of substantive value alluding to standards being developed at national and state levels whilst the actual instructional practice is more influenced by decisions and actions at a local district and schools level (Letschert, 2004, pp. 7-24).

The transformational impetus to meet the challenges of the rapid changing world of work requires the acquisition of educational transcendence across domains. A competence framework in TVET that aims to prepare Vocational students for readiness to change their professional profiles in accordance to labour market changes necessitates the shift from vocation specific competence frameworks to a more general competence framework (Klep & Van Haperen, 2004, pp. 25-33). This shift from a context free, regulated problem solving paradigm to intuitive, flexible thinking and problem solving is crucial for the development of higher order thinking skills, such as meta-cognition and is desirable for developing holistic, shaping occupational competence.

2.7 LEGISLATIVE AND SOCIO-ECONOMIC CONTEXT OF OCCUPATIONAL COMPETENCE.

Qualifications associated with a trade, occupation or profession resulting from work-based learning, comprising of knowledge, practical skills and work experience, with an external summative assessment are defined as occupational qualifications. An occupation is a cluster of jobs similar of nature sharing common occupational tasks of similar complexity, requiring

similar performances across different processes and industries as identified and classified on the Organising Framework for Occupations (OFO), managed by the Department of Labour (DOL) (QCTO, 2011, pp. 3-4; SABPP, 2014, p. 2).

TVET is confronted with consistent change dynamics. These changes are rooted in the historical elements of the sector being spread across education and labour related policy and practice. Various structures, strategies, councils and frameworks as outlined below regulate the TVET landscape.

Occupational Learning Systems (OLS) is a new approach to skills development focusing on job-related qualifications and its relevance to employment requirements (Botha et al. , 2013). OLS identifies three types of qualifications: occupational, which are job-specific and designed by industry; vocational, where learners are prepared for various occupations; and higher education, where the focus is on theory and research in preparation for an academic career or a basis for entering several occupations. Occupational tasks constitute three forms of learning, namely: general knowledge and theory provided by schools and universities outside real working conditions, practical skills typically provided by TVET institutions and work experience provided by a workplace in real working conditions where real products and services are produced. All these qualifications are situated on the NQF (Act 67 of 2008) with the aim to integrate education and training.

The segregated approach between education and training on the one hand and the world of work was a barrier to be crossed in the search for a more effective skills development approach. A seven-step model for artisan development was approved by the DHET, emphasizing the integration of fundamental, practical and workplace training (Stuart, 2015, pp. 18-19).

The Quality Council for Trade and Occupations (QCTO) as a sub-framework of the National Qualifications Framework (NQF) governs occupational qualifications in terms of quality assurance and standards setting. Occupational learning programs are manifested in Learnerships that were introduced in the Skills Development Act (1998) to address skills development for empowerment and economic purposes, apprenticeships being a learnership in a listed trade including the corresponding trade test as well as PIVOTAL skills programmes with a specific application and potential for continuing professional development (CPD) (Botha et al. , 2013, pp. 146-158).

The QCTO view three components being, Knowledge, Practical (simulation) application and Work experience as a fundamental part of an occupational qualification (QCTO, 2015). Given the high expectations of TVET occupations to transform the socio-economic landscape, these components are necessary but not sufficient to equip the sector to deliver on these expectations. The demand for evidence-based policies to include research models designed to generate new data, has become essential in transforming TVET occupations.

The Organising Framework for Occupations (OFO) allow for categorizing and grouping of all related occupations and groups of occupations from entry level to advanced levels of competence. The OFO is revised annually to be relevant in identifying, reporting and the monitoring of scarce and critical skills (Botha et al., 2013, pp. 120-121). Working closely with the South African system, OFO focus is on eight critical employment groups: Managers, Professionals, Technicians and Associate Professionals, Clerical Support Workers, Service and Sales Workers, Skilled agriculture, forestry, fisheries, craft and related trades, Plant and Machine Operators and Assemblers as well as Elementary Occupations.

Disciplined-based learning (primarily in the Department of Education) and work-based learning (primarily in the Department of Labour) are referred to as a turf war and is seen as a fundamental rift evident in the polarities of Academic versus Practical; Theoretical versus Experiential; Teaching versus Learning; Inputs versus Outputs; Institution versus Work Place and Discipline versus Occupation.

South African Standards Classification of Occupations (SASCO), a model for labour market statistics and research in South Africa is based on the International Standard Classification of Occupations of the International Labour Organisation (ISCO). ISCO classifies occupations in 10 major groups. The Human Resource Development Strategy (HRDS) for South Africa (2010-2030) is the umbrella body that aims to co-ordinate private and public sector initiatives, specifically in social and economic fields that improve productivity and employment with the goal to assist individuals in achieving their optimal potential (Stuart, 2010).

Programmes that provide a full occupational directed qualification anchored in a college or university inclusive of supervised practical learning in the workplace are seen as PIVOTAL in NSDS III. NSDS Goal 3 affirms this pillar: promoting the growth of a public TVET college system that is responsive to sector, local, regional and national skills needs and priorities (DHET, 2011-2016).

Botha, et al. however highlight the challenges and possible restraining factors of TVET Colleges as the prompt merger of 152 small, individual colleges into 50 multi-campus institutions as well as the limited available research regarding the nuanced picture of colleges' systems and their strengths and weaknesses (DHET, 2011, p.12; Botha et al. , 2013, pp. 52-53).

NSDS III 2011-2016 is a mandatory skills development policy, emphasizing relevance, quality and sustainability of skills development programmes as outlined in eight goals:

- The establishment of a credible institutional mechanism for skills planning.
- Increasing access to occupational directed programmes.
- Strengthening the public TVET college system to respond to sector, local, regional and national skills needs and priorities.
- Addressing Literacy and Numeracy backlogs among adults and youth to enable additional training.
- Improved work-based skills development.
- Encouraging and supporting cooperatives, small enterprises, worker-initiated, NGO and community training initiatives.
- Increase the public-sector capacity for improved service delivery and supporting the building of a developmental state.
- Strengthening career and vocational guidance (DHET, 2013, pp. 10-32).

The NSDS III is a sub-component of the Human Resource Development Strategy for South Africa II (HRDSSAII) and actively advocates and support the integration of workplace learning with theoretical learning to inculcate an ethos of a competent workforce and the effective and efficient transition from institutions of learning to the place of work.

The White Paper for Post-School Education and Training is a principle directive for TVET College operations, aiming to build an expanded, effective and integrated post-school system. Challenges such as the difficulty to administer and quality assure the current mix of TVET programmes is acknowledged and a review of programmes and qualifications are proclaimed. Key objectives for the strengthening of TVET Colleges are:

- Improving Management and Governance;
- Developing the quality of Teaching and Learning;

- Increasing responsiveness to local labour markets;
- Improving Student Support Services;
- Infrastructure development (DHET, 2013, pp. 11-19).

A comprehensive, scientific study of occupational competence is needed for equipping students and institutions to survive the consistent change in the world of work and technology at local, national and international levels.

Another compass for socio-economic development in South Africa is the National Development Plan (NDP) setting the goal to eliminate poverty and reduce inequality by 2030. This plan focus on critical capabilities required for the transformation of the economy and society but acknowledges that these capabilities are not automatic and will equally so, not emerge if the country continues on its present trajectory. The document strongly speaks to the urgency in reducing the disturbing levels of youth unemployment and urge for the provision of broader opportunities for young people. Once again as in most key directives, a pertinent focus is on FET/TVET, in this plan, expanding the sector to increase student numbers to 1,25 million by 2030. Quality and relevance of courses to increase the employability of graduates is essential in terms of costs and to combat demoralizing students as well as further stigmatising the sector (SA Government National Planning Commission, 2012). To achieve these goals all sectors in South Africa need to contribute in a measurable manner to the envisaged outcomes of the NDP. The persistent mismatch between TVET programmes and competences needed in the workplace intensifies the global challenge of youth unemployment. A new TVET approach in responding to continuous quality improvement has become a matter of urgency given the increasing youth unemployment rate and slow economic growth rate in South Africa. An economic growth rate of approximately 5% in real terms was recorded between 2004 and 2007. However, the period 2008 to 2012 only recorded average growth just above 2%. This decline is perceived largely as a result of the global economic recession (Statistics South Africa, 2015). Notwithstanding the probable correlation between South Africa's economic growth and the global recession, caution needs to be taken against unilateral cause-effect explanations, resulting in overlooking numerous high-risk, contributing factors.

Artisan development is regulated by the Skills Development Act (SDA), Act 97 of 1998 and resorts under the Minister of Higher Education and Training in South Africa. This act was amended in 2008 and led to the establishment of a National Artisan Moderation Body (NAMB) on 30 November 2010.

The Director General is the accounting officer for NAMB and delegated the operational functions thereof to INDLELA, resorting under the Skills Branch of the DHET and is situated in Olifantsfontein, Gauteng. The aim is to serve as a one-stop center for all Artisan related data and information (Rapport, 2014, p. 7). The urgency of DHET in supporting a dual education system whereby learning an occupation must include theoretical and work based learning is articulated in the strategic plan 2010/11-2014/15, as well as the Annual Performance Plan for 2013-2014, stating: "provide a dynamic interface between the workplace and learning institutions and to promote quality of learning at work and for work" This strategic objective is supported by the operational objective: "Support the growth of a FET (TVET) College system by linking all quality assurance artisan learning processes with FET (TVET) colleges by March 2014". The main responsibility of NAMB is to coordinate Artisan development nationally towards national standardisation for Artisan development in all economic sectors. This include the execution of statutory function stipulated by SDA, registration of Artisans, regulation of Trade tests, being an assessment quality partner for all listed Artisan trades and to address the standardisation of all quality assurance functions (Nadsc.dhet.gov.za/Document/NAMB.pdf, n.d.). The National Artisan Development Funding and Learner Administration Policy of 1 April 2013, coinciding with the year 2013 being declared as the Year of the Artisan, further endorse these sentiments. SETA's and the National Skills Fund (NSF) play an important role in the execution of this policy and are now mandated to a "single guaranteed funding model for all artisan trades applicable to all sectors including a single, simple artisan learner administration and grant disbursement system" (DHET, 2013). An Artisan is defined as a person, certified as competent to perform a listed trade according to the SDA and a Trade, as an occupation requiring an artisan qualification in terms of the SDA (Government Gazette RSA 35625 dated 31 August 2012).

A study of the Thames Valley Medium Sizes Businesses (MSB) recorded that 78% of respondents placed shortage of talent and skills among their three top impediments to growth. Only one out of ten employers offer apprenticeships according to Relly: "It's such a competitive market for good people out there now. There's no way we can get growth going without a steady stream of qualified talent coming through" (Thornton, Thames Valley medium-sized business, 2013). He argues that work-based training can assist companies in winning the talent battle and address the skills shortages in the United Kingdom (UK). He emphasised the national insurance contributions (NIC) as a fundamental stumbling block to apprenticeships and the investment in equipping people with relevant market related skills.

Furthermore, he strengthens his plea by referring to Austria, Germany and Switzerland where approximately one out of four employers offer apprenticeships (Thornton, 2013). The importance of a dual education and training system and a collaborative approach with Government is critical to influence Policy. A well-researched and evidence based model and measurement will impact positively on companies and government strategic planning and policies. Costs, Benefits and Quality (CBQ) of in-company training, an online-measurement instrument holds the potential to initiate a paradigm shift towards valuing apprenticeships as a major factor in quality assurance. CBQ is a self-evaluation tool for South African companies to assess cost effectiveness of in-company training offered. It is developed by Bremen University's TVET Research Group (I: BB) and adapted for South African companies by the Manufacturing, Engineering and Related Design Sectorial Education and Training Authority (MerSETA). Six quality parameters are implemented – Learning in the workplace, Professional level of training, Autonomous/Independent learning, Business process orientation, Professional competence and Vocational commitment (MERSETA & I:BB, 2014).

Legislative Acts and policies govern TVET college operations. The right to basic and further education is outlined in the Constitution of the Republic of South Africa (Section 29(1) -(4). The FET Colleges act (Act 16 of 2006) and the FET Colleges Amendment Act (Act 3 of 2012) regulate the establishment, governance, funding and quality assurance in TVET (DHET RSA, 2013). The DHET listed the following set of legislation that impact on the TVET sector:

- The National Qualifications Framework (NQF) Act 67/2008
- The Higher Education (HE) Act 101/1997
- The Skills Development Act 97/1998 and amendments
- The National Financial Aid scheme (NSFAS) Act 56/1999
- South African Council of Educators (SACE) Act 31/2000
- Labour Relations Act 76/1998
- Employment of Educators Act 76/1998
- National Policy Act 27/1996
- General Further Education and Training Quality Assurance Act 58/2001

The influence of social factors defining the status of being viewed as an occupation or a profession is invasive. The battle of TVET related occupations not to be seen as second class could be linked to the highly controversial socio-political history of South Africa.

The NQF is inclusive of outcomes based assessment strategies with the aim to transform education and training in South Africa. Collectively, the Quality Councils and the South African Qualifications Authority (SAQA) serve learners and employers by the development and implementation of policy and to quality assure occupations. SAQA is a statutory body, regulated in terms of the National Qualifications Framework Act No 67 of 2008 that defines a qualification as a planned combination of learning outcomes with a defined purpose to provide learners with applied competence and a foundation for further learning (Botha et al. , 2013, pp. 59-62).

The Occupational Qualifications Sub-Framework is one of the three sub-frameworks on the NQF as illustrated in Table 6.

Tab. 6: NQF Sub-framework

Sub-framework	NQF Levels	Quality Council
General and Further Education and Training Sub-Framework (GFETQSF)	1-4	UMALUSI
Higher Education Qualifications Sub-Framework (HEQSF)	5-10	Council on Higher Education (CHE)
Occupational Qualifications Sub-Framework (OQSF)	1-8	Quality Council for Trade and Occupations (QCTO)

The articulation of pathways within the NQF is essential to promote and position TVET professions. A pathway can be described as a correlation between an educational programme and its destinations, mediated by institutional logistics, labour market arrangements, as well as informal and advisory systems. OECD countries put in great effort over the last few years to improve and change articulation and transfer amongst different pathways. Switzerland's construction of *maturité professionnelle* (professional maturity), opening up pathways from apprenticeship to tertiary education, serves as a good example (Sweet, 2010, pp. 17-32).

The Occupational Qualifications Sub-framework (OQSF) was developed to be responsive to the Constitution of South Africa stating that all Citizens have a right to education, including an occupational education. The OQSF aims to effect workplace-based education for post school learners in providing accredited qualifications benchmarked against similar international qualifications, to be user-friendly and to promote articulation in and beyond the sub-framework towards relevant NQF qualifications (Government Gazette No. 36803, 2013). This innovative

policy which includes Occupations on the NQF is inspiring and a step in the right direction but still lacks equality in terms of OQSF pitched at levels 1-8 and HEQSF up to level 10. There is a gap in terms of occupational competence measurement and the focus is predominantly on qualifications. This study holds the potential to be the missing link in this identified gap.

The extent and depth of policies governing TVET are outlined in this section. The World Economic Forum (WEF) 2014-2015 Global Competitiveness Report, assessing competitive performance of 144 economies, placed South Africa in the 56th position and third among BRICS economies. The report emphasises the public-private collaborations to raise productivity and competiveness to ensure economic growth and the enhancement of prosperity in a country. Policy implementation should therefore drive viable competitiveness in fostering economic, social and environmental sustainability. Sustainable competitiveness is defined as the set of institutions, policies and factors resulting in long-term productivity among nations to safeguard social sustainability, with the focus on health, participation, security and the achievement of optimal potential. Active participation of citizens while benefiting from the economic prosperity of the country is imperative. It should be underpinned by environmental sustainability characterized by the efficient management of resources to enable prosperity for current and future generations (Schwab, 2014). These sentiments are affirmed by the World Economic Forum's Global Competitiveness Index (GCI) 2014-2015. Competitiveness is described as a set of institutions, policies and factors that determine the level of a country's productivity. The level of productivity benchmarks the level of prosperity that an economy can achieve. GCI measured different components of competitiveness which are grouped into 12 pillars: Institutional environment; Infrastructure; Macroeconomic environmental stability; Health and Primary education; Higher Education and Training; Good market efficiency; Labour market efficiency; Financial market development; Technological readiness; Market size; Business sophistication; Innovation (Schwab, 2014). Awareness among TVET students of the possibilities and scope of the sector is imperative. A capable and competent workforce is essential for any country to recover from an economic crisis and equally so, to create productive jobs and sustainable socio-economic growth. Globalisation and competiveness are intertwined. Situated learning with a narrow scope of application will most likely not prepare TVET students for real-world challenges and opportunities.

Global competitiveness seems to be a deliberate strategy in developing and developed countries. Pertaining to Nigeria, a developing country, Okoye and Chijioke raise concerns

regarding the state of the art of TVET. Particular concerns are identified as poor enrollments in TVET with very limited female enrollment numbers, concept transformation meaning transformation from theory to practice, a curriculum that place emphasis on academic excellence rather than skills development which result in graduates relying on the Government for employment. It is alarming that the unemployment rate for a population of about 128 million people increased from 5.8% in 2008 to 23.9% in 2012 according to the National Bureau of Statistics/World bank, 2012. The authors refer to various options applied in other countries such as a dual system or training after graduation to discourse the current TVET system to foster economic stability, a productive labour force and an improved gross domestic product. They urge for policies to seriously attend to TVET and emphasise the dual system that involves technical and vocational training in government approved industries and commissioned agencies (Okoye & Chijioke, 2014, pp. 85-91). The importance for policies to find a balance between national and international relevance is the major challenge to meet. Policies must become operational to have the desired impact. Although identifying the problem is a major step towards transformation of TVET in Nigeria, an assessment and development model to measure and provide scientific evidence to inform these policies, is critical.

The study on TVET in Europe and Eurasia (E&E) region focused on the major structures, reforms, policies and effective practices. While acknowledging the differences and challenges, common factors could be identified to assist policy makers and programme developers towards a better understanding of the existing status quo, while identifying encouraging improvements in TVET. Five new United States Agency for International Development (USAID) policies impacting and shaping TVET programmes in the agency are:

- USAID Forward: to build local sustainability and service delivery while fostering innovation and capacity.
- USAID Evaluation Policy: Evidence-based policies and programmes in TVET and workforce development.
- USAID Education Strategy: Access and equity in conflict areas; Workforce development to strengthen demand driven systems.
- USAID Gender Equality and Female Empowerment Policy: Narrowing the gender gap in terms of skills and economic opportunity by increasing female empowerment. USAID Youth Policy: Improved access for economic and social opportunities to share

in economic growth and to contribute to household, community and national well-being.

Strategies deriving from these Policies lead to TVET priorities based on five principles:

- Using evidence-based research and evaluation to establish the types of policies and programmes that can work in TVET.
- Promoting innovative TVET projects and reforms in the fields of new qualifications frameworks, skill competences, industry partnerships, increased articulation and access to Higher Education as well as social inclusion.
- Supporting equity and access to education and training inclusive of life-long learning, gender considerations and disadvantaged groups.
- Building and extending partnerships with stakeholders to promote wider participation in conjunction with demand driven solutions to ensure sustainability in TVET.
- TVET delivery is spread across levels of Government and Ministries and therefore requires effective and efficient policy co-ordination and governance (Fawcett, El Sawi, & Allison, 2014, pp. 42-44).

A deliberate plan of action should guide decisions to achieve rational outcomes. This must include frameworks of action across the system to steer and shape decisions, strategies, programmes and behaviours (Markussen & Sandberg, 2011, pp. 391-406). Furthermore, policies should not only focus on expanding the TVET system in their current state of unmet potential to meet the growing demands placed thereon, but on expansions founded in evidence based research data (Marope, Chakroun & Holmes, 2015, p.19). TVET is engaged in diverse Policy and Government initiatives to address the national mandate and simultaneously improve the glooming student success rate. Policy frameworks, strategies and guidelines require precise action plans to effect the desired change and not to remain excellent paper work.

2.8 DIMENSIONS OF COMPETENCE DIAGNOSTIC ASSESSMENT AND DEVELOPMENT MODELS.

Assessment and the pivotal role of TVET is extensively stated and acknowledged in policies, general socio-economic and educational forums but a scientific measuring model to assess the impact thereof on the development occupational competence and commitment, is seriously lacking. The steering away from a rigid, narrow problem solving paradigm and applied

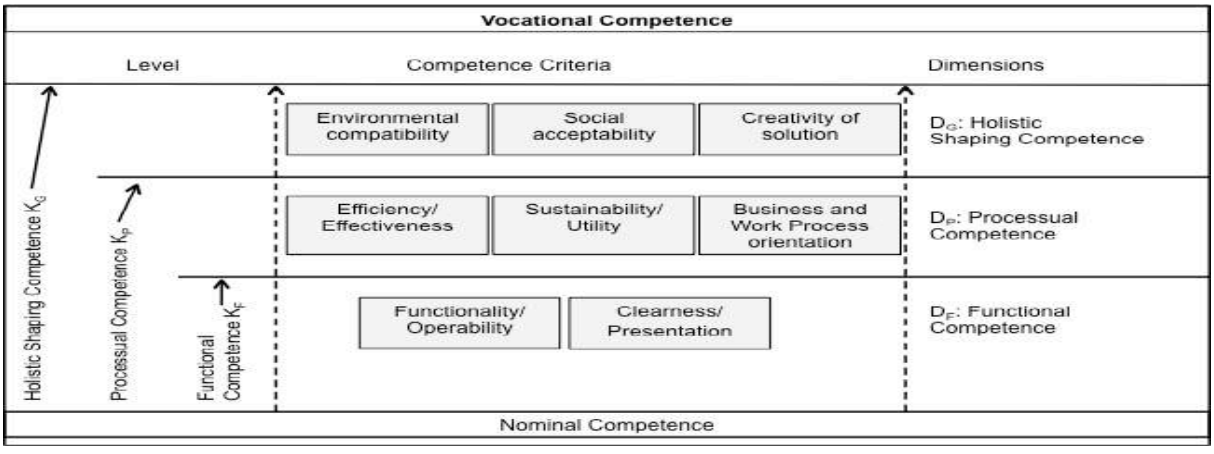
knowledge towards holistic problem solving which is reflective of nature can alter the way in which students interact with the reality of work.

Various models were developed such as the Dreyfus Novice to Expert five-dimensional model of skills acquisition based on the principle that humans evolve from rule guided "know that" to experienced "know-how" as illustrated in Figure 6. A high level of skills acquisition resulting from extensive, concrete experience in specific, contextual real life situations is imperative in an unstructured problem area (Dreyfus, Huber, Dreyfus, Stuart, 1986, pp.19-21). This model is valuable but it does not provide a measuring tool. It is of critical importance but focus on one aspect or axis of occupational competence.

COMET is designed to measure occupational competence by using open-ended test tasks corresponding to the processing of orders and training objectives in the world of work. There is therefore no simplistic YES or NO responses but rather comprehensive responses based on eight competence criteria (Heinemann & Rauner, 2011). The focus is on problem solving, project orientation and practical learning. Learning tasks are a fundamental component of occupational competence assessment and development. Competence, skills and knowledge of the target group range from detailed help and specifications to beginners to merely giving the task to advanced learners. This must be done in a manner that safeguards reflection on practice and the establishment of complex relations (Scholz & Heinemann, 2013, pp. 107-110).

The eight COMET criteria illustrated in Figure 7 below defines the three levels of competence. The competence levels are accumulative of nature but allows for the possibility to determine the diversity in terms of the quality of the solutions within the levels as illustrated in Figure 7.

Figure 7: Criteria and levels of occupational competence

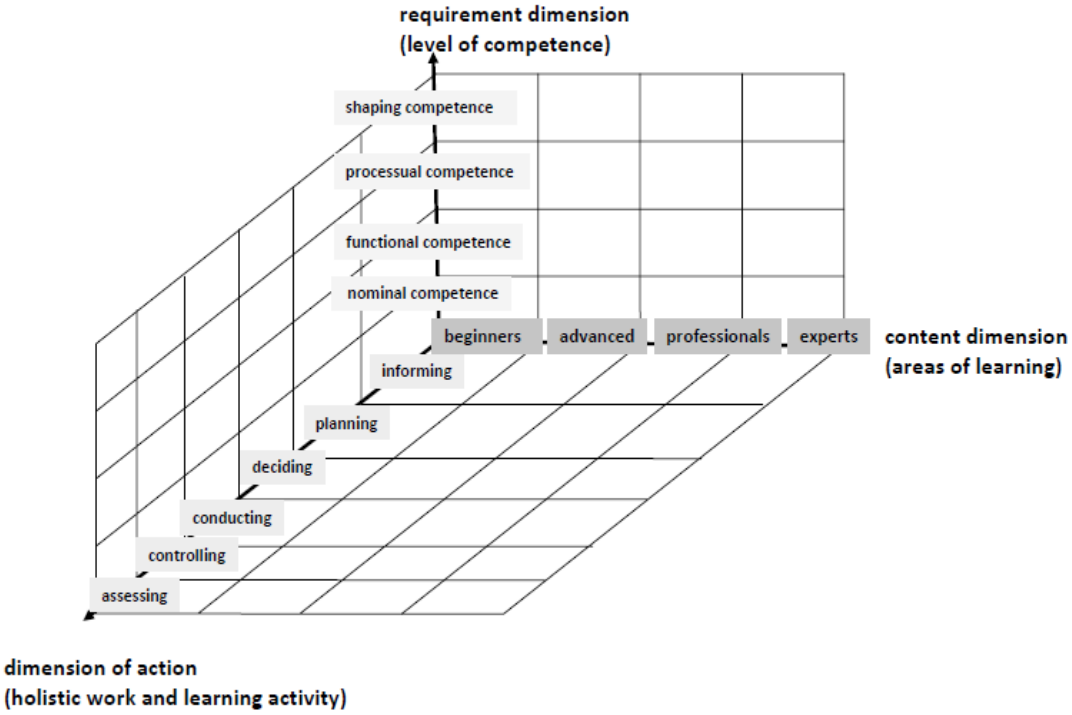


(Rauner, 2016)

These eight criteria must be implemented to enable holistic problem solving. Functionality and the clarity of the solution must be in place before the other criteria can be considered. The solution must be workable and clearly deliberated. Occupational competence measured at levels of Nominal, Functional, Processional and Holistic competence allows for diagnostic assessment. The potential for development is increased as opposed to Outcomes-based assessment results rated as either *competent or not yet competent* (Meyer & Orpen, 2012, p. 217).

COMET Competence model has three dimensions (Figure 8) namely, the Requirement dimension, Content dimension and the Action dimension.

Figure 8: Dimensions of the COMET competence model



The Requirement dimension (levels of professional competence):

- Accumulative competence is a fundamental principle of COMET: Nominal, Functional, Processual and Shaping Competence.
- It is defined on the basis of skills associated with holistic problem solving in work tasks.

- Allows for concrete description of empirically tested competences at various levels ranging from Low to High competence levels.
- Quantitative and qualitative differences at competence levels can be described.
- Competence profiles can be generated based on the eight competence criteria.
- Quantitative scores or performance indicators can be interpreted according to the eight competence criteria underpinned by rules for the transition from one competence level to the next according to threshold values.
- COMET methodology is not a norm-oriented test procedure meaning that the boundaries between competence levels are not based on the complexity and degree of difficulty of the test tasks.
- It is a multi-level model implying a ranking from lowest to highest in three competence levels, one being lowest and three highest possible level of competence. The levels can be achieved independent of the phase of the training process.
- The model allows for the matching of a solution to an appropriate competence level. The crossover test arrangement makes it possible to assess professional competence development during training (Rauner et al. , 2013, pp. 41-43).

The Content Dimension:

- The content of teaching and learning in a specific subject or learning area serve as a basis for the test development.
- Diverges from large-scale international comparative assessments such as PISA where a "world-curriculum" is adopted.
- COMET is based on professional validity as a criterion for the content development of test tasks.
- This dimension is justified by learning and development theory and the application thereof allows for an occupation-specific implementation of a trans-occupational test concept. This means that competence levels and development of learners in different occupations as well as different VET (TVET) systems can be assessed comparatively. Furthermore, Competence development can be systematically assessed at different stages in a vocational training programme.
- Phases of competence development must be identified from Novice to Expert worker.

- Competence development must be supported by characteristic work tasks transformed into developmental tasks (Rauner et al. , 2013, pp. 43-49).

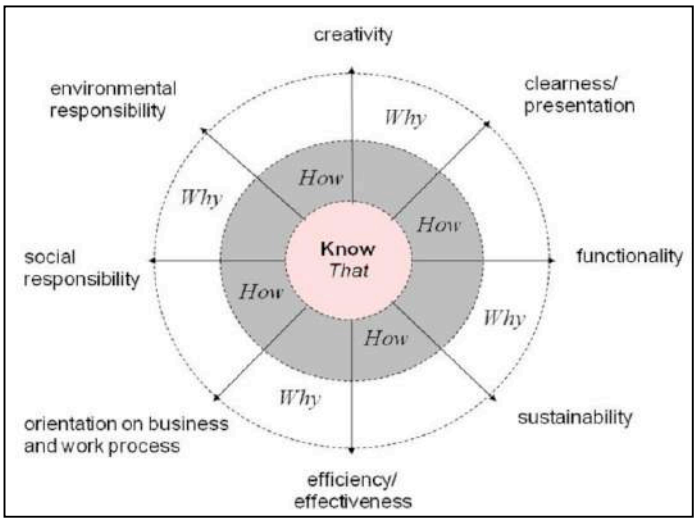
The Action Dimension:

- The humanisation of the world of work underpinned by "complete professional action" is a fundamental normative principle.
- Holistic tasks, meaning the shaping of work, are viewed as an aspect of personality development.
- It is diverged into six steps of activity aiming at validating holistic problem solving constituted by the requirement and the action dimensions, contributing to refining COMET as a basis for the development of test tasks and the rating of solutions.
- The instrumental rationality didactic approach adopted in the action dimension is however more appropriate for beginners and less so for advanced learners and experts. It is necessary to take cognizance of the vocational debate regarding instrumental rational activity typical of professional tasks with a clearly defined objective within a structured and systemic approach and design-oriented, dialogical type of activity, with more open objectives and limited foreseen and planned activities. Both approaches are applied in professional work according to the characteristics of the work task and tend to overlap.
- The actions are: informing, planning, deciding, conducting, controlling and assessing (Rauner et al. , 2013, pp. 49-52).

As discussed above, the dimensions of competence diagnostic assessment and development models must serve as quality assurance tools that lead to the development of holistic competence in an occupation. The achievement of work process knowledge requires a fine balance between knowledge and skills learnt at institutions of learning such as TVET colleges and real work place undertakings. A dual vocational education programme holds the potential to develop shaping competence and equally so, the ability to independently control and manage professional tasks. The dimensions described are embedded in the Work Process Knowledge criteria for the complete (holistic) solution of professional tasks.

The eight COMET criteria required to solve problems holistically within the context of the specific task are illustrated in Figure 9 at the Work Process Knowledge levels of *know that* (knowledge to guide action), *know how* (knowledge to explain action) and *know why* (knowledge to reflect action).

Figure 9: Criteria for the complete (holistic) solution of professional tasks – Work Process Knowledge.



(Rauner, 2011, p. 25)

These eight criteria need to be deliberated to alleviate the risk of a worker offering solutions to customers that do not comply with legal and technical rules. Economic operability, Social compatibility and equally so, Environmental compatibility in the world of work are fundamental principles of professional problem solving competence. The *know-why* level of Work process knowledge, referring to the knowledge to reflect action is essential in sustaining the capacity for holistic problem solving competence and involves reflective thinking such as: *why doing it this way and not in another way?* (inAP, 2012, p. 4; Rauner, 2011, pp. 19-26).

2.9 OCCUPATIONAL COMPETENCE AND COMMITMENT FRAMEWORK.

Various approaches are adopted to explain the concept of competence. It is likely that the frameworks will be impacted by these conceptualisations. The Behaviourist approach highlight observation of successful and operative job performers in an attempt to determine what differentiates them from less successful employees, hence the importance of training and development; Generic approach identifying general abilities in substantiating differences in performance based on an analysis of predominant characteristics of top performers; Cognitive

approach focusing on general cognitive competences and is often applied in intelligence psychometric models which is very specialised; Social-constructive approach stressing the corresponding competences required for successful societal conduct on the one hand, being learning competence, cooperation, problem solving, information processing, coping with uncertainty, decision-making, risk management and on the other hand, collaborative competence indicative of social-constructive learning (Mulder, Weigel & Collins, 2006, pp. 65-85).

It is clear that the traditional methods of TVET delivery does not suffice and alternative measures to impact the current system must be examined. A problem-based learning (PBL) approach is one possibility. The German-Malaysian Institute (GMI) identified a lack of generic skills such as problem solving, critical thinking, communication and leadership amongst TVET students and recommends a shift from traditional teaching to a PBL approach. In this approach the educators move from providing knowledge to facilitating knowledge, actively involving learners in the learning process. The need for TVET students to acquire technical skills through hands-on-work experience to be able to solve authentic problems in the place of work is once again highlighted (Mohamad & De Graaff, 2013). The PBL principle where the curriculum-based content is transformed to become the problem to be solved is a distinctive component of COMET assessment and development of occupational competence, focusing on solving complex real-world problems, holistically.

Critical elements of the COMET occupational competence and commitment framework are outlined below:

- Interactive, scientific, practical and administrative competence towards change corresponding with negotiated objectives.
- TVET practitioners as promoters of innovative projects.
- Theoretical sound and empirically verified model.
- Establishment of strengths and weaknesses in the system.
- Provision of immediate pedagogical support to educators.
- Large-scale competence diagnostics for comparative studies with use value for governance and support systems in TVET.
- Creating opportunities for constructive dialogue.
- Concept of learning areas.
- A theory based model empirically analysed.

- A paradigm shift from a subject based TVET to a design based on developmental logic.
- Quantitative assessment of professional competence and competence development.
- Assessment of vocational identity and commitment.
- Professional acting competence as an indicator of the level of professional aptitude.
- Professional work process knowledge.
- Normative of nature as a result of learning action guiding rules valid by virtue of social convention.

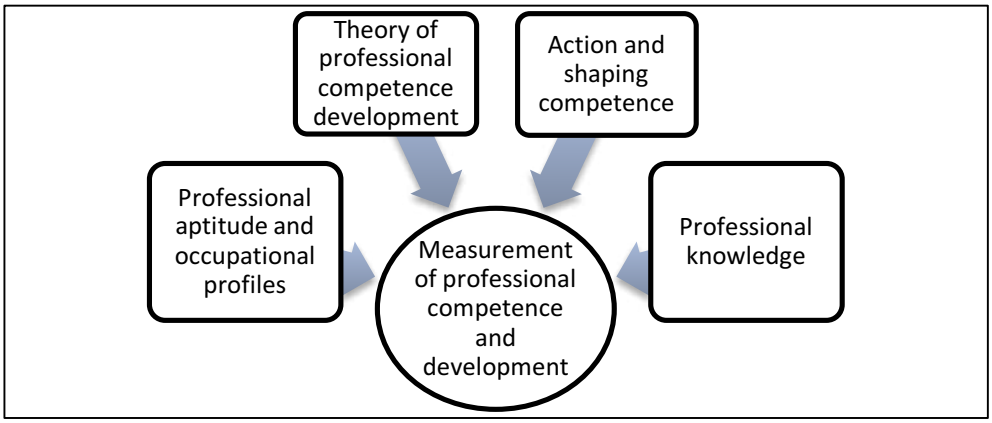
Vocational Education and Training processes are based on the intention to influence the process of learning action –guiding rules that are valid not by virtue of natural or technological regularities, but by virtue of social convention. A model of professional competence therefore always includes a normative component according to Brandstäster, 1984.

Components of the Framework of vocational education are composed of:

- The concept of professional knowledge.
- The learning objective "action and shaping competence."
- The objective of professional aptitude as defined in the professional profiles and curricula.
- The theories of professional competence development.

The conceptual framework for the measurement of professional competence is illustrated in Figure 10 below:

Figure 10: Professional competence framework



(Rauner et al. , 2013, pp. 19-20)

The conceptual framework of COMET occupational competence model includes a normative component and is founded in normative as well as relevant empirical research. A thorough and precise understanding of the anticipated results of programmes and institutions of Vocational Education constitute the basis for the development of a competence model.

Knowing within the vocation as outlined by Lindberg (2003) can be seen as a result of reflected work experience and involves the following work related categories:

- Tools needed for performing the vocation specific work.
- Materials and their properties – vocational language for the categorisation, identification and description of material.
- Methods and techniques that are vocation specific.
- Planning – sensualised idea of the task and the ability to organise the work.
- Professional Ethics – interaction between the quality aspect of the vocation and being a representative of the vocation.

The relevance of a competence diagnostic model that is based on the concepts of working process orientation and shaping orientation in TVET is highlighted.

The training objective is therefore to develop:

- Professional Aptitude
- Acting Competence
- Shaping Competence

The common objective for the above is: "*to learn an occupation*".

With regard to Professional knowledge, there is a shift from the PISA deterministic ideology of *applied science* to *design of technology*. The work tasks of the professional profile need to be the point of departure for technology pedagogy.

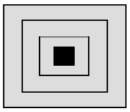
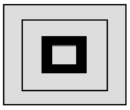
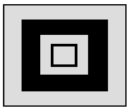
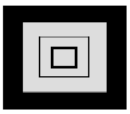
Work process related dimensions of work and learning are based on the following criteria:

- The subject matter of professional work - to analyse and organise work and learning from the perspective of professional work processes. It is captured in work related concepts and their representation in the professional terminology.
- Tools, methods and organisation of professional work – the domain specific and situated context determines the condition for the tools, methods and organisation of work to become a topic for research and development in TVET pedagogy.
- Requirements for professional work – determined by legislative directives, public authorities, industry, customers, the enterprise and the subjective interests of employees. These diverse requirements must culminate in documents to inform the organisation of work and learning processes with the intention to accomplish shaping competence.

TVET is a process of developing acting and shaping competence. Professional competence development requires that the contents of vocational training programmes be based on subject theory that must be developmental of nature. Figure 11 shows the four progressive stages of learning according to the developmental structure theory:

- Knowledge for orientation and overview.
- Integrated knowledge/systemic work tasks.
- Knowledge of details and functions/problem oriented, special tasks.
- Experiential and systemic in-depth work knowledge/unpredictable work task.

Figure 11: The progressive stages of learning according to the developmental structure theory.

Learning areas			Working tasks	problem- solving
(4) Experiential, systematic in-depth knowledge	How to relate knowledge to changing contexts.		Unpredictable work-based problems	experience-based and intuitive (non-deterministic) problem-solving
(3) Detail and functional knowledge	What is important in detail and how things operate.		Problem-based special working tasks	Theory based (non-deterministic) problem-solving
(2) Integrated, professional knowledge	Why and how things are related the way they are.		Systematic working tasks	Systematic, rule-guided problem-solving
(1) Orientation and overview knowledge	The occupation's main content.		Career guided oriented working tasks	Guided (deterministic) problem-solving

(Rauner et al. , 2013, p.28)

Figure 11 outlines the four developmental areas according to which TVET programmes can be organised on developmental logic, as:

1. Orientation work tasks – Novice apprentices work systematically according to rules and regulations and quality standards.

2. Systemic work tasks – professional knowledge is integrated and may lead to a reflected professional identity.

3. Problem-orientated special work tasks – major developmental tasks that involve professional responsibility and quality awareness.

4. Unpredictable work tasks – reflective professionalism is integrated with subject specific competence that may lead to an extended self-concept and higher education towards a career path associated with the relevant occupation.

Professional identity and occupational commitment are two aspects that give an indication of how employees relate themselves to their work. Professional identity is the result of a development process and it is closely linked to the development of professional competence.

Earlier studies by amongst other, Becker and Carper (1956) influenced the evolving of the Organisational Commitment Questionnaire (OCQ) by Porter and Smith (1970). The concept of occupational commitment as revised by Cohen alludes to: *one's attitude, including effects, beliefs and behavioural intention towards his/her occupation* (Rauner et al., 2013, p. 34).

The movement from functional orientation to business process orientation in the organisational structure enhances the development of professional identity. The move towards a business process orientation articulates in participatory management with a flatter hierarchy and subsequent emphasis on shaping competence, commitment, responsibility, and quality consciousness (Rauner, et al., 2013, p. 32).

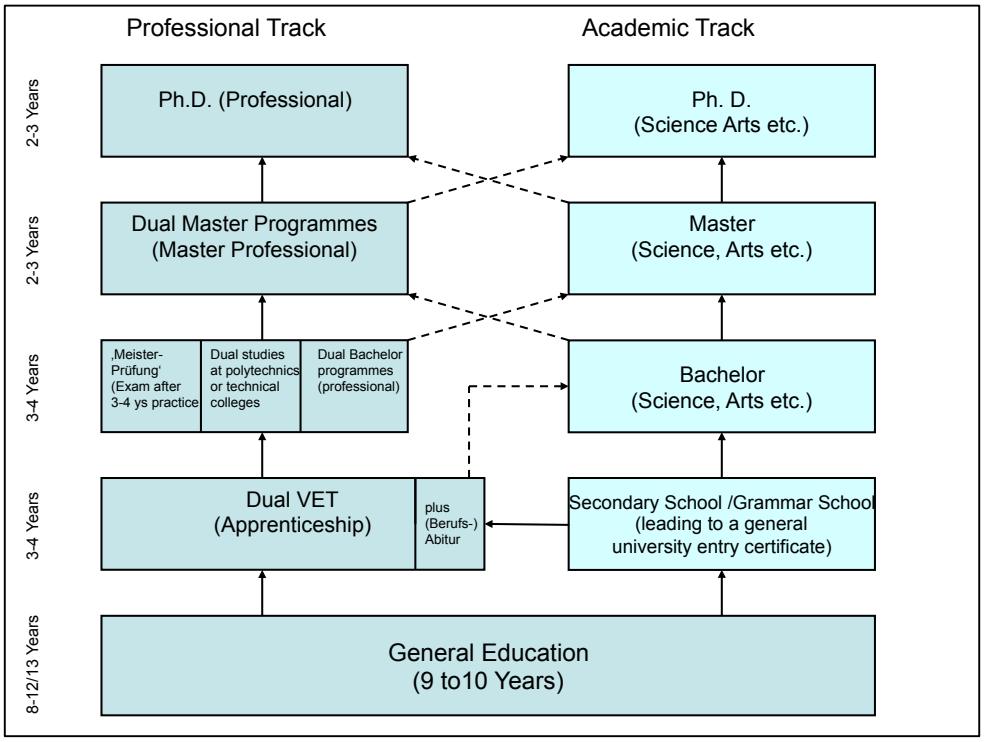
A dual academic track is an instrumental facet of the occupational competence framework and aims to facilitate articulation to further learning opportunities in Higher Education to pave the way for lifelong learning and accredited recognition of prior learning (RPL). The integration of a continuous dual track alongside the traditional academic levels beyond compulsory school education as presented in Figure 12 below, is a major achievement. This reform strategy holds the possibility of addressing the inequalities between TVET programme levels and Higher Education program levels on the NQF with the possibility of an improved attractiveness of TVET occupations.

The dual track is based on two key elements:

- An academic track based on the student's ability to study in a scientific discipline to ensure that standards are not compromised;
- A continuous track of dual vocational education ranging from the level of skilled workers to dual study programmes (Master professional).

The three qualifications below the doctoral level (Skilled worker, Master craftsperson/Bachelor professional, Master professional) leads to professional competence inclusive of professional aptitude, reflecting the understanding that every occupation needs to be learned in a live work process. The objective requirements in the world of work necessitate skilled workers to be able to find holistic solutions for professional tasks, which is convincing in the particular located context, capable of reconciling conflicting criteria.

Figure 12: Architecture of parallel tracks with a continuous dual vocational track



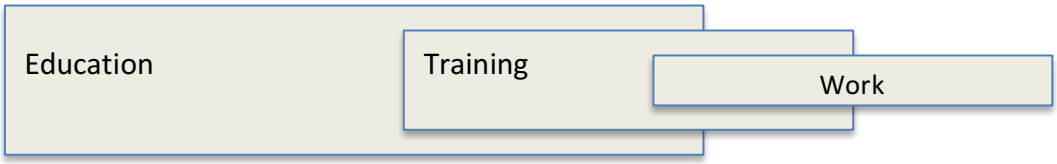
(Rauner , 2015).

Achieving the ideals of a dual track system in developing countries such as South Africa requires intensive intervention strategies. The high dropout rate is a typical challenge to be addressed. Lessons are to be learned from countries such as Germany who made significant progress whilst acknowledging the challenges facing a dual vocational system. Many students are not included in such a system and alternative pathways must be sourced to provide access for them to meaningful socio-economic inclusion. The basic vocational training year (Berufsgrundschuljahr) exposes students to a specialised vocational training. The pre-vocational year exposes students to a variety of occupational fields (Deitmer, Hauschildt, Rauner & Zelloth, 2013). These two levels may serve the TVET students in South Africa very well. Currently policy allows the NCV students direct access to full time vocational education. The exposure to a vocational education environment will serve as a transition strategy from school to college and might impact positively on throughput and retention rates, occupational competence and commitment and socio-economic responsiveness.

An integrated education, training and work approach as adopted in the PIL (Pathways of Work Insertion – Figure 13) by the University of Ferrara in Italy serves the occupational competence and commitment framework better than a totally fragmented sequential approach, but the fact

that actual work experience is introduced in the last phase of the educational pathway poses a risk. PIL is an alternation process that requires coordinated effort to add value for all stakeholders (Masino & Gandini, 2011, pp. 171-174). Notwithstanding, the dual system of vocational training, implemented in Germany, Austria and Switzerland to train artisans for numerous occupations appears to be a more suitable option for TVET. It involves training that occurs at both company level and in a vocational school (Stuart, 2015, pp.22-23).

Figure 13: PIL alternation approach (Percosi di Inserimento Lavorativo', Paths of Work Insertion)



(Masino & Gandini, 2011)

The interaction between workplace and institution based leaning and training is imperative to enhance learner and trainer professional development. Effectiveness of collaboration can be improved by addressing the elements of clear goals, communication, cooperation in terms of roles and responsibilities, trust, evaluation and feedback (Rashidi, Rauner, Ludger & Hassan, 2011, pp. 195-198).

This research study investigates the possibility of incorporating social competence in the overall occupational competence framework. Social competence can be seen as a composite of social skills and adaptive behavior. Socially competent people engage in social skills behavior that leads to positive outcomes and consequences during social interaction. It is therefore the ability to perform a social skill (Elksnin & Elksnin, 1995). Social competence development is of specific relevance to TVET being one of the most complex sectors in Education, covering a wide range of ages and profiles. Social skills are applied in the interaction and communication with others while developing a social structure characteristic of sustainable, positive relationships (Mustapha & Rahmat, 2013, pp. 1-15). Greenspan's model of social competence defines social competence as that portion of an individual's perceived effectiveness in interpersonal situations and social roles that can be ascribed to qualities of temperament, character and social awareness (Oppenheimer, 1988, pp. 43-49).

The Centre for Organisational Cultural Competence brands social competence as *The New science of Success.* Karl Albright describes Social Intelligence (SI) as the ability to get along with others while winning their cooperation. A *social radar* reflects a combination of sensitivity to the needs of others, an attitude of generosity and consideration and a set of practical skills for interaction (The Center for Organizational Cultural Competence, n.d.). The aspect of personality type must however be taken into account and can complicate the assessment of SI. Identifying Social competence is more comprehensive than SI. It is multidimensional concept consisting of social, emotional, cognitive and behavioural skills. It is further underpinned by motivational expectations such as moral development and self-efficacy as a requirement for successful adaptation. Social skills need to be developed to achieve social competence.

2.10 CONCLUSION

Assessment concepts are frequently used in education, public and government circles. The complexity of assessment as outlined in the first part of Chapter Two is often underplayed. Assessment as a fundamental element of learning requires in-depth understanding of the construct. The assessment of occupational competence and commitment in TVET is a central factor in preparing students for the complex world of work. The policy mandate of TVET to address socio-economic challenges requires a competent and capable workforce. A dual TVET system, comprising of theoretical knowledge and workplace practice, seems to be a suitable option in the preparation of students to solve problems holistically. The conceptualisation of assessment and development of occupational competence in TVET is often fragmented and diminished to specific abilities or skills. Although the science of assessment has been extensively studied, very few researchers have analysed the power thereof on occupational competence needed for modern work and equally so, the impact of related policies and strategies on the actual development of holistic shaping competence.

The second part of Chapter Two relating to the theoretical framework outlined the national and international policy guidelines, strategies and governing bodies in TVET. Challenges and opportunities for TVET were examined and fundamental components of occupational competence and commitment such as transformational competence diagnostic assessment,

legislation and socio-economic context, the dimensions of competence diagnostic and assessment and the occupational competence and commitment framework were interrogated.

South Africa is a constitutional state and offers protective measures to its inhabitants. This country has one of the most comprehensive labour law systems in the world (Kinnear, 2009, pp. 81-85). Amendments are continuously made to policy and strategy documents to improve the quality thereof. South Africa is placed in the 56th overall position on GCI 2014-2015 but performed well on policy matters for example, its legal framework for disputes is placed at 9th position. Macroeconomics, however, is placed at 89th position. The need for transcendence from policy to practice is an opportunity for diagnostic assessment and the consequent development of occupational competence in TVET, to apprehend.

This chapter demonstrates the need for scientific research to find new ways of addressing challenges in TVET. It is clear that the curriculum-based assessment cannot measure occupational competence levels of TVET students or systems. While the use of formative and summative assessment types in TVET to obtain a qualification is mandatory, its use value in advancing the occupational competence needed for real work in modern occupations is debatable. The possibilities of a model to discourse the TVET system to include the development of holistic shaping occupational competence, as a primary focus in preparing students for real work, is essential. Globally, TVET is perceived to be capable of producing students with the expertise to address socio-economic and political challenges. One of the major challenges identified, is youth unemployment. Moreover, the paradox of youth unemployment and vacant jobs discussed in this chapter necessitates an in-depth enquiry in student readiness for a flatter work organisation that needs responsible and competent employees in the direct productive layer. A model to quality assure the operations of workers in this flatter organisational design of modern work which requires creative solutions to address complex problems, has become a critical element in TVET reform.

This study contributes to emergent literature on the assessment in TVET to include the diagnostic assessment and development of occupational competence beyond traditional curriculum assessment processes. In fact, it introduces a model of diagnostic assessment that is pivotal for a new debate regarding institutional quality processes in TVET curricula and examinations.

Chapter Three unpacks the Research questions

CHAPTER THREE

RESEARCH QUESTIONS

3.1 Introduction

The assessment and development of occupational competence in TVET is positively associated with student readiness for a constantly changing world of work. Many national and international policies and strategies have professed the decisive role of TVET to impact on a workplace ethos responsive to socio-economic and political imperatives. The correlation between these directives and the current TVET structure to deliver a competent workforce, capable of transforming the socio-economic and political landscape, is explored in this study. The NSDS III adopted in Commitment Five, the focus on young people's access to Education and Training for the purpose of sustainable employment. In Commitment Six, the emphasis is on technological and innovation capabilities to enhance global economic competitiveness and to respond to human development priorities (Department of Higher Education, RSA). Another key directive for TVET is the DHET White Paper for Post School Education and Training published in November 2013, which extensively addresses issues pertaining to the strengthening of TVET Colleges to become the cornerstone of South Africa's skills development system. This White Paper further acknowledges that engineering studies are still strongly dominated by Males. UNESCO endorses this observation by referring to real gender parity that goes beyond numbers, to find equilibrium in gender participation in programmes that lead to employability as well as to decent and high-paying jobs (Marope, Chakroun & Holmes, 2015, p. 19). Furthermore, a major consideration is on improving Teaching and Learning. Youth unemployment is noted as a principal aim for an increase in education and training opportunities in TVET for Youth. Deficiencies in Workplace Learning is recognized as a barrier to the development of the necessary practical skills causing students to exit their TVET study programmes without practical competence (DHET, 2013). The South African Government identified twelve outcomes of which Outcome Four is situated in creating decent employment through inclusive economic growth. Outcome Five focuses on developing a skilled workforce and outcome Six, an efficient, competitive and responsive economic

infrastructure. These outcomes are linked to the MDG's: Outcome Four, to MDG One, focusing on productive employment and decent work and Outcome Five links to MDG Three on Gender equality and empowering women. In the MDG Country report-2013, poverty, unemployment and inequality are identified as the triple challenge of South Africa (MDG Country Report, 2013, pp. 19-20).

The predicament of TVET delivery is intensified by the G20 Leaders' agreement that training workers for their specific current needs is no longer feasible. Instead, training programmes should focus on lifelong skills development with future markets in mind. Impetus should be on the demand for non-routine analytic skills such as creativity, problem solving, communication, teamwork and entrepreneurship (ILO, 2011).

In further support for the need for research to reform TVET, Owens refers to the concept of a new era in manufacturing that requires a new kind of *elite* worker who is equipped with reading, writing and mathematics skills, as well as advanced problem solving capabilities. The supply of the elite workers necessitates creative, resourceful and tangible solutions as a precondition for addressing the skills gap characterized by mismatched workers attempting to do *today's work with yesterday's tools* (Owens, 2015, pp. 37-39). TVET initiatives thus far, did not manage to deliver these elite workers to narrow the skills gap.

The understanding of Lean manufacturing, adopted by numerous companies as introduced in Chapter One, is an additional reality to be addressed by TVET. The sector needs to produce students capable of functioning in a *managing by participation* environment as illustrated in Figure 3. One of the key elements of lean manufacturing is to involve everyone and to ensure that they know the score. Employee understanding of, and engagement in various company objectives such as identifying areas for improvement, leading projects or to be active in the execution of tasks constitute the foundation for a lean culture of proactive problem solvers (Garvin, 2015, pp. 42-45). The inquiry around student holistic problem solving capabilities is a major focus of this research that ultimately directed the formulation of the research questions.

TVET systems need to deliver way beyond the typical request to contribute to economic growth, employment and competitiveness. TVET is considered to be a crucial vehicle for social equity and inclusion as well as for sustainability of development (Marope, Chakroun & Holmes, 2015, p. 8). TVET as a means to decent work is clearly considered as a priority by Governments globally. Youth unemployment figures are however not reflecting the investment in the TVET system.

The question arises: What is needed to reform and capacitate current TVET systems to be responsive to the socio-economic-political and innovation demands on occupations in the 21st century?

This chapter deals with the research questions that will guide the scientific investigation in responding to the what, how and why of the potential and relevance of the COMET competence diagnostic model for the assessment and development of occupational competence and commitment in TVET.

The move from the deterministic understanding of Technology → Work Environment → Education and Training to an interrelated approach compels a paradigm shift from adaptation to a shaping approach. This interrelated approach requires a new way of thinking in TVET as described in Chapter Two.

3.2 MAIN RESEARCH QUESTION:

TVET has become a driver for the primary and secondary mandates of global socio-economic and political imperatives as indicated in the literature review in Chapters One and Two. This stance towards TVET implies an understanding far beyond policies and strategies, because it requires a change in the organisational culture of TVET and the reshaping of TVET decision-maker frame of mind. The extent, to which TVET is prioritized at prominent global forums to mitigate national and international socio-economic and political crises, is becoming a focal area of interest to be researched. Current interventions thus far did not deliver the desired result relative to the investment. As a result, alternative assessment models, such as COMET should be tested for its potential to address the occupational competence dilemma in TVET.

The literature review revealed numerous ontologies for assessment in TVET but the focus is on curriculum and examinations within an applied knowledge paradigm, which is not effective for the development of futuristic, reflective, professional competence for the 21st century, modern organisations and work.

The approach in this study goes beyond assessment to obtain a qualification for a specific occupation but to a broader development of professional competence leading to multi-skilled workers equipped with holistic shaping occupational competence, hence the main research question:

Would the implementation of the COMET competence diagnostic model in TVET effect higher quality assessment for the development of occupational competence and commitment?

The NSDS III Framework empasises the need for a broader foundation for work in a variety of contexts, full occupational competence and critical citizenship. Currently TVET occupations are quality assured by the Quality Council for Trades and Occupations (QCTO). The QCTO Curriculum and Assessment Policy (2011) presented assessment as a crucial element of occupational curricula. The policy document however, does not present a model for the development of occupational competence to accomplish the strategies envisaged. QCTO as part of the National Qualification Framework (NQF) stipulates knowledge, practical work and work experience as the criteria for occupational qualification towards NQF level progression (NETWORX FOR CAREER DEVELOPMENT, n.d.). The purpose of the study is to test and present the potential of COMET competence diagnostic model to address the identified gaps such as national benchmarking in TVET assessment.

Literature on assessment in general is numerous but very rare on assessment of occupational diagnostic competence that is measurable and transferrable.

The research question investigates firstly the assessment concepts implemented in TVET in terms of developing competence. Secondly, it investigates the relation between conceptual and practical competence. Thirdly, it investigates the impact of the assessment feedback structure and tools on the development of occupational competence and commitment.

3.2.1 SUB-QUESTION 1: Which assessment concepts are implemented in TVET?

The complicated scenario of competence viewed as an overarching term for divergent research strands on human capacity and its assessment elevate the risk of misunderstanding in public and scientific discussions about TVET (Straka, 2004, pp. 263-311). It is therefore imperative to empirically research the relevant concepts of Competence.

> "It is important to ensure that TVET programmes provide real-world skills required by the public and private sectors. Social and economic growth of the country relies heavily on the development and maintenance of a viable, responsive and effective TVET sector" (DHET, 2013). The methods of research adopted in this study will result in the substantiation of vague terminology such as viable, responsive and effective.

3.2.1.1 How do current assessment systems in terms of practice, regulations and quality assurance compare to the COMET measurement?

3.2.1.2 What are the characteristics of the explicit and implicit competence models?

3.2.1.3 Which assessment methods are used?

3.2.1.4. How reliable is the performance criteria for the measurement of occupational competence?

3.2.1.5 What are the strengths and weaknesses in the assessment of the outcomes of final competence measurement?

3.2.1.6 To what extent can students solve occupational problems on a conceptual and a practical level?

3.2.1.7 What is the impact of modularised assessment on competence development?

3.2.2 SUB-QUESTION 2: How are the cognitive domain specific dispositions (competence) transferred into practice? (What is the relation between conceptual and practical competence)

According to the Global socio-economic paradigm as reflected in 2nd edition 2010 of Innovative Apprenticeships, the readiness of TVET students for transition from theory to practice and the subsequent transfer of competence-based knowledge and skills to real-life situations have become increasingly significant in a demanding socio-economic environment. The assessment levels of work process knowledge in tests and examinations need to be researched in terms of their strengths and weaknesses towards the development of occupational competence (INAP Conference, 2009).

DHET is in the process of reviewing all vocational curricula to align it to labour market requirements with a huge focus on artisan development programmes. The aim is to improve the integration among theory, practice and workplace experience (Stuart, 2015, p. 21). In order to progress towards achieving the goals set out for TVET, this envisaged integrated learning approach in TVET, will benefit from an evidence centered reform strategy as proposed in this study.

Research is needed to test the impact of a competence-based model on transferrable skills. The quality of assessment as demonstrated in the readiness of the professional to address complex work tasks in real life situations must be established. The Organisation for Economic Co-operation and Development (OECD) stated that learning one set of skills at school, technical college or university is no longer enough to carry people throughout their working life (OCED, 2007).

3.2.2.1 Is it possible to use the COMET competence model for measuring practical competence?

3.2.2.2 What is the impact of the curriculum design on competence and qualification development?

3.2.2.3 How does the concept of occupational areas (lernfeldkonzept) influence the transfer of conceptual knowledge to practical competence?

3.2.2.4 Can social competence be measured?

3.2.3 SUB-QUESTION 3: What is the impact of the assessment feedback structure and tools in TVET on competence development?

The practice of assessment and subsequent feedback to students has long been acknowledged as an essential part of an effective TVET delivery. Suitable measuring instruments are needed to conduct a realistic assessment of the skills and competencies of trainees. The competencies of young people who are trained for various occupations are measured to make them aware of their own abilities (The ASCOT Research Initiative, 2012).

The HSRC report 2008 - 2011, revealed the average throughput rate for Further Education and Training Colleges in South Africa (FETC) NATED programmes from 2007-2009 as 47% and for the National Certificate Vocational (NCV) programme, 30%.

The average retention rate for NCV in 2012 was 61% and the certification rate was approximately 42%. This is a serious indication of the lack of commitment amongst these students. The impact of COMET competence diagnostic measurement and subsequent feedback strategies on throughput rates within the South African context needs to be explored in this study.

Australia's National Quality Council (NQC) refer to an assessment tool as an instrument used to gather and interpret evidence of competence that should assist with validity and reliability (Work-based Education Research Centre of Victoria University, 2009). Assessment should therefore serve the purpose of quality Feedback processes in identifying strengths and areas for development in a reliable manner at an individual and systemic level.

3.2.3.1 How do the established assessment feedback systems in TVET contribute to the development of occupational competence and commitment?

3.2.3.2 How can the COMET competence and measurement model be used as a diagnostic feedback tool?

3.2.3.3 How do the students and staff reflect on the traditional way of feedback in contrast to COMET based feedback?

3.2.3.4 Does the current assessment systems in TVET identify the levels of work process knowledge?

3.2.3.5 What is the potential of COMET competence model to measure the degree of heterogeneity at a higher level of objectivity and reliability?

The research questions provide the framework for the development of the Research design in Chapter Four.

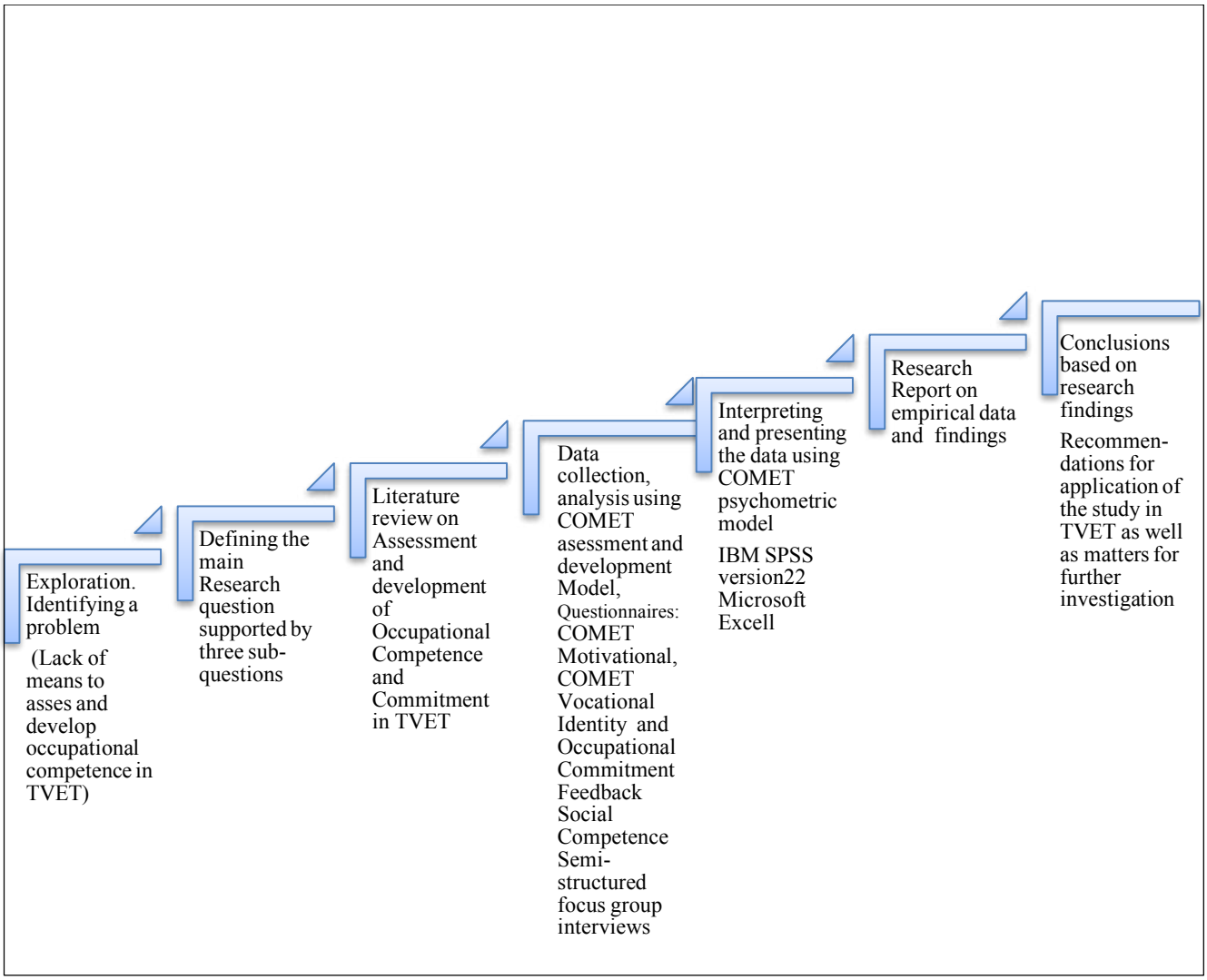
CHAPTER FOUR

RESEARCH DESIGN AND METHODS

4.1 INTRODUCTION

In this Chapter the research design and methods applied in steering the data collection, data analysis and reporting on the findings to address the research questions are explained. Validity, Reliability and Ethical considerations as research principles are verified. The steps followed in the research study are illustrated in figure 14.

Figure 14: Graphic Illustration of the Research Process



4.2 RESEARCH DESIGN

The Research design is a deliberate framework that can be seen as a guiding plan for the execution and implementation of the research. It ensures that research differs from everyday observations in a sense that it is structured and planned. Research designs ensure that the study fulfills its intended purpose as well as feasibility in terms of completion with available resources (Terre Blanche, Durrheim & Painter, 2009, p. 563). It serves as a detailed plan for data collection aimed at answering a specific research question (Bhattacherjee, 2012, p. 5). The research design refers to specific procedures of the research study namely, data collection, data analysis and report writing (Creswell, 2012, p. 26). In this study, it will guide the researcher in answering the overall research question by implementing a mixed method of research consisting of qualitative and quantitative methods. The research questions are not set in concrete and may change as the empirical work proceeds. It however forms the backbone of the empirical procedures and serves as the *what* for the *how* (methods) that we want to apply in the investigation (Punch, 2009, pp. 5-6).

The results expected from TVET research predominantly aim at the planning process of modernisation and reorganising of occupations and occupational fields, the corresponding vocational training plans, the testing of new training tools as well as the development and assessment of new learning and training methods (Rauner, 2009, pp. 703-708). This chapter introduces a research design and methods implemented in searching for the transformational imperatives needed in TVET as outlined by Rauner.

The Cross-sectional research approach was implemented. The data was collected at one point in time (Check & Schutt, 2012, pp. 6-7). The COMET open-ended test tasks minimise the challenge of time order effects of this research design in a sense that it is domain specific, includes test-validation pre-tests and entails comprehensive assessment of real occupational scenarios, which is standard based. The focus group interviews further contributed in clarifying the data. Elements of a parallel design was implemented where, in the case of the National Certificate Vocational (NCV) students, a cohort of levels 2, 3 and 4 students were tested simultaneously on the same COMET open-ended test tasks in the 2014 large-scale occupational competence assessment. This will enable the Researcher to investigate possible stagnation as well as the impact of competence assessment and development on occupational competence and commitment.

The Explanatory Sequential Design as a Mixed Method Design type is used. The focus is predominantly on the quantitative data, which is selected first and followed up by a smaller qualitative data collection to refine the results from the quantitative data (Creswell, 2012, pp. 541-543).

This research study attempts to answer the research questions as outlined in Chapter Three by obtaining direct, observable information from the identified 715 respondents. Research is an organised, systemic inquiry directed at answering well-defined questions (Slavin, 2007, p. 5). This direct experience of the world, in this study, occupational competence and commitment levels in TVET, is referred to as data. Data can be qualitative or quantitative of nature (Punch, 2009, pp. 2-3). Literature review in quantitative research typically entails a substantial volume of literature studies in the beginning of the study. It plays a major role in justifying the need for the research problem and impacts on the formulation of the research questions as well as the potential purpose of the study. A Thematic Review of the literature, where only major ideas and results from studies, supported by numerous references, are used (Creswell, 2012, pp. 13-14). The comprehensive literature study in the first two chapters on occupational competence in TVET clearly indicates the need for a measuring tool for occupational competence, which is necessary for the development thereof.

4.2.1. Research design context

This research study is done within a project initiated by the Manufacturing, Engineering and Related Services Sector Education and Training Authority (MERSETA) in partnership with the TVET Research Group (i:BB), University of Bremen. Skills Education Training Authorities (SETA's) in South Africa are established to address skills shortages. SETA's play a critical role in facilitating workplace learning as well as the establishment of partnerships between employers and educational institutions (DHET, 2013, p. 64). The Researcher, per se, executed the PhD research study independently according to scientific, empirical research requirements.

4.2.2. Quantitative Research

Quantitative research methods allow for efficiency, modeling of real-world phenomena and a powerful, familiar language (Tredoux, 2009, pp. 3-6). The data collection in quantitative methods in this study is influenced by the need for explanation, description and evaluation (Check & Schutt, 2012, p. 11) of occupational competence and commitment in TVET. A quantitative approach of data gathering and analysis, including the analysis of existing forms of learning and measuring of competence in relation to COMET competence diagnostics criteria was conducted. Critical to the COMET large-scale occupational competence assessment is the development of open-ended test tasks accompanied by a large scope of possible solutions.

4.2.2.1. COMET Open-ended Test Tasks

The development of the open-ended test tasks met the following criteria:

- It serves as the key element of the research methods and is the result of technical, didactical and psychometric groundwork.
- The problems to be solved were realistic and domain specific.
- Occupation specific work tasks ranging from Novice to Expert level were included.
- Various levels of accumulative complexity to enable the assessment of occupational competence levels were considered.
- A solution space to allow for a variety of solutions and divergent thinking was incorporated.
- The design of the test task is open and not subject to merely right or wrong answers.
- Tasks go beyond technical knowledge and expertise but are inclusive of the eight COMET criteria (Figure 9) and three dimensions (Figure 8).
- Test tasks had to be solved on a conceptual level for the large-scale assessment. At identified sites conceptual and practical proficiency were assessed.

- Test tasks did not directly refer to college/academic curricula but rather the occupational scope of work (Rauner et al., 2013, pp. 39-53).
- The criterion-referenced COMET Test Tasks is designed to indicate how an individual performs in comparison to a pre-established criterion (Slavin, 2007, p. 100), in this study, holistic problem solving competence.

4.2.2.2 Core Principles of the Research Study

The following core principles were applied:

- Test tasks were developed by subject/occupational specialists to ensure domain specific relevance and content validity.
- A pre-test was conducted to assess Test task validity and suitability.
- Most suitable test tasks in response to holistic problem solving were selected for the main COMET large-scale assessment.

The COMET psychometric model was applied for the analysis of results. The measurement of competencies should be based on a solid theoretical and psychometric basis (Koeppen , Hartig, Klieme & Leutner, 2008, pp. 61-73). This is crucial in terms of inferring quantity and quality.

The Researcher and COMET Raters engaged in observation in conjunction with interviews to assess students' occupational competence and commitment in a work-based/practical scenario. Observation as a data collection technique can be structured or unstructured, qualitative or quantitative of nature (Punch, 2009, pp. 153-155). Structured observation was more applicable to this investigation and hence being implemented. COMET dimensions served as the detailed observation structure. Test Tasks were selected. Students planned the execution of the tasks using relevant resources and finalised a comprehensive plan. COMET test tasks were executed and observed. Students were interviewed during and after the test tasks. COMET raters and the researcher assessed the entire process.

The literature review as part of the desktop research provided substantial insight in the conceptualisation of occupational competence assessment and development as well as occupational commitment and identity as distinct elements in TVET. Conceptualisation refers

to the process of specifying what is meant by a term or concept (Check & Schutt, 2012, p. 66). The literature review encompasses a summary of a variety of books, journal articles, reports, conference papers and government documents and it aims to document the contributions of this study to existing literature (Creswell, 2012, p. 80). It is critical to have a clear understanding of the concepts before an investigation can be done to assist in solving the problem at stake.

4.2.3. Qualitative Research

Qualitative research is designed to be able to examine a phenomenon within the social and cultural environment in which it occurs (Salkind, 2009, p. 12). It succeeds in doing so by generating a rich source of information from which a detailed understanding of the respondent's subjective experiences can be understood and examined in the way in which it manifests itself in their daily lives (Terre Blanche et al., 2009, pp. 47-48). Qualitative research may lead to useful insights to the complexity of human behavior, which is needed for the understanding of holistic shaping competence in the development of occupational competence as well as occupational commitment. Qualitative research characteristics include a natural setting, the researcher as a key element, using multiple methods, complex reasoning, participants' meanings, emergent design, reflexivity and holistic account (Creswell, 2013, pp. 44-47). Data was collected in a natural setting at the sites where students are trained; the researcher conducted the interviews and collected the data; the interview was supported by direct observation of group dynamics; complex reasoning and thinking were facilitated; students' underlying understanding of the problem were explored; the interviews were adapted according to emerging themes outside the initial questions; the researcher explained her background pertaining to the research study to students and a holistic approach supported by divergent problem solving was adopted throughout the interview.

Qualitative research, using the assessment interviewing method enabled the researcher to clarify the contextual matters that surfaced during the COMET large-scale assessment. Three Focus Group interviews of approximately sixty minutes each were conducted with 62 students at three test sites after receiving the COMET Feedback reports.

The purpose of the semi-structured interviews was to ascertain the students' reasons for the levels of occupational competence achieved in the COMET large-scale assessment, their understanding of and experience of COMET assessment versus the curriculum assessment and their values regarding TVET. Transcription refers to the process of transforming audiotaped recordings or field notes into text data (Creswell, 2012, p. 239). The interviews were transcribed and dominant themes were identified.

4.3 DESCRIPTION OF PARTICIPANTS

This section provides an outline of the participants responding to the different research methods adopted in this study.

4.3.1 COMET Large Scale Assessment

A total sample (N= 715) comprised of TVET students and apprentices. Sampling is the first step in data collection. Sampling refers to the selection of participants from a relevant population (Terre Blanche et al., 2009, pp. 49). A combination of TVET students at a variety of institutions enrolled in four TVET occupations were selected. The sample for the study was obtained from six public TVET Colleges (seven campuses), two private TVET Institutions and three Industry Training Academies offering the identified study programmes, namely Mechatronics, Millwright, Welding and Electrical Engineering. True to the nature of COMET, the research is context and domain specific and therefore, four specific study programmes were selected. The various TVET training institutions and programmes provided a broader spectrum of occupational competence scenario and allow for comparisons amongst these variants. Purposive sampling is selected for a specific purpose and may target individuals particularly informed regarding the issue under investigation (Check & Schutt, 2012, p. 104). Purposive sampling as a practical and information specific method for in-depth analysis was chosen as a viable sampling type.

The COMET large-scale assessment encompassed the completion of three fundamental activities for this study namely COMET open-ended test tasks, the Motivational Questionnaire as well as the Vocational Identity and Occupational Commitment questionnaire.

4.3.2 Focus Group Interviews

62 students participating in the semi-structured qualitative focus group interviews at the two TVET Colleges were all in their final year of study - NCV L4 and the Training Academy group was a senior student cohort. The reasons for this selection were that the NCV L4 students had relevant experience in TVET and have been exposed to COMET and the DSAP. The Training Academy students were also sufficiently exposed to TVET Colleges and Universities of Technology, COMET and an Apprenticeship programme.

4.3.3 Social Competence Questionnaire

The senior students involved in the Focus Group Interviews, were deemed suitable to complete the Social competence questionnaire comprising of eight Social competence dimensions. Social competence is a multi-dimensional construct and can be described as the ability to effect and maintain positive social outcomes by organising one's personal and environmental resources (Arnold & Lindner-Muller, 2012, pp. 7-19). The student assessed himself or herself while the lecturer familiar with these senior students assessed the student's social competence on the same criteria. This survey research tool is suitable in a sense that it allows a study of many variables and is relatively easy for students to use (Slavin, 2007, p. 101).

4.3.4. Feedback Questionnaire

Eighteen COMET Raters (N=18) completed the Assessment Feedback Questionnaire.

4.4 DATA COLLECTION METHODS

Statistical inference implying the act to generalise from the sample to the population (Tredoux, 2009, pp. 2-17), to ensure external validity can be justified on the size of the sample, general representativeness of the population in terms of the curriculum content, study programmes, qualifications and guiding policies. Internal validity, referring to the research design and measuring tools, was obtained by implementing pre-tests to validate the COMET test tasks.

All the questionnaires were administered in person to groups of students as written questionnaires. This approach allowed for the completion of surveys once started as well as clarification where needed (Cozby, 2005, pp. 134-135). Rating scales applied in conjunction with COMET measurement for context questionnaires include Binary scales assuming one or two possible values such as yes or no, true or false and Likert scales indicating respondent statements to an extent of agreement or disagreement (Bhattacherjee, 2012, pp. 45-49).

The following measuring tools were applied:

4.4.1 COMET occupational competence assessment and development open-ended test tasks.

Subject experts developed the open-ended test tasks. A Rater Training Seminar followed. Test validation was done during a COMET pre-test. This pre-test or pilot testing assisted in detecting possible problems and it ensured that test tasks selected for the main COMET large-scale assessment were reliable and valid measures of assessing holistic occupational competence (Bhattacherjee, 2012, p. 23). Four test tasks per occupation (Electrical, Millwright, Mechatronics and Welding) were selected. Occupational Competence was measured on the three-dimensional COMET occupational competence and commitment model. A high degree of consistency also referred to as inter-rater reliability, in the rating of solutions is a prerequisite for open-ended test tasks. The 40-item rater responses were validated by means of an exploratory factoring analysis based on the correlations among the 40 items. A typical test task comprises a realistic narrative of a problem, typical and representative of the occupation at stake, to be solved by means of professional problem solving, using the eight COMET criteria. The degree of complexity must allow for the assessment of contextual understanding. The grading of the test outcomes is ability based, making it possible to differentiate among test takers according to levels of solutions presented as being functional, procedural or holistic of nature (Rauner, 2010).

4.4.2. COMET Vocational Identity & Occupational Commitment Questionnaire

This tool explores the participants' attitudes and values towards their profession and training. It comprises of five sections: 1. Personal data and general questions regarding their training company; 2. Personal opinion of students regarding their professions; 3. Company based

Vocational training; 4. TVET College State of affairs and 5. Communication and cooperative Teamwork.

4.4.3. COMET Motivational Questionnaire

This questionnaire measures the levels of motivation applied in test task completion as well as experience of the relevance thereof for TVET. Test tasks complexity, Time spent on task, Student commitment and interest in the test tasks and the student's overall sense of approval for this type of assessment are explored.

4.4.4. COMET Practical Test Tasks and Interviews

The close partnership between workplaces and institutions of learning is a major priority for DHET and the Minister of Higher Education and Training is delighted to see it being endorsed in the motto of the Skills Handbook 2015/2016: *Every workplace a learning space* (Stuart, 2015). It is therefore imperative to explore the impact of COMET on the assessment and development of occupational competence in a practical setting. One TVET College as well as one Industry Training Academy exposed to COMET and DSAP/Apprenticeship participated. There is an increasing appeal for adaptability to new demands, responsibilities and technologies in the workplace. The traditional approaches that focus narrowly on the mode of production are of limited value. TVET should aim to provide a sound foundation in particular skills while inculcating the skills needed to respond to new production modes (Government Gazette No. 38796, Vol. 599, 2015). This investigation consisted of two processes- Firstly the COMET Practical task executed by students and secondly, an interview with the students on COMET dimensions covered in the Practical task. Two COMET Raters rated the Practical task.

4.4.5. Feedback Questionnaire.

This Questionnaire comprises of two sections of 15 items each, measuring the impact of assessment feedback on learning and the development of occupational competence. Section A measures Assessment Feedback in the current TVET Curriculum and section B, COMET Assessment Feedback. TVET staff (*N*=18) involved in COMET assessment and Rater training completed the questionnaire. Raters reported on Assessment Feedback criteria applying a 4-point Likert scale ranging from Strongly Disagree to Strongly Agree.

4.4.6. Social Competence Survey

Senior students from two TVET Colleges (*N*= 20 + *N*= 20) as well as one Industry Training Academy (*N*=22), exposed to COMET and DSAP/Apprenticeship completed this survey. TVET students (self-rating) and TVET staff reported on student social competence on the same instrument measuring eight Social Competence dimensions, defined by four criteria each. An average rating was calculated. Students and Staff reported on the 32-criteria measurements with a 4-point Likert scale from 1(*Never*) to 4(*Always*).

4.4.7. Focus Group Semi-Structured Interviews

The interview as a research method is seen as the most prominent data collection tool in qualitative research. It is a powerful technique to understand and assess people's perceptions, meanings, definitions of situations and the construction of reality (Punch, 2009, pp. 144-148). There are many forms of interviews. For this study, focused group, semi-structured interviews were deemed the most suitable method to use in conjunction with the COMET quantitative assessment. Questions were open ended and posed to the group allowing for group interaction where certain comments triggered a variety of responses (Cozby, 2005, pp. 136-137). The group interaction yielded valuable information to improve sense making of behavior and performance measured in the quantitative research. TVET students who completed the Social Competence questionnaire at the three sites also participated in the interviews - (TVET 1- *N*= 20 + TVET 2- *N*= 20 + Industry Training Academy *N*= 22). The researcher served as a facilitator, moderator and mediator while nine open-ended questions alluding to the impact of

TVET on improving quality of life, differences between Curriculum assessment and COMET assessment, experiences of the DSAP, Student readiness for the workplace, Feedback process after assessments and open comments were discussed, recorded and transcribed. Main emerging themes were identified.

COMET open-ended test tasks and context questionnaires will enable the researcher to collect a significant amount of in-depth data to respond to the research question. Focus Group Interviews using open-ended questions posed to the group allowed for dynamic group interaction. Valuable supportive and clarifying data can be derived from such interviews.

4.5 DATA ANALYSIS

4.5.1 Introduction

The research questions in this study are seeking to establish the relationship between variables as measured entities, being occupational competence and work process knowledge levels as the dependent variable and student problem solving skills as the independent variable. The dependent variable refers to the *effect* and the independent variable, the *cause* (Cozby, 2005, pp. 79-81). Descriptive statistics were applied primarily for the analysis of data. Descriptive statistics describe the distribution of and the relationship amongst variables and include frequency distribution tables, graphs, central tendency and variation and reliability tests (Check & Schutt, 2012, p. 276). For a large section of the study quantitative methods were used. A quantitative measure has the possibility of providing powerful academic and intellectual measurement and promotes efficiency of communication, approximation/modeling of real-world phenomena and a powerful research language (Tredoux, 2009, p. 5). Quantitative research involves measurements of variables across the sample of which main tendency (the mean, mode and median) and variation (deviations from the mean) are key concepts. The mean is a point of distribution and is also commonly known as the average (Punch, 2009, pp. 261-263). The Median refers to the middle score in a ranked distribution and is useful for counteracting the influence of an extreme score. (Tredoux, 2009, pp. 45-47). Given the relative big range between the maximum and minimum scores recorded in this study, the Median as a statistical measure of central tendency is used to lessen the impact of outlying scores.

4.5.2. COMET occupational competence assessment of open-ended test tasks.

The three dimensions of COMET will be used to analyse and interpret competence assessment and competence development. Elements of a longitudinal approach for comparison will be used. COMET psychometric model, Context questionnaires for students and lecturers will be empirically analysed (Rauner, Haasler, Heinemann & Grollman, 2009)**.** IBM SPSS software products were applied to analyse the results.

Descriptive statistics, applying IBM SPSS version 22 and COMET psychometric model to analyse quantitative data in the form of statistics and graphs were implemented. Qualitative interviewing data was analysed, main themes identified and reported on.

The collection of data to analyse occupational competence and commitment was done using the COMET large-scale competence diagnostics model (Heinemann, Maurer & Rauner, 2010).

4.5.2.1 Content dimension is a critical part of the data analyses and refers particularly to subject domains. It impacts on the solution space generated inclusive of the eight competence criteria, to assist in the analysis of test solutions.

4.5.2.2 Action dimension is applied to advance holistic problem solving as opposed to fragmentation of solutions and is fundamental in the development of test tasks as well as the rating of solutions.

4.5.2.3. Requirement dimension that is cumulative of nature is presented as Nominal competence, Functional competence, Processual competence and Holistic shaping competence. Quantitative scores obtained serve as performance indicators for a criteria-oriented interpretation of test results (Rauner et al. , 2013, pp. 41-47).

4.5.3. Vocational Identity and Occupational Commitment Questionnaire

The Likert scale was applied for sections of part one as well as the other five sections of the questionnaire. The first part of section one obtained biographic information as well as training company information by means of Binary scales. SPSS statistical analysis was used to analyse this data. Responses were coded into numbers and captured on an excel data file which was imported into SPSS for data analysis.

4.5.4. Motivational Questionnaire

This written questionnaire was analysed using Multiple-choice response scaling where a number of possible answers are provided for each item and the respondent should select one. Response scaling refers to methods where numbers are associated with responses (Tredoux, 2009, p. 203). Respondents had to qualitatively motivate the selected responses. The section on the Test task motivation was analysed according to Likert-type response categories ranging from *very much* to *not at all*.

4.5.5. COMET Practical Test Tasks and Interviews

Exploratory research aims to learn *what is going on here* and to investigate educational processes and practices without explicit expectation (Check & Schutt, 2012, p. 11)**.** COMET large-scale assessment was done at a conceptual level. This sub-question seeks to explore the possibility of implementing the conceptual paradigm in a practical setting. Two explorative case studies were conducted at an Industry Academy and a TVET Public College. Case studies are known for an interpretative approach to data where a phenomenon is studied within its context. The subjective meanings brought into the situation by respondents must be considered (Clough & Nutbrown, 2007, p. 18). Observations entail the taking of structured or semi-structured field notes on the conduct and activities of the individuals at the research site (Creswell, 2003, pp. 185-188). To minimize the impact of subjective meanings, this study was constructed around two processes, firstly the actual planning and execution of the COMET practical test tasks and secondly, an interview with the respondents to obtain a clear understanding of observations and subjective meanings. Observation field notes were taken in a structured manner by applying the eight COMET criteria for holistic problem solving competence as outlined in the 40-item rating sheet.

4.5.6. Feedback Questionnaire

This questionnaire consists of two sections of fifteen questions each. The Likert scale ranging from *Strongly Disagree* to *Strongly Agree* was applied. The Likert scale is an interval or rating ordinal scale which provide response options ranking from the most important to least important trait, attribute or characteristic (Creswell, 2012, pp. 166-167). The researcher argued against the midpoint to allow respondents, in line with COMET holistic problem solving paradigm, to apply thinking skills in responding to the questions. The Likert scale is particularly useful for the measuring of attitudes and opinions and is therefore a suitable response scaling method for this questionnaire. The researcher must decide which format suits the research objectives best (Tredoux, 2009, pp. 204-205).

4.5.7. Social Competence Survey

This eight-dimension social competence questionnaire was analysed according to a four point Likert scale ranging from *Never* to *Always*. A comparative study of staff and student self-perception of social competence was conducted and analysed. Descriptive statistics as a means of analysis and synthesis were applied.

4.5.8 Focus Group Semi-Structured Interviews

Data analysis in Qualitative research requires the preparation and organising of data, synthesizing data into themes and presenting data in tables, figures or a discussion (Creswell, 2013, pp. 180-188). The semi-structured focus group interviews have been planned, conducted, recorded, transcribed and interpreted. Challenges such as the interviewer – interviewee relationship and ethical issues (Creswell, 2013, pp. 173-174), associated with interviewing were anticipated and planned for. Focus Group Interviews were conducted at three different sites with TVET discussion groups to ensure that the information gathered was not group specific. The main themes, which arose, will be discussed in the next Chapter.

5. VALIDITY

Validity refers to the degree to which a measure actually represents the construct that it intends evaluating (Bhattacherjee, 2012, pp. 58-59). COMET methods zoom in on measuring the constructs of occupational competence and holistic problem solving. Content validity is ensured by the use of domain/subject specific test tasks. Inter-rater reliability, where raters will

come to an agreement on rating on what has been observed was applied. COMET tasks are open-ended and therefore more challenging to score. Proper training is therefore essential for the standardization process. Assessment validity is a key factor as outlined in Table 7:

Tab. 7: Assessment Validity framework

Interpretive Argument		Validity Argument	
Inference	Warrant justifying the inference	Validation Question	COMET quality assurance evidence for assessment validity
Construct representation	Tasks elicit performances representative of the intended constructs	Are the intended constructs reflected by the performance produced?	Open ended, domain specific, test tasks founded in the COMET occupational assessment model provide specific measurement for work-process knowledge at three levels: *Know that* (knowledge to guide action), *Know how* (knowledge to interpret action) and *Know why* (knowledge to reflect action). Occupational competence levels can be measured. COMET criteria can be assessed.
Scoring	Scores reflect the quality of performances on the assessment tasks	Are the scores dependable measures of the intended constructs?	Test tasks validation done. Inter-rater reliability achieved. Solution space provided.
Generalisation	Scores are reflective of likely performances on all possible relevant tasks	Do the tasks adequately sample the constructs set out as important in the syllabus?	Test tasks are context and domain specific. It is standard referenced. It assess fundamental didactic phenomena such as holistic problem solving within the content, requirement and action dimensions of COMET.
Extrapolation	Scores reflect wider performances in the domain	Are the constructs sampled representative of competence in the wider subject domain?	Occupational competence is measured in the relevant occupation. The eight COMET criteria assessed, focusing on holistic problem solving are relevant to wider subject domains. COMET assessment and development goes beyond a qualification and focus on competences that are domain specific abilities and strategies with open applicability.
Decision-making	Appropriateness of scores are clear	Is guidance in place to clarify what scores mean and how it can be used to develop competence?	COMET reports are graphically illustrative and provide explanatory levels of occupational performance: Nominal, Functional, Procedural and Holistic. Radar graphs provide a clear picture of individual and collective performance of respondents.

Adapted from (Shaw, Crisp & Johnson, 2012, pp. 159-176)

Validity is further strengthened by triangulation where the researcher make use of multiple sources to obtain evidence to clarify a theme or perspective (Creswell, 2013, pp. 250-251)**.** Data has been generated by a variety of methods as indicated in 4.4.1.

6. RELIABILITY

Reliability refers to the degree in which a concept is consistent or dependable (Bhattacherjee, 2012, pp. 56-58). Inter-rater reliability is a key element in COMET assessment. In this study two or more Raters of the same COMET open-ended test task completed by a TVET student, worked towards a reliable consistent rating for each item. Inter-rater reliability refers to the degree in which raters agree in their observations (Cozby, 2005, p. 96). To quality assure the assessment or rating of respondents' individual solutions a common understanding of the expectation of the solutions of test tasks or work assignments must be established among raters. Raters need to be trained in the following key principles:

- Evaluation criteria for the rating. This step involved a thorough understanding of COMET occupational competence model and its assessment criteria for the description and assessment of professional competence.
- Test tasks/Test assignments constitute the core of the methodology for the assessment of professional competence. Subject experts developed these tasks. The role of the rater as an assessor in this regard is to have an in depth understanding of the occupational profile and the expectations of skilled workers in professional work.
- Rating practice based on empirical material to familiarise raters with the handling of the 40-item rating assessment sheet and the achievement of convergence of individual ratings. A Finn coefficient score from 0.5 onwards are considered as satisfactory and scores above 0.7 as good (Rauner et al., 2013, pp. 149-154).

A Rater training seminar conducted from 30 September until 2 October 2014 at the MERSETA in Johannesburg addressed these key elements towards the establishment of inter-rater reliability to provide a reliable, consistent and dependable measure of occupational competence in this study.

7. ETHICAL CONSIDERATIONS

Ethics is concerned with respecting research participants throughout the study by adhering to approved standards of conduct. Ethical principles alluding to voluntary participation, confidentiality, disclosure where applicable, analysis and reporting to the scientific community as well as safety measures, were applied.

The research was justified by anticipated results and the potential to impact positively on the domain are well served in this study (Plowright, 2011, pp. 155-158).

The researcher is a staff member in a management position at a TVET College. It was therefore important to be constantly aware of the possible impact of personal and professional experience and knowledge, values, assumptions and concerns regarding the TVET sector on the investigation. The mitigation of researcher bias had to be ensured at all times.

This research study was conducted within a project where ethical matters such as memoranda of understanding were negotiated, discussed and formal agreements signed off between participating institutions and the project owner, MERSETA. Additional written consent was obtained from participants for the Focus Group Interviews, Social Competence Survey and the COMET Practical Test task. The Research Topic and Proposal, summited to the Doctoral Committee on 13 January 2014, was assessed and approved autonomously, according to Bremen University requirements for enrollment for a PhD study. The Doctoral Committee issued a letter of acceptance for this PhD on 28 March 2014.

8. CONCLUSION

This chapter exemplifies the research design and methods that are implemented to measure constructs in a reliable and valid manner. Inter-rater reliability serves as a core element in this study. Ethical considerations are explained. The thorough exploration of the research design and methods pave the way for presenting the research results in Chapter 5.

CHAPTER FIVE

DATA PRESENTATION, ANALYSIS FINDINGS AND DISCUSSIONS

5.1. Introduction

The purpose of this Chapter is to present and analyse the data collected from the methods implemented in this study. Data obtained will be illustrated and presented in the form of descriptive statistics, narratives and graphics. Research findings towards responding to the research questions will be presented in this chapter. These findings will be extensively unpacked and tested in terms of adequacy to respond to the research questions and subsequent contributions made by the research. The research findings will be summarised in Chapter 6. Statistical results will be graphically presented in the form of tables and figures.

The three sub-questions formulated and investigated to substantively support the answering of the main research question will be responded to first. The results of these questions and methods applied within the research design will accumulate in responding to the overall research question.

5.2 Participant descriptive data

The total number of TVET students/artisans participating in the COMET large-scale assessment that obtained scores > 5, is 488. Total number of test takers is 715. The highest percentage (69.1%) of participants are Males. Female participants account for 26.1%. The other 4.8% did not indicate their gender. These participants are enrolled at seven public TVET college campuses, three Industry Academies and two private TVET Institutions. The age range for this sample is from 17 to 39 years with the highest percentage (34.4%) in the 21-24-age bracket, followed by age brackets 25-29 at 20.3% and 17-20 at 18.3%. Students aged 30 to 39 accounts for 6.5%. The other 20.5% did not indicate their age.

5.3 Research results for responding to sub-question 1 – Which Assessment Concepts are implemented in TVET?

Key concepts for assessment in TVET identified are extensively described in Chapter Two. The assessment of occupational competence in TVET implies effective divergent, reflective thinking in finding holistic solutions for open-ended, occupation specific tasks of a universal nature. COMET occupational model offers the assessment dimensions needed to psychometrically and didactically assess occupational competence in TVET as illustrated in Figures 7, 8, and 9 in Chapter Two. The three defining Content, Requirement and Action dimensions of the COMET model constitute the framework within which the eight Comet criteria are operationalised. Work process knowledge is a core principle in the development of Holistic, Shaping occupational competence. The work process knowledge developmental levels are *Know That* – Guide action*, Know How* - Explain action and *Know Why*- Reflect action (Figure 9).

5.3.1 Occupational Competence levels

Results from the COMET large-scale assessment provide empirical data for analysing and understanding occupational competence concepts and dynamics in TVET.

Occupational competence levels, Student Motivation in task completion and Vocational Identity and Occupational Commitment are the fundamental areas of this assessment.

This section presents occupational competence performance per occupation and more specifically, performance in the eight COMET criteria and holistic problem solving competence levels. It also deals with identifying areas for development. 20 Students did not indicate their occupation. The following key for COMET criteria is applicable to this section:

K1-Clarity/Presentation K2-Functionality K3-Use value K4-Cost Effectiveness K5-Business /Work Process	K6-Social Responsibility K7-Environmental Responsibility K8-Creativity Kf-Functional Competence Kp-Processual Competence Kg-Holistic Shaping Competence

5.3.1.1 Electrical Occupation

The Tables 8 to 11 below indicate the scores for the eight COMET criteria as well as the Functional, Processual and Holistic Shaping competence performance for the occupation, Electrical. The data is presented according to occupations assessed at the indicated institutions.

According to the data presented, occupational competence portrayed for Electrical studies at all institutions is at the *know that* level which is indicative of basic guiding action capacity. Holistic problem solving competence is critically low at 0.5%. Slightly better performance was shown for K1-Clarity and presentation. The worst performance was for K7 – Environmental compatibility. This is a critical criterion for all work processes as indicated in Table 1. The majority of students in this occupation are at risk with 84.2% functioning at Nominal level. A relatively better performance was achieved by the Public TVET Colleges with the poorest performance recoded for the Industry Academies.

The lowermost performance for K7 - Environmental Compatibility being a vital criterion for professional problem solving competence towards work process knowledge in the 21st century workplace, is a concern.

Tab. 8: Test site = Industry Academy, Occupation = Electrical

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	23	23	23	23	23	23	23	23	23	23	23	23
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	6.00	4.00	3.00	3.33	3.00	4.00	2.00	3.00	4.50	3.67	2.67	8.83
Minimum	2.00	.00	.00	.00	.00	.00	.00	.00	2.00	.42	.00	5.17
Maximum	17.00	13.00	10.00	12.00	18.00	12.00	10.00	12.00	15.00	13.33	10.00	34.33

Tab. 9: Test site = Private TVET Institution, Occupation = Electrical

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	27	27	27	27	27	27	27	27	27	27	27	27
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	5.00	4.00	2.00	3.00	3.00	4.00	2.00	2.67	4.50	3.00	2.67	9.17
Minimum	1.00	1.00	.00	.00	.00	.00	.00	.00	1.00	.67	.33	5.67
Maximum	13.00	11.00	12.75	8.00	8.00	13.00	9.00	12.00	11.50	8.58	11.00	27.83

Tab. 10: Test site = Public TVET College, Occupation = Electrical

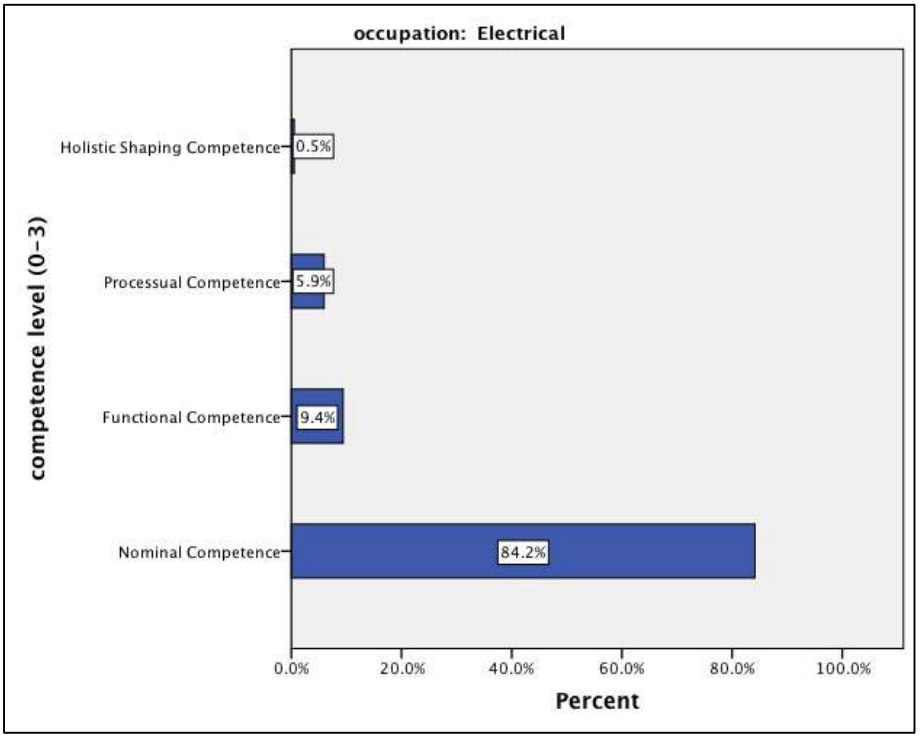
	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	151	151	151	151	151	151	151	151	151	151	151	151
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	6.00	4.00	3.00	3.00	3.00	4.00	2.00	4.00	5.00	3.00	3.67	11.33
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	1.50	.00	.00	5.17
Maximum	20.00	19.00	20.00	19.00	20.00	20.00	16.00	18.00	19.00	18.00	16.33	45.00

Tab. 11: Combined Electrical Occupation scores

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	202	202	202	202	202	202	202	202	202	202	202	202
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	6.00	4.00	3.00	3.00	3.00	4.00	2.00	4.00	5.00	3.00	3.33	11.00
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	1.00	.00	.00	5.17
Maximum	20.00	19.00	20.00	19.00	20.00	20.00	16.00	18.00	19.00	18.00	16.33	45.00

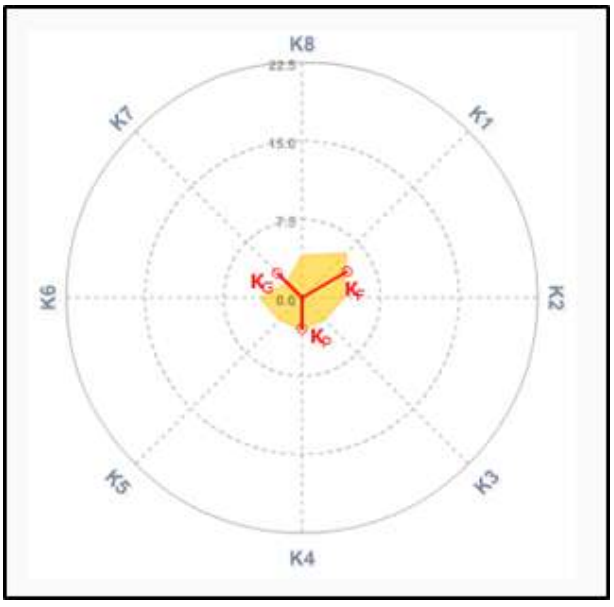
Figure 15 below graphically illustrates the occupational competence levels for the Electrical occupation. It is clear that holistic problem solving competence is limited and a high-risk situation for work process knowledge is evident with only 0.5% at Holistic competence level.

Figure 15: Combined Electrical Occupation scores



Figures 16 and 17 further exhibit the *know-that* work process knowledge levels for the group (Figure15) and the respective test sites for the Electrical occupation.

Figure 16: Combined Profile for Electrical Occupations



N = 202

Total Median Score = 11.0

Figure 17: Graphical Illustration of Electrical Occupation

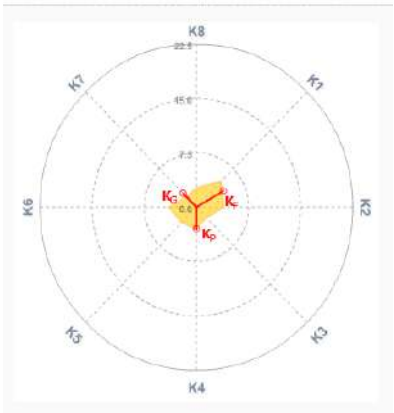
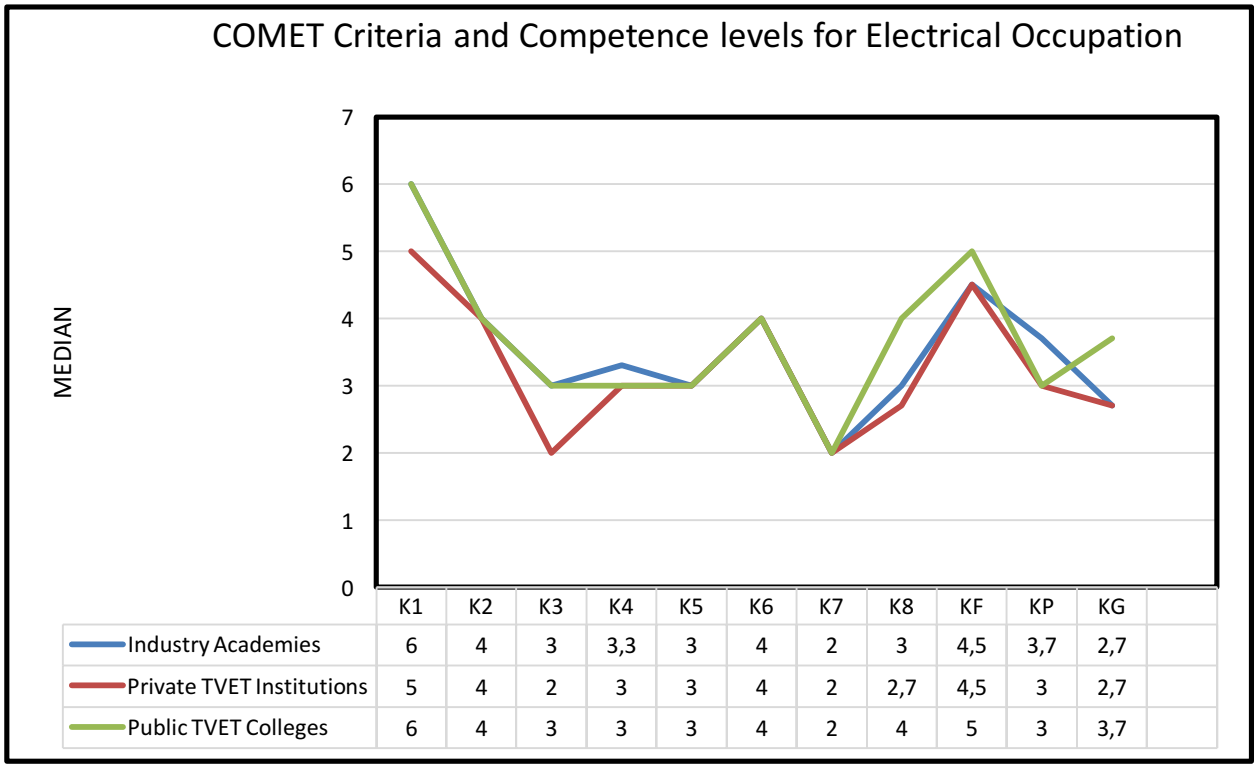
Industry Academies	Private TVET Institutions	Public TVET Colleges
		
N = 23 Total Median Score = 8.83	N = 27 Total Median Score = 9.17	N = 151 Total Median Score = 11.33

Figure 18: Median Comparison for Test Institutions for Electrical Occupation



	K1	K2	K3	K4	K5	K6	K7	K8	KF	KP	KG
Industry Academies	6	4	3	3,3	3	4	2	3	4,5	3,7	2,7
Private TVET Institutions	5	4	2	3	3	4	2	2,7	4,5	3	2,7
Public TVET Colleges	6	4	3	3	3	4	2	4	5	3	3,7

A drop from K1 to K2 is observed for all Institutions for the Electrical Occupation as illustrated in Figure 18. The poor performance in K7 is of particular concern for this occupation. Slightly better performance was shown for K6 – Social acceptability, alluding to an improved focus on humane and health considerations as well as customer satisfaction. The best performance was for K1, the theoretical presentation of the solution, which can be an indication of a higher emphasis on theoretical than on practical work and holistic problem solving.

5.3.1.2. Welder Occupation

Tables 12 to 15 provide information on student occupational competence in the Welder occupation. Students in the Welder occupation performed relatively well. Table 15 indicates a drop from K1 to K2, while slightly lower scores were recorded for K8 and K3 and a significantly lower score was recorded for K7. 25.2% of students achieved Holistic Shaping Competence and 22%, Processual Competence. 17% achieved Functional Competence. A significant smaller percentage in comparison to the other occupations is at the Nominal, at risk level, at 35.8%. Welders advanced beyond the *know that* level of work process knowledge into the *know how* level. Reflective knowledge – *know why,* remains a concern and a risk for creating sustainable, holistic solutions.

Figures 19 and 20 provide a clear picture of the occupational competence levels achieved by students in the Welder Occupation. Figure 22 shows that K7-Evironmental compatibility rating is lower than the other COMET criteria for Public Colleges and Industry Academies. Private TVET Institutions scored (10) notably higher than the group median (7) for K7.

Industry Academy students showed the best median performance overall. Figures 20 and 21 provide insight in holistic problem solving competence patterns of students. Industry Academy students performed overall significantly better than the group median for all occupational competence levels.

The Private TVET institutions recorded the highest score for K7 (10 – Median versus Group median of 7). This group showed the best score for Holistic Competence criteria in comparison to the other Welder occupation institutions (Table 14).

The Public TVET Colleges of which the Welder Occupation forms part of the DSAP programme progressed to the *Know how* level of work process knowledge, which is an indication of the initial impact of real work experience. The poor occupational competence (Median - 6) in K7 is however, a significant finding.

Tab. 12: Test site = Public TVET College, Occupation = Welder

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	119	119	119	119	119	119	119	119	119	119	119	119
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	10.00	10.00	8.00	9.00	10.00	10.00	6.00	8.00	10.00	8.67	7.33	25.00
Minimum	1.00	.00	.00	.00	.00	.00	.00	.00	.50	.33	.67	5.17
Maximum	28.00	25.00	26.00	25.00	25.00	30.00	23.00	21.00	26.50	24.33	24.67	75.50

Tab. 13: Test site = Industry Academy, Occupation = Welder

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	31	31	31	31	31	31	31	31	31	31	31	31
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	11.00	11.00	10.00	11.00	10.00	11.00	9.00	10.00	10.50	10.33	9.33	30.17
Minimum	.00	.00	.00	1.00	.00	.00	.00	3.00	.00	1.67	2.33	6.00
Maximum	25.00	21.00	21.00	23.00	22.00	21.00	20.00	24.00	23.00	21.67	20.67	61.00

Tab. 14: Test site = Private TVET Institution, Occupation = Welder

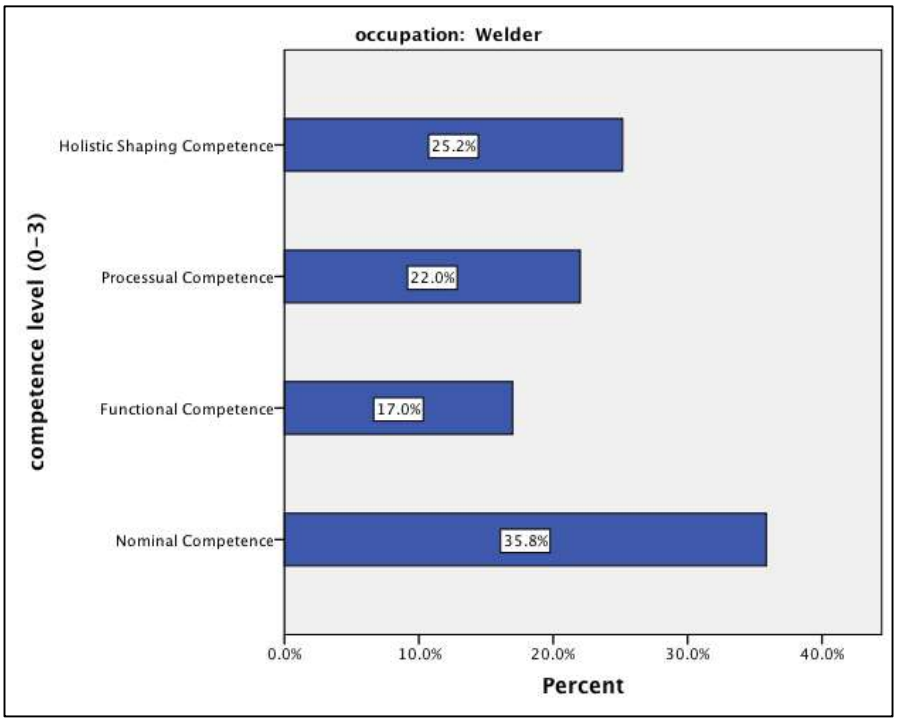
	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	8	8	8	8	8	8	8	8	8	8	8	8
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	10.00	8.50	7.50	10.00	9.50	11.00	10.00	10.00	9.25	7.75	10.33	29.00
Minimum	3.00	.00	1.00	.00	.00	7.00	.00	2.00	1.50	.67	3.67	5.83
Maximum	20.00	18.00	17.00	20.00	17.00	20.00	15.00	18.00	19.00	16.33	17.67	53.00

Tab. 15: Combined scores for Welder Occupation

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	159	159	159	159	159	159	159	159	159	159	159	159
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	11.00	10.00	9.00	10.00	10.00	10.00	7.00	9.00	10.00	9.00	7.75	26.17
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	.00	.33	.67	5.17
Maximum	28.00	25.00	26.00	25.00	25.00	30.00	23.00	24.00	26.50	24.33	24.67	75.50

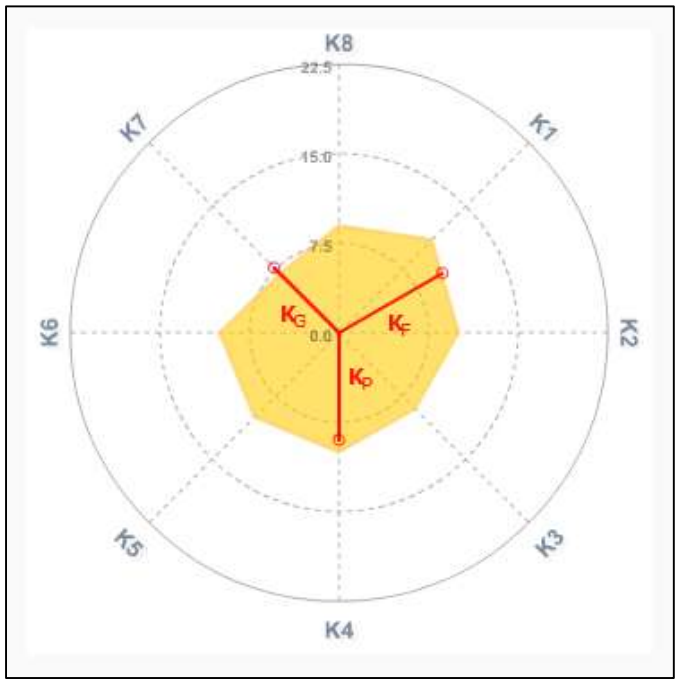
Occupational competence levels reflected in Figure 19 show the relatively higher problem solving competence for the Welder occupation. The performance on the Processual and Holistic competence levels serve as an indication of higher work process knowledge levels and more complete solutions.

Figure 19: Percentage of occupational competence for Welder Occupation



Figures 20 and 21 below present the radar graphs for the Welder Occupation as a group and per institution. It is more rounded with a slight indent for K7.

Figure 20: Combined illustration of scores for Welder Occupation



N = 159

Total Median Score = 26.17

Figure 21: Graphical Illustration of Welder Occupation Occupational Competence

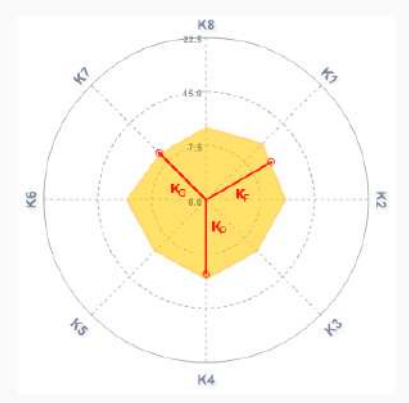
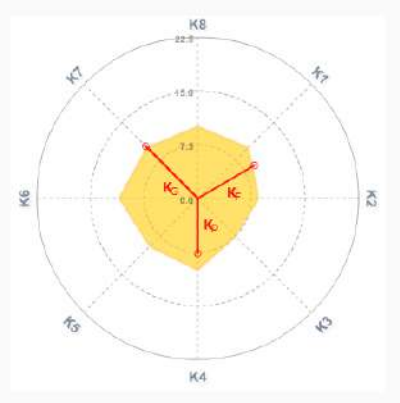
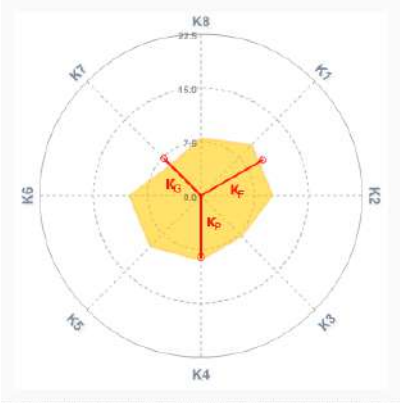
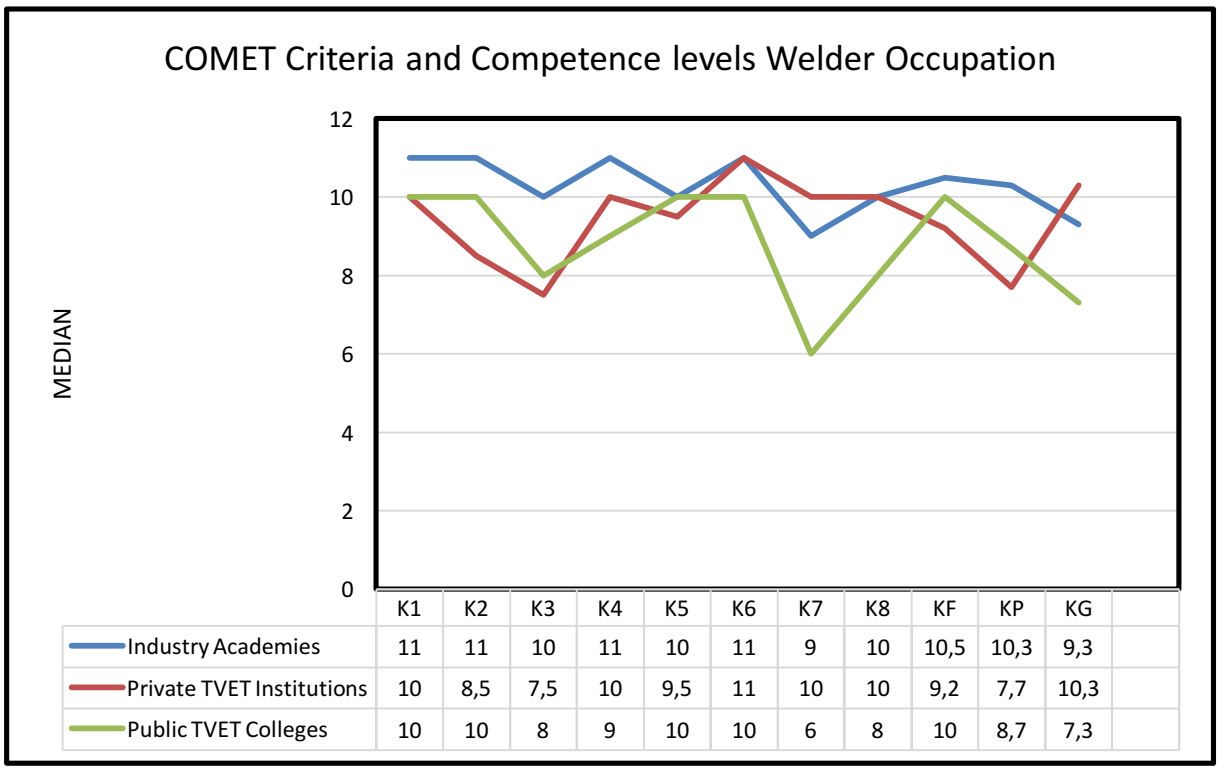
Industry Academies	Private TVET Institutions	Public TVET Institutions
		
N = 31 Total Median Score = 30.17	N = 8 Total Median Score = 29.00	N = 119 Total Median Score = 25.00

Figure 22: Median Comparison for Test Institutions for Welder Occupation



	K1	K2	K3	K4	K5	K6	K7	K8	KF	KP	KG
Industry Academies	11	11	10	11	10	11	9	10	10,5	10,3	9,3
Private TVET Institutions	10	8,5	7,5	10	9,5	11	10	10	9,2	7,7	10,3
Public TVET Colleges	10	10	8	9	10	10	6	8	10	8,7	7,3

Figure 22 illustrates a general lower score for K7 – Environmental compatibility, particularly for the Public TVET Institutions who also performed lower than the other entities for the Welder Occupation. The Private TVET Colleges performed at the *Know how* level of work

process knowledge but a lower score was obtained for K3 – Sustainability and utility which is crucial for customer service and satisfaction. Industry Academies produced a well-balanced Occupational competence profile.

5.3.1.3 Mechatronics Occupation

Tables 16 to 19 outlines the problem-solving competence of the students in the Mechatronics occupation.

Table 17 illustrates COMET criteria and occupational competence levels for Mechatronics at the Private TVET Institutions. The overall occupational competence levels are above the median performance for this occupation as shown in Table 19. The poorest performance was for K7.

Tab. 16: Test site = Industry Academy, Occupation = Mechatronics

	K1	K2	K3	K4	K5	K6	K7	K8	KF	Kp	Kg	total score
N Valid	15	15	15	15	15	15	15	15	15	15	15	15
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	8.00	6.00	5.00	5.00	5.00	7.00	2.00	4.00	7.00	4.33	4.67	14.67
Minimum	.00	1.00	.00	.00	.00	.00	.00	1.00	1.00	.67	1.08	5.17
Maximum	20.00	20.00	15.00	14.00	18.00	18.00	13.50	18.00	20.00	15.33	15.33	50.67

Tab. 17: Test site = Private TVET Institution, Occupation = Mechatronics

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	6	6	6	6	6	6	6	6	6	6	6	6
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	12.00	8.00	8.50	7.00	10.00	12.00	5.00	11.50	11.75	9.00	10.00	31.08
Minimum	2.00	.00	.00	1.00	2.00	2.00	1.00	.00	2.50	1.33	2.00	5.83
Maximum	16.00	14.00	19.00	13.00	12.00	19.00	18.00	19.00	13.00	14.00	18.67	44.00

Tab. 18: Test site = Public TVET College, Occupation = Mechatronics

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	71	71	71	71	71	71	71	71	71	71	71	71
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	9.00	8.00	6.00	7.00	6.00	8.00	3.33	5.00	9.50	6.67	5.67	19.60
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	5.33
Maximum	30.00	27.00	22.00	24.00	23.00	25.00	24.00	23.00	26.50	22.33	24.00	72.83

Tab. 19: Combined scores for Occupation Mechatronics

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	92	92	92	92	92	92	92	92	92	92	92	92
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	9.00	8.00	6.00	6.00	6.00	8.00	3.66	5.25	9.00	6.29	5.50	18.92
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	5.17
Maximum	30.00	27.00	22.00	24.00	23.00	25.00	24.00	23.00	26.50	22.33	24.00	72.83

Figure 23: Percentage of occupational competence achieved per level.

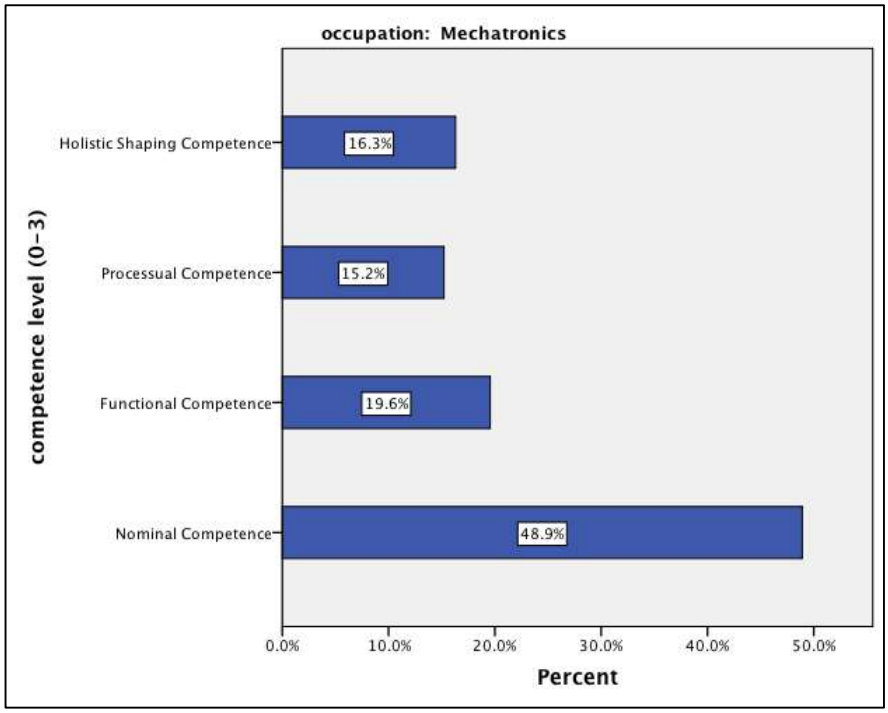
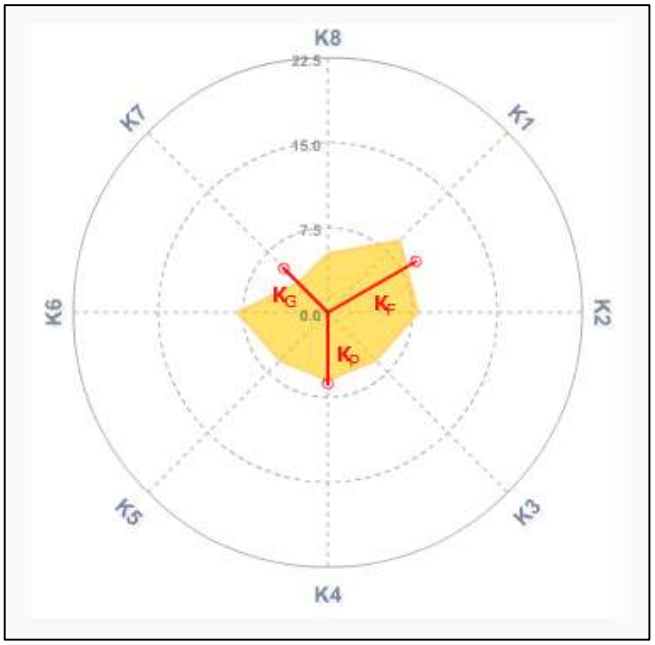


Figure 23 illustrates that 48.9% of Students in the Mechatronics occupation are functioning at Nominal Competence level and are therefore at risk. A relatively higher percentage of 16.3% is however recorded for Holistic Shaping Competence and 15.2% for Processual Competence. 19.6% are at a Functional Competence level. These indicators of accumulative competence for the Mechatronics occupation students are promising and can probably be ascribed to the fact that these students at TVET Colleges form part of the DSAP group. K7 and K8 for Public TVET Colleges are however still very low leading to a poor result for Kg- Holistic competence. A similar pattern of poor performance in K7 and K8 is observed for the Industry Academies. The impact of Staff exposure to the COMET model and Rater training can be a contributing factor to the overall improved occupational competence performance demonstrated in Figures 23, 24 and 25.

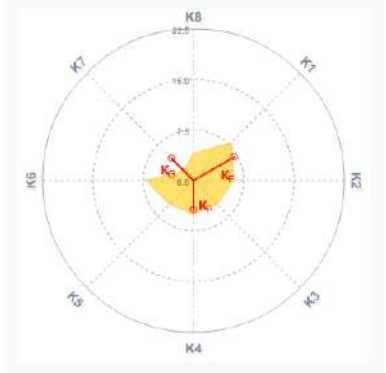
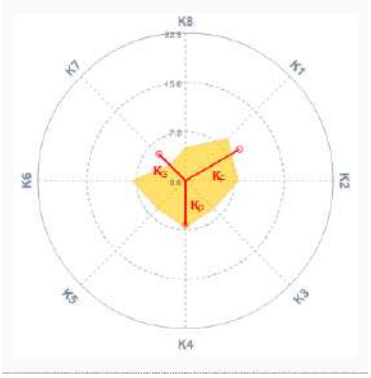
Figure 24: Combined illustration of scores for Mechatronics Occupation



N = 92

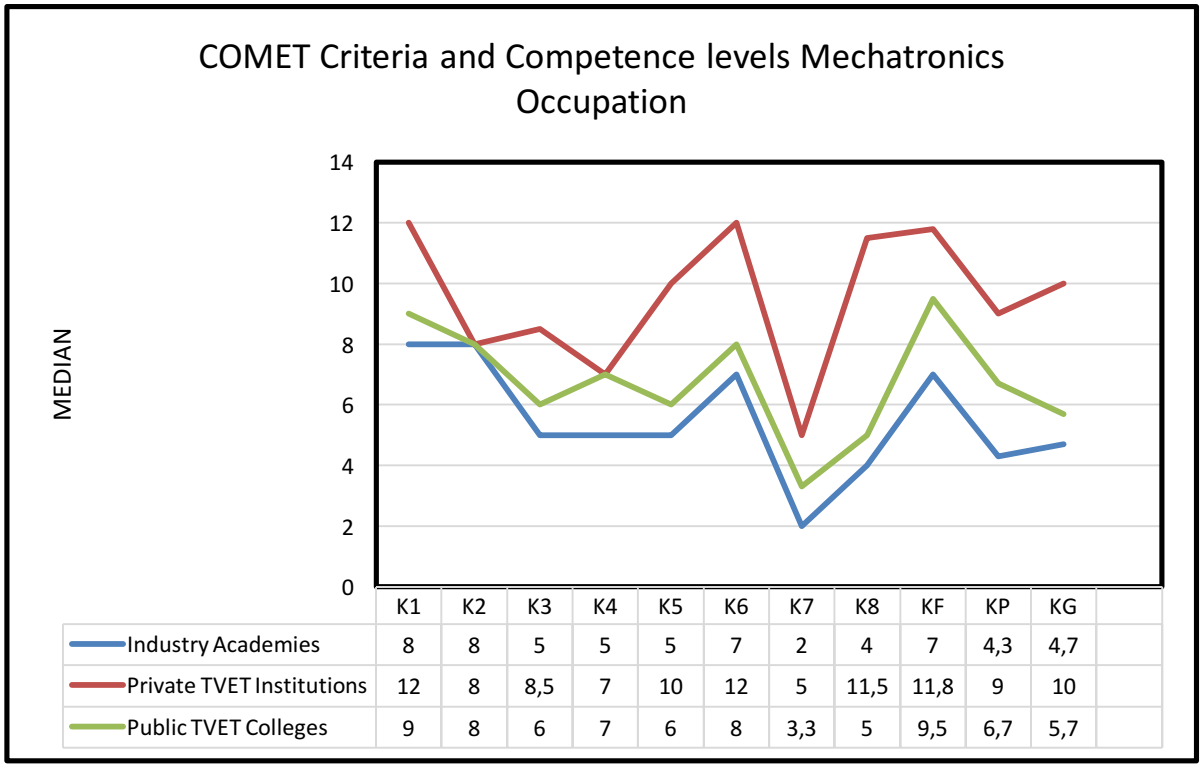
Total Median Score = 18.92

Figure 25: Graphical Illustration of Mechatronics Occupation Occupational Competence

Industry Academies	Private TVET Institutions	Public TVET Colleges
		
N = 15 Total Median Score = 14.67	N = 6 Total Median Score = 31.08	N = 71 Total Median Score = 19.60

Figures 24 and 25 give a clear picture of the student holistic competence profile for the Mechatronics occupation as a collective and at the different TVET centers.

Figure 26: Median Comparison for Test Institutions for Mechatronics Occupation



	K1	K2	K3	K4	K5	K6	K7	K8	KF	KP	KG
Industry Academies	8	8	5	5	5	7	2	4	7	4,3	4,7
Private TVET Institutions	12	8	8,5	7	10	12	5	11,5	11,8	9	10
Public TVET Colleges	9	8	6	7	6	8	3,3	5	9,5	6,7	5,7

Figure 26 illustrates a huge fluctuation in COMET criteria for all Test Sites in the Mechatronics Occupation. K7 – Environmental compatibility is particularly and surprisingly low for Industry academies. The Private TVET Institutions performed significantly better in comparison to the other groups in Mechatronics. Yet, an interesting drop from K1- Presentation and Clarity to K2 on Technical Functionality is observed.

5.3.1.4 Millwright Occupation

Tables 20 to 22 and Figure 27 reflect the performance on the eight COMET criteria and the occupational levels for the Millwright Occupation. 66.7% of the participants performed at a high risk, Nominal Competence level. 33.3% performed at a Functional Competence level and no student reached Processual or Holistic Shaping Competence levels. Very poor performance was recorded for K7 – Environmental Responsibility and K8- Creativity.

Tab. 20: Test site = Private TVET Institution, Occupation = Millwright

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	1	1	1	1	1	1	1	1	1	1	1	1
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	12.00	8.00	4.00	5.00	2.00	14.00	6.00	4.00	10.00	3.67	8.00	21.67
Minimum	12.00	8.00	4.00	5.00	2.00	14.00	6.00	4.00	10.00	3.67	8.00	21.67
Maximum	12.00	8.00	4.00	5.00	2.00	14.00	6.00	4.00	10.00	3.67	8.00	21.67

Tab. 21: Test site = Public TVET College, Occupation = Millwright

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	14	14	14	14	14	14	14	14	14	14	14	14
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	8.00	6.00	5.00	4.00	4.00	8.00	1.50	2.00	6.50	4.00	4.00	15.08
Minimum	2.00	2.00	.00	.00	2.00	3.00	.00	.00	3.00	1.33	2.67	9.67
Maximum	11.00	10.00	9.00	10.00	12.00	12.00	11.00	5.00	10.50	10.33	7.67	22.50

The contrast in better performance in K1 – Clearness and Presentation and K6 –Social Acceptability in relation to the poor outcomes for the rest of the COMET criteria resulted in a very skew radar graph and is indicative of challenges in holistic problem solving competence as indicated in Figures 28 and 29 below.

Tab. 22: Combined scores for Occupation Millwright

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	15	15	15	15	15	15	15	15	15	15	15	15
Missing	0	0	0	0	0	0	0	0	0	0	0	0
Median	8.00	6.00	5.00	4.00	4.00	8.00	2.00	2.00	6.50	3.67	4.00	16.33
Minimum	2.00	2.00	.00	.00	2.00	3.00	.00	.00	3.00	1.33	2.67	9.67
Maximum	12.00	10.00	9.00	10.00	12.00	14.00	11.00	5.00	10.50	10.33	8.00	22.50

Figure 27: Percentage of occupational competence achieved per level.

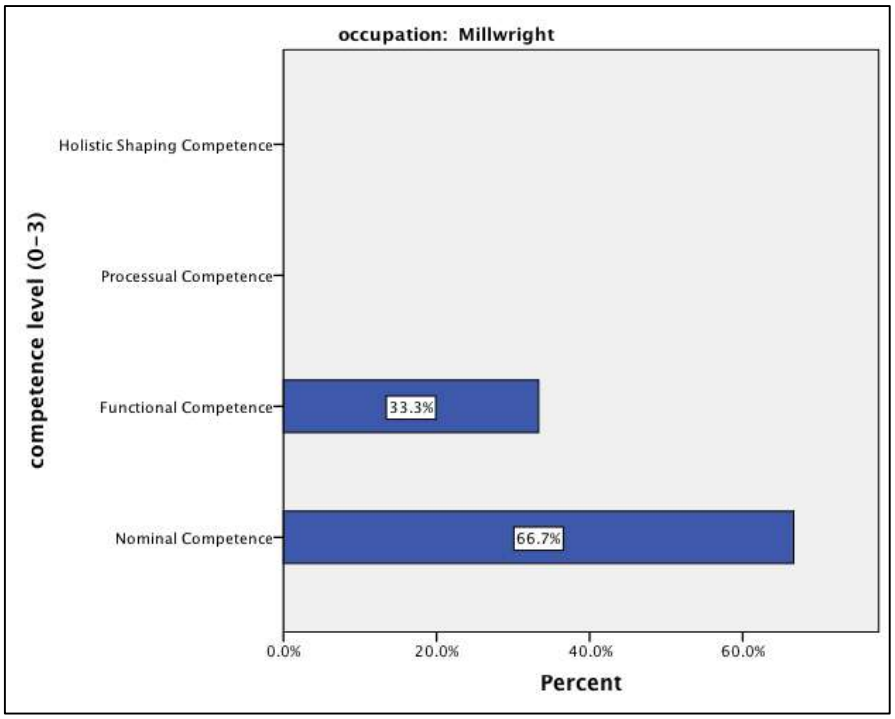
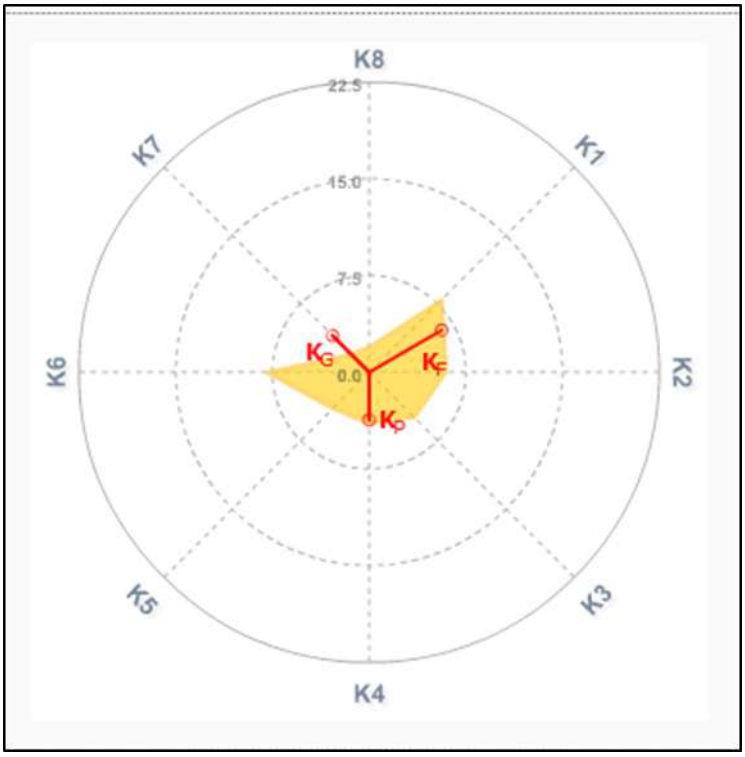


Figure 28: Combined illustration of scores for Millwright Occupation



N = 15

Total Median Score = 16.33

Figure 29: Graphical Illustration of Millwright Occupation Occupational Competence

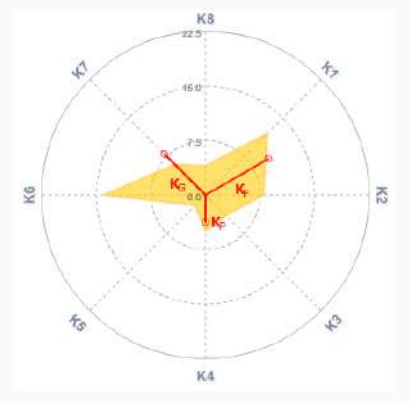
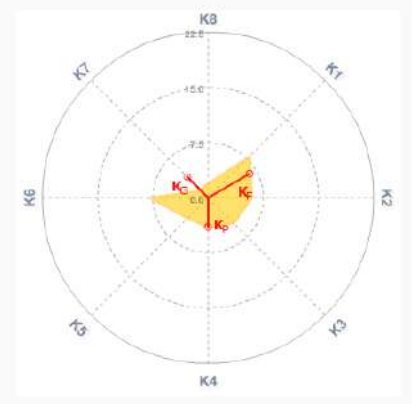
Private Institution	Public TVET Colleges
	
N = 1 Total Median Score = 21.67	N = 14 Total Median Score = 15.08

Figure 30: Median Comparison for Test Institutions for Millwright Occupation

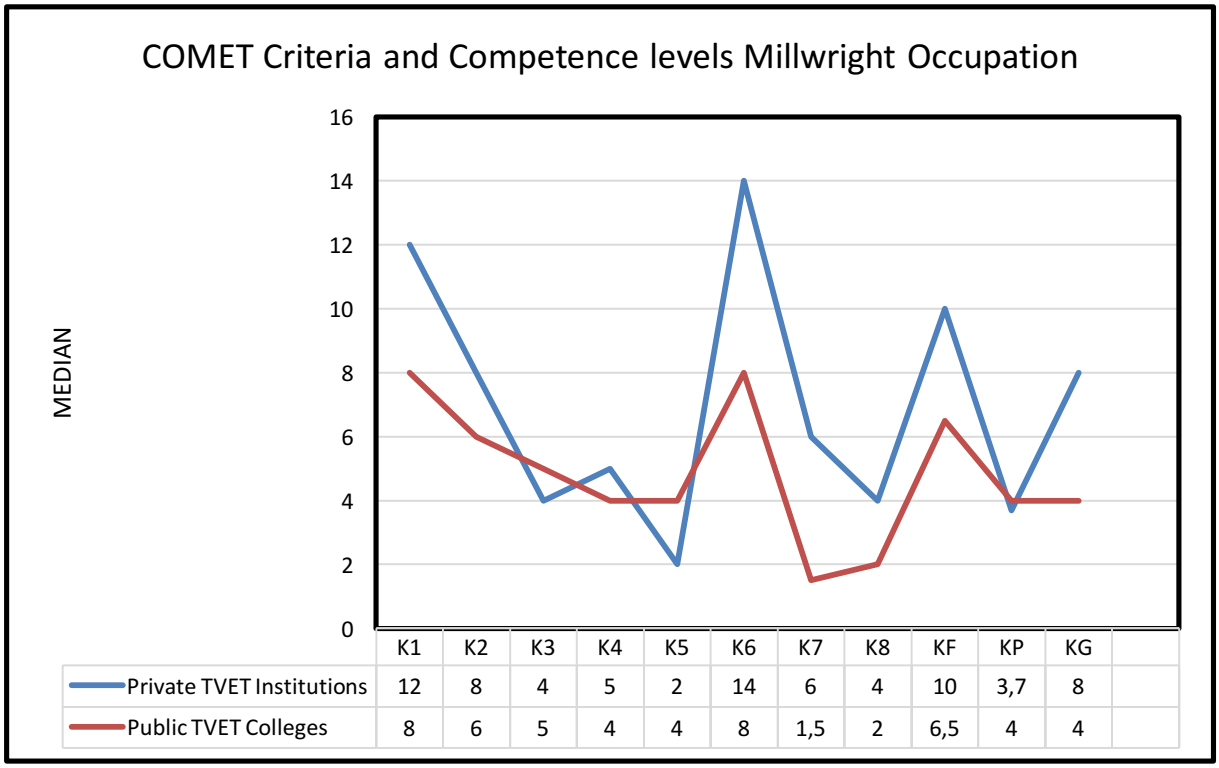


Figure 30 shows a huge fluctuation in COMET criteria and subsequent occupational levels for both groups. No Industry academy completed the Millwright test tasks. A significant drop from K1- Presentation and Clarity of the task to K2 – Functionality and Operability as a fundamental criterion for the solution is observed. Private Institutions recorded an exceptionally high score for K6 on Social acceptability referring to customer service and work safety.

5.3.1.5 Summary of total scores for COMET criteria and Competence levels of all twelve Test Sites

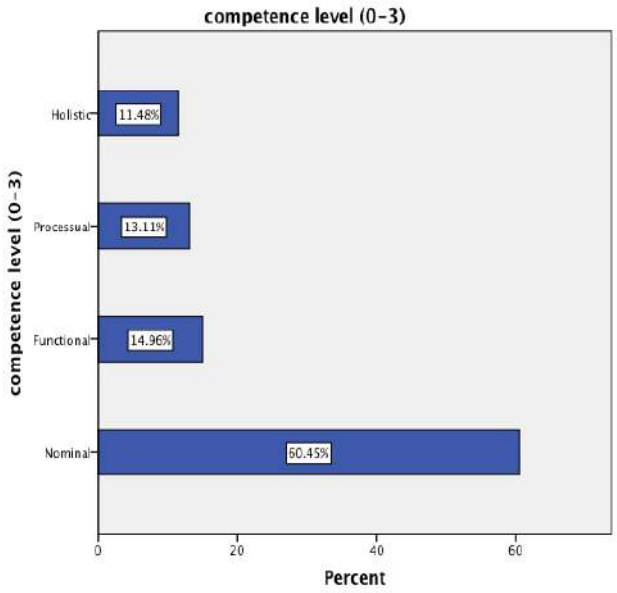
Table 23 presents a summary of the COMET criteria and occupational levels for all test takers across the 12 test sites. K7 – Environmental compatibility yielded the poorest result (3.0) and K1- Clearness/ presentation, the best result (8.0). The overall occupational competence levels achieved are indicative of poor professional problem solving competence amongst students.

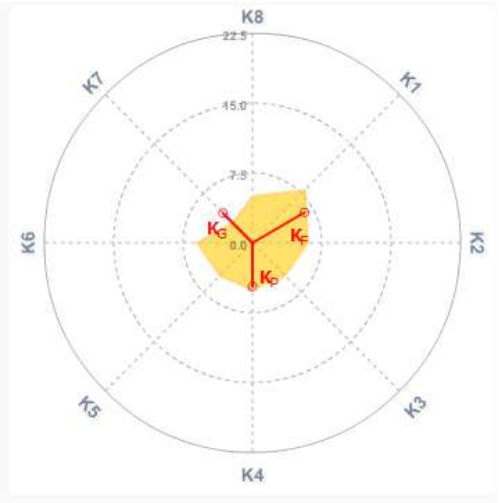
Tab. 23: Total score for all test sites - COMET criteria and occupational competence levels

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg	total score
N Valid	488	488	488	488	488	488	488	488	488	488	488	488
Median	8.00	6.00	5.00	5.00	5.00	6.00	3.00	5.00	6.50	4.70	4.50	16.25
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	5.17
Maximum	30.00	27.00	23.00	25.00	25.00	30.00	24.00	24.00	26.50	24.33	24.67	75.50

Figure 31 illustrates the occupational competence levels achieved by students in the sample. 60.4% of participants portray a high-risk occupational competence profile, functioning at a Nominal competence level. 14.9% of Students achieved Functional competence and significantly lacks proficiency in terms of professional problem solving competence. Processual competence is recorded for 13.1% of respondents. A small percentage of respondents (11.4%) achieved Holistic Shaping competence and are capable of solving problems holistically. The relatively high coefficient of variance (CV) values for all occupations is indicative of the heterogeneity of the group with regard to holistic problem solving competence.

Figure 31: Percentage of occupational competence achieved per level.





N = 488 Total Median Score = 16.25

5.3.2 Occupational competence performance recorded according to Gender.

Gender based performance in COMET large-scale assessment is presented in Tables 24 and 25 and illustrated in Figure 33. It is evident that females generally achieved lower levels of holistic problem solving competence than males in this study. Poorest performance for both groups was in K7.

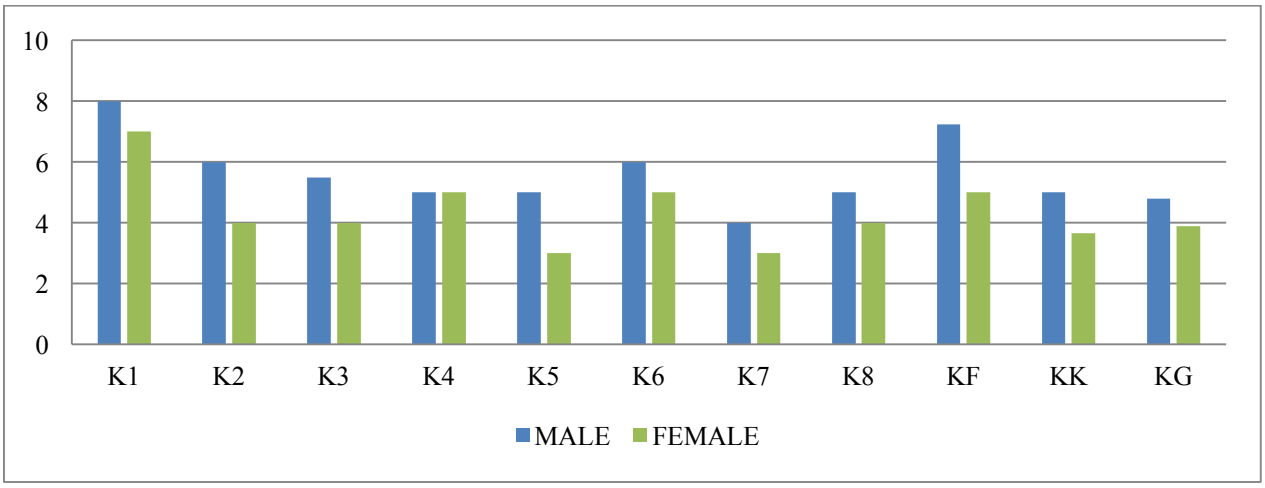
Tab. 24: Total score for all test sites for FEMALE participants- COMET criteria and occupational competence levels

		K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg
N	Valid	112	112	112	112	112	112	112	112	112	112	112
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		7.00	4.00	4.00	5.00	3.00	5.00	3.00	4.00	5.00	3.67	3.90
Minimum		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Maximum		23.00	19.00	22.00	23.00	20.00	21.00	20.00	21.00	21.00	20.67	20.33

Tab. 25: Total score for all test sites for MALE participants - COMET criteria and occupational competence levels

	K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg
N Valid	354	354	354	354	354	354	354	354	354	354	354
Missing	0	0	0	0	0	0	0	0	0	0	0
Median	8.00	6.00	5.50	5.00	5.00	6.00	4.00	5.00	7.25	5.00	4.80
Minimum	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Maximum	30.00	27.00	23.00	25.00	25.00	30.00	24.00	24.00	26.50	24.33	24.67

Figure 32: Occupational Competence – Gender Distribution according to Median scores

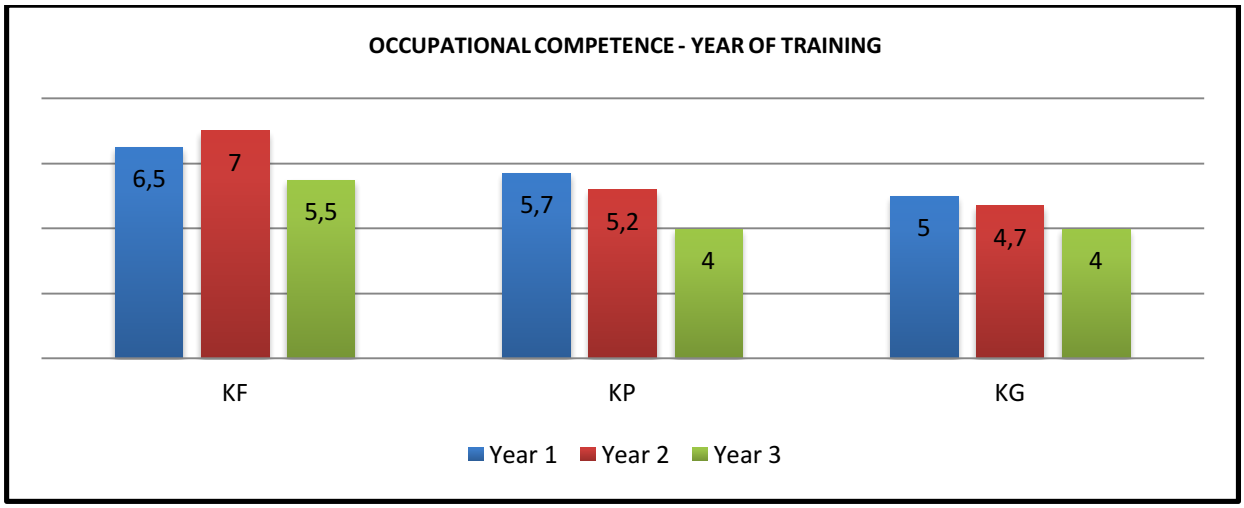


5.3.3 Year of Training – Progressive Competence development and accumulation

Figure 33 below, shows that there is no significant difference in Holistic Competence scores over years of training:

Year 1 at a Median score of 5, Year 2 at Median score 4.7 and Year 3 at Median score 4. A tendency towards a lower score recorded for the third year of study is observed. This finding is indicative of a stagnant TVET programme in terms of responding to the fundamental didactic principle of accumulative, progressive growth of occupational competence across years of learning.

Figure 33: Occupational Competence Median Scores According to Year of Training



5.3.4 The impact of workplace based learning on Occupational Competence

Figure 34: DSAP and NDSAP comparison of Occupational Competence levels achieved

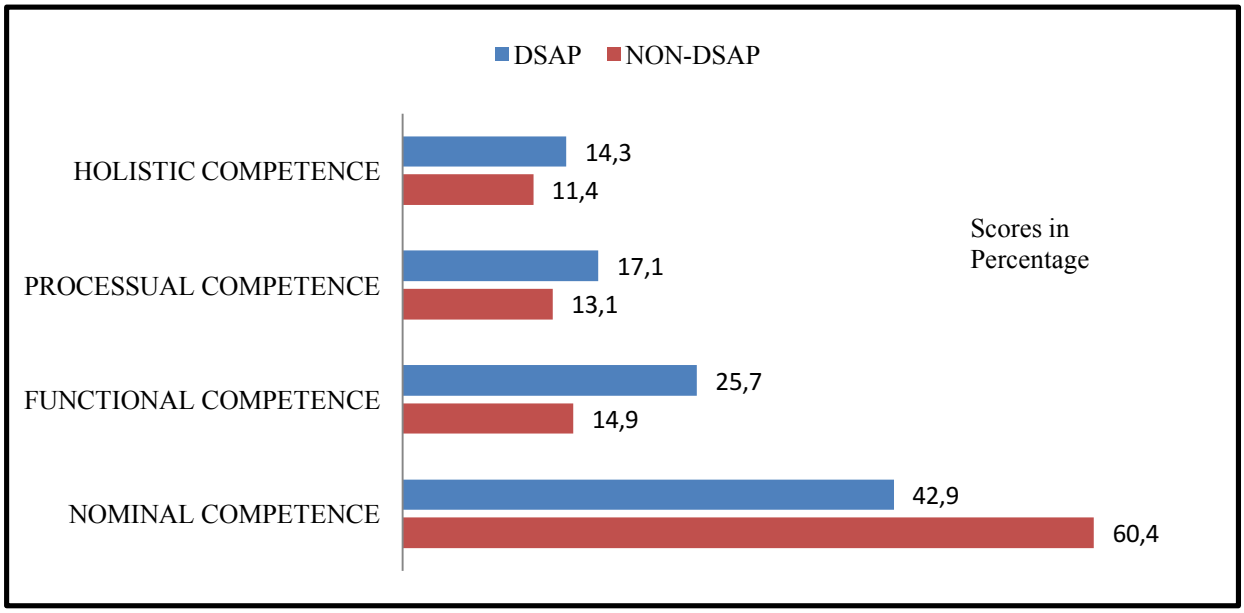


Figure 34 summarises student occupational competence for the DSAP in comparison to the group performance according to COMET occupational competence level performance. It is evident that students attending the DSAP programme achieved higher levels of occupational competence. The same pattern of occupational competence across the cumulative COMET

requirement dimension is observed for both groups, namely a very high percentage of students at Nominal level (60.4% and 42.9%) and the lowest percentage for Holistic Shaping competence (11.4% and 14.3%). The discrepancy between the group (Nominal level – 60.4% and Holistic Shaping level – 11.4%) in comparison to the DSAP group (Nominal level - 42.9% and Holistic Shaping level – 14.3%) is however significant for the evaluation of the impact of dual College / Workplace learning versus sole College based learning in TVET.

5.3.5 Occupational Competence per Training Institution category

Figures 35 and 36 below show the median performance per training category for the eight COMET criteria and the competence levels. The Industry academies achieved higher levels of occupational competence than the Public and Private TVET Colleges and Institutions. Best rating for all three groups was recorded for K1 – Clearness and Presentation. A drop in scores for all in K2 – Functionality and Operability can be an indication of a challenge with the transfer from conceptual to technical functionality. Another general peak is observed for K6 – Social acceptability. K7 – Environmental compatibility was low for all the groups. The huge fluctuation in scores obtained across the eight per COMET criteria paints a clear picture of the deficits in terms of holistic problems solving competence amongst these groups.

Figure 35: Comparison of median scores for COMET criteria and competence levels

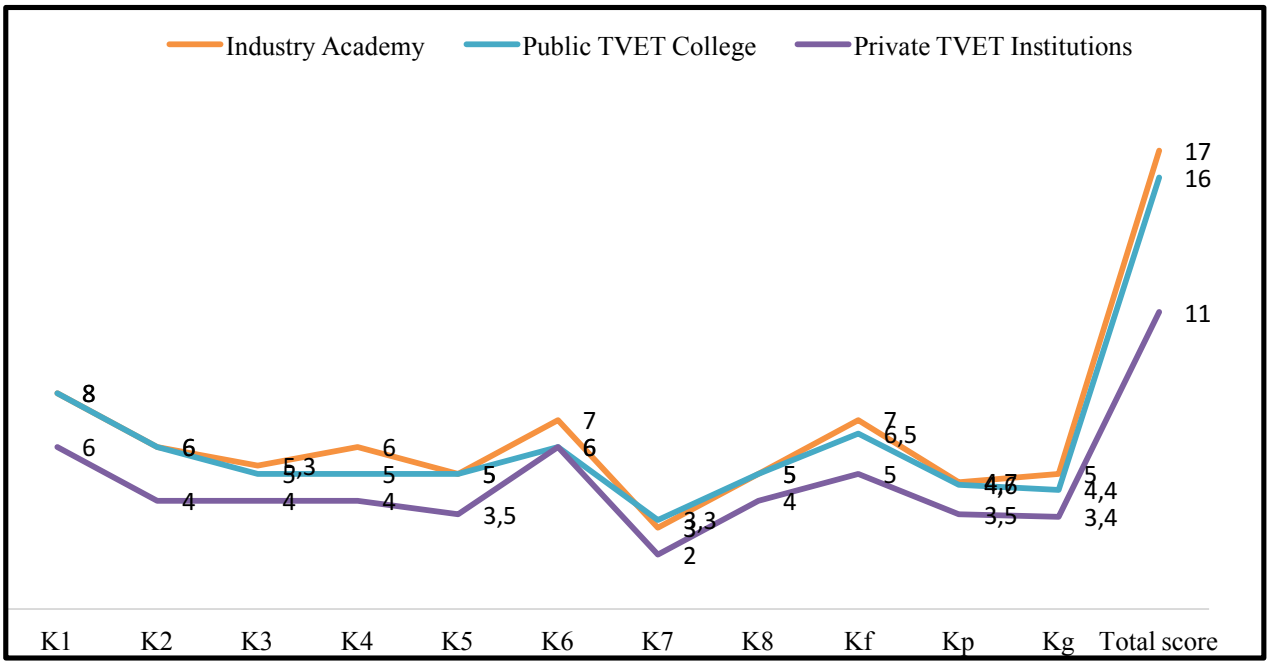
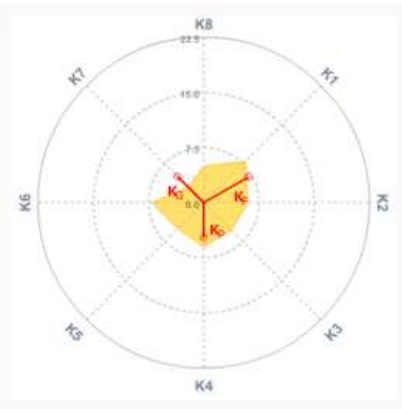
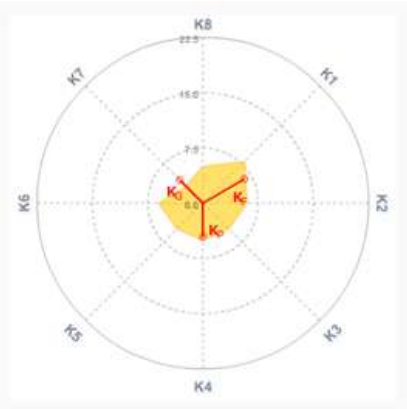


Figure 36: Graphic illustration of Occupation Competence levels per Training Institution category

Industry Academies	Public TVET Colleges	Private TVET Institutions
		
N = 69 Total Median Score = 17.0	N = 356 Total Median Score = 16.3	N = 42 Total Median Score = 10.9

In this section assessment, related constructs were unpacked, assessed and analysed beyond the historically conservative approach of curriculum based assessment known in TVET in South Africa. The focus of the assessment process was on clarifying vague ideas and ensuring that each assessment concept contains valid values that can be implemented.

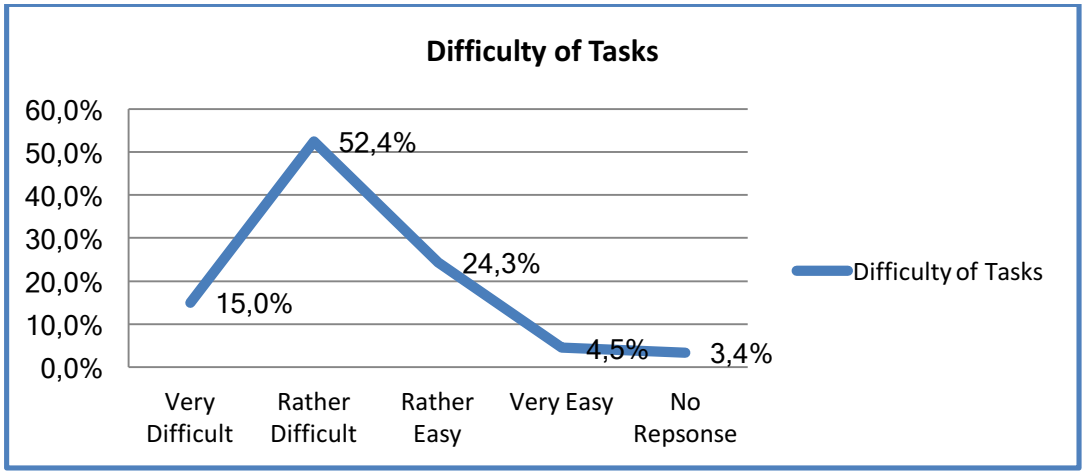
5.3.6 Motivational Questionnaire

This questionnaire measures student motivational levels towards their experience of task complexity and their commitment in completing the tasks. Task usefulness and recommendations for similar tasks to become part of their vocational training are assessed. This questionnaire is founded in a model that incorporates Primary Motivational factors alluding to Meaningfulness, such as job reference, usefulness and interest and Secondary Motivational factors referring to Investment Factors such as the effort, diligence or care, concentration and concern/trouble exerted in performing the test tasks. The Primary and Secondary factors impact either as a collaborative or as individual factors on performance and achievement (Bachmann, Frenzel & Rauner, 2014).

5.3.6.1 Difficulty of Tasks

Figure 37 indicates that 15% of the respondents found the tasks very difficult and 52.4%, rather difficult. Only 4.5% reported the tasks to be very easy.

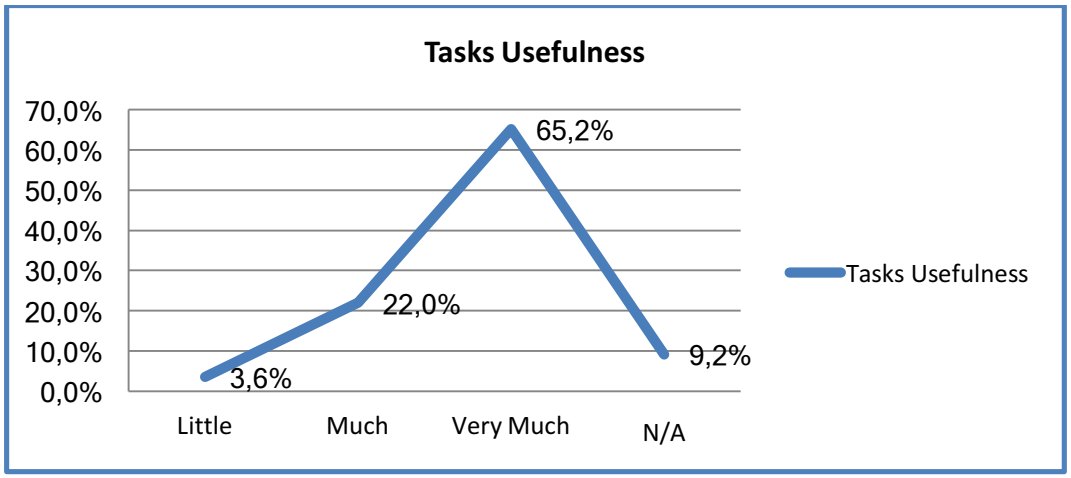
Figure 37: Percentage of students in response to Difficulty of Tasks



5.3.6.2. Task Usefulness

Students expressed a need for the test tasks and 65.2% rated the tasks as very much useful, 22.0% as useful and only 3.6% viewed these tasks as of little use in Figure 38 below.

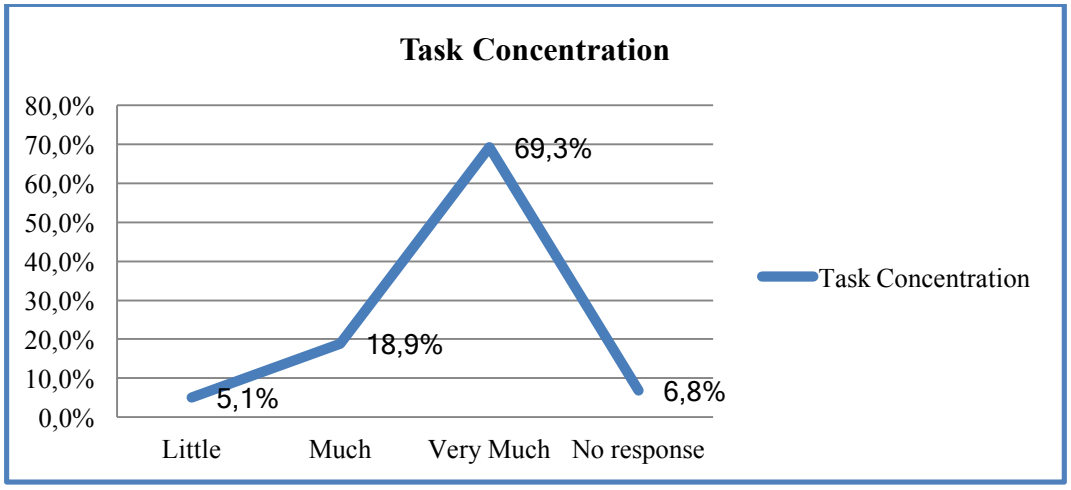
Figure 38: Student response to Task usefulness



5.3.6.3 Task Concentration

A high level of concentration was reported during the task completion. Very much concentration was reported by 69.3% of respondents – figure 39.

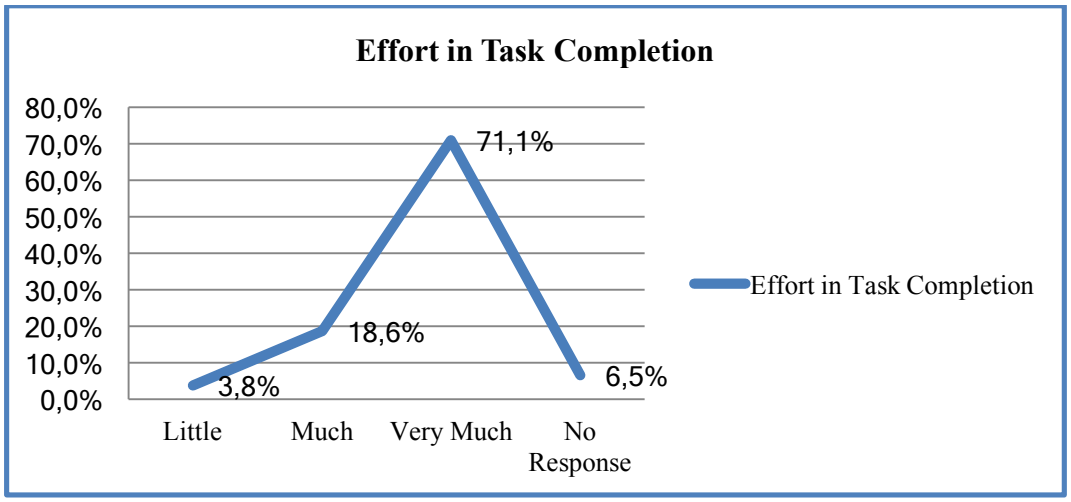
Figure 39: Tasks Concentration



5.3.6.4 Effort in Tasks Completion

Figure 40 illustrates that 71.1% of respondents applied very much effort in doing the tasks

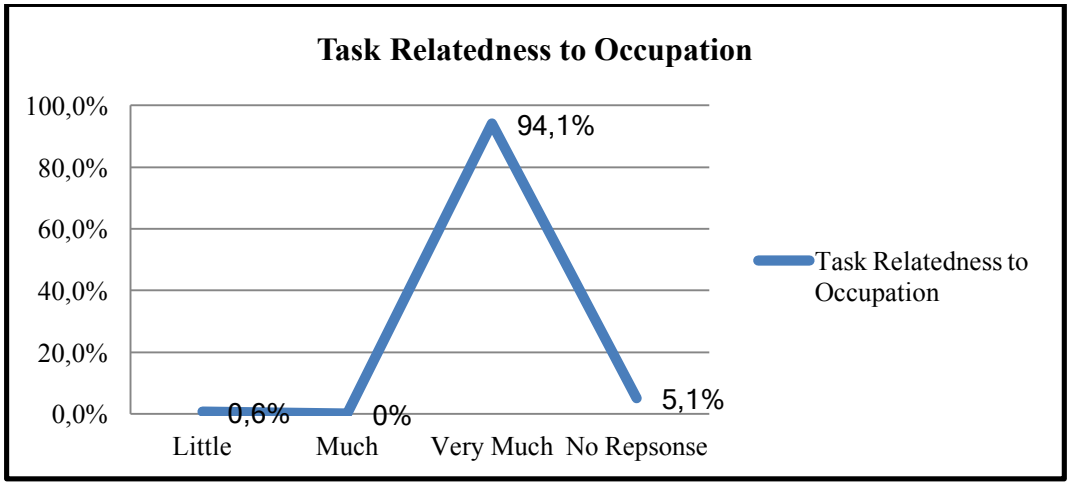
Figure 40: Percentage of student effort in Tasks Completion



5.3.6.5 Task Relatedness to Occupation

According to Figure 41, almost all the students (94.1%) relate the COMET test tasks to their occupation.

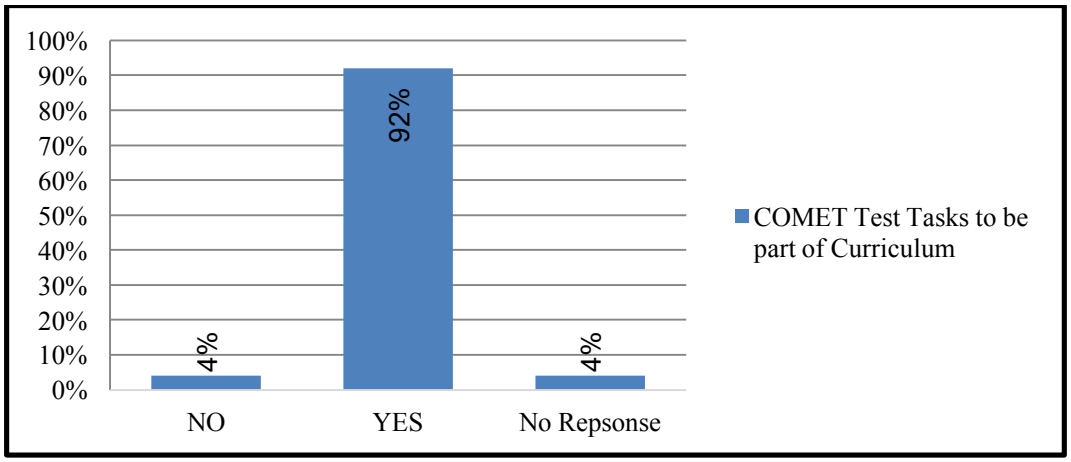
Figure 41: Student response to Task Relatedness to their occupation



5.3.6.6 COMET Tests tasks to be part of the Curriculum

92% of respondents are of the opinion that COMET tasks should become part of the curriculum as indicated in Figure 42.

Figure 42: Percentage of student response rate to COMET Tests tasks to be part of the Curriculum



51.5% of respondents spent 90 minutes to 2 hours completing the task and 30% spent between 60 minutes to 90 minutes. Merely 0.5% reported spending less than 30 minutes.

Majority of students reported finding the tasks rather difficult but there is a clear indication of high motivation levels and the value attached to these tasks by students. The quantitative responses support the qualitative data as illustrated in the graphs and data above.

The main themes identified from the qualitative research responses are as follow:

- The importance of applying your mind and thinking skills when doing the tasks.
- These tasks are valuable and more exposure to these types of tasks will be beneficial.
- The tasks relate to their current work and curriculum and have the possibility to enhance the current training.
- It teaches you problem solving skills where better ideas, innovation and improvement are important.
- It will improve problem solving by looking at all aspects of the task.
- The tasks serve as good preparation for the actual workplace.
- Tasks are difficult but very interesting.
- Shortcomings in their current training in terms of holistic problem solving competence.

Data from the Motivational Questionnaire provide the researcher with valuable information of what is needed to improve the development of occupational competence amongst TVET students. The endurance and positive attitude of students can be capitalised on when programmes are developed for holistic shaping competence and work process knowledge. The responses are indicative of student readiness for COMET to be part of the current TVET programmes.

5.3.7 Vocational Identity and Occupational Commitment

The Identity and commitment of respondents to their Vocation is high as indicated in figures 43 to 47. The impact of economic factors is however evident in Figure 47.

Figure 43: Feeling comfortable in Profession

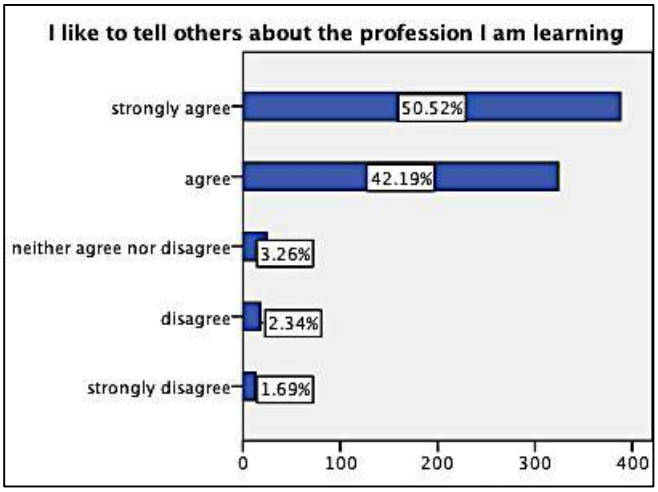


Figure 44: Profession suitability

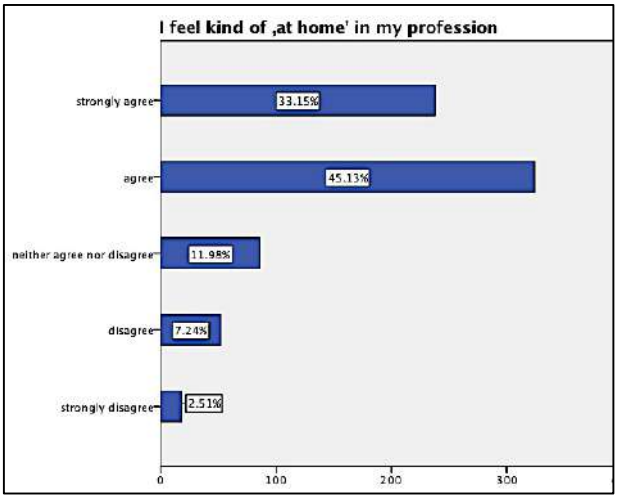


Figure 45: Work quality commitment

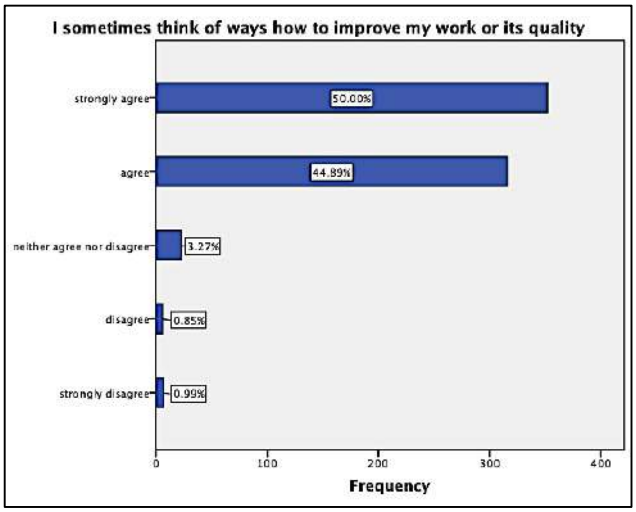


Figure 46: Suitable vocational placement

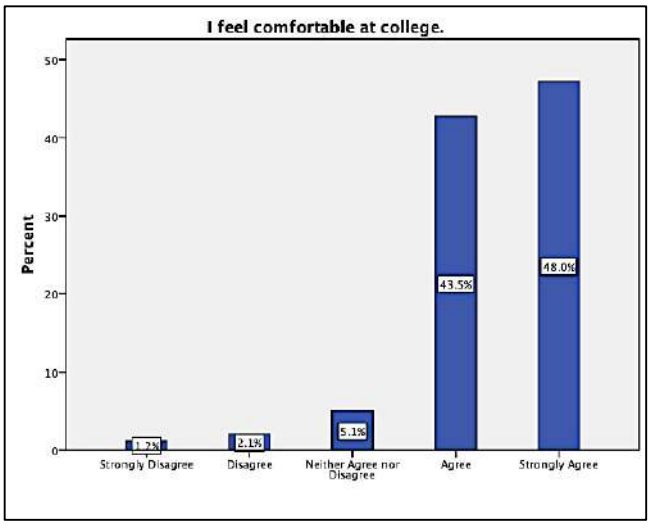


Figure 47: Vocation and Employment

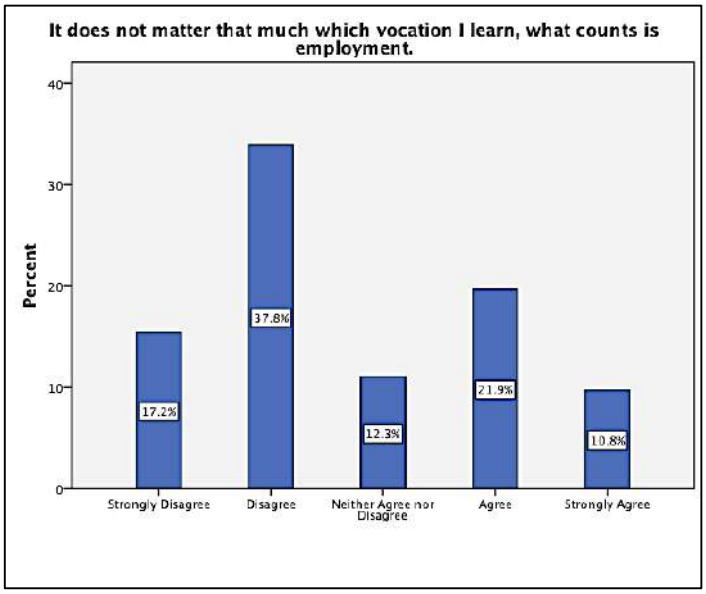
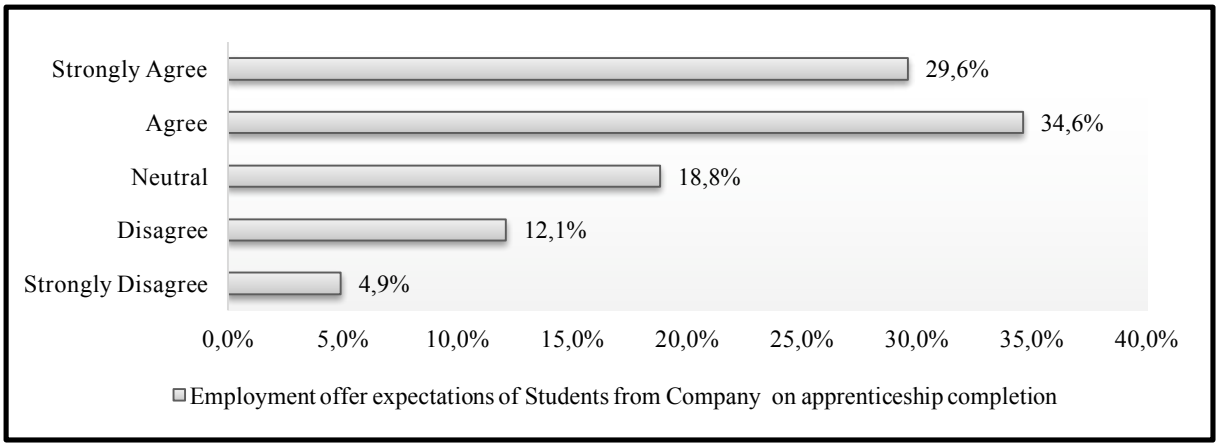


Figure 48: Employment offer expectations of Students from Company, on apprenticeship completion



Besides choosing a vocation in relation to vocational identity and commitment, economic factors and improved employment prospects was identified as an important factor in career decisions as shown in Figures 47 and 48.

Figures 49 – 52 provide a view of student perception of Vocational learning in TVET Colleges.

The following key is applicable for Figures 49 to 54:

1 – Strongly Disagree; 2 – Disagree; 3 – Neither Agree nor Disagree; 4 – Agree;

5 – Strongly Agree

Figure 49: Educator response to student needs

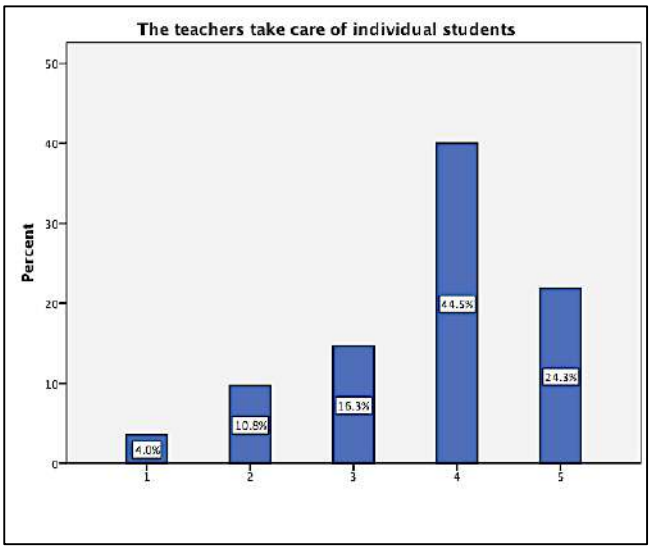
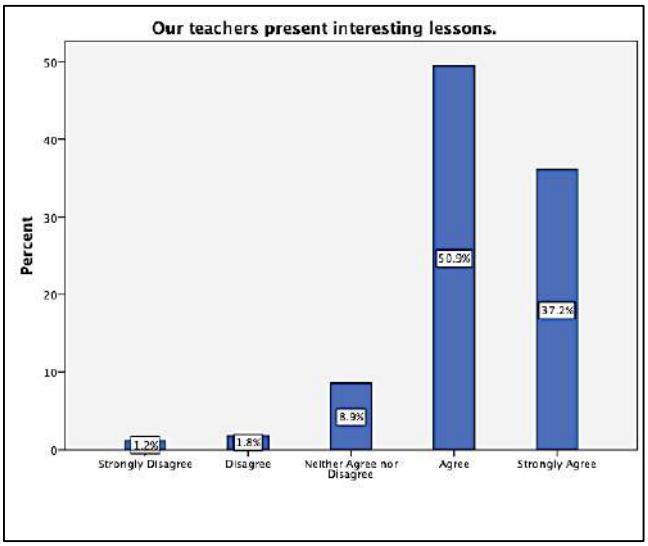


Figure 50: Lesson presentation



The overall response to *Educators taking care of student needs* is positive – 44.5% (*Agree)* and 24.3% (*Strongly Agree)*. A similar pattern is observed for *lesson presentation* with 50.9% of students that *Agree* and 37.25 who *Strongly Agree* to receiving interesting lessons. These students also reported that 29.6% (*Agree*) and 10.3% (*Strongly Agree*) of their fellow classmates often disturb lessons. They also reported that 40.6% (*Agree*) and 13.4% (Strongly *Agree*) of Schoolmates are often absent from school as indicated in Figure 52. The response pattern observed in Figure 53 is fairly spread out across categories with 48.2 % (34.9%-*Disagree* and 13.3% *Strongly Disagree*) of students indicating that students do show respect for each other and 34.4% (26.2 % - *Agree* and 8.2%-*Strongly Agree*) who reported that students do not show respect for one another. There is a disjuncture between student perception of receiving interesting lessons and feeling nurtured and student conduct in terms of social behavior and absenteeism.

Figure 51: Student Absenteeism

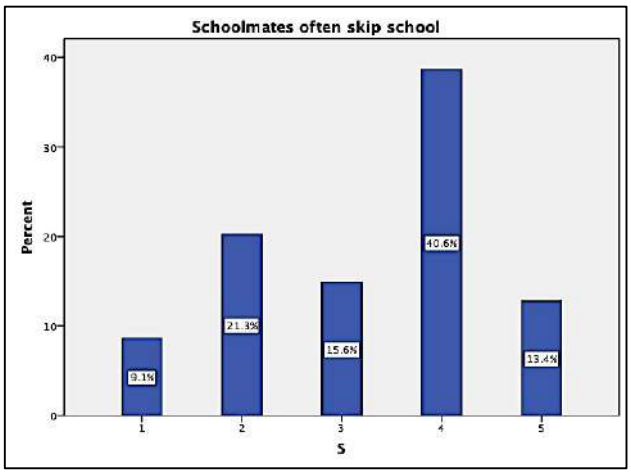
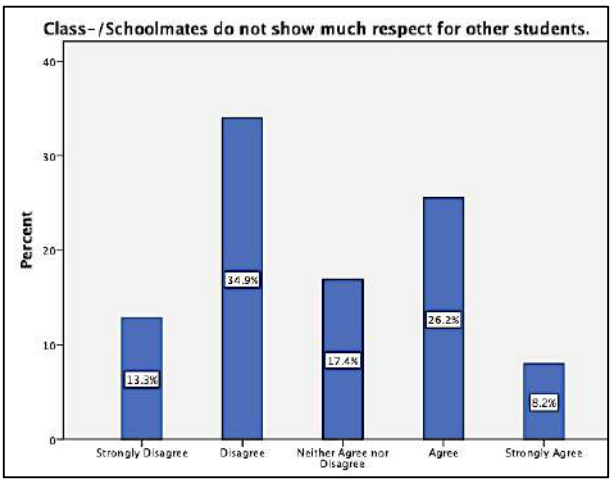


Figure 52: Respect for fellow students



Figures 53 to 54 give an overview of College – workplace relations for the advancement of Vocational Identity and Occupational Commitment.

Figure 53: College-Workplace Transfer of knowledge

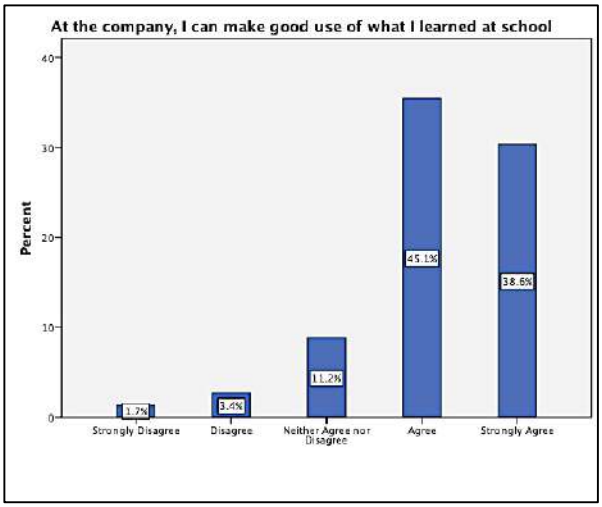
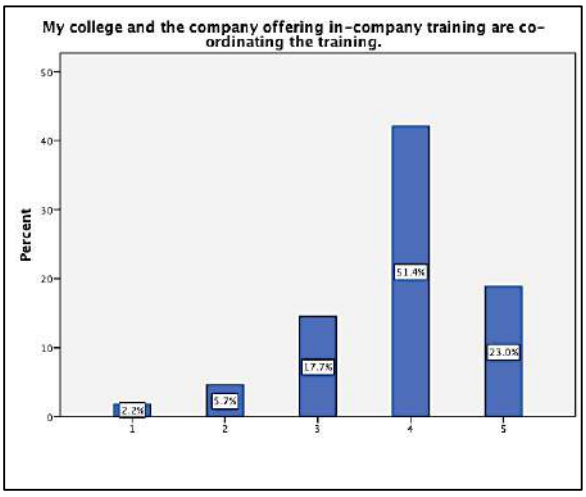


Figure 54: College-Workplace learning



51.4% of Students *Agree* and 23% *Strongly Agree* to a well-coordinated College-workplace learning system. 45.1% *Agree* and 38.6% *Strongly Agree* to the relevance College learning for application in the workplace.

Figure 55: Student Vocational Identity in relation to their Occupation

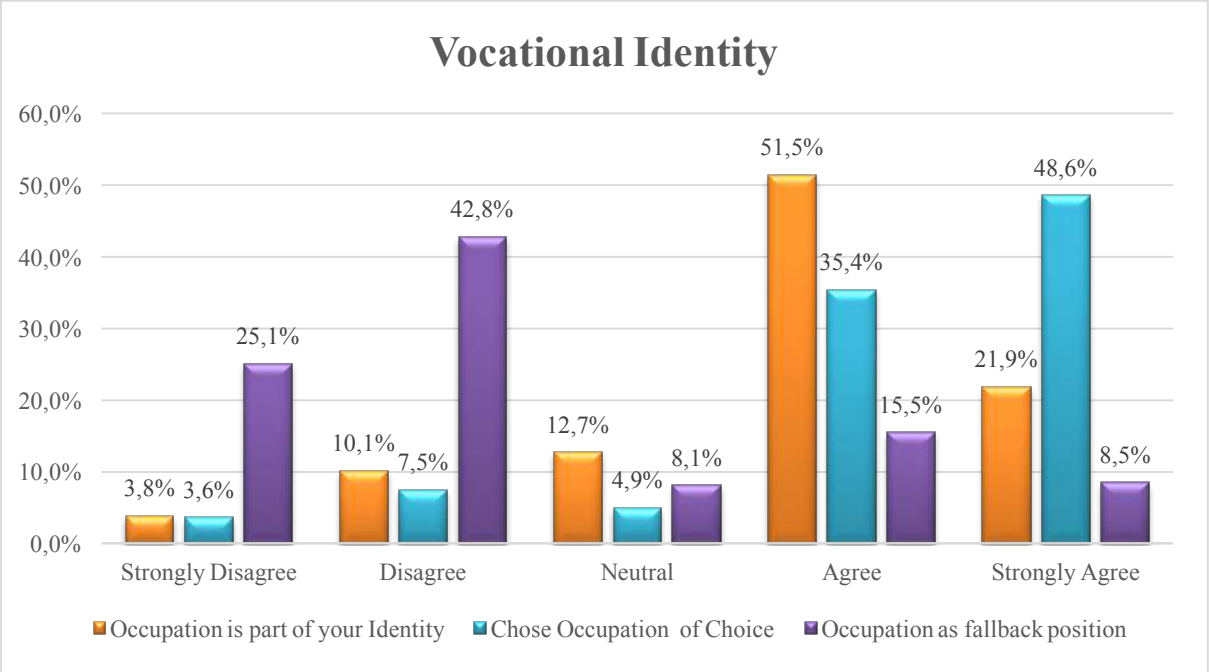


Figure 55 shows that students identify strongly with their vocation. 51% *Agree* and 21.9% *Strongly Agree* that an occupation is part of your identity with only 13.9% not agreeing and 12.7% decided to remain neutral. This strong stance in identifying with an occupation is further endorsed by 35.4% *Agreeing* and 48.6% who *Strongly Agree* that they are in their occupation of choice. 24% reported their occupation as a fallback position while 67.9% disagreed (42.8%-*Disagree* and 25.1% - *Strongly Disagree*).

Vocational identity and Occupational commitment of students are high and in distinct contrast with occupational competence measured in this study. It appears that the personal attributes such as intrinsic motivation and commitment portrayed in relation to the preferred occupation is not optimised in their current training in TVET.

5.4 Research Sub-Question 2: How are the cognitive domain specific dispositions transferred into practice?

This question seeks to explore the relation between conceptual and practical competence. The impact of the curriculum on competence development is illustrated in Figure 31 highlighting the poor levels of professional competence amongst students as well as the evidence of stagnation in terms of the development of occupation competence as illustrated in Figure 34. Furthermore, the possibility of measuring social competence as a fundamental competence for

the development of occupational competence as illustrated below in Tables 26 to 28 and Figures 58 to 60 is examined.

5.4.1 COMET Practical task

The Practical task was conducted at two sites, a TVET College and an Industry Training Academy.

5.4.2. COMET Practical Task at the TVET College

Practical task: The original stamping system had to be fully automated. COMET criteria had to be taken in to account.

Four students in NCV L4 enrolled for Mechatronics had to complete the practical test task. Four individual solutions were planned and graphically presented. All conceptual solutions were found to be functional. This corresponded well with the large-scale assessment indicating a higher score for K1 – Clarity and Presentation.

During Part A of the assessment, students performed the practical task. The diversity in terms of occupational competence and the transfer from conceptual to practical competence was evident. One student completed the practical task without any problems or assistance. Two students completed the task but with the assistance of the Raters. One student could not transfer the conceptual task to a practical task. For Part B of the exercise, students diverted to conceptual solutions.

The Practical task could not be rated as a result of certain COMET criteria not being able to be measured. This explorative study provides valuable information for the assessment and development of practical occupational competence in TVET:

- This task, done in a College workshop, in a simulated setting, did not allow for all the COMET criteria required in real work to be assessed.
- It demonstrated that it is most unlikely for students to develop Holistic Shaping competence in the absence of real workplace learning.
- The skills acquired in the simulated practical tasks can however equip `students with the basic technical skills and competence needed in their Occupational workplace based learning.

- The COMET conceptual tasks to which these students have been exposed to had a positive impact on their problem solving and divergent thinking skills. It can serve students well in workplace-based learning.

5.4.3 COMET Practical task in Industry

This task was done at a Steel Industry plant. Students had to design and build a Hydraulic system that will clamp and bend a steel plate at a 90-degree angle.

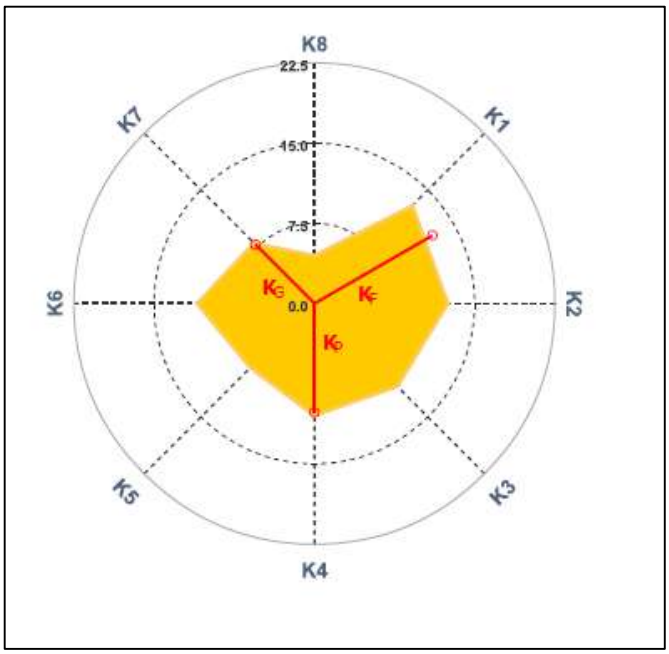
The participants were Apprentices alternating between the Industry Academy and their respective workplace. Two students completed their studies at a TVET College and two at a University of Technology.

Four Students individually planned a solution and the best solution was selected for the COMET practical task. The task was completed as a Team in real workplace with all the equipment and material needed.

The two COMET Raters could rate all the COMET criteria, which was substantiated by the interview during and after the practical test task. All four students reported that their College and University TVET training was too theoretical of nature and did not equip them sufficiently for the workplace.

The Team performed well in the execution of the practical task and the interview. They scored relatively lower in K5 and K7 with the lowest score for K8 as shown in Figure 56 below.

Figure 56: Competence profile of a Team of four apprentices for the COMET practical task



K1	K2	K3	K4	K5	K6	K7	K8	Kf	Kp	Kg
13	12.5	11.5	10.5	8	11	8	4.5	12.8	10	7.8

Illustrated in this graph is that in a real workplace COMET Practical test task can measure and identify strengths and weaknesses in holistic problem solving competence as well as progress in terms of work-process knowledge. For this group of TVET apprentices, competence for all COMET criteria, except for K8, falls within the *know-how* phase of work process knowledge while K8 falls within the *know-that* phase.

5.4.4 SOCIAL COMPETENCE

The Social competence questionnaire comprised of eight prominent Social competence dimensions. Each one of these dimensions was defined by four measurable and weighted criteria as illustrated in the Table 26. The overall inter-correlation amongst 32 sub-items measuring Social Competence, shows a Cronbach's alpha of 0.9, which is a good internal

consistency rating in terms of the reliability of the Scale. Cronbach's alpha is a coefficient ranging from 0 to 1, indicating the consistency of a scale (Terre Blanche, Durrheim & Painter, 2009, p. 558).

Tab. 26: Social Competence Dimensions and Criteria.

Social Competence Dimensions	Social Competence Criteria
1.INTERPERSONAL CONDUCT	Make friends easily and become part of the TEAM Frequently offer assistance to friends during teamwork tasks Deal well with critique and can apologise when necessary Giving and accepting compliments/accolades/recognition for a task well done
2.COMMUNICATION SKILLS	Good listener Articulate ideas well Stay focused on task at hand Give feedback to the speaker
3.SELF – AWARENESS	Understand and manage own feelings and conduct well Is self-confident Good self-esteem Has clear vision of personal achievement goals
4. SELF-REGULATING CONDUCT	Can assess the social situation and select the appropriate social skills Can control anger and aggression Assess the effect on the situation Dealing effectively with stress
5. ASSERTIVENESS	Can say NO Strive for a WIN-WIN situation Is sensitive to the feelings of others Will compromise with peers when appropriate
6. CONFLICT MANAGEMENT	Using self-control Problem solving Accepting consequences Staying out of fights
7. ACADEMIC ADJUSTMENT	Is flexible and adapt to the changes in the learning environment Responds appropriately when corrected Produce work of acceptable quality Adhere to group/class rules
8. COMMITMENT	Complete tasks on time Social self- efficacy (effectiveness) to achieve personal goals and maintain values Loyal to group/team goals Help peers succeed to achieve overall goals of the group

The figures in Table 27 reflect Student self-rating social competence and Table 28 the Staff-Student combined rating of student social competence levels.

Tab. 27: Student self-rating scores of Social Competence

SOCIAL COMPETENCE DIMENSIONS	N	Minimum	Maximum	Mean	Std. Deviation
INTERPERSONAL CONDUCT	62	10	16	13.16	1.74
COMMUNICATION SKILLS	62	9	16	12.90	1.64
SELF-AWARENESS	62	10	16	13.97	1.76
SELF-REGULATING CONDUCT	62	7	16	12.27	2.27
ASSERTIVENESS	62	9	16	12.69	1.94
CONFLICT MANAGEMENT	62	9	16	13.66	1.86
ACADEMIC ADJUSTMENT	62	9	16	13.42	1.78
COMMITMENT	62	8	16	13.89	1.83
Valid N	62				

Tab. 28: Combined staff and student scores for student Social Competence.

SOCIAL COMPETENCE DIMENSIONS	N	Minimum	Maximum	Mean	Std. Deviation
INTERPERSONAL CONDUCT	62	10.0	16.0	13.4	1.37
COMMUNICATION SKILLS	62	9.0	16.0	13.1	1.48
SELF-AWARENESS	62	10.5	16.0	13.9	1.42
SELF-REGULATING CONDUCT	62	9.5	16.0	12.9	1.52
ASSERTIVENESS	62	9.0	16.0	13.1	1.57
CONFLICT MANAGEMENT	62	8.5	16.0	13.6	1.66
ACADEMIC ADJUSTMENT	62	10.0	16.0	13.7	1.55
COMMITMENT	62	9.5	16.0	14.0	1.33
Valid N	62				

Figures 57 to 59 illustrate the social competence ratings, which will be discussed holistically thereafter.

Figure 57: Student Social competence ratings per Social Competence dimension

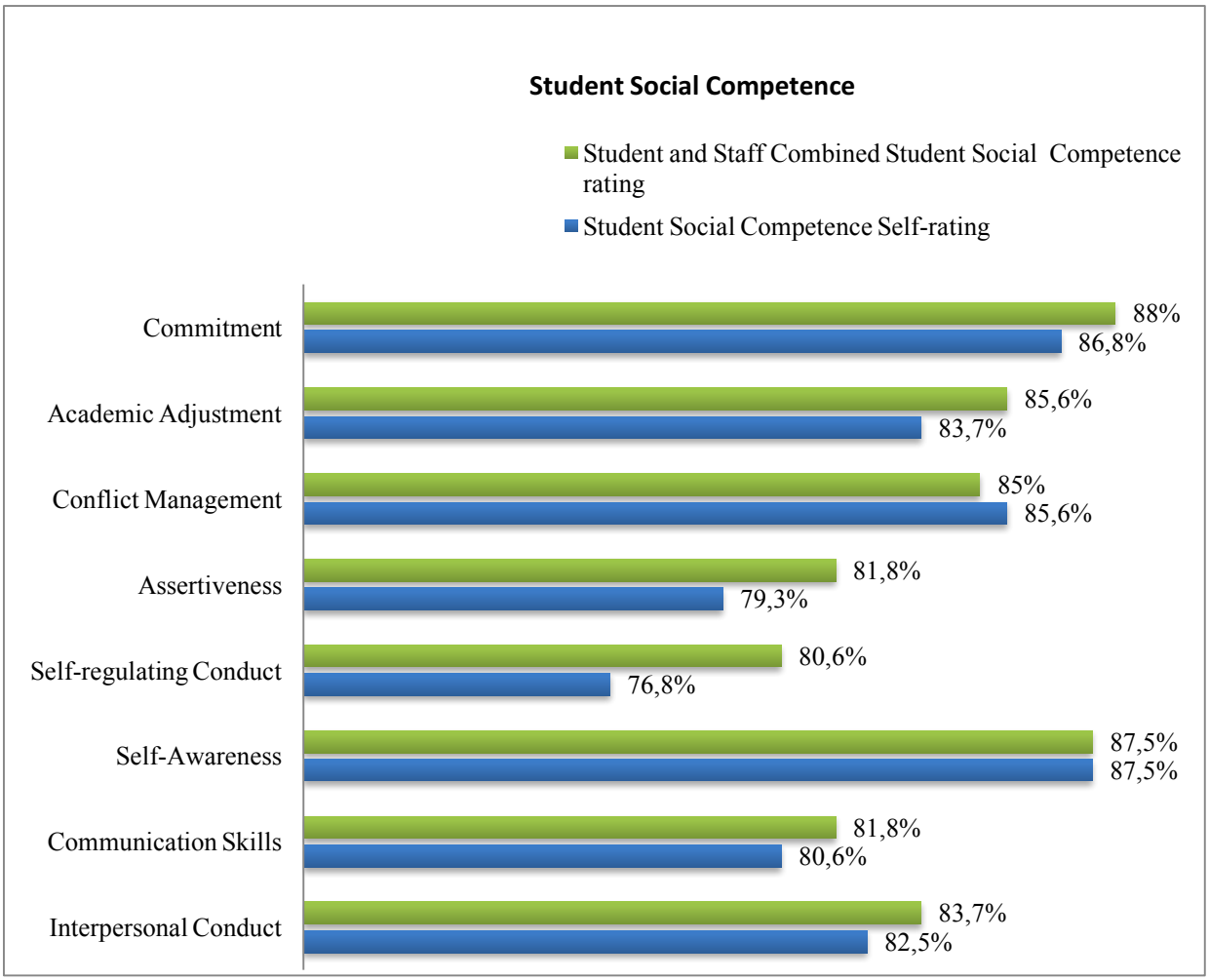


Figure 58: Student Social Competence self-rating comparison as per test site

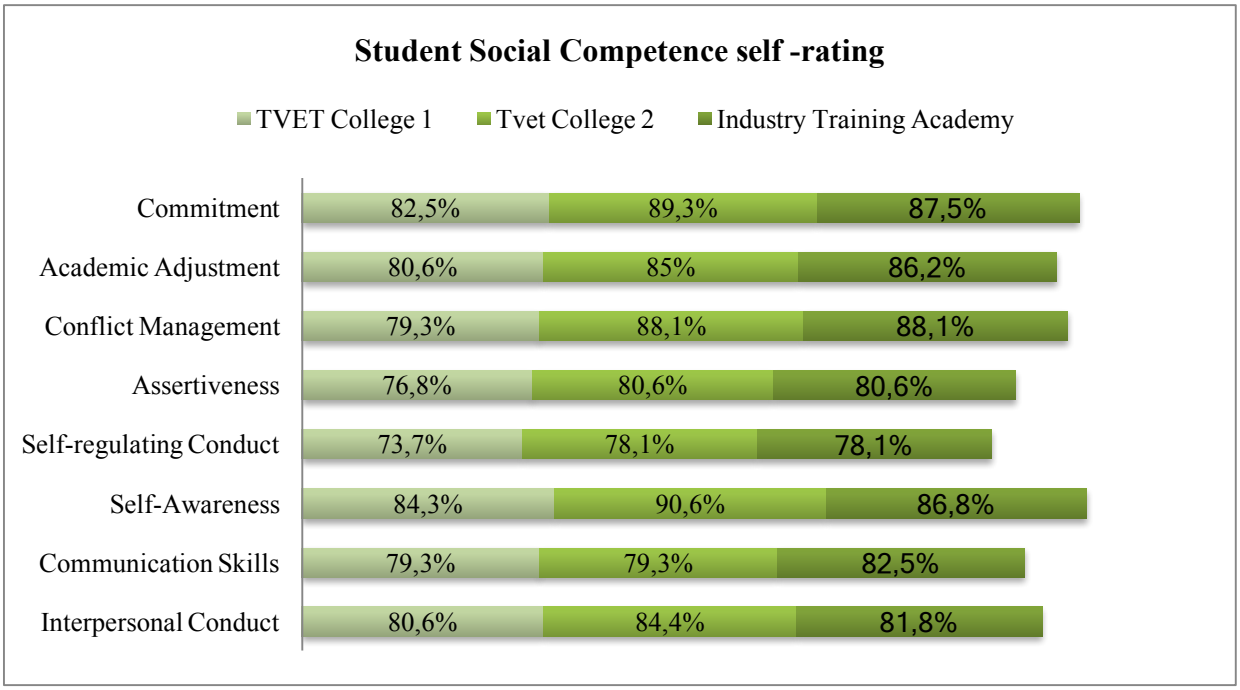
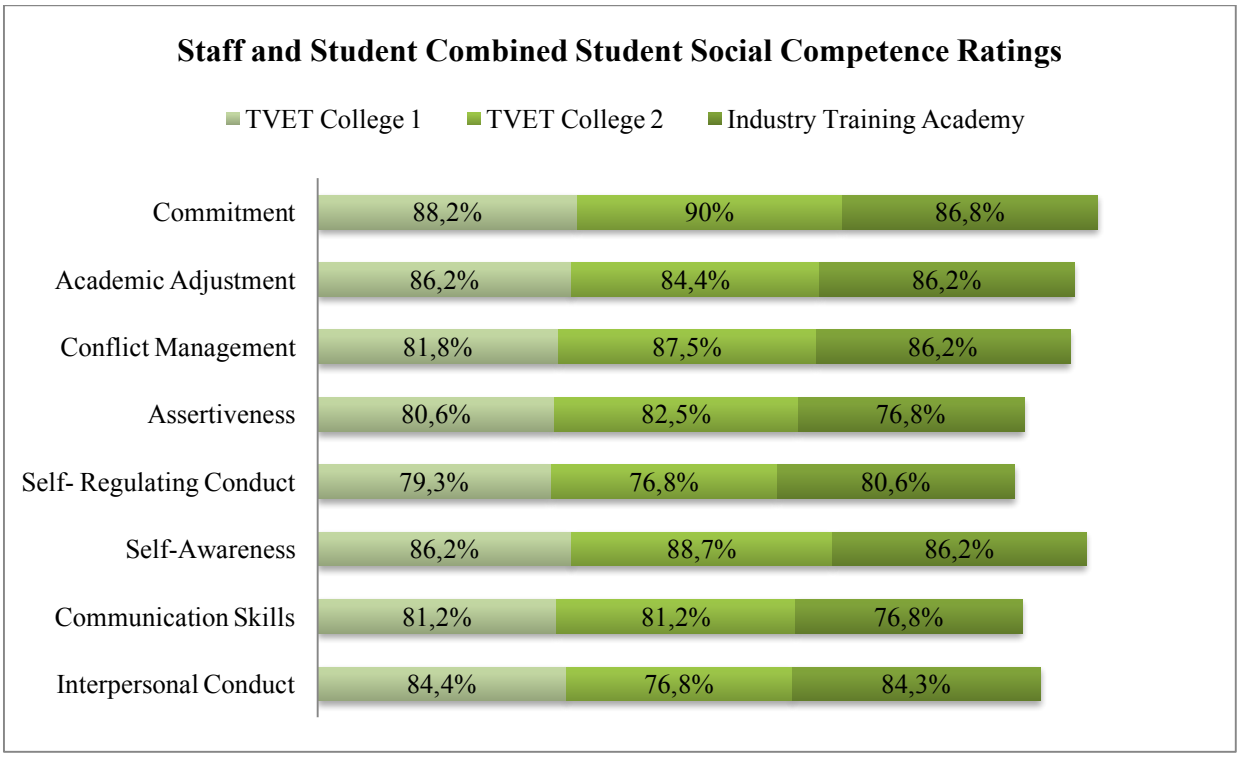


Figure 59: Student and Staff combined Student Social Competence rating comparison per test site



Total Combined Student Social Competence Minimum is score 69.1% (88.5/128) and the maximum score is 97.7% (125/128). There is a significant difference of 28.5%, which gives an idea of the diversity in social competence amongst students.

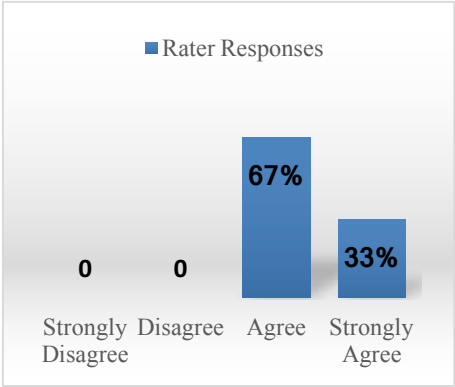
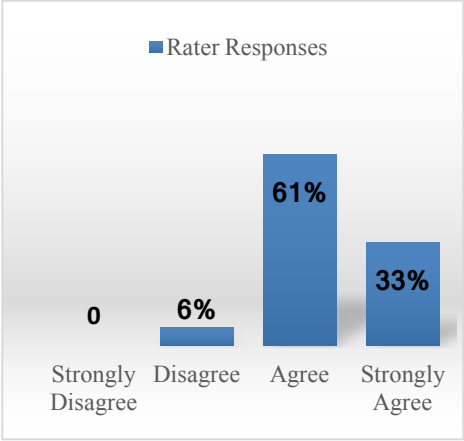
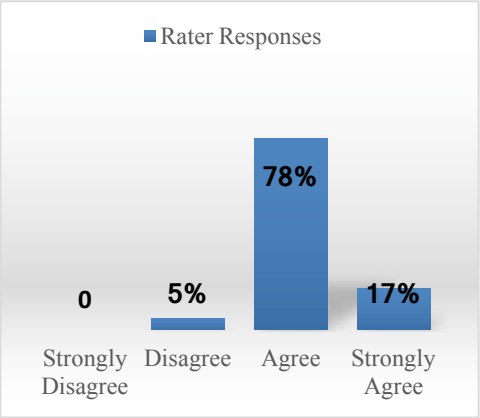
Combined Staff and Student ratings are higher than student self-ratings. Student self-rating Minimum score is 77/128 – 60.1% and therefore 8.9% lower than the combined score. The student maximum self-rating at 105.8/128-82.6% is 15.6% lower than the combined rating. This can be indicative of students with a well-developed self-awareness portrayed in the highest social competence dimension average measured in this survey – 14/16 (87.5%). The lowest combined score was achieved in the Social Competence Dimension, Self-regulating Conduct – 12.9/16 - (80.6%); Student self-rating score for this dimension is 12.3/16 – 76.8%. This is a high-risk area in terms of social competence required in the workplace given the increased importance of interconnectedness, co-existence and teamwork as critical 21st century competences as indicated in Chapter Two-2.2.

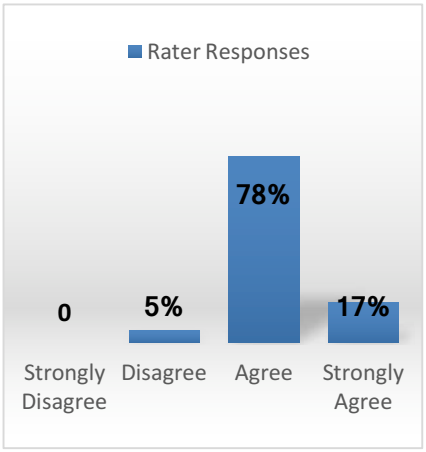
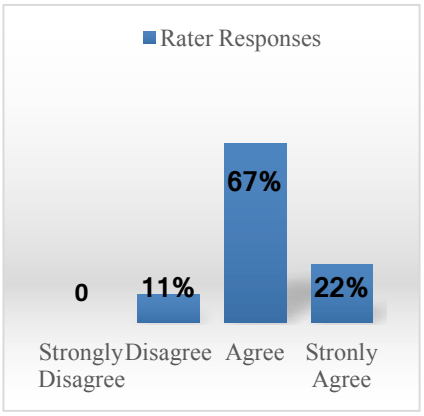
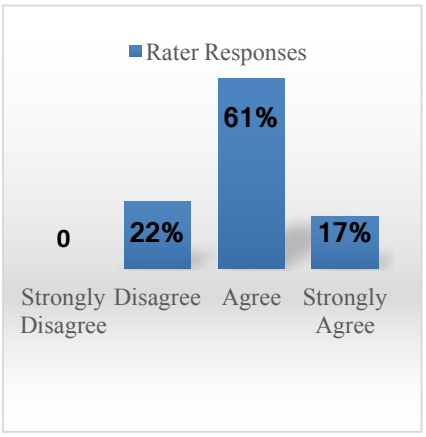
5.5 Research Sub-Question 3: What is the impact of the assessment Feedback structure and tools in TVET on Occupational Competence development?

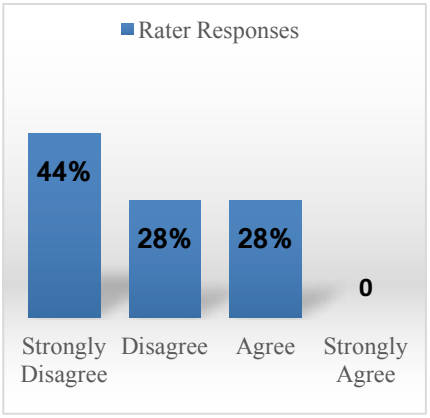
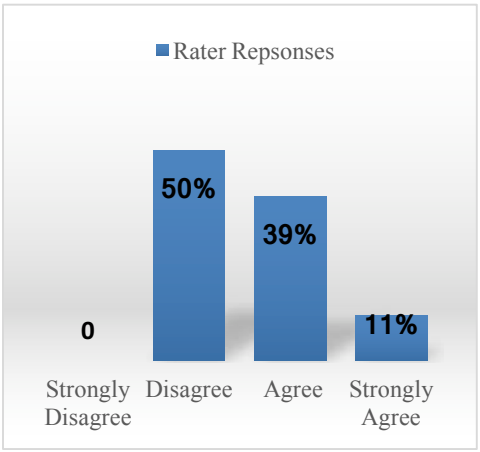
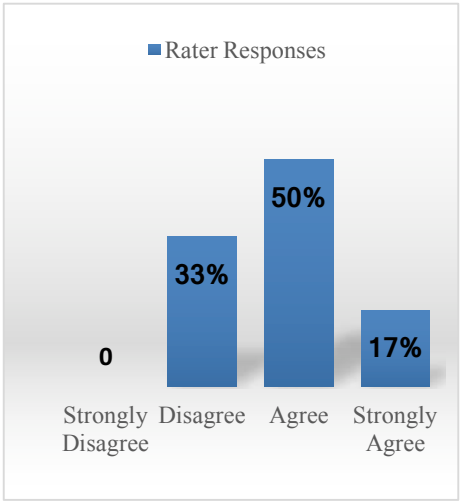
5.5.1 Feedback as an integral part of TVET Curriculum Assessment

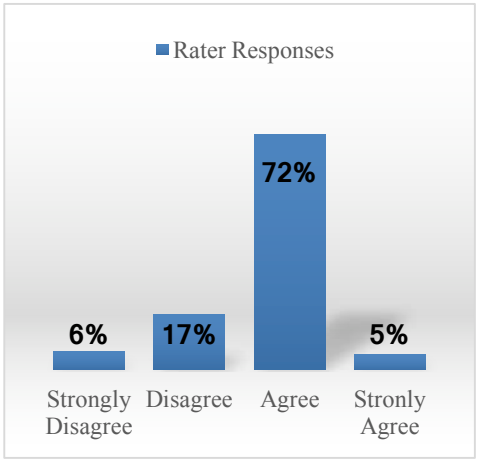
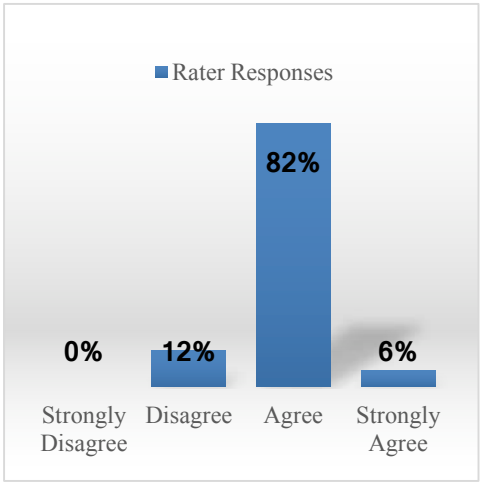
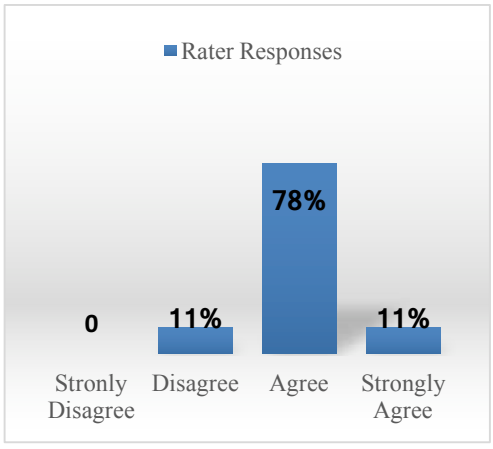
A Feedback Questionnaire is developed to respond to this question. This questionnaire comprises of two sections. Section 1 (Table 29) assesses the process of Feedback in the current curriculum and section 2 (Table 30) the process of Feedback within COMET assessment. Qualitative, semi-structured interviews supply additional information regarding Feedback as a central element in the assessment and development of effective and efficient occupational competence. Semi-structured interviews with students provide valuable qualitative feedback and feed-forward data to substantiate findings from the quantitative data.

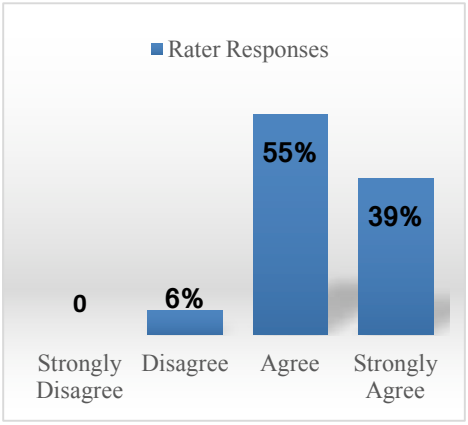
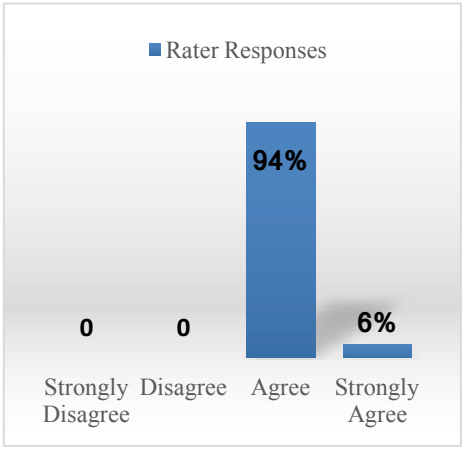
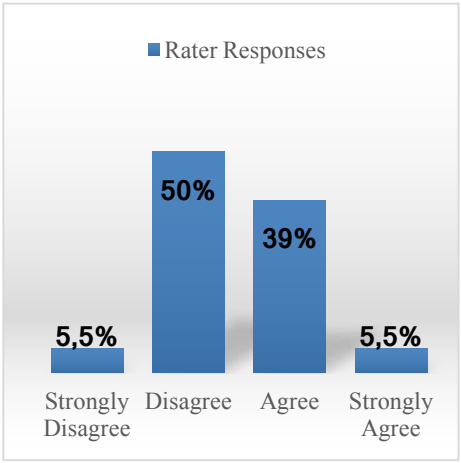
Tab. 29: Feedback criteria and graphic illustration of responses for TVET Curriculum Assessment

Assessment Feedback criteria Current TVET Curriculum	**Rater responses graphically illustrated**
1. Assessment results are thoroughly discussed with students regarding assessment tasks done at the College/Institution.	
2. Results of practical tasks are thoroughly discussed with students regarding assessment tasks done in the workplace centre/workshop.	
3. Challenges are discussed and intervention strategies are provided after every assessment.	

4. Students' strengths are acknowledged and discussed.	
5. Students are given the opportunity to share their point of view with regard to the assessment results.	
6. Students receive feedback less than one week after the assessment.	

7. Students receive feedback more than one month after the assessment.	
8. Students receive specific help (developmental programmes) with the work they struggled with in the assessment tasks.	
9. The current assessment and feedback that students receive, stimulates creative and innovative thinking strategies towards finding effective and efficient solutions to address socio-economic challenges.	

10. Students are thoroughly prepared and equipped to perform well in their occupation in the workplace as a result of effective feedback, which helped them improve their competence in finding better solutions.	
11. Students will be able to apply the theory of their course with ease in the practical part of their job in the real workplace, as a result of feedback with regard to the transfer of theory to practice.	
12. Students experience the feedback environment as positive: a good learning and development opportunity to help them take charge of their development and learning.	

13. Assessment and feedback processes help me as a Lecturer/Supervisor with the ongoing improvement of the quality of my training/service delivery to students.	
14. Students clearly understand the feedback and specific suggestions they receive from me, as a Lecturer/Instructor, and know which steps to take to improve their performance by finding new ways of thinking about problem solving and finding holistic solutions.	
15. The current assessment system does not allow for quality, detailed feedback to students and feedback occurs predominantly in the form of a static statement of results (report/test scores).	

The responses on the Curriculum Feedback provided by TVET staff involved in COMET assessment, rating and development processes is indicative of their perception of Feedback. The predominantly positive responses regarding Feedback do not correlate with the overall

performance of students in the COMET Large-Scale assessment. There are various indicators of confusion and contradiction:

Challenges are discussed and intervention strategies are provided after every assessment. - 78% - Agree and 17% Strongly Agree versus *Students receive specific help (developmental programmes) with the work they struggled with in the assessment tasks* – 50% indicated Disagree.

The current assessment system does not allow for quality, detailed feedback to students and feedback occurs predominantly in the form of a static statement of results (report/test scores) – 39 % Agree and Strongly Agree, 5.5%.

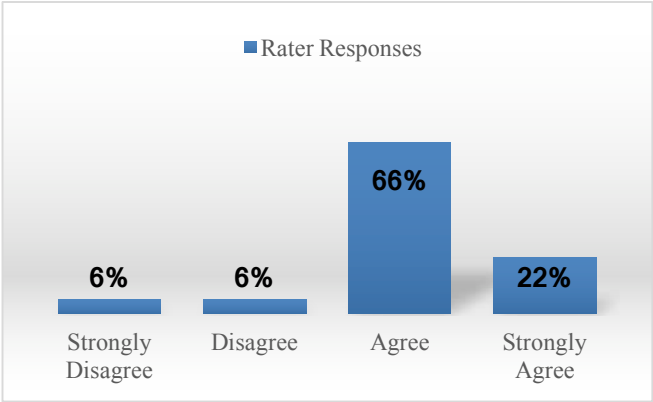
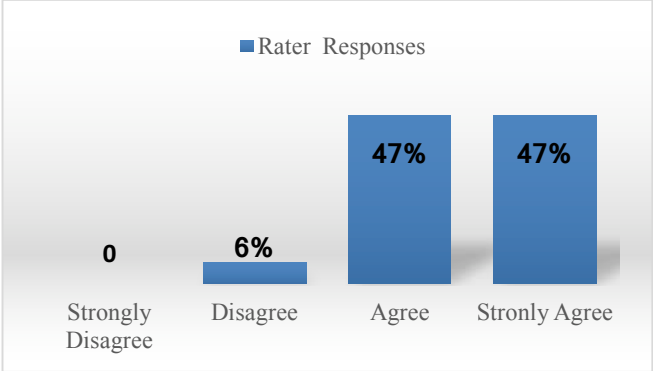
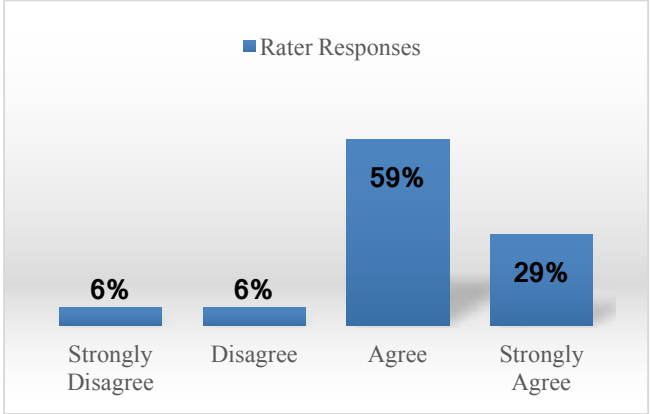
The current assessment and feedback that students receive, stimulates creative and innovative thinking strategies towards finding effective and efficient solutions to address socio-economic challenges – 50% Agree; 17% Strongly Agree and 33% Disagree. The occupational competence levels achieved by students in the COMET Large Scale assessment based on their problem-solving skills differ significantly – Nominal – 60.4 %; Functional - 14, 9%; Processual- 13, 1% and Holistic Occupational Competence- 11, 4%.

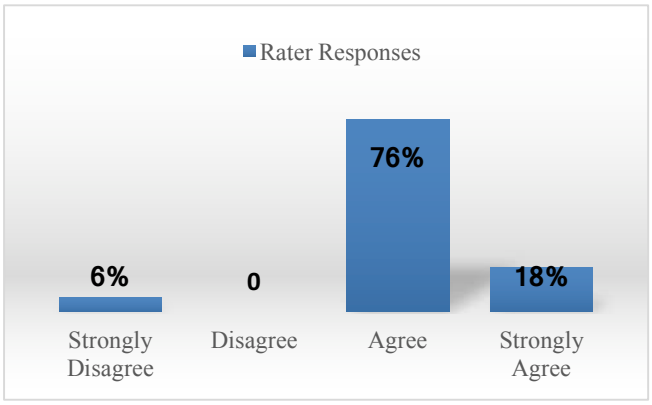
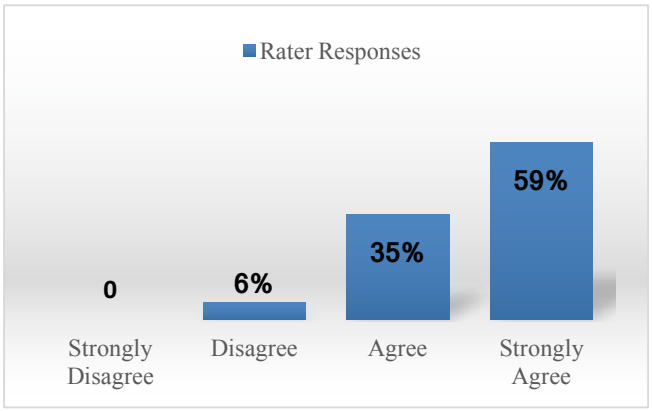
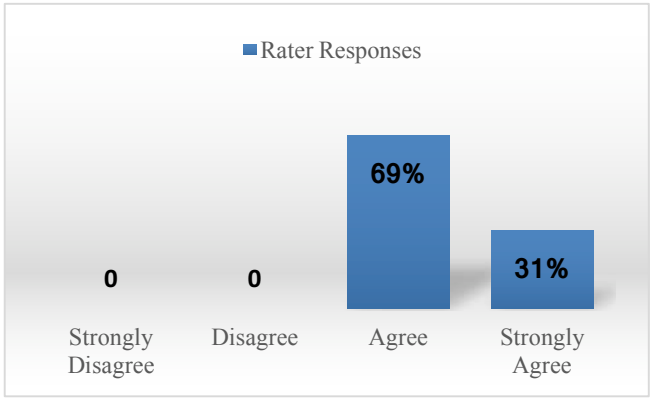
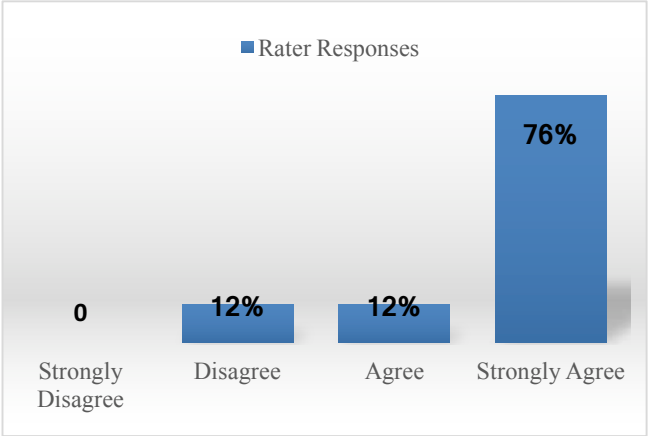
Very few *Strongly Agree* nor *Strongly Disagree* responses were provided which allude to not completely adhering to the Feedback criteria but only to a certain extent.

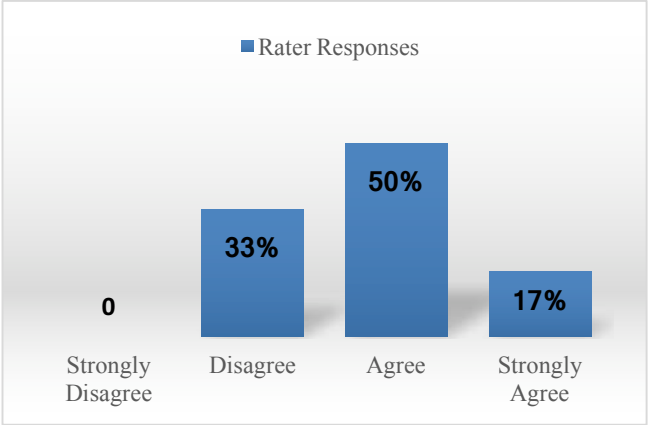
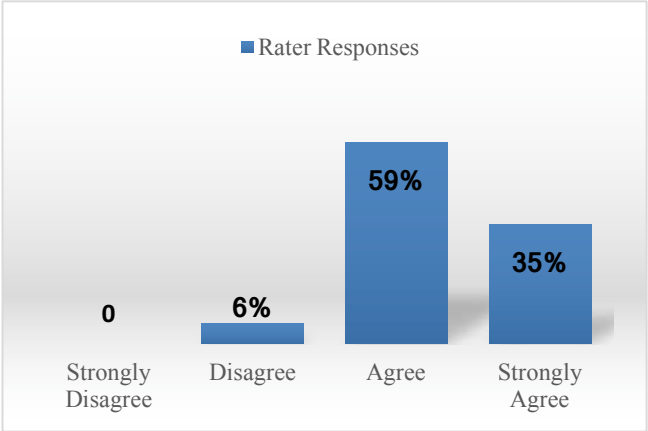
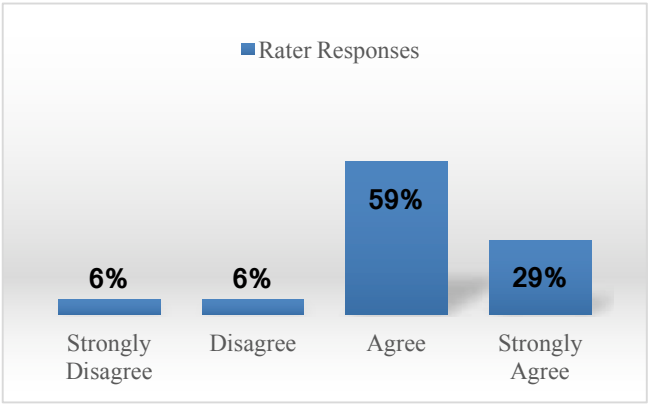
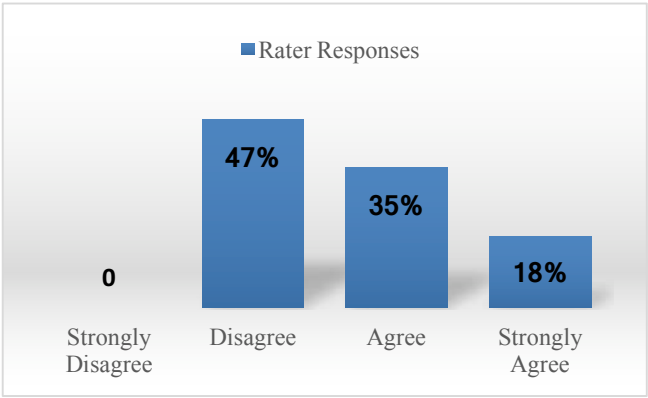
These discrepancies can be an indication of a poor perception of the science of Feedback as an integral part of Assessment and Development of Occupational competence and commitment.

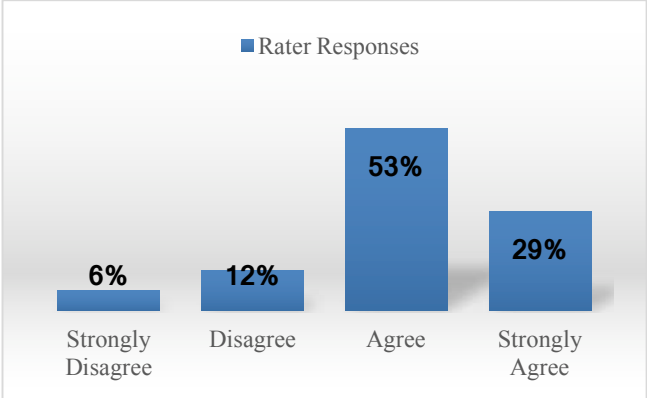
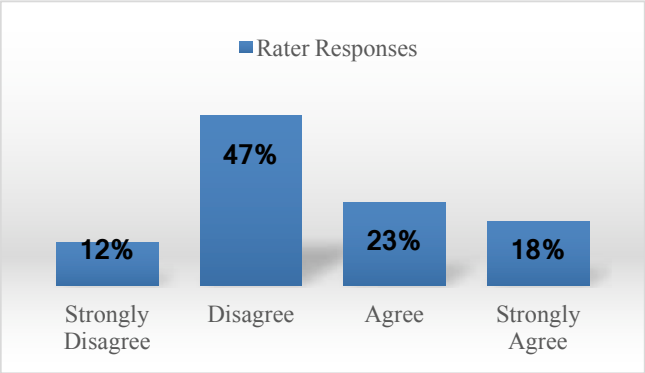
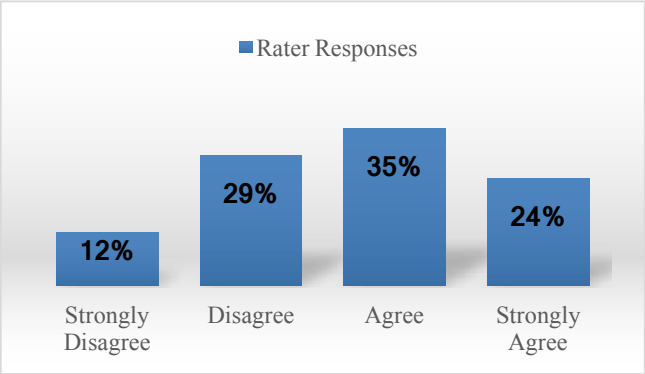
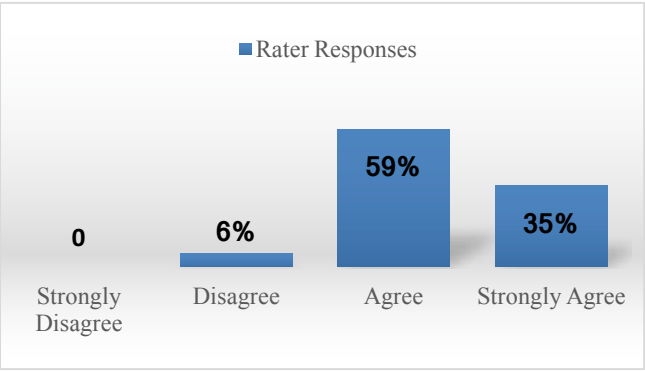
The second section of the Feedback questionnaire focus specifically on feedback related to COMET. COMET Raters have been exposed to the COMET feedback process.

Tab. 30: Rater responses to COMET assessment criteria

COMET Assessment Feedback Criteria	Rater Responses
1.The open test tasks assessed according to COMET criteria allows for more specific feedback actions.	
2. Inter-rater reliability as a first step in preparation for COMET assessment equips staff with improved competence to provide quality feedback to students.	
3. The rating scale, using the eight COMET competence criteria assists Staff with the self-evaluation of their work, hence strengthening their professional development to provide more accurate feedback to students.	

4.The typical character of COMET where a solution space is provided, describing possible solutions and variants associated with the open test tasks improve Staff confidence and competence for the feedback process.	
5.A high-quality feedback process will assist in preparing students to be able to solve complex problems holistically in the place of work.	
6.Occupational identity is interrelated to occupational commitment and can be shaped by a specific, directive and empowering reflection on assessment results.	
7.Dual education and training programmes, where students learn theory (academic learning) and workplace practice (vocational learning) is the best solution for developing self-evaluation and reflective feedback among students.	

8.Current Government TVET policies and strategies place sufficient emphasis on feedback as a process to inform effective and efficient, industry related education and training.	
9. Work Process Knowledge – know that (guide action), know how (interpretation of action) and know why (reflective action) are valuable levels to interactively discuss assessment outcomes with students with regard to their levels of occupational competence as well as development needs.	
10. Decisions on how to improve teaching and learning rely heavily on previous assessment outcomes and feedback reports.	
11. Feedback is often seen as an add-on to assessment and not an integral part of assessment.	

12.COMET feedback reports provide a clear, graphic illustration to students on their performance, assisting in self-evaluation and reflection.	
13.A TVET qualification, as outlined in the current curriculum, is sufficient to prepare students to solve problems holistically and therefore competent to succeed in the world of work.	
14. Feedback results are captured and well documented for future reference.	
15. COMET feedback can assist the students to be actively involved in shaping their progress from being a novice (beginner) to an expert (skilled) in their respective occupations.	

The possibility of COMET having a positive impact on Feedback is clearly illustrated by the responses of the Raters. There is a significant higher level of decisiveness in comparison to the first section on Feedback within the current Curriculum.

The impact of the COMET Open-ended Test Tasks to allow for specific feedback action is valued at 66%-*Agree* and 22% *Strongly Agree* level. This rating signals the need for assessment based on diverse, holistic problem solving skills.

High quality Staff training such as inter –rater reliability training provided to COMET Raters seems indispensable for quality, meaningful Assessment feedback to students according to 47% -*Agree* and 47% - *Strongly Agree* ratings.

76% of Raters *Strongly Agree* to a Dual Education and Training programme as essential for self-evaluation and reflective feedback. 59% indicated that the TVET qualification as outlined in the current curriculum does not adequately prepare students for the world of work. 33% alluded to Government TVET policies and strategies not emphasising Feedback sufficiently to an extent where it will inform industry related education and training while 67% reported that it is sufficiently emphasised. The impact of the positive ratings regarding Government Assessment policies is however not reflected in the student occupational competence levels measured in this study.

94 % of the Raters see the solution space provided with COMET open-ended test tasks as a method to improve Staff confidence and competence. This is a principle feature in the development of effective and efficient Assessment Feedback strategies, procedures and principles.

Raters (94%) acknowledge that the COMET Feedback process can assist students to be actively involved in their journey from being a Novice (Beginner) to an Expert (Skilled worker) in their occupations - *Agree – 59% as well as Strongly Agree-35%.*

The results yielded by the Feedback questionnaire affirm the position of Feedback as an integral part of Assessment and Development of TVET Students. It is however clear that whilst the acknowledgement of the importance of Feedback, the process need to be established and situated in TVET.

5.5.2 SEMI-STRUCTURED FOCUS GROUP INTERVIEWS - FEEDBACK AND FEED-FORWARD INFORMATION.

Nine open–ended qualitative questions directed the interview with students. Students responded to questions in a manner that required deviation from the planned sequence of questions**.** This dynamic allows for a more holistic and integrated approach to the enquiry. Student responses are presented in *Italic* to corroborate and clarify the emerging themes.

The main the themes that emerged are presented below:

1. There is general consensus amongst students that their current TVET studies can improve their quality of life. Some were however doubtful and referred to unemployed qualified artisans in their field as well as concerns with the current Curriculum. Participants motivated their stance in the following statements:

- *As we have heard, many developments will happen over the next few years. It can improve my quality of life. There are negative aspects that cause me to doubt at times because sometimes guys come to where we work with a red seal but unemployed. But I focus on the need for Artisans in future.*

- *Yes and No. Your studies in mechatronics are not enough. You need to study more to be able to do your occupation. At the end, it will help you.*

- *Curriculum must be broader - you just know the basics*

- *It improves your way of thinking. Help you to be more organised. You must follow certain steps to make sure that your design works perfectly.*

- *Yes. In the future, you can refer to your technical training for example, when you going for Engineering (studies).*

- *I did a 360-degree turn. I started as an apprentice but ended up in an alternative job where I worked as a laboratory assistant. Thereafter I went to a production facility where I worked as an operator. At the end of the day I saw that I was not getting what I wanted when I started as an apprentice- so I came back to complete the cycle.*

- *When you do something with your hands you learn much better than just theory. When you learn and see what you doing, you learn much better. Say if your car breaks you*

will know how a nut works. I won't say it is a second choice to a University. At university, you don't learn as much practical as here (Industry Academy).

2. The University versus TVET/Artisan Training surfaced and TVET appears to be perceived as a fallback position.

- *Why most people become Artisans …. Universities are too expensive. You can start here (Artisan) and later study further. Artisan is not a bad place to start.*
- *Yes, it is a good place to start if you do not have another choice.*
- *I want to disagree with some responses. Universities develop your mind. If you enter industry you have the theory.*

3. Students value the COMET assessment tasks and focused extensively on the major differences in terms of level of thinking, research requirements, creativity and applied knowledge when compared to their current TVET curriculum.

- *Big Difference. Curriculum Tasks at college are not scenarios. You just do theory. With COMET, you must think more, do a lot of research. You must do a lot of stuff such as being creative while at normal college work you study the text book and you give it back. We are not use to this type of (COMET) thinking.*
- *It is more challenging (uitdagend).*
- *Exam tasks are easy and based on theory. COMET is more in depth. Curriculum tasks just ask things like draw a diagram as it is in the textbook.*
- *With COMET, you also need to understand how the outside world works.*
- *COMET is more based what you do in the real world.*
- *COMET involves problem solving. In the book they just teach you the techniques. Just because you know the techniques doesn't mean that when you have a problem you will be able to implement it because you have never done it before. It is different reading a textbook.*
- *COMET is more than just Mechatronics – how you understand stuff, how to solve a problem to avoid any faults.*

- *Gives you real life situations- to solve the problems.*

- *You won't have an exact answer. In a normal test task, they will just say make a cupboard this wide and high. With COMET, you will have to think where this cupboard will come in this room. It makes you think more directly about the answer*. (Why will they ask you where to place the cupboard?) *Maybe for safety, accessibility.*

- *It trains you to respond quickly* to *questions. You have been given the case study to solve. You need to choose the best route to solve the problem.*

4. All participants agreed that COMET would result in improved TVET delivery and workplace readiness.

- *Yes. You will be able to solve problems. Using creativity will help you solve tasks that you are not familiar with in the workplace. You can contribute to problem solving.*
- *Do it correct the first time.*
- *Before you solve a problem, you must analyse it. If you do COMET tasks all the time you will be able to analyse any problem in record time.*
- *COMET model philosophy and principles can be applied everywhere you go. Everywhere you go you going to get some faults. You need to solve something.*
- *COMET tasks- you get a scenario that can help you see different options to solve problems.*

5. Workplace learning as an apprentice in a real-life workplace such as this Steel Industry improves the quality of TVET.

- *I will not compare (TVET College) to this place (Training Academy) because this place is much further (more developed).*
- *Only a few of us have a basic idea or skills of the trade we are doing. Coming straight from a College or University is a bit challenging. As time goes on we learn.*
- *The practical part is much better here.*
- *You understand better.*
- *After N6, you only have the theory but not the practical.*
- *From the College, you have more theory than practical. When you get to the workplace you feel that you know nothing. You know the name but if you put that thing in front of you, you won't know what it is.*

- *When you go to a college all the information is put into your head. When you go to work, you must go through it again. If you do theoretical and practical you will remember stuff faster and it will be imprinted in your brain and you won't forget it that fast. Too much information to remember from N1 to N6……How many books?*
- *They (COMET) teach you to think not only for today but also for ten years. Safety aspects etc.*
- *It is people's life you are working with not just theory. There are consequences.*
- *You get cautious and curious. Want to know what is happening. I also want to know better how to connect things and what can be done to solve problems. For example, load shedding.*
- *If you go to a university you will still have to come back to a place like this and do what we do to obtain the diploma.*

6. Students involved in the DSAP expressed positive and negative experiences regarding the programme. Valuable information is gathered to inform this pilot project. It is clear that the workplace dynamics and logistics play a defining role in the DSAP experience for students. Students placed at different companies reported a vast difference in experiences. The TVET College and hosting Industry need to be prepared for the student/apprentice and both should have an in-depth understanding of the expected outcomes and training delivery. Student/Apprentice participation in deliberation and memoranda of understanding must form an integral part of the process.

The positive comments and opportunities expressed outnumbered the challenges. Both are however significant for future development of such programmes.

- *DSAP gives you more of what is expected after these studies. You know more about tools. You learn industry vocabulary. Exposed to more tools. Learn more about industry as such. It is challenging being two weeks in Industry and two weeks in college. You are then behind with your work at College and must then catch up the work.*

- *The catch up is a big challenge. Two weeks behind. Sometimes we return a week before examinations and this is causing a lot of stress. Work is rushed.*

- *The type of maths (mathematics) must be looked at such as rather doing engineering maths (mathematics).*

- *No…we do Life Orientation too. Don't know where it fits in.*
- *In the workplace, you must work on your own. At College, you are taken care of. Sometimes they do not guide you in the workplace.*
- *Where I work, they guide us and show us what to do. They stand by us and give guidance.*
- *Sometimes they (workplace instructors) challenge you to see how well you can think but will not leave you totally on your own.*
- *From when I started with DSAP to date I learned to take responsibility. There outside you need to take care of yourself. My knowledge of Welding as a trade was broadened. We went beyond Welding and did some Boilermaking too. It went beyond the textbook.*
- *They broaden my leadership. Every two weeks one of our students act as leader (Voorman). He obtains orders from the real leader and gives it to the group. If things go wrong, then he must take responsibility. So, he must communicate with everybody in the group.*
- *Being exposed to the workplace gave us the insight of the real workplace and what is expected from us in the real world. Main advantage. I gained a lot.*
- *Did not get what we expected from the programme. The system was dual but it took long for us to actually receive practical training. We had to observe for a too long time.*
- *How are you supposed to get the exposure if there are no mechatronics technicians out there (in the workplace)?*
- *Think they could have planned it better. We gave our input but nothing happened or was done about it. It took us a year before we started with training at the Company. We had different training at different companies. In some companies, students got the appropriate training.*
- *Be clear and transparent on expectations regarding DSAP. Better planning. Industry knowledgeable people must be part of the planning.*

- *The host employers and coordinators also gave contradictory messages to students. Then we don't know.*
- *They say the gap is too wide between their training (Host employers) and NCV.*

  (How do you feel about the comment from Employers above?)

- *It is true.*
- *Not enough time to for example to do basic handskills at the college. You must go to other lectures and classes.*
- *The exposure side was great. We learnt a lot from that.*

7. Students not exposed in the DSAP had conflicting opinions and experiences of being excluded from the programme that ranged from very negative to positive.

- *Not being part of the DSAP just kills us. (Questioned the selection criteria).*
- *I preferred to opt out of DSAP because I want to be at College doing my College work.*
- *Time is an important challenge.*
- *We managed the work in the curriculum. We had more time.*
- *We felt left out. Did not feel so right. We also want work experience.*

8. All participants expressed the desire and need for articulation and the opportunity to further their studies in their particular occupation to the highest level equally positioned and graded as academic qualifications on the NQF.

9. Female students expressed their challenges with regard to physical strength in the training workshops.

- *For us ladies we find things difficult where physical strength is required.*
  (How do you manage this?)
- *We just try until we get it right.*
  (How often does it happen with the females?)
- *Most of the time.*

10. Students' understanding of the scope of qualities needed to succeed in the workplace are narrow and particularly the activation thereof to develop occupational competence in the workplace. They however do have an idea of these student qualities needed to succeed in the workplace. The most important qualities mentioned for students to be successful in the workplace are:

- *Pride, attitude, commitment, willing to learn, self-discipline, attendance, teamwork, punctuality, self-respect, self-confidence, follow rules/code of conduct, see opportunities, respect others, think outside of box, adaptability, work ethics, time management, responsibility and leadership, to be productive, creativity, honesty, happiness, give credit to people, to receive feedback.*

- *Discipline, qualification, dedication, committed, like what you doing, passion, respect, knowledge, understand people are different, diversity, assertiveness, address problems, communication, friendly, sacrifice to meet deadlines, work hard and dedicated, determination, listening skills, ambition, work experience, punctuality, teamwork, considerate, observant, presentable, open to learning, take and accept leadership, follow rules, have a vision.*

11. Students made it clear that they will benefit from the translation of the conceptual COMET open-ended test tasks to actually doing the COMET Practical Test tasks.

- *Will be much better. Will enjoy doing it in a practical setting. Will then see that it can work.*

12. Precise and effective Feedback after Assessment are needed to improve overall performance. It is clear that the Feedback process differ at various institutions and amongst staff at a particular institution. There is no evidence of a clear process and minimum standards of quality assurance.

- *Know where you stand. You know your strong and weak points and know how to improve.*

- *We do corrections after assessments.*

- We *get our Papers back.*

- *No discussions. Just read our marks out loud to the entire class.*

- *It depends. Differ from lecturer to lecturer.*
- We *definitely receive good feedback. We know where we went wrong.*
- *No, we do not receive good feedback. Lecturer must explain topics that most students fail. Corrections must be done on where we went wrong.*
- *We as peers, help each other.*
- *Yes, we do corrections. We also work through old (previous) question papers.*

13. Students experienced the focus group interviews as positive and inspiring.

- *It was nice. Interesting. We heard different points and opinions. Sometimes we just want people to hear your own opinion but you don't take care of the interest of others. If we can have more of such sessions, then we will understand the other people and their needs better.*
- *It gives us a positive mindset to move on. To be listened to make us feel special. We are guinea pigs (proefkonyne) of the DSAP.*

Feedback data presented here affirm the position of Feedback as an irreplaceable component of Assessment and development of Occupational Competence as presented in Chapter Two and Figure 2.

The participants described how their personal experience from learning in an institution such as a TVET College and University of Technology differ from real work in companies. They pointed out that the theory learned at these institutions is not sufficient for preparing students to perform real work. They extensively expressed the desire for COMET to be part of TVET as a means to improved workplace readiness. They stressed the importance of COMET assessment for the development of higher levels of thinking, exposure to research and creativity. The impact of the current applied curriculum differing significantly from COMET was highlighted as discussed in 5.5.2 under point 3. The design of a dual TVET delivery system should be planned meticulously and student experiences should be taken into account. The feedback pertaining to the DSAP programme had elements of a feeling of disempowerment amongst some of the students. They expressed the need to be listened to and be granted the opportunity for agency in shaping these programmes.

The feedback from the focus group interviews highlights the students' underestimation of the possible value of learning at a TVET institution. It leads to the question: why do they have this perception? Possible reasons can be that the medium of TVET learning is communication and language predominantly with minimal reference to the reality of real work. In a company, students receive direct feedback on whether a solution is working or not when performing a practical task. The difficulty experienced in the transfer of knowledge from theory to practice in a fragmented TVET system can be a contributing factor for their comments on College based learning. At higher levels of work process knowledge, at a know-why level requiring reflective thinking, it becomes even more complicated to understand the relevance of value-free knowledge in the workplace. This ability to transfer conceptual knowledge to practical competence is needed for personal development as well as for the development of companies. Educator occupational competence is a further contributing factor. If the teacher has a rigid understanding and approach towards the curriculum, this transfer from conceptual to practical learning may result in poor career prospects for students and company success. A rigid, prescriptive curriculum and assessment policy may impact on the potential of Colleges, in addition to reflective work experience to become agents of TVET reform and student experiential learning processes. Valuable information to inform a future dual system in TVET learning was obtained during these interviews.

5.6 Conclusion

The results and research findings presented and analysed in this Chapter provide valuable empirical data to inform the necessary perspectives, competence and understanding needed for the improvement of occupational competence in TVET. In the next chapter the summary of the findings, conclusions and recommendations based on the empirical investigation and literature review will be presented.

CHAPTER SIX

SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

6.1 INTRODUCTION

The aim of this research study is to explore the potential of COMET competence diagnostic model to effect higher quality assessment for the development of occupational competence and commitment in TVET. The possibility of assessing practical occupational competence, using COMET is explored. Furthermore, the impact of Feedback on the assessment and development of occupational competence have been cross-examined. The investigation also sought to establish whether it is possible to measure Social competence in TVET. The extensive literature review study serve as a point of departure for the assessment and development of occupational competence and commitment in TVET. The theoretical literature review on the subject of occupational competence in TVET is however, found to be inadequate on various vital conceptual constructs and particularly on a model to measure and develop occupational competence and commitment in TVET. COMET was identified as the first of its kind and the researcher therefore thoroughly investigated the potential of this model for the measurement of occupational competence and development. The exploration is concerned with the disjuncture between the high expectations of TVET as suggested in the Literature review and the poor occupational competence measured in this investigation.

This study contributes to the body of research on occupational competence in TVET, specifically on the assessment and development of holistic problem solving competence and more so the impact thereof on student readiness to respond to complex workplace demands at a local level and in terms of global competitiveness. TVET is distinguished for its alignment to the world of work. This investigation is the first PhD research of this kind in South Africa to examine firstly, the potential impact of occupational competence, in capacitating students for complex problem solving in the world of work and secondly, the consequence of the current TVET curriculum on the development of occupational competence.

This Chapter presents a report on how the goals of the study have been achieved. Answers are provided to the research questions. Implications for the assessment outcomes on the development of occupational competence and commitment in TVET are identified. Areas for future research are identified and recommended. Findings, conclusions and recommendations resulting from the investigation are presented - firstly, assessment concepts implemented and measured using COMET, secondly, the relation between conceptual and practical occupational competence and thirdly, the role of Feedback in the assessment and development of occupational competence. These findings, conclusions and recommendations are the implications of the reflections, interpretations and acumens presented in Chapter Six and are scientifically informed by Chapters One to Five.

6.2 SUMMARY OF RESEARCH FINDINGS

The findings and conclusions will be presented in accordance to empirical evidence accumulated to reflect, construe and provide insights followed throughout the research. The ultimate objective is to provide substantial evidence to answer the main research question namely: Would the implementation of the COMET competence diagnostic model in TVET effect higher quality assessment for the development of occupational competence and commitment?

The main objective during the research was to test the potential of COMET diagnostic model to assess and develop occupational competence and commitment. This investigation was done with the knowledge and conceptual background from the literature review on assessment dynamics, opportunities and challenges in TVET. The intention was to understand the extent to which students can solve complex occupational problems holistically by implementing COMET criteria and work process knowledge at a skilled worker level of professional competence.

The findings emerged from the data analysis of the 2014 South Africa - large scale COMET assessment, contextual questionnaires and focus group interviews as indicated in Chapters Four and Five predominantly.

The findings show that the COMET diagnostic model provide a clear direction on how to assess and develop occupational competence in TVET which is concise and empirically measurable. Embedded in this model are the essential assessment concepts of practice, regulations and quality assurance, extensively outlined in the literature review in Chapters One and Two.

The overall salient finding is that occupational competence levels of students are alarmingly low – 60.4% at a Nominal level indicating a high risk for skilled professional work. Holistic shaping competence was achieved by 11.4% of students.

- Very poor holistic problem solving competence (0.5%) was achieved in the Electrical occupation with 84.2% at a Nominal, high-risk level. The lowest score was for Environmental sustainability, K7.
- 25.2% was recorded for Holistic shaping competence for the Welder occupation. Work process knowledge advanced to the *know—how* level. A good balance among COMET criteria is measured, except for Environmental sustainability, K7.
- Mechatronics occupation yielded Holistic Shaping competence for 16.3% of students and 15.2% at Processual competence. Higher order thinking competence is poor as indicated by Creativity and Environmental sustainability scores.
- Millwright occupation shows a huge fluctuation in performance on the eight occupational competence criteria, resulting in a skewed radar graph (Figure 28).
- COMET criterion K7 on Environmental sustainability, recorded the lowest score
- Students in the DSAP programme achieved higher occupational competence level scores (Holistic Competence – 14.3%) in relation to the group (Holistic Competence – 11.4%). This dual apprenticeship programme requires a well- orchestrated delivery plan among all stakeholders.
- A comparative analysis amongst Training institution categories indicated that the Industry Academies achieved higher levels of occupational competence than the Public TVET Colleges and Private TVET Institutions. For all categories, a pattern of higher scores for Presentation - K1 followed by a drop in scores for Functionality - K2 is observed (Figure 35).
- Vast fluctuation in performances on COMET criteria is recorded for all Training Institution groups (Figure 35).
- A significant disparity between the group median and individual scores is indicative of the diversity in the group. This same pattern is recorded for the group as a collective versus individual institutions.
- Male respondents obtained higher occupational competence levels than Female respondents as indicated in Tables 24 and 25.
- There are significantly more male students (69.1%) than female students (26.1%) in the Engineering occupations in this study. (4.8% - no gender indicated)

- The highest percentage (34.4%) of students falls in the age group 21-24.
- Occupational competence does not improve according to the year of training.
- A huge discrepancy between occupational competence and student motivational levels during assessment is recorded.
- Student Vocational Identity and Occupational Commitment performance is very high contrary to the low Occupational Competence levels.
- Students valued the COMET test tasks and 94.1% see a relation between the test tasks and their occupation and even more so, 92% expressed the desire for COMET test tasks to become part of the current curriculum.
- Students identified the shortcomings in their current vocational training in terms of not applying your mind and thinking in doing tasks and insufficient focus on problem solving competence.
- Student perception of the learning of any vocation in order to be employed, is vague with 17.2% who strongly disagree, 37.8%- disagree, 12.3% - neutral, 21.9% agree and 10.8% - strongly agree.
- It is challenging to assess all the COMET criteria in practical tests tasks in a simulated workshop scenario.
- COMET competence diagnostic model can be applied in a practical setting in a real workplace environment as reported in 5.4.3 and Figure 56.
- Social competence as a fundamental requirement for succeeding in the 21st century workplace can be measured and developed as an integral part of occupational competence.
- Staff social competence rating of students is higher than the student self-rating (Figures 57; 58; 59).
- The lowest score for Social competence was recorded for Self-regulating conduct.
- Staff perception of the Feedback procedure in the current curriculum is vague and contradictory responses were observed.
- 39% of staff *Agreed* and 5.5% *Strongly Agreed* that the current curriculum does not allow for quality, detailed feedback to students.
- 67% reported that the current curriculum feedback promotes creative and innovative thinking strategies which is perfectly in contrast with the poor holistic problem solving competence portrayed by students during the COMET 2014 assessment.

- Raters indicated that the current curriculum does not prepare students adequately for the world of work (47% *Agree* and 12% *Strongly Agree*). 76% *Strongly Agree* and 12% *Agree* that a Dual Education system in TVET is essential.
- Raters (94%) appreciate the solution space provided within COMET assessment as a method to improve staff confidence and competence in assessment feedback.
- 59% *Agree* and 35% *Strongly Agree* to COMET feedback having the potential to didactically develop students from a novice level to an expert level.
- Findings from qualitative data collected by means of the semi-structured focus group interviews expanded the understanding of the context of student experience of the curriculum, their occupational aspirations and challenges as well as their deliberations pertaining to COMET assessment.
- The majority of raters *Agree* (35%) and *Strongly agree* (59%) to the need for high quality feedback in equipping students to solve complex problems holistically.
- The research revealed that Holistic Problem solving competence and Work Process Knowledge is a remote paradigm in current TVET delivery.
- Quality assurance processes for the assessment and development of occupational competence in TVET is inadequate.

6.3 CONCLUSIONS FOR THE RESEARCH PROBLEM

Based on the results of the research study the following conclusions were drawn:

The small percentage of students (11.4%) achieving holistic problem solving competence pose a threat to the expectation of TVET to respond to the demand for skilled labour in response to global competiveness and equally so, to scientific innovative technology and production processes referred to in 2.4. Furthermore, the position of TVET to address youth unemployment, which pitches at 36.1% currently in South Africa, appears to be bleak. It is evident that the current TVET curriculum resulting in a teaching to test paradigm does not equip students sufficiently for the world of work as described in 2.2. The OECD meeting in Paris in 2014 on youth unemployment identified the role of TVET to provide programs that are responsive to labour market needs, inclusive of work-based learning as one of the key imperatives as explained in Chapter One. The poor capacity to solve complex problems within the framework of their occupational domain is of great concern.

The overall performance of students in the Electrical occupation showing problem solving competence at a *Know-that* level of work process knowledge is a risky situation. The Welder occupation recording 25.2% for Holistic shaping competence and a progression to the *Know-how* level of work process knowledge is encouraging. It is showing evidence of the impact of workplace-based learning in the DSAP programme on the development of occupational competence in students and most probably lecturer competence. The Mechatronics occupation, where TVET College students are part of the DSAP programme, is still predominantly in the *know-that* level but some progress is made towards the *know-how* level of work process knowledge. For the Millwright occupation, 66.7% of students are at Nominal competence level and at risk with the rest at Functional competence level. It appears as if holistic problem solving is a major challenge as portrayed in the huge disparity in performance on the eight criteria-very poor occupational competence in Environmental sustainability (K7) and Creativity (K8) and relatively good performance in Social acceptability (K6) and Presentation/Clarity (K1).

The drop in performance from K1 (median – 8) to K2 (median – 6) for the group occupational scores is proof of the emphasis on the theoretical part of their current curriculum. K2, referring to technical insight in terms of functionality and operability, which is critical for all solutions, shows lesser occupational competence then K1, which focus on the presentation of the solution. This can also be a sign of the lack of transfer from theory to practice, which is an indicator of a limited college-based vocational learning.

The innovative mandate of TVET is at stake given the poor holistic problem solving competence of students. The didactic principles needed in TVET delivery must be strengthened. Little evidence of a fundamental didactic principle of COMET, to grow student competence from a novice to expert level, unpacked in 2.6 and illustrated in Figures 4, 5 and 6, is observed.

Real work placement of students is reported to be challenging. Some of the pilot DSAP students raised concerns regarding inadequate supervision and actual work practice. The expected transfer of technical skills training at College to meet workplace requirements and standards caused major problems for the students in the pilot programme. NCVER in 2.3 highlights the concerns of Industry alluding to VET/TVET graduates lacking skills, knowledge and job-readiness declared by their qualifications.

The diversity observed in the individual and institution occupational competence in comparison to the median scores need to be taken into consideration for the delivery of a

relevant TVET curriculum with built-in support structures to address possible barriers to vocational education and professional learning. It is therefore imperative for TVET policy to mandate well established Student Support and Development structures with suitably qualified and competent staff as well as resources, to be able to render a quality service to students to grow into mindful, reflective citizens and professionals.

The low occupational competence levels achieved versus very high levels of motivation, vocational identity and occupational commitment recorded can be an indication of a misconception among students of the 21st century workplace professional demands discussed in 2.2.4. This paradox can also be an indication of underutilization of student innate motivation and commitment. Inadequate career guidance on professional and personal attributes required for the selected occupation can be a contributing factor.

The literature review pointed out the predicament of TVET being perceived as a fallback position. The low occupational competence levels portrayed can contribute to stigmatization of TVET as second-class education. This will compromise the global ideal of TVET being a vehicle out of socio-economic crises as outlined in 2.3. With the majority of students operating at the *know that* level of work process knowledge, the risk of TVET preparing students for the lowest level of their occupations is of concern and contrary to the high Global expectations as explained in 2.8 and Figure 9. At this level of work process knowledge it will be extremely difficult for students to cope within flatter organisational structures where a shift from management by control to management by participation has become the norm for modern professions as illustrated in Figure 3.

The poorest performance shown for the COMET criterion - K7 on Environmental sustainability holds serious implications for the expectation of TVET to advance the development of skills and competences towards establishing sustainable solutions for the environmental challenges as outlined in the Millennium Development Goal 7 in 2.5. This is a critical finding given the fact that the result was obtained across four occupations and sixteen open-ended test tasks and not in one question as in a typical examination. Furthermore, this criterion was empirically assessed for its relevance in these test tasks during a pre-test, test validation assessment.

Students exposed to workplace-based learning in conjunction with theoretical training achieved higher levels of occupational competence than their counterparts who receive predominantly college based training. This finding reaffirmed the need for real workplace based learning in a dual system to develop the competence needed for students to succeed in

their occupations. This dual theory-apprentice approach holds the potential to position TVET as a means to accelerate skills development in South Africa as stipulated in NSDS III under 1.2. It is however essential to deliver workplace-based learning within a scientific, didactical context such as COMET assessment and didactic model.

Gender equality is one of the key imperatives for the OECD Position Paper on Education Post 2015, discussed in 2.5. This study revealed that Gender inequality in TVET is still prominent with a male: female ratio of 2.7:1. Female students reported physical strength as a barrier to effectively performing some practical tasks – (5.5.2:9). This is an aspect of gender equality that was overlooked and underscored in leveling the TVET practical playground.

The current curriculum assessment system in TVET does not adequately result in the cumulative development of occupational competence and this study depicted evidence of stagnation in problem solving competence over the three years of training as specified in Figure 33. It can be inferred from the data presented that it was not possible to identify adequate quality assurance for occupational competence in the current TVET curriculum learning and training.

Semi-structured focus group interviews and interviewing students during and after the COMET practical test task as qualitative research methods implemented in this study enhance the possibility of optimizing the impact of explicit and implicit competence in assessing and developing reflective thinking. The qualitative assessment methods generated valuable data for clarification of performance on the quantitative methods as described in 5.5.2. Data gathered from these interviews sketched a clear picture of the limitations of the current assessment system to develop professional competence. Students at all test sites indicated that holistic problem solving of complex occupation specific problems, is not part of their current assessment system.

Comprehensive assessment feedback and feed forward mechanisms to facilitate effective learning in the current curriculum exemplified in 2.2.10, show that responses for feedback in the current curriculum does not correspond with student occupational competence levels and numerous signs of confusion and contradictions were recorded as shown in Table 29. The feedback from students during the focus group interviews support this conclusion where an array of responses were provided for the Feedback process after assessment.

This poor perception of feedback accompanied by feedback by grades, as reported by students, may jeopardise the aim of assessment to serve the purpose of advancing and facilitating student learning, and shown in Figure 2.

All respondents *Agree* to *Strongly Agree* that COMET Feedback can assist students to develop from a novice to an expert. The inter-rater reliability training workshop is highly valued by 94% of respondents. COMET feedback methodology contributes to staff professional development. The open-ended test task structure, and the provision of a solution space allow for more specific feedback actions as indicated in Table 30. Response by Raters on COMET Feedback furnished a clear representation of the value and potential of COMET to improve teaching, training, practice and learning in TVET

Social competence in the 21st century, conceptual age workplace, is inevitable for inculcating a work process knowledge paradigm. A community of practice within the context of work is required in a swing from narrow defined job specifications to a more organic way of work and multi-skilling as explained by Fischer and Boreham in 2.3. Student social competence is overall well developed but there is a vast difference between lowest and highest scores. This diversity in social competence development may result in certain students not being ready for the 21st century workplace. The lowest score noted for Self-Regulating Conduct alluding to anger management, selecting the appropriate social skills for a specific social setting, assessing the effect on the situation and dealing with stress pose a risk for developing a social radar needed to succeed in modern organisations as explained in 2.9.

Diversity in student performance as outlined in 2.2.7, is evident in the difference between minimum and maximum scores recorded for all eight COMET criteria, the coefficient of variation values, as well as the Social Competence questionnaire responses. This study suggests that diversity be taken account when TVET programmes are designed to incorporate well-structured support systems to ensure quality education for all students.

6.4 POLICY AND PRACTICE IMPLICATIONS

The research findings and conclusions have implications for current TVET policy and strategy implementation. Firstly, several new deliberations should be considered to revise the *Teaching to Test* (TTT) approach resulting in curriculum narrowing as explained in 2.2. Holistic problem solving competence should be incorporated in vocational training in a dual system to allow for students to achieve a professional skilled worker level of occupational competence. Policy

imperatives should be strengthened and accelerated to address the poor state of TVET student occupational competence. Whilst policies and strategies such as the DHET White Paper on Post-School Education and Training, the NSDS III, the NDP and the MDG's acknowledge the role of TVET in developing a competent workforce (SA Government outcome 5 and MDG 1), no specific guidelines are provided to ensure a quality, capable and competent workforce. Similarly, UNESCO, SADC, and OECD amongst other international organisations emphasize the role of TVET to address innovation and socio-economic challenges and overall prosperity for Nations as outlined in Chapters One and Two. This study has the potential to inform directives that are needed to quality assure TVET delivery towards a competent workforce capable of solving and detecting complex global, national and local opportunities and problems.

TVET colleges and training institutions should align their policies with National and International policies to position TVET as a credible and workable post-school education sector.

A TVET system without authentic workplace based learning, explained in 2.2.8, will most likely not equip students adequately for quality work in their occupations. The capacity to solve complex problems that require divergent and reflective thinking cannot be effectively developed in the absence of real work experience and learning. This dual TVET system needs to be embedded in sound National policy and strategy.

Undoubtedly, incorporating a reflective assessment model into the TVET curriculum is an essential policy aspect for consideration in addressing barriers in the what, how and why of the existing assessment dimensions.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

This research study contributed to a comprehensive understanding of the state of the art of the assessment and development of occupational competence in TVET. While significant advancements were made in developing our understanding of occupational competence assessment and development, new questions emerged. Firstly, does the context of the TVET sector, including staff competences, the curriculum and extent to which it responds in preparing TVET students for the 21st century conceptual age and expectations of DHET, suffice for the development of expert, holistic problem solving competence? Secondly, are the training resources adequate to prepare students to survive beyond the *know that* phase of work process

knowledge, in a flatter work organisation? Thirdly, what are the Educators' understanding of holistic problem solving and how do they relate to this thinking paradigm? In the fourth instance, what is the capability of the student in relation to the demands of the vocation of choice? Lastly, what is the role of management and government in the development of occupational competence? These areas create opportunities for future research.

The researcher is of the opinion that the current applied curriculum assessment and learning in TVET does not effectively prepare students for solving complex problems in the workplace. Open-ended test tasks, as a trademark of COMET diagnostic model for the assessment and development of occupational competence should be included in the TVET curriculum. COMET learning tasks must form part of the TVET didactical approach.

The technical training of TVET students must be infused with professional training underpinned by holistic problem solving competence.

The current curriculum must be rooted in sound COMET didactic principles such as accumulative competence and an education and training curriculum content that is based on progressive competence development. Students must evolve from a novice to an expert level within a well-developed and accomplished didactic approach in TVET.

Workplace learning in a dual TVET system must be an integral part of the curriculum and not an add-on. This will alleviate the *catch-up of work challenge* reported by DSAP students in 5.5.2. The transfer of theory to practice in real work should be a mandatory function of TVET, supported by Policy.

Staff capacity need to be enhanced continuously to ensure that staff develop occupational competence to equip students adequately for the 21st century workplace. The discrepancies observed in the results raise the question of how staff goals are aligned to student processes and anticipations of the vocational training towards their occupation. The possibility of including staff occupational competence, as a performance criterion in quality assurance systems, must be considered.

Findings in this study are guiding future research to seek explanations for the disjuncture between high levels of motivation, occupational commitment and social competence measured versus the poor levels of occupational competence.

Implementation guidelines need to be established and underpinned by policy at National DHET level to foster the development of higher occupational competence amongst TVET students.

Workplace learning should not focus only on large industries and companies but also medium and small size businesses to place students for work-based learning and the development of professional competence. This workplace-based learning must be a credit bearing, integral part of all TVET curricula.

More female students must be exposed, prepared and equipped for occupations in TVET, starting with awareness strategies at a Grade Six level. Career guidance by professional staff registered at a recognized professional body to perform such a service, must guide and mediate career choice and development intervention.

A robust operation for Research studies in TVET should be effected towards an increased understanding of the impact of occupational competence on quality assurance in positioning the sector to respond in a scientific manner to occupational challenges and opportunities.

The newly announced South African Institute for Vocational and Continuing Education and Training (SAIVCET) referred to in Chapter One – 1.4, offers the ideal space for the above-mentioned research and equally so, the establishment of comprehensive systems for scientific rigor in occupational competence assessment and development in TVET.

6.6 FINAL CONCLUSION

The results of this study demonstrate the need for robust transformation in TVET to be relevant in an interconnected, increasingly complex global community. This interconnectedness necessitates a shift from profound rooted specialisation in a subject field towards a holistic understanding of the world of work. This holistic understanding requires divergent thinking, finding meaning and sense making of how your occupation fits into the entirety and completeness of the company.

The domain specific competence measurement made a significant contribution towards understanding the perception of current TVET systems and the attributes needed for the world of work. The results proved profoundly that the current TVET system does not equip students adequately with occupational competence needed for modern economies and socio-political expectations.

New knowledge regarding assessment in TVET that is aligned to 21st century work is gained. Furthermore, direction is provided on how to implement sound didactic dimensions in TVET that will result in the development of holistic shaping occupational competence.

Would the implementation of the COMET competence diagnostic model in TVET effect higher quality assessment for the development of occupational competence and commitment?

The assessment concepts were identified and extensively assessed by using COMET diagnostic model. The empirical results presented in Chapter Five demonstrate the potential of COMET to assess occupational competence at a systemic and individual level. It allows for analyses and synthesis of results. Specific occupational competence levels could be measured at Nominal, Functional, Processual and Holistic Shaping Competence levels as presented in Figure 31. The eight COMET criteria (Figure 9) could be analysed to identify strengths and areas for development as well as trends at a systemic and individual level. The eight criteria are grounded in the three didactic dimensions of COMET, namely the Requirement, Content and Action dimensions (Figure 8; 2.8). These didactic foundations provide a vehicle for the development of accumulative occupational competence in a structured, scientific manner. Work process knowledge levels could be measured and demonstrated by means of COMET. The development of these concepts is made possible by this ability to measure the extent of holistic problem solving at a level of being able to guide action, explain action or reflect action. The study furthermore proved that COMET could measure all these constructs in a practical setting taking into account implicit and explicit knowledge in a real workplace. COMET reports, graphs and measurement allows for precise feedback and feed forward practice.

My argument is further substantiated by the potential of COMET to develop occupational competence towards creating a new way of thinking around employment. It is essential to capacitate TVET students for career prospects beyond entry-level jobs. The results expand our understanding of how an applied curriculum in TVET can jeopardize the development of occupational competence and holistic problem solving of complex, real work problems. Given the high youth unemployment rate (36.9% - 2015) in South Africa as unpacked in Chapter Two, students must be empowered to become job seekers as well as job inventors. The COMET model is uniquely designed to measure and develop real 21st century, conceptual age workplace needs and challenges in responding to global competitiveness, as outlined in 2.2.4.

The findings in this study make a valuable contribution to the philosophy around assessment and learning in TVET. These findings have implications for a TVET curriculum design and theory capable of transformative change. The understanding of how policy and theory unfolds in real work readiness has been demonstrated. The results further suggest that assessment and development of occupational competence in TVET should be embedded in sound COMET didactics. To facilitate such imperatives, the most provocative findings of only 11.4% of students achieving Holistic Shaping Competence, 60.4% are at risk at a Nominal competence level (Figure 31) and the stagnation of competence over three years of training (Figure 33), urges the re-thinking of the current assessment and curriculum practice in TVET.

In summary, this research study was conducted within the relevant context of the TVET landscape. Occupational competence was not assessed in isolation but with the National and Global policy and strategy frameworks for the sector as a backdrop. The consequence of the implementation of COMET occupational competence diagnostic model for 21st century workplace readiness was meticulously monitored and reflected on throughout the research. Critical Assessment indicators of Feedback, Social Competence and Focus Group Interviews enriched the reflective thinking in the analysis and synthesis of the findings. Knowledge obtained in this study is therefore value-related with a higher probability of improving the development of holistic problem solving competence as the driving force for rigorous quality assurance in TVET.

Finally, the extensive literature research in Chapters One and Two corroborate the position of TVET to serve occupations and to significantly contribute to psychosocial, economic and political inclusion of Youth. Knowledge with high use-value obtained in this study as presented in Chapters Five and Six, has the potential to develop occupational competence to capacitate TVET in responding to these imperatives. This use-value knowledge is situated in the COMET pedagogy and structure of the test tasks where students solve complex, occupation specific problems within the real work context of Presentation, Functionality, Sustainability, Cost effectiveness, Business orientation, Social acceptability, Environmental compatibility and Creativity (Table 1; Figure 31; 2.8).

Against these foregoing postulations this study proposes that the implementation of the COMET competence diagnostic model in TVET has the potential to effect higher quality assessment for the development of occupational competence and commitment.

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