EVALUATION OF THE COMPETENCE GAP BETWEEN SOUTH AFRICAN VOCATIONAL-ORIENTATED AGRICULTURAL EDUCATION AND TRAINING (AGRICULTURAL DIPLOMA) AND AGRICULTURAL INDUSTRY REQUIREMENTS

By

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Dedication

This study is dedicated to my wife and my children who supported me throughout this study. They continually provided moral, emotional, spiritual support and endured over the period of study.

A special word of thanks to the management of the University of Mpumalanga for their financial support to make this study possible. A special word of thanks to all colleagues and industry friends who crossed my path over 30 years' involvement in Agricultural Education. Thank you for your guidance and provided insight into the reality of Agricultural Education. Agricultural education is the cornerstone of sustainable food production and I am privilege to be part thereof.

Thank you to my supervisor and co-supervisor Prof Mudau and Prof Antwi, for your support and guidance.

I pay tribute to my parents, who passed on long ago, for the example they set to us, their strong believe in education, compassion and the value of hard work. I also pay tribute to my late father in law, who supported me in my earlier studies and taught me the values of Agriculture especially the practical application thereof.

Special dedication to My Heavenly Father that gave me the ability and wisdom to complete the study.

Declaration

I, Gerhardus Petrus Viljoen, declare that **Evaluation of the Competence Gap Between South African Vocational-Orientated Agricultural Education and Training (Agricultural Diploma) and Agricultural Industry Requirements** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis to originality checking software. The result summary is attached.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

Signed at Mbombela on this 28th day of June 2021.

Signature: G.P. Viljoen.

Abstract

The study was prompted by the current unemployment of agricultural diploma graduates and the negative perception of the agricultural diploma programmes. The study aimed to determine the gap between the agricultural industry and higher education institutions, as well as to identify the competencies the agricultural industry requires from the diploma graduates. The triangular study involved the agricultural industry, higher education institutions that offer agricultural diplomas and diploma graduates. The study investigated the perceived gap between the competence of the agricultural diploma graduates, the competencies required by the agricultural industry and the measures required to close such a gap and transform Vocational-Orientated Agricultural Education.

The study used questionnaires and semi-structured interviews according to the mixed-methods approach in order to triangulate the data and determine the extent of the gap and the competencies required. The overall and most prominent shortcoming identified was the lack of practical experience, which subsequently needs to be addressed by the higher education institutions. Soft skills or 21st century competencies were ranked, using the mean rating values, in order of preference and also the production and technical competencies. Production and technical competencies would be best evaluated if they are commodity-orientated.

The agricultural diploma is by nature a vocational-orientated programme and attention is given to the pedagogy and assessment of Vocational-Orientated Agricultural Education to understand and promote the transformation of the diploma programmes. The research indicates clearly that there is a demand for more practical experience and a greater emphasis on the relevant competence, and that the employability of the graduates is affected by their lack of practical experience.

The study highlighted the need for a clear understanding of Vocational-Orientated Agricultural Education by all role players, as well as the necessity to develop and implement vocational-orientated pedagogy in the teaching of the diploma programmes and suggest a model for Vocational-Orientated Agricultural Education. The results of the study showed a need of closer collaboration between higher education institutions that offer agricultural diploma programmes as well as

collaboration between the agricultural industry and the higher education institutions in order to determine commodity-based competence.

The transformation of Vocational-Orientated Agricultural Education is of critical importance for the employment of graduates and to promote food security. The transformation of Vocational-Orientated Agricultural Education is central to the regaining of relevance of higher education institutions.

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List of Abbreviations and Acronyms

AgriSETA	Agricultural Sector Education and Training Authority
AIQ	Agricultural Industry Questionnaire
ATI	Agricultural Training Institute
CBE	Competence-Based Education
CBL	Competence-Based Learning
CEDEFOP	European Centre for the Development of Vocational Training
CHE	Council on Higher Education
DAFF	Department of Agriculture, Forestry and Fishery
DGQ	Diploma Graduates Questionnaire
DHET	Department of Higher Education and Training
EL	Experiential Learning
ESECT	Enhancing Student Employability Coordination Team
HEI	Higher Education institutions
HEQ	Higher Education Questionnaire
HEQC	Higher Education Quality Committee
HEQF	Higher Education Qualifications Framework.
LD	Learner Development
NDA	National Department of Agriculture
NQF	National Qualifications Framework
QCTO	Quality Council for Trade and Occupations
SADC	South African Development Community
SOLO	Structure of the Observed Learning Outcomes
TL	Transformational Learning
TVET	Technical Vocational Education and Training
VET	Vocational Education and Training
VOAE	Vocational-Orientated Agricultural Education
VOE	Vocational-Orientated Education

WBL	Workplace-Based Learning
WIL	Work-Integrated Learning

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Questions regarding agricultural education and training had been asked for many years worldwide as well as in South Africa. Investigations into the reform or transformation of agricultural education and training have a long history, and over years various inputs and contributions were made to provide the needed reform (Acker, 1999; Swanepoel, 2017) but it is still very relevant today.

In an article published on the Bizcommunity website in 2018, Reinhardt asks questions about the reform and transformation of the South African agricultural education and training (Reinhardt, 2018). In addition, the *Farmers Weekly* issue of 17 August 2013 reports: *"South Africa's agricultural education sector is failing to produce a new wave of farmers and agriculturalists, with fewer youngsters being drawn to study agriculture as a career. In addition, colleges and universities are producing under experienced job candidates, while a lack of training among unskilled and semi-skilled workers is preventing the sector from building from the bottom up*". In the Farmers Weekly article, Karaan is quoted as stating, *"What we're doing is far from adequate. We're not pushing through the numbers, nor are we getting the quality right"* (as cited in Joubert, 2013).

Agriculture in South Africa is dualistic in nature: one side is spanning subsistence and the other highly innovative commercial farmers. In the South African context, there are the small scale and emerging farmers who are mainly beneficiaries of land reform and can be described as subsistence farmers, micro scale and small scale farmers. Emerging farmers are new farmers who aspire to become commercial farmers, mega farmers as well as industrial type of farming operations. The diverse composition of farmers, as can be seen in Table 1 on page 7. This diversity of the farmers influences the training needs of the different components. Land reform beneficiaries and smallholder farmers required training to allow them to continue with the farming operations and food production after restitution, while emerging and the commercial farmers have different needs for themselves and their workers. The larger commercial farmers expand their operations to receive the benefit of scale with larger operations and need to employ skilled lower-level and middle-level management staff. Agricultural diploma graduates are competent for the job is critical to play a role in the farm

business management and in becoming the agricultural-entrepreneurs who have to create the much-needed employment in the sector.

The questions, then, are as follows: Do the higher education institutions (HEIs) in South Africa provides graduates who satisfy the requirements of the industry? Does the transformation in agricultural education and training support the need for competent graduates? The researcher hopes that this study will be able to provide insight, answers and solutions to these questions.

Various researchers emphasise the needs for agricultural education at HEIs to be relevant and keep up with the demands of the 21st century, where technological and organisational changes due to globalisation and the demand for higher and more profitable production call for a better-trained workforce with improved skills (Borghans, Green & Mayhew, 2001; Alibeigi & Zarafsnani, 2006). The improvement of competence can primarily be achieved through education and training.

Agricultural education and training need to transform to meet the requirements of the times in which we live. It needs to be technologically advanced and address the current production and development issues to prepare the graduates to be change agents in their world of work. Wals states that, *"We live in turbulent times; our world is changing at accelerating speed. Information is everywhere, but wisdom appears to be in short supply when trying to address key interrelated challenges of our time such as runaway climate change, loss of biodiversity, depletion of natural resources, the ongoing homogenisation of culture and rising inequality. Living in such times has implications for education and learning*" (Wals & Corcoran, 2012).

Lotz-Sisitka stated that, *"the nature of the sustainability challenges currently at hand is such that the dominant pedagogies and forms of learning that characterise higher education need to be reconsidered to enable student and staff to deal with accelerating changes, increasing complexity, contested knowledge claims and inevitable uncertainty"* (Lotz-Sisitka *et al*., 2015).

The Academy of Science of South Africa conducted a consensus study on agricultural education and found that agricultural education and training in South Africa need a profoundly serious overhaul. The study identified three key focus areas, namely

substantial institutional reform, inspiring innovation and the end of fragmentation in the education and training (Swanepoel, 2017).

With the aforementioned in mind, the aim of this study is to determine the competencies needed by the South African agricultural industry. The divide between the agricultural industry and the HEIs needs to be identified and described to find innovative solutions to bridge the gap. This study will focus on the agricultural diploma (NQF6) that is offered by nine universities and 11 agricultural colleges in South Africa.

The reason for focusing on the agricultural diploma is that on the Council of Higher Education' (CHE) Higher Education Qualifications Sub framework (CHE, 2013), it states clearly that the diploma *"... primarily has a vocational orientation, which includes professional, vocational, or industry-specific knowledge that provides a sound understanding of general theoretical principles as well as a combination of general and specific procedures and their application. The purpose of the diploma is to develop graduates who can demonstrate focused knowledge and skills in a particular field. Typically, they will have gained experience in applying such knowledge and skills in a workplace context"* (CHE, 2013, p.29).

Key elements from the CHE description are: 1) The qualification is vocationally orientated, 2) It includes professional, vocational or industry-specific knowledge, 3) It provides a sound understanding of general and specific procedures and their application [practical work], 4) Focused knowledge and skills in a particular field and 5) Experience in applying knowledge in a workplace context [practical application].Based on the description and its key elements, various questions need to be addressed such as. Does the agricultural diploma meet the criteria of vocational-orientated education and training? What is HEIs' understanding of vocational-oriented education and training? Would it be fair to assume that the outcomes of the diploma studies will equal whether the students graduate from university or agricultural college? The dissimilarity between a university diploma and a college diploma? The ideal ratio between theory and practice in VOAE?

1.2 Overview of the South African higher education system

The CHE reports in the overview of the South African higher education system that the system includes 26 public HEIs consisting of 11 traditional universities, eight

comprehensive universities, six universities of technology and one health sciences university. Of the 26 HEIs, 10 offer an agricultural diploma qualification (CHE, 2013). There are also 11 agricultural colleges or agricultural training institutes (ATIs) in South Africa, with 10 of the 11 agricultural colleges still linked to the provincial department of agriculture and one to the Department of Agriculture, Forestry and Fisheries (DAFF). All the ATIs are involved in the process of transition from the college sector in the DAFF to higher education and training (NDA website[1]). Three provinces in South Africa, Gauteng, the Northern Cape and Mpumalanga do not have an agricultural college.

Synergy should exist in the relationship between all the HEIs that offer the agricultural diploma programmes, as indicated in Figure 1 below, in order to promote quality of learning and ensure they deliver a product that meets the requirements of the agricultural industry.

The purpose of the colleges – TVET, nursing and agricultural colleges, as outlined by the *White Paper on Post School Education* (Department of Higher Education and Training, 2013) – *"is to train students for the workplace in order to meet economic imperatives, while acknowledging that students will not be able to operate autonomously on qualifying"* (cited in Garraway, 2015). That is also the aim of universities of technology and should be the focus of the comprehensive universities.

Miettinen emphasises the importance of education and the workplace to consider how the education and practical experience can contribute positively to their future employment. It is also understood that higher education does not and cannot become a slave to the industry; that there are differences between them and that they need to engage with each other ensure learning (Windberg *et al.*, 2006). In Australia, as with several other countries, the ability of universities to meet the skills demand in agriculture is hampered by the design, content and delivery of the curriculum, and the promotion of agriculture as a career opportunity. There is also a debate over whether universities should deliver *"employment-ready graduates, armed with knowledge and generic skills applicable to the workforce"* (Botwright Acuna et al., 2014)

[1] www.nda.agric.za

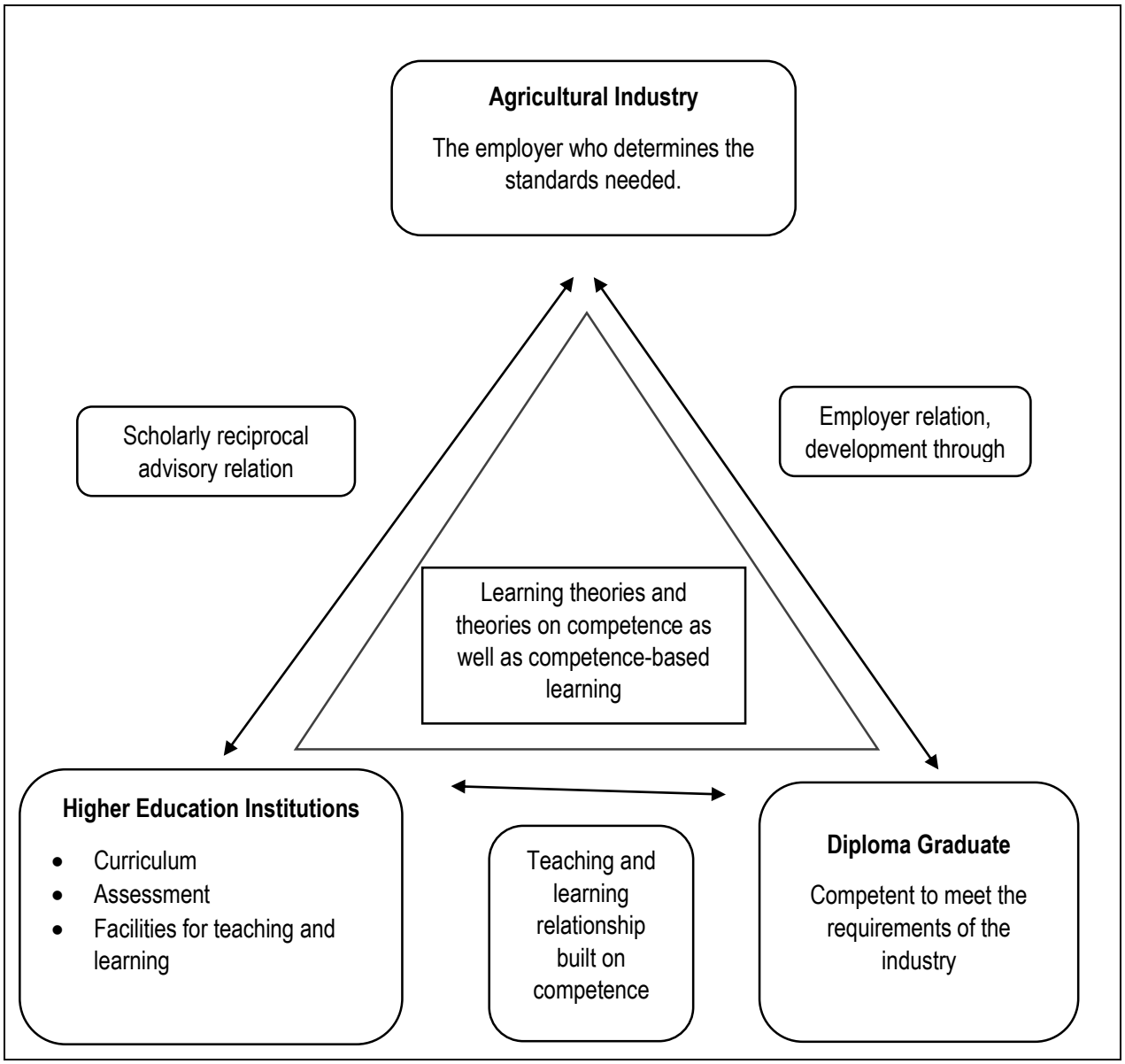

Figure 1: Relationship of stakeholders in agricultural education and training

The perspective of South African organisational framework of occupations

In South Africa, education and the training and skills training system exist as a parallel, with the higher education system as one component and the Quality Council for Trade and Occupations (QCTO) and the Sector Education and Training Authorities (SETAs) as the other component. The South African Organisational Framework of Occupations compiled by the QCTO, as interpreted by AgriSETA (2013), assists in the determination of the skills and competence required for the various positions in the

agricultural work environment. The questionnaires used in this study are based on this information. It will, therefore, also be necessary to investigate the occupational profile of certain occupational groups and required qualifications, e.g. the profile of the students currently studying the diploma in agriculture, to determine gaps and areas of improvement, including the pitching of qualifications on the NQF levels together with the link between qualifications and occupational levels.

In the South African agricultural landscape, there are different categories of employers or farmers such as emerging commercial farmers and commercial farmers as indicated in Table 1 below. Each of these groups requires different skills or competencies as their foci differ, based on their main production activity and the farming unit. Farmers in South Africa can be classified as small-scale or smallholder farmers, emerging commercial and commercial farmers (Vink & Van Rooyen, 2009).

Graduates who aspire to be agricultural entrepreneurs or to be self-employed need all the knowledge, skills, and abilities to become successful sustainable commercial farmers. It may also be a situation where a large commercial farmer requires a farm manager to assist with the management of one or more production units (AgriSETA, 2010).

Table 1: Classification of South African farmers

<table>
<tr><th colspan="6">Classification of South African commercial farmers</th></tr>
<tr><th colspan="3">Small-Scale Farmers</th><th>Emerging Farmers</th><th colspan="2">Commercial Farmers</th><th>Turnover</th></tr>
<tr><td rowspan="6">Subsistence farmer</td><td rowspan="6">Micro-scale</td><td rowspan="6">Small-scale</td><td rowspan="6">Emerging commercial farmer</td><td rowspan="6">Existing commercial farmers</td><td>Mega</td><td>> R5m +</td></tr>
<tr><td>Large</td><td>> R2m</td></tr>
<tr><td>Medium</td><td>R300 000 – R2m</td></tr>
<tr><td>Small</td><td>> R300 000</td></tr>
<tr><td>Commercial farmers in communal areas</td><td>> R300 000</td></tr>
<tr><td colspan="3">< 20 Ha</td><td>> 20 Ha</td><td colspan="2">Farm classification</td></tr>
<tr><td colspan="3" rowspan="3"></td><td rowspan="3"></td><td colspan="2">Small farms</td><td>> 1 000 Ha</td></tr>
<tr><td colspan="2">Medium farms</td><td>2 000 Ha +</td></tr>
<tr><td colspan="2">Large farms</td><td>5 000 Ha +</td></tr>
</table>

Sources: Combination of information from Vink & Van Rooyen (2009), Ncube et al. (2017), and Kirsten & Sihlobo (2019).

1.3. Key agricultural role players.

Role players are involved in agriculture and they play a role at various levels in the industry itself, on the peripheral and with regard to the VOAE. Communication between the different stakeholders is essential to express the needs and to get advance notice for curriculum, and pedagogical changes needed to meet the demands of the different role payers in agriculture, illustrated in Figure 2

In addition to the various stakeholders, South African agriculture also have the duality between commercial and smallholder farmers. HEIs focus on the one or the other depending on their role in the community and purpose of the qualifications.

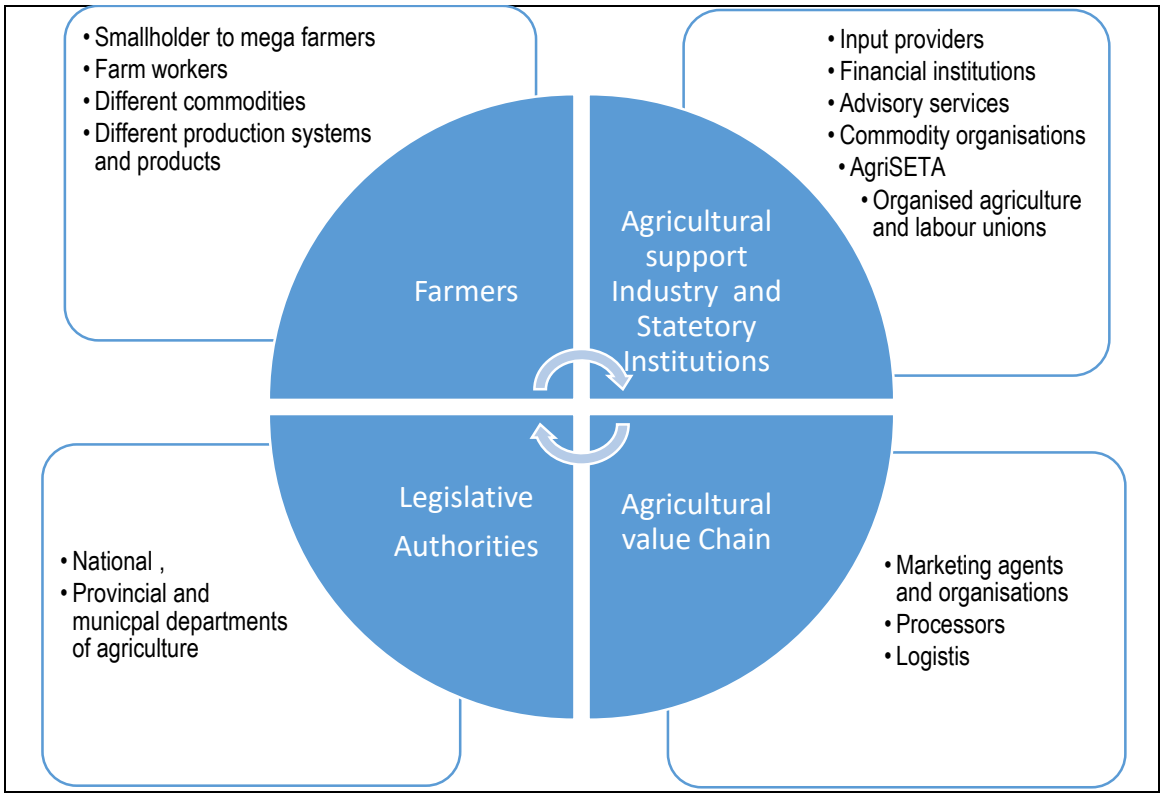

Figure 2: Key agricultural role players. *(Diagram: Researcher's own design)*

The researcher's view is that VOAE need to focus on the middle ground between the two components, to determine the core functions and essential knowledge needed to provide the basic competence and create linkage loops to either side that will meet the specific educational needs. By doing that, it provides space for either side and for upliftment and specialisation. The two areas need to be aware of each other and work hand in hand to transform the duality, by creating opportunities for the smallholder

farmers to grow and become part of the bigger commercial farmer component. The development can be addressed through learner development and education for sustainability (Winter *et al.*, 2015). Concepts will be dealt with in later chapters.

1.4 The problem statement of the study

The main problem that this study investigated is the perceived gap that exists between the competence of the agricultural diploma graduates from HEIs and the competence required by the agricultural industry. The problem that will be investigated in this research is threefold:

1. The perceived gap that exists between the competence of agricultural diploma graduates from the HEIs of South Africa.
2. The competence required by the agricultural industry.
3. How the closure of the gap can/should be addressed by the HEIs?

As alluded to earlier, agricultural diploma graduates who possess the correct competence for the specific job is critical to play a role in the farm business management and also in becoming the agricultural entrepreneurs who have to create the much-needed employment in the sector. However, currently most graduates from the existing agricultural education and training institutions in South Africa are unable to become agricultural entrepreneurs or to be self-employed, and do not have all the knowledge, skills and abilities to become successful sustainable commercial farmers.

The skills gap effects negatively on the employability of graduates and the perception of the qualification and the institutions offering these qualifications. Similarly, no synergy exists between all the HEIs that offer agricultural diploma programmes in order to promote the quality of learning and ensure they deliver a product that meets the requirements of the agricultural industry.

1.5. Research questions of the study

1.5.1. Research question

Given the problems stated above, the main research question is formulated as:

1) What are the competencies required by the South African agricultural industry for agricultural diploma graduates?

2) Is there a gap between the competencies of agricultural diploma graduates? and 3) How does the diploma graduates measure up to the requirements?

1.5.2. Subquestions

The following subquestions are formulated to guide the research, to find relevant answers.

Sub-question 1: What are the competencies required by the agricultural industry and how are they rated in terms of importance?

Sub-question 2: What is the perception of the academic staff of the HEIs regarding the competence needed by their graduate students, and how are these competencies assessed at HEI level?

Sub-question 3: Which measures are put in place by HEI's to address or bridge the skills/competence gap?

Sub-question 4: What is the opinion of the Agricultural Diploma Graduates regarding the influence of their competence on their employability and what is their inputs to close the competence gap?

Sub-question 5: What is the position regarding vocational orientated agricultural training at HEIs in the Southern Africa Development Community (SADC) region?

1.6. Justification for the study

The study objective to determine the competence gap between the agricultural industry requirements and the diploma graduates produced by higher education institutions. Therefore, identifying the competencies, the agricultural industry requires from the diploma graduates. The triangular study involved the agricultural industry, higher education institutions that offer agricultural diplomas and diploma graduates. The focus will mainly be on the competence needed by the agricultural industry, as first day working competence, and how the agricultural diploma/s offered as vocational education address that competence or prepare the students for the world of work. The answer to these questions will assist with the transformation of agricultural education at diploma level and will hopefully assist to increase the competence level of the graduates and, through that, also their employability, reducing the number of unemployed diploma graduates. The improved competence levels will benefit the

industry by providing them with competent workers saving time and money for retraining.

1.7 The importance and urgency of the study

The study envisages obtaining a management perspective of which competencies the South African agricultural industry requires from a person who completed an agricultural diploma. The complexity of the South African agricultural landscape necessitates a noticeably clear classification of the different role players. Vink and Van Rooyen (2009) and others (Tabel1) classify farmers into the following groups: subsistence, microscale, small-scale, emerging commercial and existing commercial farmers. The existing commercial farmers can further be subdivided into commercial farmers in communal areas; small, medium and large farmers. It will be appropriate to add an additional subdivision for mega farmers, as indicated in Table 1 on page 7.

1.8. A broad objective of the study

The goal of the study is to address the effect of the competence gap between the Agricultural Industry and the Diploma graduates, that is negatively affecting the employment of the graduates. Proposing recognition and transformation of Vocational Orientated Agricultural Education to stimulate innovation in terms of pedagogy, assessment of competence and collaboration between the industry and Higher Education institutions and amongst the Higher Education institutions.

1.9.1 Objectives of the study

The objectives of the study as informed by the problem statement and the research questions are to:

Research objective 1. To investigate identify competencies required by the agricultural industry of South Africa and determine how they are rated in terms of importance.

Research objective 2. To identify the competencies academic staff of the HEIs perceived and deemed necessary for their graduate students, to also determine how these competencies are assessed by the HEIs.

Research objective 3. To identify, measures that HEI's and the Agricultural Industry put in place to address the skills/competency gap in Agricultural Graduates

Research objective 4. To identify how the agricultural diploma graduates, view their own competence, how it effects their employability and what is their suggestions to close or bridge the competence gap.

Research objective 5. Explore vocational agricultural training at HEIs in the SADC region.

1.10. Delineation and limitations of the study

For the purpose of the study, the agricultural industry was viewed holistically in all its elements, consisting of subsistence farmers; emerging commercial farmers; small, medium and large commercial farmers; mega farmers; agribusiness; and the national and provincial departments of agriculture. The agricultural industry in South Africa consists of 41 subsectors (AgriSETA, 2019) and it is exceedingly difficult to develop a sector-specific recommendation; therefore, a more generic approach was followed for the study.

The study aimed to focus primarily on the HEIs that offer a diploma in agriculture in South Africa. The CHE reports in the overview of the South African higher education system that the South African higher education system includes 26 public HEIs comprising 11 traditional universities, eight comprehensive universities, six universities of technology and one health sciences university. Of the 26 HEIs, 11 offer an agricultural diploma (CHE, 2013). There are also 11 agricultural colleges or training institutions (ATIs) in South Africa, with 10 of the 11 ATIs still linked to the provincial department of agriculture and one to the DAFF. All the agricultural colleges are involved in the process of transitioning from provincial competence to a national competence under the college sector in DAFF (DAFF, 2018). The different institutions are indicated in Table 2 below.

Table 2: Higher education institutions offering agricultural diploma programmes

Province	University	Agricultural Colleges (ATIs)
Western Cape	Cape Peninsula University of Technology	Cape Institute for Agricultural Training (Elsenburg)
	Nelson Mandela University (Saasveld Campus)	
Eastern Cape	Nelson Mandela University (Port Elizabeth)	Tsolo Agricultural and Rural Development Institute (TARDI)
		Fort Cox Agricultural Training Institute
		Grootfontein Agricultural Training Institute (GATI)
Free State	Central University of Technology	Glen Agricultural Training Institute, (Bloemfontein)
North West	North West University (Mafikeng campus)	Potchefstroom Agricultural Training Institute
		Taung Agricultural Training Institute
Limpopo		Tompi Seleka Agricultural Training Institute
		Madzivandila Agricultural Training Institute
KwaZulu-Natal	Durban University of Technology	Cedara Agricultural Training Institute
	Mangosuthu University of Technology	Owen Sithole Agricultural Training Institute
Northern Cape	Vaal University of Technology (Upington campus)	No agricultural training institute in the province
Mpumalanga	University of Mpumalanga	No agricultural college in the province
Gauteng	University of South Africa	No agricultural college in the province
	Tshwane University of Technology	

Source: Compiled by information from the websites of the different higher education institutions and from researcher's personal knowledge

Ideally the HEI's need to collaborate to ensure that synergy exist between the HEIs offering the agricultural diploma programmes to promote the quality of learning and ensure they deliver a product that meets the requirements of the agricultural industry.

1.8. Significance of the study

The outcome of this study will advise HEIs on the competence the agricultural industry requires from the diploma graduates. It will indicate if there is a gap between the industry's expectations and the product of the HEIs. Secondly, the study will provide

a platform or a baseline where HEIs can compare their practices and outcomes. If a gap exists between industry and the HEIs, suggestions can be made how to bridge that gap. Finally, the study will also provide a perspective from the graduates whether they meet the standards or not.

Based on the study, HEIs can make changes to their curriculum, pedagogy and practices to promote and ensure competence that will meet industry requirements. The study envisages to bring the HEIs closer to the industry and thereby promote collaboration. The adjustments by HEIs will aid to restore the industry's confidence in the HEIs.

1.9. Brief chapter overviews

Chapter 2: Literature study

In the literature study the main focus is on current literature dealing with the main areas of research and can be divided into the following categories: 1) Literature regarding competence in agricultural education and training as well as on competence-based learning. 2) Literature on transformational learning, transformation and sustainable agricultural education. 3) Research methodologies. 4) Transformation and/or change in agricultural education and training in other countries and 5) Vocational education at higher education level.

The aim of the literature study is to give a holistic picture of agricultural education and training, the current trends and how it can be used to promote transformation.

Chapter 3: Research methodology

Mixed method research based on data collected from three different sources: the agricultural industry, HEIs and diploma graduates. Through statistical analysis, the order of preference of competence and what is it the industry expect a diploma graduate need to have or can do it, will be established. Triangulation will be used to compare the three data sets with each other and will involve cross-checking for internal constancy or reliability while between-method triangulation test the degree of external validity (Jick, 1979), The outcome of the research and the data collected will be discussed in Chapter 4 to Chapter 7.

Chapter 4: Agricultural industry perspective on competence needed

The South African agricultural industry/sector is a dual system, with well-developed commercial farmers and subsistence-based smallholder farmers. The sector employs 638 000 people in formal employment and large number as contract workers during the production seasons. The agricultural sector contributes roughly 3% of the county's GDP. It represents about 7% of formal employment and it is estimated that around 8,5 million people are directly or indirectly dependent on agriculture for employment and income (Tibane, 2017).

In the agricultural sector, there are also other role players involved in training such as AgriSETA and the QCTO, and their views on competence will be incorporated. In this large and diverse industry, there are numerous role players with different requirements for production competence and knowledge. Their perspective will be highlighted in this chapter as well as the outcome of data collected.

Chapter 5: HEIs' perspective on competence needed

In this chapter, the data from research at HEIs will be discussed and based on the information paint a picture of the current situation at HEIs, identify areas that need to be addressed and make suggestions on how it can be addressed. The aim of the study is to facilitate or promote positive transformation that will be beneficial to all and that will be done by highlighting and sharing best practices.

Chapter 6: Graduates perspective

Graduates are the product of HEIs and it is, therefore, very relevant to get their perception on the competence they acquired during their studies for the diploma and whether they convinced that their competence is sufficient to ensure employability. The demographics of the students give a snapshot of the diversity of the collective term students. Most students who study at the HEIs are first-generation students from a diverse background and with limited exposure to agriculture prior to their studies. This makes the acquisition of competencies al the more important, as the background experience and knowledge is limited and need to be obtained through practical activities and the period of experiential learning.

Chapter 7: Vocational-oriented agricultural education (VOAE)

It is important to understand the concept of vocational-oriented education and how can it be applied at the different HEIs. There are various views on what vocational-oriented education and training comprise. The question should also be asked whether there is a difference between a diploma obtained at an agricultural college and a university diploma? The chapter will also deal with the concept of sustainability. How sustainable is the current model can it be supported financially and does the facilities to offer vocational-orientated education exist at the HEIs? The chapter will also address how the millennium development goals are incorporated into the curriculum and agricultural education and training, applying the VET toolkit to the diploma in agriculture (McGrath, 2012).

Chapter 8: Vocational agricultural education in SADC countries

The study will not be complete if it does not take cognisance of what is happening in the SADC countries with regard to agricultural education and how they ensure competence. The agricultural sector in these countries may differ from that in South Africa, but the development of agriculture in Africa is one of the areas on which many governments are concentrating. Africa can and must become a major role player in world food production and for that, competent agriculturalist and farmers will be needed. A desktop study will be used to collect relevant information with personal interviews and questionnaires to collect data from universities in SADC countries.

Chapter 9: Conclusion and recommendations

The last chapter consolidates the research and presents the final answers to the research questions. From the data collected and literature reviewed, recommendations will flow to aid the transformation of VOAE and training at HEIs.

In the last chapter, the outcome of this study will be used to advise HEIs on what competence the agricultural industry require from the diploma graduates, and how to address the gap between industry expectations and the product of the HEIs. The study will further provide a platform or a baseline where HEIs can compare their practices and outcomes and define their view of vocational-orientated education. If a gap exists between the industry and the HEIs, suggestions can be made on how to bridge that gap. The study will also provide a perspective from the graduates on whether they meet the standards or not.

CHAPTER 2: LITERATURE REVIEW

2.1 Background

The first books and articles on transformation of agricultural education appeared around 1914 yet today transformation of agricultural education it is still a very relevant and important. Agricultural education is a study of two disciplines: agricultural science, the production and science side; and education, the vocational-orientated teaching of agriculture students and the scientific teaching of agriculturalist, agricultural economists and agricultural teachers. This distinction is made because the agricultural diploma, the focus of the study, is a vocational-orientated qualification (CHE, 2013) and the approach and pedagogy differs from the degree qualification.

It is further important to note that there is a difference between agricultural education and agricultural extension. Agricultural extension is the training and advising of farmers, while agricultural education focuses on the teaching of undergraduate and postgraduate students. Melak & Negatu (2012) state the difference in their study on Ethiopian agricultural education; that agricultural education is essential for the development of the knowledge, skills and attitudes of the people, whereas agricultural extension is the agent that does the training in the field and convey the competence to the farmers, (Melak & Negatu, 2012). Lieblein *et al.* (2000) have a different perspective on agricultural education, viewing the complex and changing paradigm of agriculture. Agriculture evolved *"from a narrowly oriented private food production sector to a broader societal activity involving management of natural resources and social issues"* (Lieblein *et al.*, 2000). This transformation poses a challenge to agricultural HEIs; the educational framework changes focus to emphasis on learning and the relationship between learning and action further contributes to the complexity of change (Lieblein *et al.*, 2000).

Formal agricultural education started in the USA with the establishment of agricultural colleges, after the proclamation of the Morril Acts of 1862 and 1890, with the purpose to deliver agricultural knowledge to the masses through an extension of the college (Barrick, 1989). In South Africa, the first agricultural college was established in 1898 at Elsenburg in the Western Cape. The tussle between the science and practice started already in early days. At the Conference of Friends of Agricultural Education,

a meeting of land grant colleges in 1871, the following was quoted in the proceedings: *"There are a class of men who have no knowledge of abstract science, who have become, by long experience, skilful in the manipulations of the farm, and they call these practical, and they have knowledge, no doubt, of an exceedingly important part of farming. Then there are men … who work in the laboratory, who are skilful botanist (and zoologists), and who have accumulated ... great knowledge in their departments. The so-called practical men... cannot do without the scientific work … [and] the scientific men never could reduce their experiments, their discussions to practice on the farm without the muscular workers"* (Barrick, 1989). The discussion regarding theory and practical is ongoing and still relevant to date.

2.2 Definitions, theories and concepts

The definitions, theories and concepts discussed below were used in this study, and are highlighted at the start of the Literature review to aid understanding and for consistency.

Agricultural industry

The South African agricultural industry/sector is a dual system, with well-developed commercial farmers and subsistence-based smallholder farmers. The sector employs 638 000 people in formal employment and a large number as contract workers during the production seasons. The agricultural sector contributes roughly 3% of the country's Gross Domestic Product (GDP). It represents about 7% of formal employment and it is estimated that around 8,5 million people are directly or indirectly dependent on agriculture for employment and income (Tibane, 2017).

Competence

The National Postsecondary Education Cooperative (NPEC) workgroup define competence as *"a competency is a combination of skills, abilities, and knowledge needed to perform a specific task*" (Voorhees, 2001). Competency-based education is described by Grant as tending to be *"a form of education that derives a curriculum from an analysis of a prospective role or actual role in modern society and that attempts to certify student progress on the basis of demonstrated performance in some or all aspects of that role"* (Biemans, 2004).

The Royal College of Veterinary Surgeons describes competence as a concept that integrates knowledge, skills and attitudes; the application of which enables the professional to perform effectively, including be able to cope with contingencies, change and the unexpected (Royal College of Veterinary Surgeons, 2014).

The difference between competence and skills lies in the ability to perform a task correctly. This may include numerous associated skills (recorded in the student's log as evidence of developing competence). Competence requires more than just acquisition of technical skills; it involves applying relevant knowledge and having the confidence and ability to transfer what has been learnt to a variety of contexts and new unpredicted situations.

Day one competence

Day one competence is a concept developed to describe the ability of the worker the first day at work. Guided by the Royal College of Veterinary Science's document on day one competencies (Royal College of Veterinary Surgeons, 2014), a working definition was developed to defined day one competence. Day one competence for agricultural diploma graduates is defined as *the minimum essential competence that a diploma graduate is expected to have when he/she start to work, to ensure that he or she will be able to perform work on day one, when he/she starts to work*. The day one competence will differ from company/farm, about the specifics of the production commodity, but there is definite generic competence that are essential at the first day of work. It is necessary for the agricultural industry, in bridging the gap between industry and the HEIs to draft a document defining to define what is regarded as day one competence for the agricultural industry.

Education for sustainability

Education for sustainability was developed to support sustainable development. Its aim is to help people to cope with, manage and shape social and ecological conditions, characterised by change, uncertainty, risk and complexity. Sterling (2012) defines it as *"a kind of education, teaching and learning that appear to be required if we are concerned about ensuring social, economic and ecological wellbeing now and into the future"* (Winter, Barton & Cotton, 2015).

Experiential learning

Kolb's (2005) experiential learning theory model is the basis of experiential and work-integrated learning (WIL) in agricultural education and training. It is based on a four-stage cycle that can also be expressed as a learning cycle. The four stages – concrete experience, reflective observation, abstract conceptualisation and active experimentation – are the basis of his experiential learning theory and is also applied as such in the teaching of skills in agriculture (Kolb, 2005).

Farmers

For the purpose of this study, the farming sector of the agricultural industry will be classified, according to a combination of the classification of Vink and Van Rooyen (2009), and Kirsten and Sihlobo (2019), by the size of the land and turnover as per Table 1. Other role players in the agricultural industry are agricultural business, commodity organisations, organised agricultural sector, training providers, AgriSETA, the provincial and national departments of agriculture.

Learning development

Learning development is defined as *"*a *complex set of multi-disciplinary and cross-disciplinary academic roles and functions, involving teaching, tutoring, research and the design and production of learning materials, as well as involvement in staff development, policy-making and other constructive activities"* (Hilsdon, 2011 as cited in Winter *et al.*, 2015). Learning development focuses on students and how they learn, how they interpret and give meaning to academic conventions. Together with the students, it is explored how they increase levels of enquiry into, and critical participation in, such conventions and practices (Winter *et al.*, 2015).

Sustainable education

Pretty (1995) argues *"that sustainability is a complex and contested concept and precise definition thereof is not possible*". Therefore, *"sustainable agriculture is not simply an imposed model or package, it must become a process for learning and perpetual novelty"* (ibid.). The question is also how sustainable is the current model of agricultural education used for the training of agricultural diploma graduates? Will it be able to withstand the demands of modern agriculture and the *transformation* of agriculture currently taking place in South Africa?

To be sustainable means it must be able to continue over a long period of time. Lotz-Sisitka *et al.* (2015) state that: *"The nature of the sustainable challenges currently at hand is such that dominate pedagogies and forms of learning that characterise higher education need to be reconsidered to enable students and staff to deal with accelerating changes, increasing complexity, contested knowledge claims and inevitable uncertainty"* (Lotz-Sisitka *et al.*, 2015).

Transformational learning

Transformational learning is the process of deep, constructive and meaningful learning that goes beyond simple knowledge acquisition and supports critical ways in which learners consciously make meaning of their lives (Simsek, 2012). There is strong support from the Wageningen University with supporters such as Wals, Biemans, Wesselink and Mulder, who promote competence-based learning and also lifelong work-related learning (Lans,et al.2004). Central in transformational learning is John Mezirow's transformative learning theory, which states that *"transformational learning is a 'deep, structural shift in basic premises of thought, feelings and actions'"* (cited in Kitchenham, 2008). The use of transformational learning changed the way adult learners are taught and need to be noted in the context of agricultural education and training.

Vocational-orientated education

Vocational education and training is a set of practices and technologies rather than a clearly defined concept (McGrath, 2012). McGrath (2012) states the following *"any definition of vocational education and training is highly problematic. In the broadest sense, VET is conventionally understood as encompassing the myriad forms of learning that are primarily aimed at supporting participation in the world-of-work, whether in terms or not) integration into work or increased effectiveness of those currently defined as being in work"* (McGrath, 2012).

In a research paper by the European Centre for the Development of Vocational Training (Cedefop) that focused on vocational education and training at higher qualification levels, vocational-orientated education was defined by their working definition: *"Vocationally oriented education and training at higher qualifications level means education and training that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects. It is usually located*

at levels equivalent to levels 6 to 8 of the European qualifications framework" (Cedefop, 2011).The agricultural diploma contains elements of vocational education and purely academic education, and fits the working definition of a vocational-orientated qualification. The education and training to which the pedagogy needs to be adjusted fit its characteristics. Vocational-orientated education and learning cannot be offered successfully if facilities are not available and the educators, lecturers or facilitators do not have the experience and practical skills to facilitate the skills training.

Industry-specific knowledge is concept that needs explanation. In the definition of the diploma it is stated that: "This qualification primarily has a vocational orientation, which includes professional, vocational, or **industry-specific knowledge** that provides a sound understanding of general theoretical principles as well as a combination of general and specific procedures and their application" (CHE, 2013). The researcher's interpretation of the concept is that industry-specific knowledge is knowledge specifically related to the industry applicable to the qualification; in this case the agricultural industry. The industry-specific knowledge should provide a sound understanding of the general theoretical principles and specific procedures and their application. The knowledge gained leads to understanding and through understanding to application and finally to competence.

2.3 Agricultural education

Education is defined by Barrick (1989) as *"a discipline in the field of study that concerns itself with the principles and methods of teaching and learning"* (Barrick, 1989). Agricultural education is a community of scholarship between agricultural science and education in order to become the scientific study of the principles and methods of teaching and learning as they pertain to agriculture (Barrick, 1989).

A clear distinction between agricultural education and agricultural extension is needed; agricultural education and training is broader than extension. Agricultural extension is a component of agricultural education and training. Promoting sustainable improvements to the agricultural value chain can only take place if the whole value chain is addressed (Roberts, 2016a). Roberts (2016a) states that "*sustainable, transformative change in agriculture requires both human and institutional capacity*

development in the whole agricultural education and training system" (Roberts, 2016a).

Agricultural education can sometimes be uses synonymously with 'vocational agriculture'. Roberts quotes Stimson (1919), who stated that *"… neither skill nor business ability can be learned from books alone, nor merely from observation of the work and management of others. Both require active participation, during the learning period, in productive farming operations of real economic or commercial importance"* (Roberts, 2016a, p.32).

Agricultural education is the scientific study of the principles and methods of teaching and learning as they pertain to agricultural practice; it must also be hands on and that is where several of the challenges arise (Barrick, 1989). In South Africa, the agricultural diploma study is classified as a vocational-orientated qualification, (CHE, 2013), implying that there is an equal balance between theory and practice.

2.3.1 The South African vocational-orientated agricultural education situation

There are 21 HEIs offering VOAE spread throughout the country. The HEIs consist of 11 agricultural colleges, six universities of technology and four comprehensive universities. A large number of the diploma graduates produced annually are unemployed – of the respondents who responded to the questionnaire that was sent out for this study 58% are employed.

In recent comments on agricultural education in South Arica, various calls were made for change in agricultural education and training. The then Minister of Agriculture, Forestry and Fisheries, Senzeni Zokwana, stated in 2018 that, *"agricultural colleges should be reconfigured as this would allow them to help to respond to challenges facing the sector including climate change"* (SANews, 2018).

Schroeder states that, *"a total new approach to training in South African agriculture is needed … To have an agricultural degree is acceptable, but we need applied training that includes practical and management training"* (cited in Schultz, 2018).

Reinhardt states that, *"many leading South African farming entities share the common sentiment that agricultural colleges are no longer delivering the well-rounded, technical skilled professionals who are critical to the role of not only production managers but also lesser-skilled workers"* (Reinhardt, 2018).

Reinhardt adds that, *"the boundary of agriculture is pliable – there are numerous qualifications and courses with links to the field of agriculture. To be relevant, agricultural education and training must focus on building capacities not only for agricultural production but also to equip a broader range of professionals and practitioners with the necessary skills to engage successfully with the key links in the value chain"* (Reinhardt, 2018).

The Higher Education Quality Committee (HEQC) of the CHE (2014), in its advice to the Minister of Higher Education, reported their findings in their report "Advice to the Minister of Higher Education and Training on the Status and Location of Public Colleges (2014)". Their findings included the location of the colleges at provincial level, lack of governance structures, absence of academic governance structures, lack of academic leadership, mismatch of available facilities, poor maintenance of infrastructure, teaching spaces and student residences. The also reported that, *"the governance status of agricultural colleges is not peculiar to the agricultural sector"* (CHE, 2014).

With the comments and remarks made regarding agricultural education, the relevance of the main research question, the perceived gap that exist between the competence of agricultural diploma graduates at HEIs of South Africa, is clear; and ways of addressing it need to be found. A definite action is to improve the competence of the graduates to match industry standards. To be able to do that, attention need to be given to VOAE, an agricultural education pedagogy, provision of practical experience and facilities and the formation of strong industry partnership. These topics will be discussed below.

2.3.2 Vocational-orientated education

The focus area of this study is the agricultural diploma programmes offered by HEI. The CHE defines the purpose and characteristics of a diploma as: a **qualification**

[that] primarily has a vocational orientation, which includes **professional, vocational or industry-specific knowledge that provides a sound understanding of general theoretical principles as well as a combination of general and specific procedures and their application**. The purpose of the diploma is to develop graduates who **can demonstrate focused knowledge and skills in a field.** Typically, they will have gained experience in applying such knowledge and skills in a workplace context. A depth and specialisation of knowledge, together with practical skills and experience in the workplace, enables successful learners to enter a number of career paths and to apply their learning to employment contexts from the outset. Diploma programmes typically include an appropriate Work Integrated Learning (WIL) component (CHE, 2013) (own emphasis).

The concept of **vocational-orientated education** needs to be unpacked to ensure a common understanding thereof. The *Merriam Webster* dictionary defines vocational education as *"training for a specific occupation in agriculture, trade or industry through a combination of theoretical teaching and practical experience provided by many high schools in their commercial and technical divisions and by specialised institutions of collegiate standing (as a college of agriculture, a school of engineering or a technical institute)*". The Skills Portal (2018) defines vocational training as a phrase that is often used by education and training institutions, and is defined by Businessdictionary.com as *"training that emphasises skills and knowledge required for a particular job function or a trade"* (theskillsportal, 2018). Dictionary.com defines vocational education as *"educational training that provides practical experience in a particular occupational field, as agriculture, home economics, or industry"* (Dictionary.com, n.d.). Considering the meaning of the word **oriented**, it indicates 'directed towards, showing the direction in which, something is aimed'. If the words are combined as **vocational-orientated qualification**, it can be defined or described as '*a qualification that is directed towards or showing the direction towards, training for a specific occupation as a combination of theoretical teaching and practical experience that emphasise skills and knowledge that is required for a particular job function'* (researcher's own formulated definition).

According to City and Guilds and others (Lucas, et al, 2012; Roberts, 2016b; Mulder, 2017.) the contexts and the methodology of teaching will determine the success and deep learning. It is emphasised by the following citation *"vocational education needs to be taught in the context of practical problem-solving, and that high quality education*

always involves a blend of methods. The best vocational education learning is broadly hands-on, practical experiential, real world as well as, and often at the same time, something which involves feedback and, when required theoretical models and explanations" (cited in Lucas *et al.*, 2012).

Highlighted by the working definition, vocational-orientated programmes can be explained as a mixed entity with elements from academic and vocational programmes, as indicated in figure 2 below. With the focus on academic and practical realities, vocational-orientated programmes cannot be delivered in the same way as pure academic programmes. There should be a balance between theory and practice. In the case of a diploma programme, this ratio is normally 60:40; with 60% theory and 40% practical work or 40% theory and 60% practical (interview responses).

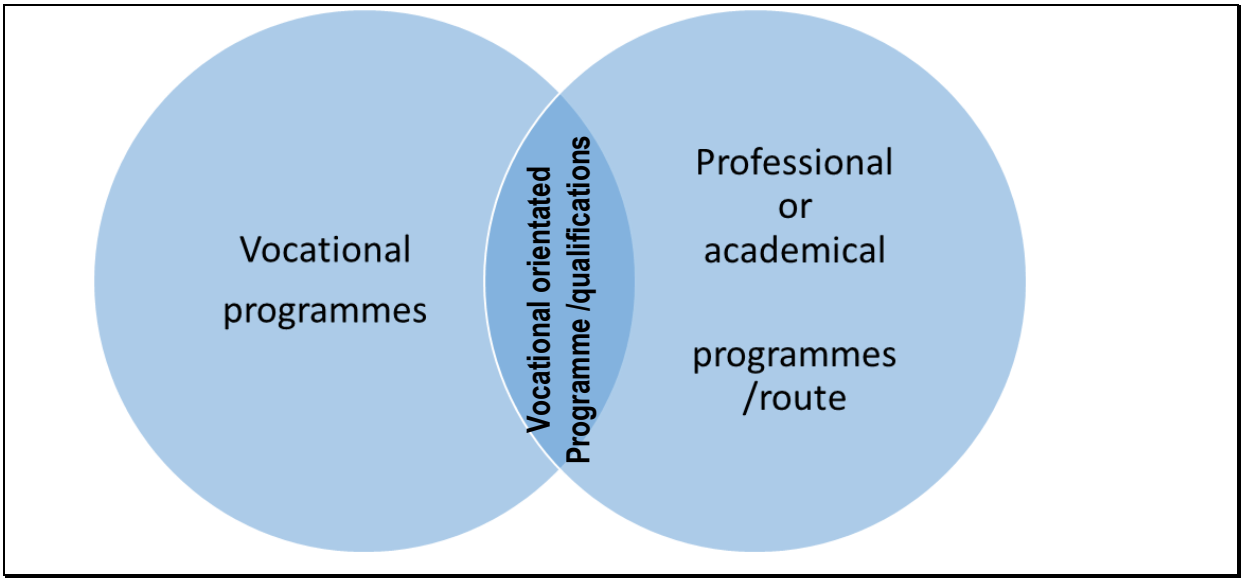

Figure 3: Vocational-orientated qualification (Source: Researcher's own design)

The connection between theory and practical is one of the main focus areas of vocational-orientated qualifications and this is one of the strengths of this type of qualifications in that it provides the students with hands-on experience that could lead to employment. It is, however, a common struggle for many HEIs to provide relevant theoretical and practical instruction (Roberts, 2016). Roberts argues further that knowledge and comprehension levels are associated with the recalling and understanding of concepts, and this compare to the practiced theoretical instruction in a large number of institutions. Practical instruction with hands-on activities uses application, analysis, synthesis and evaluation (ibid.).

The importance of the practical component of agriculture is emphasised by other researchers (Marshall et al.,1998; Oladele et al., 2011; Deegan et al, 2016; Roberts, 2016a.) and as far back as 1905, Baily said the following *"the value of the university farm from a university man's point of view consist in its usefulness as a means of teaching"* (cited in Parr *et al.*, 2007). He advocated that students engage with the practical reality in the field, experience it, make observations and reflect on the different relationships existing and what they discovered. This practical experience is an alternative to the abstract disciplinary knowledge taught in the classroom (ibid.). Baily's statement is supported by LaCharite (2015), Monaghan *et al.* (2015) and Kensinger and Muller (2006), who all emphasise the importance of the institution's farm for the routine and structured practical work.

HEIs should recognise the value and importance of the teaching farm as an extension of the classroom – it is a teaching laboratory that must be coordinated with the realities of the commercial farming practices and technology used. The challenges is the availability of the latest technology and to keep up with the rapid development of new technology. A linkage or partnership between HEIs and the private sector suppliers of agricultural technology needs to be strengthened to make the technology available for educational purposes and replace it as new technology develops. Such linkage or partnerships can be used as action research to develop new applications.

Roberts (2016a) supports the view when he identifies three barriers related to agricultural education and training, namely facilities, staff and the linkage between practical and theory. Other researchers also highlight the lack of facilities and the linkage of practical and theory (Maalouf, 1988; Dyer & Osborne, 1996; Parr *et al.*, 2007; Wals, 2017.).

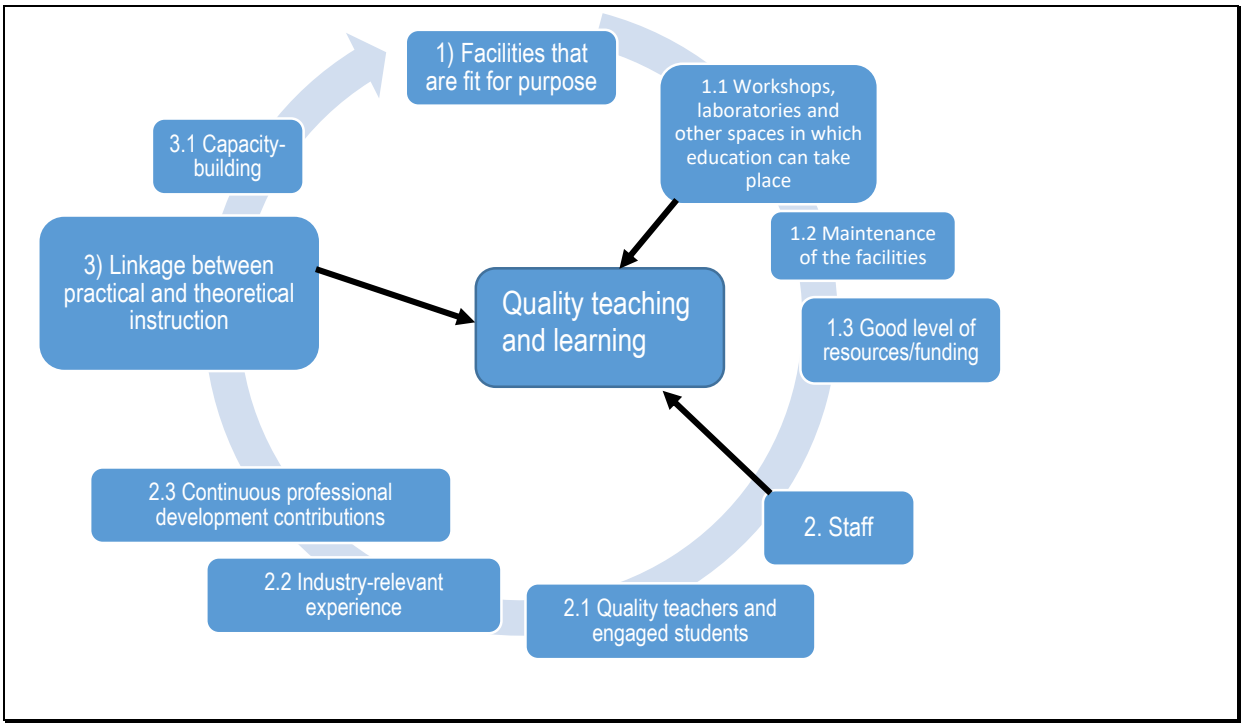

Figure 4: Illustration of Roberts' barriers to quality vocational-orientated education and training. (Source: Researcher's own design)

In his article "EARTH University: A Model for Agricultural Education and Training" (Agrilinks, February 2016), Roberts highlights the success factors of the EARTH university with regard to agricultural education. EARTH follows a systems approach and create various linkages between theory and practical instruction as well as linkages with external agricultural education and training institutions (Roberts, 2016). With regard to their teaching philosophy, the curriculum is based on experiential and student-centred learning comprising four programmatic areas such as technical knowledge, leadership development, social and environmental awareness, and entrepreneurship. What is of importance to the discussion is their approach to instruction; that there is a balance between the theoretical and practical components. This balance is brought about through a deliberate and coordinated linkage between what is taught in the classroom and what is applied in the teaching farm and local community (Roberts, 2016).

In a research paper by the European Centre for the Development of Vocational Training (Cedefop, 2011), focusing on vocational education and training at higher qualification levels, vocational-orientated education was defined by their working definition – *"Vocationally oriented education and training at higher qualifications level means education and training that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects. It is usually located*

at levels equivalent to levels 6 to 8 of the European qualifications framework" (Cedefop, 2011). This working definition correlates to the working definition developed above.

If the Cedefop definition is customised for the South African situation, it can then be defined as *"vocational-oriented education at higher qualifications level means education that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects. It is usually located at levels equivalent to levels 5 to 7 on the South African qualifications framework"*.

Vocational-oriented education is offered by TVET colleges (Level 5), while VOAE is offered by ATIs/colleges, comprehensive universities and universities of technology, at NQF6 level. Table 3 indicates the different HEIs and the laddering that can take place between the different programmes.

Table 3: South African situation with regard to technical and vocational education and training and higher education institutions

NQF level	TVET Colleges	Agricultural Colleges/ATIs	Universities of Technology	Comprehensive Universities	Traditional Universities
4	NCV				
5	Higher Certificate				
6		Diploma			
7		Adv. Diploma	B Tech	Adv. Diploma	B Agric
8					

(Source: Researchers own design)

The revised Higher Education Qualifications Framework (HEQF), that was promulgated in October 2007 and implemented in January 2009, highlights as one of the key objective the articulation of programmes and the movement of students between the programmes and HEIs (CHE, 2013). The HEQF recognises three broad qualification progress routes with permeable boundaries, namely vocational, professional and general routes; and provides greater clarity on the articulation possibilities between these qualification routes. Undergraduate diplomas are typically found in the vocational route (CHE, 2013).

Vocational-orientated learning is a combination of theory and practical, and attention needs to be given to different learning systems that will complement the vocational-

orientated approach. The following systems will be discussed: experiential learning (EL), competence-based learning (CBL) and work-based learning (WIL).

Experiential learning

Experiential learning(EL) is grounded in the life experience of the learner where the learner is directly in touch with the realities being studied. Kolb (1984) defined EL as *"a process whereby knowledge is created through the transformation of experiences"* (Kolb, 1984). Experiential Learning can be characterised by the following key concepts: Learning is best achieved as a process, not an outcome. The process of learning requires the resolution of conflict between dialectically opposed modes of adaptation to the world. Learning is a holistic process of adaptation to the world; it involves the total organism – thinking, feeling, perceiving and behaving. Learning involves transactions between the person and the environment, through experience. Learning is a process of creating knowledge.

Experiential learning can be summarised with the working definition "*Learning is the process whereby knowledge is created through the transformation of experience*" (Kolb, 2015). Kolb's (2015) model of EL is illustrated in figure 4 below. The model is followed by most of the HEIs, using WIL as a component of the diploma study.

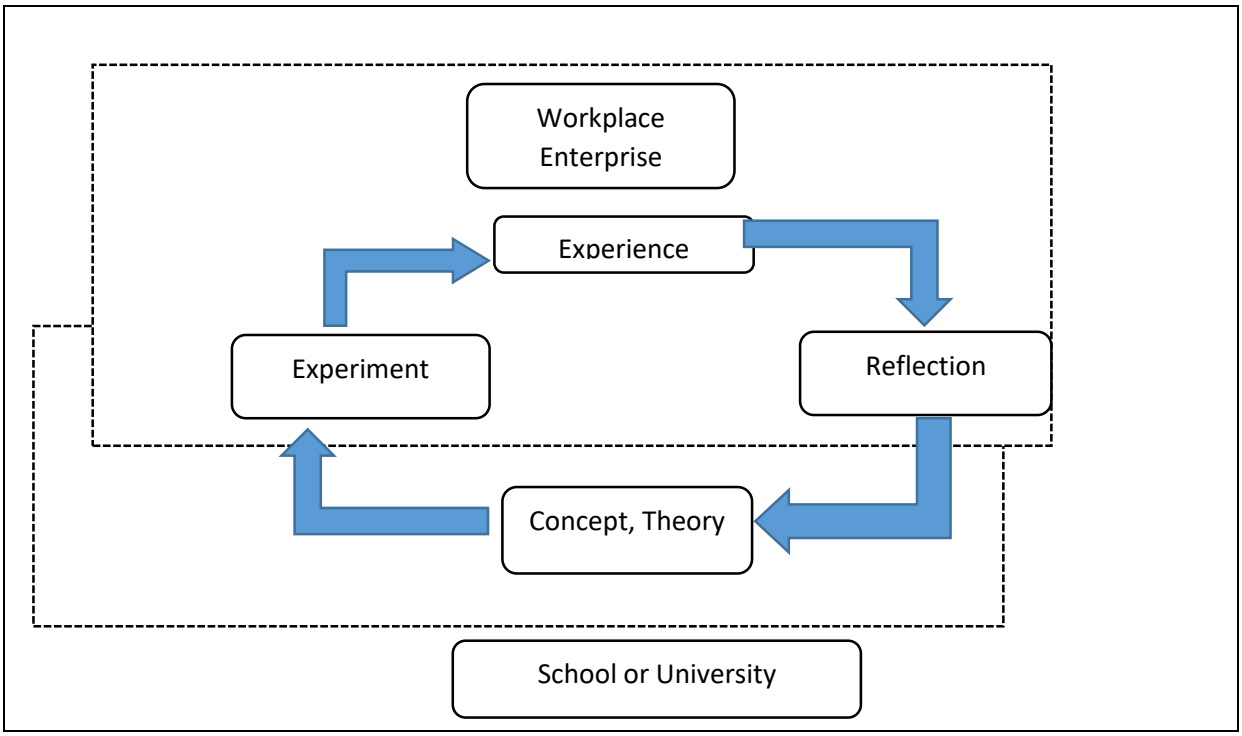

Figure 5: Kolb's theory of experiential learning (Kolb, 2015)

Competence-based learning

The CBL concept is that learning is best measured by student's demonstration of the mastery of learning, rather than the number of hours spent in a classroom.[2] Competence based learning have five essential elements. 1) Students advance upon demonstrated mastery. 2) Competencies include explicit measurable transferable learning objectives that empower students.3) Assessment is meaningful and a positive learning experience for students. 4) Students receive timely, differentiated support based on their individual learning needs.5) Learning outcomes emphasise competencies that include application and creation of knowledge along with the development of important skills and dispositions.

Contrasting to the traditional numbers assessment (tests), CBL prioritises competencies and the learning associated with it, measures the ability of the student with more precision and provides a clear description and measurement of learning (Voorhees, 2001). The CBL process is illustrated in figure 5 below, of a conceptual learning model as adapted from Voorhees (2001).

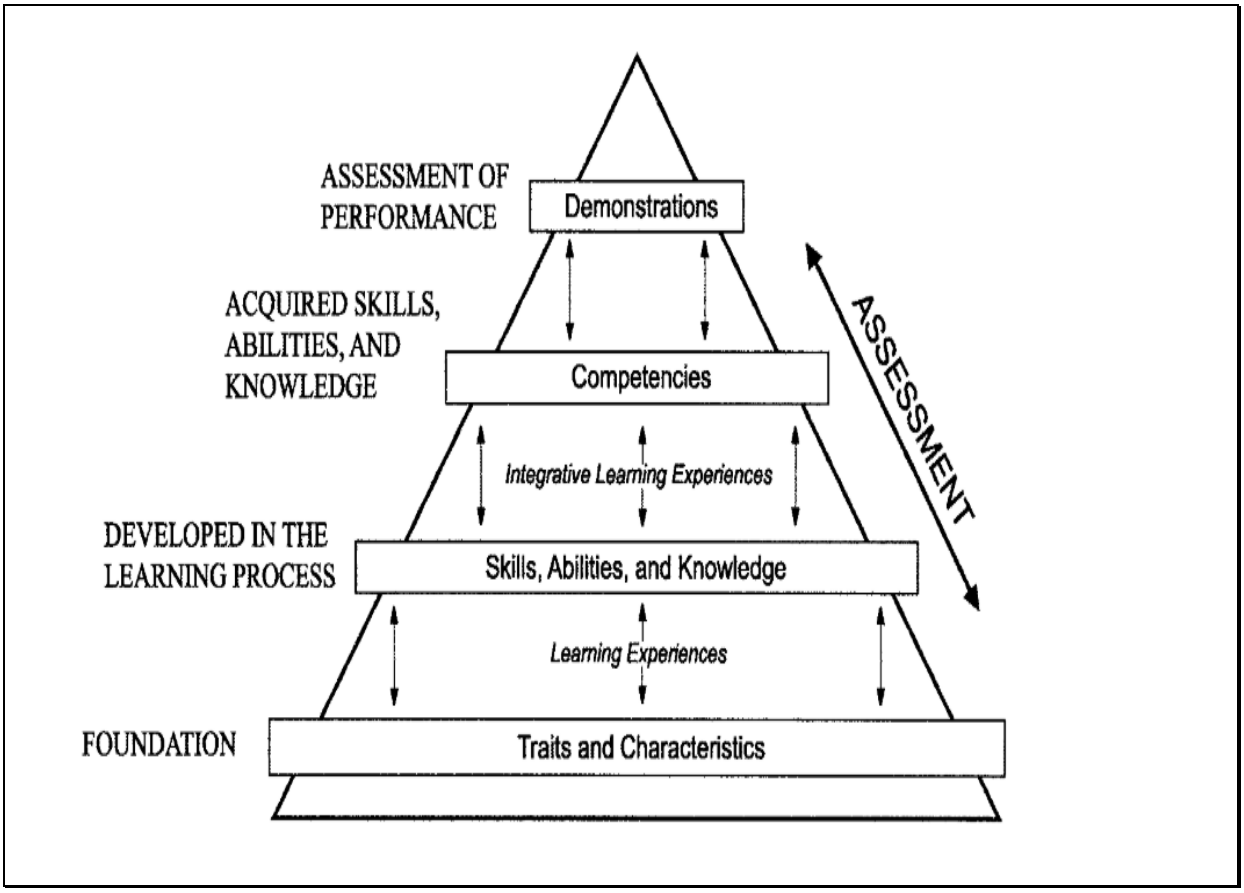

Figure 6: Conceptual learning model adapted from Voorhees (2001)

[2] www.aurora-institute.org.

The conceptual learning model display similar elements as Dale's cone of learning (Anderson, 1970) and Miller's pyramid of assessment (Miller, 1990).

Competence Based Learning was introduced into the agricultural colleges through the Transforming Agricultural Colleges into Agricultural Training Institutes (TACATI) project, where the promotion of CBL and the formation of communities of learning and action were established (Chaminuka *et al*., 2016) as a process of social learning between the different college staff members. Competence Based Learning aligns itself to the vocational-orientated education and add value to the students in promoting competence in line with the workplace requirements.

Work-based learning

The competence of the graduate is associated or determined by the practical skills obtained during the period of study; it is linked to the specialised knowledge. Students and mentors cannot be expected to obtain and provide these practical skills during the WIL phase alone; students need to gain the basic skills at the HEI to ensure that they can strengthen the practical skills during the work in the WIL phase of the qualification.

Although higher education may differentiate between the theoretical study fields (degree programmes) and the vocational study fields (diploma programmes), it is essential that the students are exposed to the latest developments in agriculture. This will require that HEIs be at the forefront of technological advances in the agricultural industry, use the latest technology and methods to ensure teaching and learning. Work-based learning is a practice to expose students to a real or simulated work environment with the intention of applying technical knowledge and skills learned in classroom within a real-world setting (Trips, n.d.).

2.4. Assessment of learning and competence

Much have been written about the assessment of learning, so for the purpose of VOAE the researcher focused on three theories of learning and assessment, namely Dale's cone of learning, Miller's pyramid of assessment and Biggs and Collis' Structure of the Observed Learning Outcomes (SOLO) taxonomy to assess competence, applicable

to the learning and assessment of competence and knowledge. A combination of the three theories will ensure accurate assessment of competence.

2.4.1 Dale's cone of learning

Practical experience is important in VOAE and the pedagogy to facilitate learning is equally important. Dale developed the cone of learning or experience, which explains the learning that takes place through different actions and is part of experiential learning or 'learning by doing' (Anderson, 1970).

The cone of learning displayed below highlights the following: after two weeks' learners remember 30% of what they see during demonstrations and practical demos; they remember 50% of what they see and hear on field trips and visits to exhibitions; they remember 70% of what they say in discussion groups or when they make an oral presentation; and they remember 90% of what they say and do while doing the real thing or practising on a simulator or doing a simulation of the real thing.

The information obtained through the Dale's cone of learning can be used as a planning guideline for practical experiential learning. Anderson (1970) added outcomes to the different levels. At the two top levels of the pyramid, namely 'reading and hearing words', the learning outcomes are defining, describe, list and explain. At the levels in the centre, 'seeing and watch' and 'demonstration or view of an exhibit' level, the learning outcomes are demonstrating, apply and practise. At the last levels, 'participation and discussion or presenting' level, the competence is analyse, design, create and evaluate. Using the cone of learning in the VOAE pedagogy and planning for lessons, large groups can be handled while it is still ensured that they get the practical experience. Dale's cone of learning is illustrated in figure 6 below.

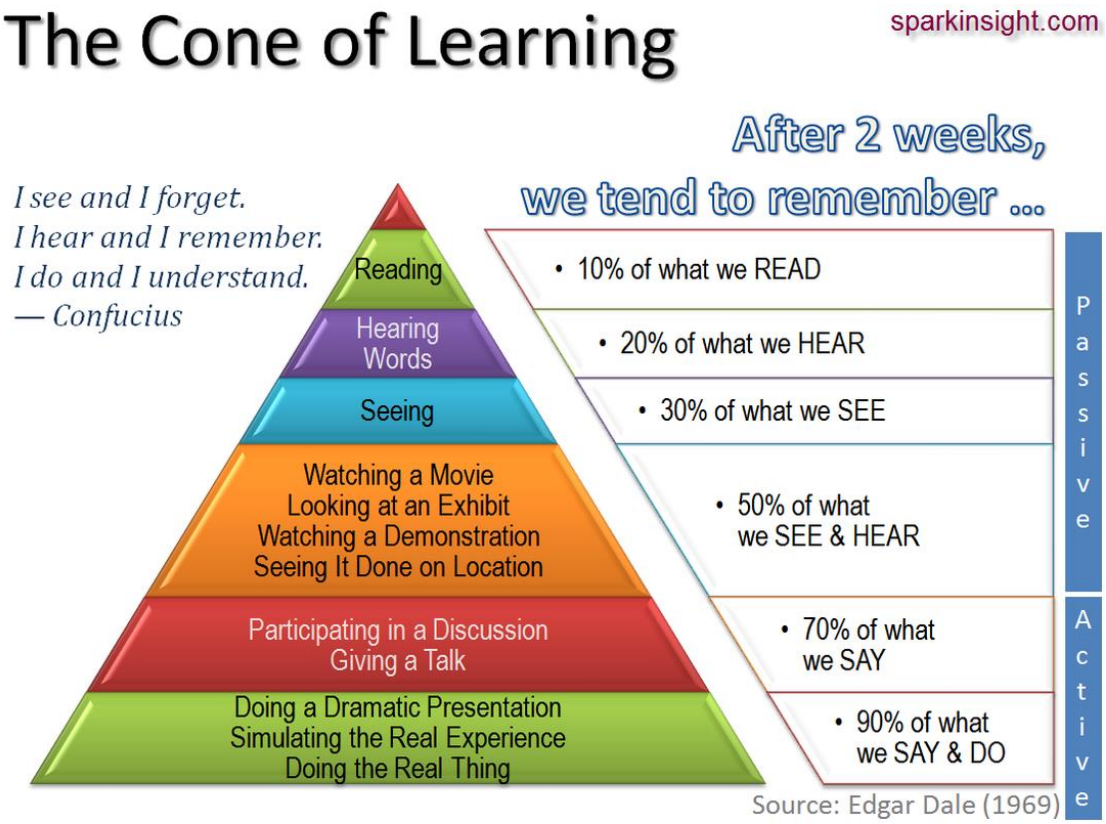

Figure 7: *Dale's cone of learning*

2.4.2. Miller's pyramid of assessment

Miller (1990) developed a pyramid of assessment for assessing clinical competence in medical education (Miller, 1990). Vocational Orientated Agricultural Education is also about the assessment and application of competence and knowledge. Adapting Miller's pyramid of assessment to suit the needs of VOAE provides a guideline for the development and assessment of competence needed in agriculture. Linking Miller's pyramid with Dale's cone of learning will assist in developing a VOAE pedagogy to ensure learning and competence.

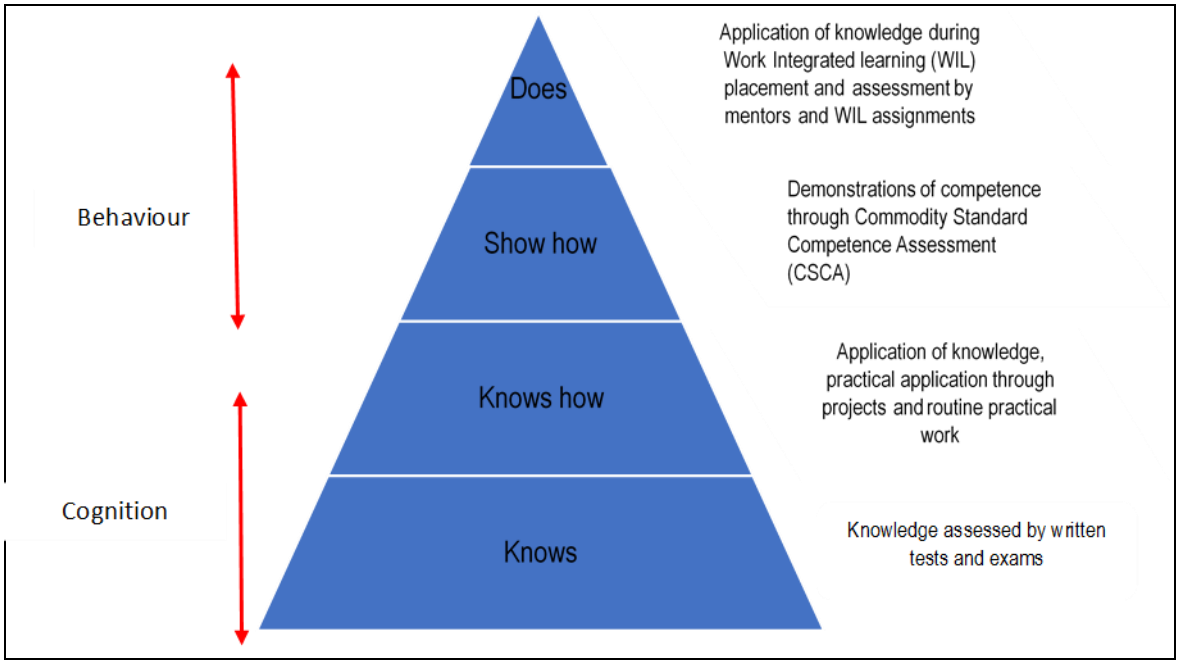

Figure 8: Miller's pyramid adapted for vocation-oriented agricultural learning (researchers design)

2.4.3. Biggs and Collis' SOLO taxonomy

The Biggs and Collis SOLO taxonomy classifies the outcomes and is a handy tool to use for assessing competence, assignments or portfolios of evidence (Brenner, 2010). The SOLO is based on the outcomes of learning as it passes through increased stages of complexity (Hoskins & Newstead, 2009). In VOAE it can be used to design assessment and for the assessment. It is a hierarchical structure where each level is the foundation of the next. The complexity of understanding and assessment increases per level from basic knowledge to extended abstract, where the learner will be able to create, formulate and reflect on the structure of the coherent whole and applied it to new and broader contexts (Hoskins & Newstead, 2009). The learner progresses from incompetent to competent or from a novice to an expert.

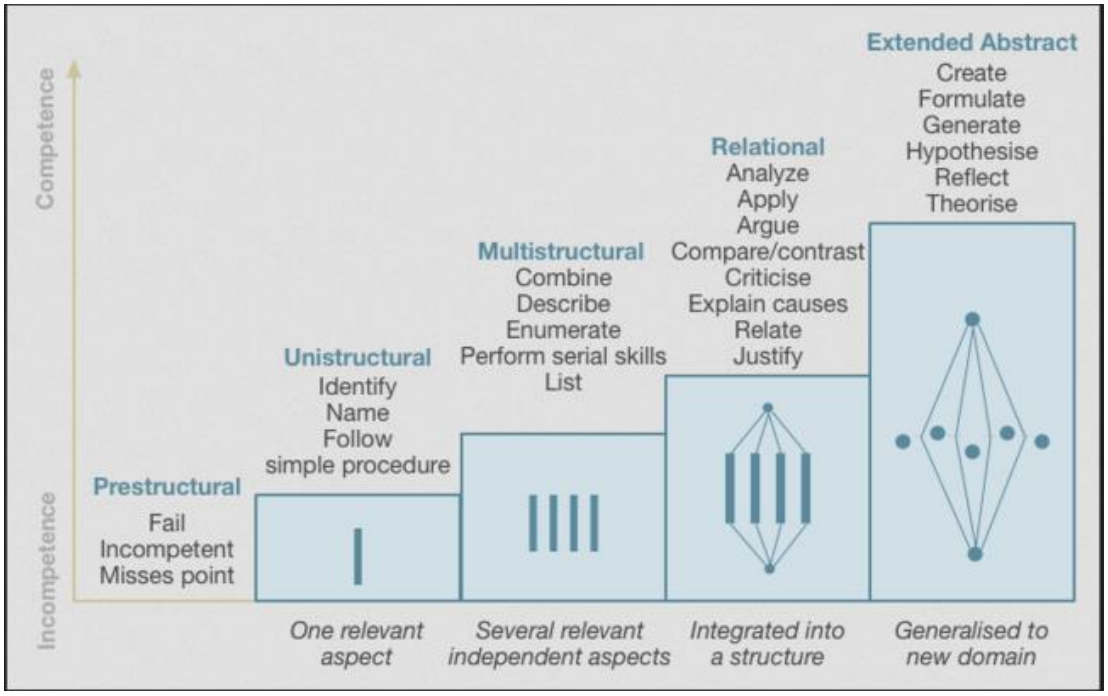

Figure 9: Biggs and Collis' SOLO taxonomy

2.5. Vocational-orientated agricultural pedagogy

Pedagogy is the method, art, science or practice of teaching; the result thereof should be learning and mastering of the subject content. Part of the curriculum transformation is to develop a pedagogy for VOAE. Searching the internet and other publications on pedagogy of agricultural education or VOAE, you realise that there is little written about pedagogy for agricultural education in South Africa. When you do a search on "agricultural education in South Africa" you get the same results – little or no research is done on the pedagogy of agricultural education. The information available is from America (Meek, 2016), India (Kumar & Kumar, 2014), Germany (Mulder, 2017), Turkey (SAHIN, 2016), Norway (Lieblein *et al.*, 2000), The Netherlands (Mulder & Biemans, 2018), Tanzania, (Msuya *et al.*, 2014) and Uganda (Jjuuko, et al, 2019). This is an indication of the interest and research done worldwide with regard to agricultural pedagogy. It is necessary for South Africa to get involved in agricultural pedagogical research. This is in line with the recommendations made in the South African Academy of Science report on the revitalisation of agricultural education (Swanepoel,et al. 2017).

When poor learner performance occur, many reasons are mentioned and when learner failure occur, the blame is put on the students who are not performing (Dosch,

2014). It can, however, also be the approach to teaching – sometimes one type of teaching is suitable or not suitable for all the learners and no differentiation takes place. Successful learning is dependent on three components, namely the teacher and the teaching, the student and the learning material. Without these three components, learning will be difficult. Equally important is the understanding of the personal character of the students as well as their academic skills. Understanding the personal character of the students, student readiness, interest and learning profile are three components that can be used as a diagnostic instrument (Tomlinson, 2001).

The modern agricultural student is not a student who traditionally grew up on a farm and have background knowledge about agriculture (Swanepoel, et al. 2017; Jjuuko *et al.*, 2019). This is also the reality in South Africa – that although a large portion of the students come from rural areas, it cannot be assumed that they have an agricultural background. With the increase in the number of student numbers who are from a non-farming background, courses and practical work need to be added to teach the students the routine aspects of farming that were previously assumed to be background knowledge or assumed skills (Kensinger & Muller, 2006).

The researcher is in agreement with Mulder (2017) when he states that domain-specific didactics for agriculture, a form of subject didactics, does not exist. He based his argument on the increase in publication regarding pedagogical content knowledge. Pedagogical content knowledge is the combination of subject-specific knowledge and didactical knowledge. Content pedagogy is the knowledge of teaching. Agricultural pedagogical content knowledge is the body of domain-specific knowledge about the design, implementation and evaluation of teaching and learning of agricultural theory and practice.

Kumar and Kumar state that agricultural education does not match the requirements of globalisation as well as the market-driven needs (Kumar & Kumar, 2014) and that radical changes in pedagogy of agriculture will be needed to address the challenges. The City and Guild document “How to teach vocational education” states the following on the need for a vocational pedagogy: *“The effectiveness of all education systems depends critically on the quality of teaching and learning in the classrooms, workshops, laboratories and other spaces in which the education takes place”* (cited in Lucas *et al.*, 2012). The statement is equally true about VOAE and in the process

of transforming or narrowing the gap between the agricultural industry and the graduates. Pedagogy will play an important part. Pedagogy is defined by them as the science, art and craft of teaching (Lucas *et al.*, 2012). Lucas sums it up to say vocational pedagogy is the sum total of the many decisions vocational teachers make as they teach, adjusting their approaches to meet the needs of learners and to match the context in which they find themselves (Lucas, 2014). Agricultural diploma lecturers need to develop a vocational-orientated pedagogy for their programmes to teach it in such a way that learning, understanding and application takes place.

A good vocational-orientated agricultural programme lecturer can be compared with the characteristics of a good stockman (Drovers, 2014). They should be: **Observant,** to notice the students who are not coping, who are struggling and when something is wrong. **Confident,** if you are not confident, the students will pick it up and disrupt your class or practical session. **Competent and innovative**, be in control of the situation, with excellent knowledge of the subject and skills, adaptable to situations. **Patient,** handle the learners patiently and provide enough time for questions and demonstrations. **Positive attitude and persistent**, a positive attitude is contagious and will rub off on the learners and keep on doing the right thing. **Respectful,** handle the students with respect, and respect the subject and learning material.

Agricultural pedagogical content knowledge is a specific type of practical knowledge, or craft knowledge, that is believed to be an essential domain in teaching as it clearly applies to knowledge and skills that are unique to the teaching of agriculture (Meijer *et al.,* 2002).The connection between theory and practical is one of the main focus areas of vocational-orientated qualifications and this is one of the strengths of this type of qualifications in that it provides the students with hands-on experience that could lead to employment. It is, however, a common struggle for many HEIs to provide relevant theoretical and practical instruction (Roberts, 2016). Roberts argues further that knowledge and comprehension levels are associated with the recalling and understanding of concepts.

In his article “EARTH University: A Model for Agricultural Education and Training” (Agrilinks, February 2016), Roberts highlights the success factors of the EARTH university with regard to agricultural education. EARTH follows a systems approach and create various linkages between theory and practical instruction as well as

linkages with external agricultural education and training institutions (Roberts, 2016). With regard to their teaching philosophy, the curriculum is based on experiential and student-centred learning comprising four programmatic areas such as technical knowledge, leadership development, social and environmental awareness, and entrepreneurship. What is of importance to the discussion is their approach to instruction; that there is a balance between the theoretical and practical components. This balance is brought about through a deliberate and coordinated linkage between what is taught in the classroom and what is applied in the teaching farm and local community (Roberts, 2016). The lesson that HEIs can learn from this is the value and importance of the teaching farm as an extension of the classroom; it is a teaching laboratory that must be in sync with the realities of the commercial farming practices and technology used. This is where the challenges lie in terms of the availability of the latest technology. A linkage or partnership between HEIs and the private sector suppliers of agricultural technology needs to be strengthened to make the technology available for educational purposes as well as deliberate and coordinated linkage between what is taught in the classroom and what is applied in the teaching farm and local community.

If vocational-orientated learning is a combination of theory and practical, attention needs to be given to different learning systems that will complement the vocational approach. The following systems will be discussed: experiential learning, competence-based learning and work-based learning.

Experiential learning is grounded in the life experience of the learner, where the learner is directly in touch with the realities being studied. Kolb (2015) defines experiential learning as *"a process whereby knowledge is created through the transformation of experiences"* (Kolb, 2015). Experiential learning can be characterised by key concepts:

Learning is best achieved as a process, not an outcome

The WWF states the following in their report on South African agricultural industry: *"Agriculture is the foundation of developing economies. As one of these economies, South Africa needs to ensure a healthy agricultural industry that contributes to the country's gross domestic product (GDP) food security, social welfare, job creation and ecotourism. But the health of the agricultural sector depends on the sustainable*

farming methods. Farming practices must, therefore, not only protect the long-term productivity of the land, but must also ensure profitable yields and the wellbeing of farmers and farm workers" (Goldblatt, 2013).

Vocational Orientated Agricultural Education pedagogy is the instrument through which the curriculum is delivered. Teaching methods are developed of teaching subject matter, ensuring practical experience takes place that will assist the students in obtaining knowledge, skills and attitude, competence, suitable for the agricultural industry. Assessment of competence is the task of HEIs, who need to ensure that assessment is in line with the commodity organisation's standard of competence. The competence plus experience obtained through the first two years on campus, and during the WIL period in the workplace or through service learning, add value to the graduate and increase the possibility of employment.

2.6. Competence

Competence consists of the following elements. It is a function of the knowledge, skills and attitudes exhibited by a person concerned. It is usually assessed on the basis of performance under particular conditions. It can exist at various levels. Various definitions of competence are available. Dooley *et al.* (2003) state that knowledge, skills and abilities are collectively referred to as competencies.

Movahedi and Nagel (2012) describe competency as *"the knowledge and skills that enable students to perform effectively in a certain role in the labour market"* (Movahedi & Nagel, 2012; p.38). Ley, define competencies as *"the personal characteristics of job-holders that they bring to bear in different situations.*

Competencies are hypothetical constructs that determine performance in a job. The set of competencies encompasses all knowledge, skills, abilities and other characteristics that are needed to successfully perform in the tasks" (Ley *et al.*, 2008, p.38). The New Zealand Qualifications Authority defines competency as the ability of individuals to apply knowledge, skills attitudes and values to standards of perfection required in specific contexts (Rainsbury, et al, 2002).

The skills or competencies needed by students in agriculture can be categorised into three different categories, namely basic competencies, production-specific competencies and 21st century competencies or skills (Allen & Van der Velden, 2001). The basic competencies are literacy, numeracy. Production-specific or operational competencies are the competencies needed for the production or task/s to be performed to ensure success in the operation. The 21st century skills are skills such as critical thinking, cooperation, communication and ICT skills or digital literacy, problem-solving skills, teamwork, collaboration, social/and or cultural skills, creativity and critical thinking (Voogt & Roblin, 2012; Romagosa *et al.*, 2015)

Allen & Velden (2001) clearly state that "*Education policy and practice should proceed from the insight that the skills of a human being form an interdependent package of all three skills"*. This is also what should be the basis for agricultural education; if not, the products of higher education will not be employable. A taxonomy of cognitive and behavioural skills developed by Birkett (1993) distinguishes between cognitive and behavioural skills. The cognitive skills includes technical, analytical and appreciative skills, while the behavioural skills include personal, interpersonal and organisational skills, as illustrated in Table 4 (Rainsbury *et al*., 2002).

Table 4: **Birkett's taxonomy of cognitive and behavioural skills**

Birkett's Taxonomy of Cognitive and Behavioural Skills	
Cognitive skills (Technical knowledge, skills and abilities)	
Technical skills	The application of technical knowledge with some expertise
Analytical/constructive skills	Problem identification and the development of solutions
Appreciative skills	Evaluating complicated situations and making creative and complex judgements
Behavioural skills	
Personal skills	How one responds and handles various situations
Interpersonal skills	Securing outcomes through relationships
Organisational skills	Securing outcomes through organisational networks

Source: Researcher's own design

Using competence as the focal point for vocational-orientated education leads to what is known as competence-based education. Grant et al.(1979) define competence-based education as follows: *"Competence-based education tends to be a form of*

education that derives a curriculum from an analysis of a prospective or actual role in modern society and that attempts to certify student progress on the basis of demonstrated performance in some or all aspects of that role. Theoretically, such demonstrations of competence are independent of time served in formal education settings."

Practical application of the different competence, soft skills, production skills, and technical skills, can be in different formats. The researcher's own original view of competence was that the soft skills are the foundation upon which the production and technical competence is developed; like an inverted T. This view changed after a workshop held at the University of Mpumalanga in July 2019 by Haas, from the FH/JOANNEUM University of Applied Sciences, Austria. The changed view is presented in the Figure 9.

A different view on competence was discussed in a workshop collaboration with Haas (2019). The traditional T-shape competence was turned around, allowing the 21st century competencies to form the foundation on which the production and technical competence is developed. When the foundation is laid, and the production and technical competence is developed the transferability of the competence to other commodities, fields or context is possible through production technology and organisation or the application of systems thinking and reflection.

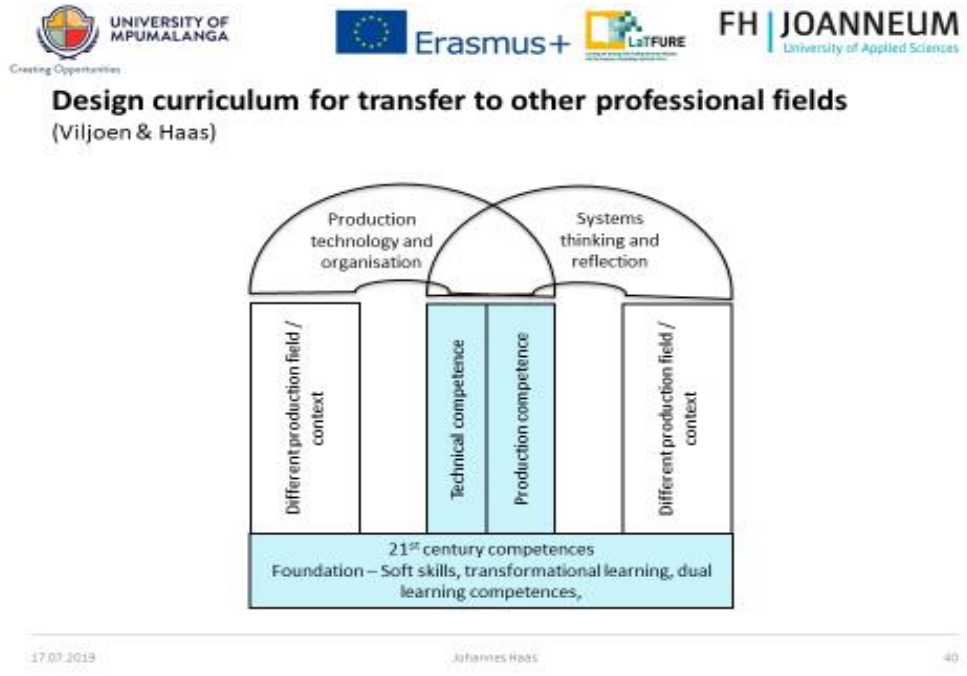

Figure 10: Transfer of skills between professional fields (Viljoen & Haas, 2019)

This model allows for flexibility and will increase the employability of graduates when they are able to apply the production and technical competence in a different field of work. The work environment and content will be different from the field in which the students are trained. The sound foundation of relevant competence linked to the knowledge of production technology and organisation and systems thinking and reflection will make it possible for the diploma graduate to move between the different commodities with ease and that will increase the graduate's employability. Agriculture in South Africa comprises 41 different subsections and it is not possible to train the diploma graduates in all of them; hence, the necessity of the portability between the different subsections (Yunlong & Smit, 1994; Corten, 2015;).

2.7. Transformation and sustainability

Agriculture worldwide is changing rapidly; the demand for food increases as the world population grows. In South Africa, there is a fast-growing population that needs food, but the greater need is that of employment and the hunger for land; land that needs to be redistributed. Land redistribution should not decrease the productive capability of land and the new recipients of land need to have the knowledge and skills to maintain the productivity.

This reality is the challenge for the South African agricultural education. How will agricultural education and training contribute to the solution? Colleges of agriculture and universities offering vocational-orientated agricultural qualifications should become cornerstone institutions in terms of their contribution.

2.7.1 Students

Worldwide agricultural education is faced with a similar problem in that the students are no longer young people who grew up on a farm with a subsequent certain amount of experience and background knowledge (National Academy of Agricultural Sciences [NAAS], 2005; NRC, 2009; Swanepoel, 2017).

2.7.2. Challenges

Agricultural education, especially the practical side of it, has been diluted and that have a negative effect on the quality of the agricultural education. Some colleges (ATIs) and universities have inadequate facilities, financial support and autonomy.
Lack of modern technology due to cost and procurement, hamstrung the training of students as they do not get to use the latest technology. Through partnerships with the agricultural industry this challenge can be addressed with simulations, workplace visit and attendance of demonstrations and farmers' days.

The focus of all students may not be on agriculture and some may only want to get a qualification and therefore use the diploma qualification as a steppingstone to gain access to another qualification or further studies. Furthermore, a percentage of academic staff are not adequately qualified and or may lack practical farming or agricultural experience. Lecturers need to get their feet on the farm/s to know what is happening and to keep up with demands of modern agriculture. Membership of study groups, learning networks and organised agriculture will benefit them and provide the practical competence.
In addition to the challenges above the provision of educational technology and the development of new teaching aids are a concern at some of the HEI's and could be addressed through learning networks. Agricultural education and pedagogy research, should be promoted to find innovative methods for the improvement of agricultural education and the development of competence. This concern was addressed through the TACATI programme in collaboration with NUFIC, at the agricultural colleges. The programme placed very strong emphasis on competency-based education and actions to transform from college to Agricultural Training Institutes(Chaminuka, et al.,2016). This transition from provincial to national competence has taken more than eight years and is to date still not finalised.

2.7.3 Transformational learning

Vocational-orientated agricultural education is facing numerous challenges such as the changes in the student population, rapid technological changes and climate change and a disjunction between the needs of the industry and products of higher education. This necessitates the transformation of VOAE at higher education level. One way of effecting the transformation is to consider different teaching and learning

methods and to change the pedagogy of agricultural education. Questions are asked how we prepare today's students for the challenges of tomorrow?

In the book *Transforming Agricultural Education for a Changing World*, it is stated that *"As a consequence of the many changes in agriculture and related industries, employers seek growing sets of skills and perspectives in the people they hire. Clearly, people with global perspectives and concern for the environment increasingly will be in demand, as will those with rigorous scientific preparation in various fields. But other skills are also essential, including problem-solving, critical thinking and financial management, and thriving in diverse environments. Thus, the agricultural-related sector seeks employees, managers and leaders who bring a wide variety of skills with an appreciation of what agriculture is today. Industry leaders and other employers look at colleges and universities to produce employment-ready graduates who meet the new and emerging standards"* (NRC, 2009). This is an indication of the product that the post school education system should produce and this study is to determine the needs of the South African Agricultural Industry and how the HEIs can/should contribute to address the needs of the industry.

Transformative learning is a departure point to address the transformation of agricultural education in South African. The rapid technological changes that is taking place all over the world but also in the agricultural industry require a new thinking about agricultural education and training and the skills students will need. The demand for competent employees is growing worldwide and therefore the emphasis on competency-based education and learning. Weinert (2001) quoted in the document "Skills for the 21st Century: Implications on Education" (Allen & Velden, 2001, p. 15), Allen states the following: *"Over the last decade, the cognitive sciences have convincingly demonstrated that context-specific skills and knowledge play a crucial role in solving difficult tasks. Generally key competencies cannot adequately compensate for a lack of content-specific competencies"*.

Wals (2015:34) states that in this new challenging world and with the new developments, graduates need new competence such as *"interdisciplinary problem-solving, addressing multiple stakeholder interest, participatory approaches in innovation, interactive methods in conflict resolution, responsive action regarding community needs, critical media literacy, social responsibility in entrepreneurship as*

well as the new notion of sustainable competences or sustained "abilities". Competence is not a once off occurrence it is something that need to be maintained over a long period of time, it must be sustainable.

2.7.4. Transformation and sustainability

South Africa experience a fast-growing population with an increasing demand for food and food security, but the greater demand is the need for agricultural transformation, reduction of unemployment specifically youth unemployment and the redistribution of land. All of it should be addressed in a sustainable way, land redistribution should not decrease the productive capability of land, agricultural development should not decrease employment and the new recipients of land and the farm workers need to have the knowledge and skills to maintain the productivity.

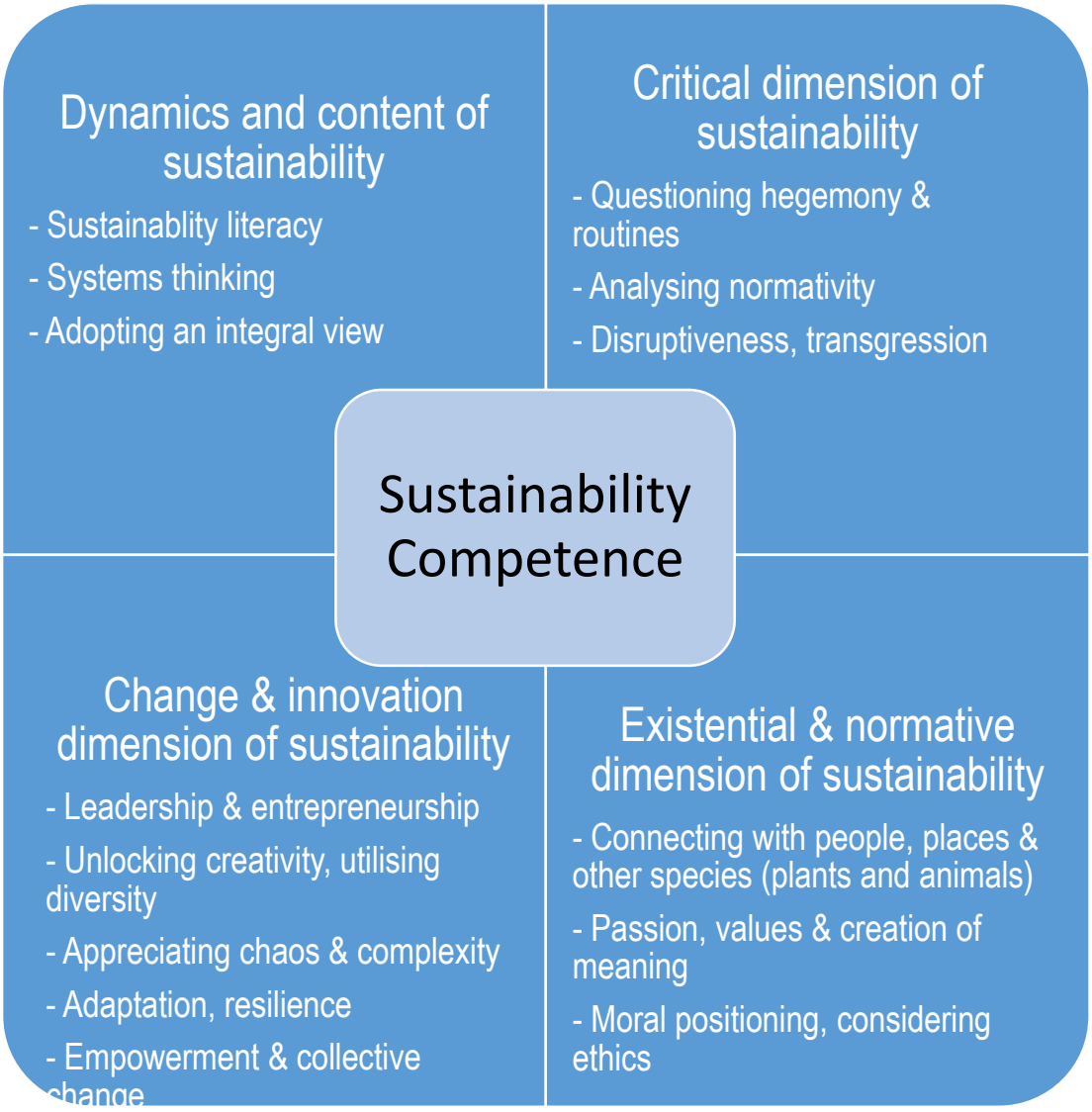

Figure 11: The dimensions of sustainability competence.(Researchers own design)

This reality is the challenge for the South African agricultural education. How will agricultural education and training contribute to the solution? Colleges of agriculture and universities offering vocational-orientated agricultural qualifications, should become cornerstone institutions in terms of their contribution to provide the sustainable competence summarised in Figure 10. Evaluating the agricultural education and training at the vocational-orientated level according to these dimensions will be necessary to determine the sustainability thereof.

HEIs need to align themselves to address the challenges of the 21st both in production and the by-products of production through what Wals (2015) identifies as 21st century education focusing on *"a learning ecology that suggest that formal, informal, community-based-learning, self-learning, apprenticeship learning, ICT-supported learning all takes place simultaneously in multiple contexts"* (Wals, 2015).
Further discussion on the idea of sustainable education, sustainability didactics and the proposed changes will be discussed and evaluated in later chapters.

2.8. Employability

Employability, it is argued, has consequent outcomes for university reputations, retention rates and course demand. For universities to prosper in a competitive education market, it is essential to ensure that their students are equipped with relevant discipline knowledge and skills as well as generic, transferable skills. The HEIs should have an intention to produce graduate students who are work ready and who have had 'hands on ' industry experience (Orrell, 2004).

An additional challenge for agricultural education, that affects employability negatively, is how to rekindle the interest of today's youth in agriculture as a career of choice. Most students studying at agricultural colleges and universities do not have an agricultural background, many of them might have grown up in the rural areas of the country, but do not have the knowledge and background of commercial agriculture. Many of the students and young people living in the city is hardly aware of the source of their daily food and have a total misconception of agriculture. Worldwide agricultural education is faced with a similar problem that the students are no longer young people

who grew up on a farm, with a certain amount of experience and background knowledge (NAAS, 2005; Swanepoel, 2017; Jjuuko *et al.*, 2019;).

Employment opportunities

The graduates can find employment in five different ways: 1) Self-employment as a farmer, 2) in a farming business in a middle management position, 3) employment in secondary agriculture, 4) as a gateway to further studies and career in education or other fields and 5) employment in a sector outside agriculture

2.9. Scarce skills in agriculture

The annual sector skills plan for agriculture, produced by AgriSETA, indicates the scarce and critical skills needed in the industry. For the purpose of this study, an abstract was made of the Scarce Skills list, indicated in Table 5 below, with only the skills involving NQF level 5-6 (AgriSETA, 2018). The exception is production manager/foreman, where the NQF level does not correspond with the job level and the training provider to be on NQF level 5-6.

Table 5: Scarce skills in agriculture at NQF level 5-6, extracted from AgriSETA sector skills plan (2018)

Scarce Skill	Sectors or Occupation	Intervention Training Providers	NQF Level	Number Required Per Year	
1. Managers involved in primary production				**2014-15**	**2015-16**
Farm manager	Agronomy	Agricultural college, learnership, mentorship	5	1 516	1 585
	Horticulture		5	293	307
	Mixed crop farming		5	283	296
	Livestock farming		5	1 982	2 072
	Mixed crop and livestock		5	1 981	2 071
Production manager/foreman	Agronomy	Agricultural college, FET college, learnership, skills programmes	4	652	682
	Ornamental horticulture		4	150	157
	Horticulture		4	1 023	1 070
	Mixed crop farming		4	705	737

Manager	Engineering/maintenance	HET, agricultural college, FET college, Learnerships	6	56	59
	Production/operational manager		6	16	17
2. Professional skills in primary and secondary agriculture					
Commodity trader	Buy and selling of commodities	HET programmes, agricultural college	6	58	61
Technical instructor/trainer	Skills transfer	Agricultural college, learnership	5	42	44
Marketing practitioner	Agricultural products	Agricultural college, learnership	5	84	88
Agricultural consultants	Agricultural advisor, extension officer (private), field officer, farm consultant	HET, agricultural colleges, PIVOTAL programmes on-line service	6	642	671
	(Target of 1 officer for 400 farmers)				
Food technologist	Primary and secondary industry	HET, agricultural college, FET	5	235	264
3. Technicians and trades workers					
Agricultural technician	Farming implements and equipment	Agricultural college, FET, PIVOTAL programmes, apprenticeship, skills programmes	5	160	168
	Food technician		5	445	466
	Diesel motor mechanic/ motor mechanic general, tradesmen		4	4 624	4 837
Agricultural inspectors	Livestock inspectors, mainly at abattoirs		5	338	354
	Health technicians		5	445	466
	Agricultural or horticultural products		5	358	375

Source: AgriSETA 2018.

For the period 2015-2016, 9 129 farm or production managers were required. The 2019-2020 PIVOTAL list indicate 7 117 posts for qualifications at NQF6 level, (AgriSETA, 2018).

This indication of the industry requirements provides an overview of what colleges and universities need to supply to fill these vacant positions. Colleges and universities need to ensure that their curriculum and skills training meet the requirements of the industry. The TVET colleges, agricultural colleges and universities are currently graduating students with qualifications rating from NQF4-6.

The need, according to AgriSETA, is 7 117 posts; TVETs and agricultural colleges supply about 1 412 graduates (DHET, 2018). Universities must, therefore, supply 5 702 graduates, which equates to 570 per institution; current numbers are as per Table 6. It is a clear indication that the demand is far greater than the supply. The question to ask, then, is why are there unemployed diploma graduates? If the HEIs are unable to produce a sufficiently high number of graduates, what are then the reasons for unemployment, since the demand exceeds the supply?

Table 6: Number of diploma graduates from TVET colleges

NQF Field	HEIs	Enrolment 2016			
TVET colleges		Total registered	Total Assessed/ examined	Total completed	Completion Rate
Agriculture and nature conservation	Primary agriculture (NCV4)	835	768	319	41,5%
	N6: Farming management	621	614	378	61,6

Source: DHET, 2017

The graduates and the HEIs should take note of these career possibilities and also understand which graduate attributes is of vital importance to prepare for employment. Employability will be further disused in later chapters.

A further important component that need to be kept in mind is what Jayne, et al. (2017) refer to as agricultural self-employment. Two groups normally exist: the entrepreneur who starts from scratch and builds up his business and the graduate who returns to the family farm and becomes part of the organisation.

Family farming (which includes all family-based agricultural activities) is defined by the Food and Agriculture Organisation (FAO) of the UN as *"a means of organising agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominately reliant on family labour, both women's and men's. The family and the farm are linked, co-evolve and combine economic, environmental, reproductive, social and cultural functions"* (FAO, 2013).It would be the ideal situation if most of the diploma graduates were part of the family farming community. In the real world, it is quite different; and therefore, too, the diversity of employment possibilities. Graduates and HEIs need to be aware of the possibilities.

2.10. Current situation in South Africa

If South Africa is serious about land reform and food security, land should be allocated to those who can make a success of farming and who had the appropriate training and skills. Every hectare of agricultural land should be farmed productively to ensure food security and the economic well-being of the farmers who are farming on the land. HEIs should assist in this through training of students, research and an outreach programme that will assist in the reskilling of the farmers and extension officials at the grass root levels.

2.10.1 Challenges

External factors that can have an effect on VOAE are global trends, export of commodities, rapid technology development, climate change that will necessitate new production methods and the sustainable development goals (Badat, 2010; Ochola & Heemskerk, 2013). Internal factors such as the skills needs or skills gap, land issues, redistribution and ownership, overall unemployment and the unemployment of graduates, the smallholder farmer issues, smallholder farmer versus mega farmer, climatic factors and drought and food security, create challenges that need to be addressed by VOAE&T (Swanepoel *et al.*, 2014).

The role of organised agriculture and the commodity groups in terms of agricultural education is one of the key issues that need to be addressed. Educational and technical support partnerships need to be established (Voorhees, 2001; Orrell, 2004). Vocational orientated agricultural education, especially the practical side of it, has been diluted and that has a negative effect on the quality of the agricultural education. Some colleges (ATIs) and universities have inadequate facilities, financial support and autonomy as well as a lack of modern technology. The transformation and correct placement of the agricultural colleges need to be finalised as a matter of urgency (Anon, 2013; Swanepoel, et al. 2017; SANews, 2018; Schultz, 2018).

2.10.2. Commodities and subsectors

The South African agricultural sector is divided into 41 subsectors, each according to their agricultural and economical focus (AgriSETA, 2018). Each of these subsectors is located in different agro-ecological zone. A summary of the different commodities their production area and relevant commodity organisations is given in Table 7.

Table 7: Different commodities produced in South Africa, production areas and commodity organisations involved

Plant Production		
Commodity	**Production Area**	**Commodity Organisation**
Citrus fruit Oranges, limes, lemons, grape fruit, kumquat fruit	Limpopo, Mpumalanga, Eastern Cape, Western Cape, Northern Cape, KwaZulu-Natal	Citrus Research International (CRI) Citrus Growers Association (CGA) Citrus Academy
Subtropical fruit Avocados, litchis, bananas mangos, pawpaw's, guavas, macadamia nuts	Mpumalanga, Limpopo, KwaZulu-Natal	SA Subtropical Growers' Association (Subtrop) SA Avocado Growers' Association (SAAGA) SA Litchi Growers' Association (SALGA) SA Mango Growers' Association (SAMGA) Macadamias South Africa (SAMAC)
Deciduous fruit Apples pears, peaches, prunes, berries, dried fruit, almonds, pecan nuts	Mpumalanga, Gauteng, Free State, KwaZulu-Natal, Western Cape, Eastern Cape, North West, Northern Cape	South African Deciduous Fruit Growers' Association (Hortgro) South African Table Grape Industry (SATI)

Viticulture The production of wine and spirits and of table grapes as well as the manufacturing of dried products of the vine	Western Cape, Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Northern Cape	Wines of South Africa (WOSA) VinPro – (wine producers) Raisins South Africa
Horticulture The science and art of growing fruit, vegetables, flowers or ornamental plants	All provinces of South Africa	South African Society for Horticultural Sciences (SASHS)
Agronomy Maize, wheat, soybeans, sunflower, barley, sorghum, canola, groundnuts and cotton	Summer and winter rainfall areas of South Africa, high rainfall production areas as well as the irrigation scheme	Grain SA Cotton SA Potatoes SA Cane Growers SA SA Sugarcane Research Institute (SASRI)
Forestry	Mpumalanga, KwaZulu-Natal, Eastern Cape, Limpopo, Western Cape	Forestry South Africa (FSA) South African Forestry Contractors Association (SAFCA)
Animal production		
Commodity	**Production Area**	**Commodity Organisation**
Small Stock Wool and mutton sheep Meat and fibre goats	Mpumalanga, North West, Free State, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape	National Wool Growers Association (NWGA) Red meat Producers Organisation (RPO)
Poultry Layers and broilers	All the provinces closer to urban areas and where feed is available	SA Poultry Association (SAPA)
Dairy Milk production, milk processing and distribution	Mpumalanga, Gauteng, North West, Free State, KwaZulu-Natal, Easter and Western Cape	Milk Producers Organisation (MPO) South African Dairy industry (MilkSA) SA Milk Processors Organisation (SAMPRO)
Beef cattle Beef cattle – different breeds and production systems	All nine the provinces	Red meat Producers Organisation (RPO) National Emerging Red Meat (NERPO) SA Feedlot association (SAFA)

Pigs Pig farming	All nine the provinces	South African Pork Producers' organisation (SAPPO) Pig Breeders Society of South Africa (Pigsa)
Equine Race horses, work horses, leisure horses	All nine provinces	Horse breeders' Societies
Animal Health (Diploma Animal Health)	All nine provinces	SA Veterinary Council (SAVC)
Aquaculture Marine species such as mussels, abalone, prawns Freshwater species such as trout, tilapia, catfish, ornamental fish	Inland and coastal provinces	Aquaculture Association of Southern Africa (AASA)

Source: Researcher's own design, data collected from web sites

Focusing on the commodity organisations, HEIs should ideally develop their programmes according to the niche areas in the agro-ecological zone where they are situated and formulate their programmes and ethos accordingly. It will create opportunities for the different commodity organisations to become actively involved in the development of programmes, establishment of competence frameworks for the specific areas. Such partnerships will lead to greater involvement and the lifting of standards. It will also allow for collaboration in teaching and learning, and research between the HEIs and the commodity organisations. Figure 11 below provides an overview of the contribution of different commodities to AgriSETA.

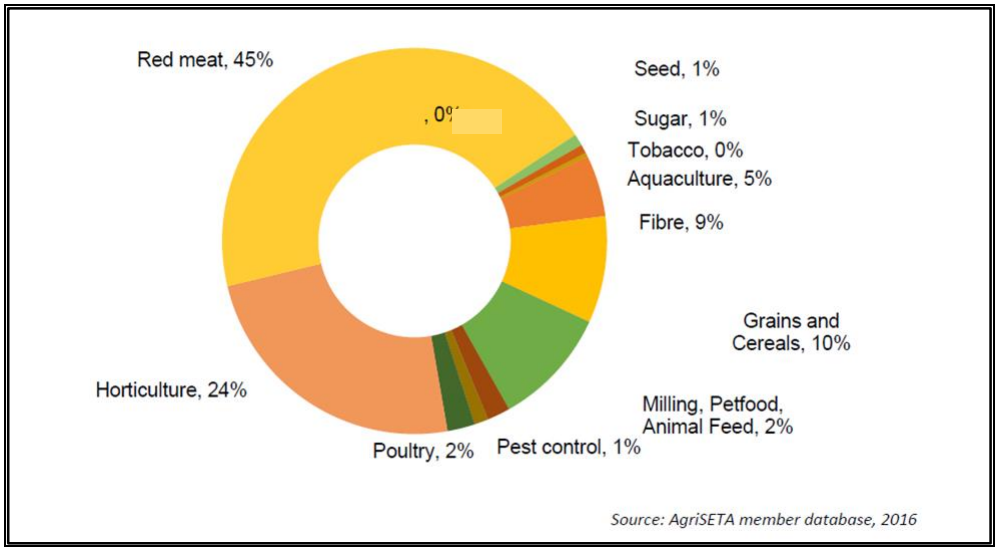

Figure 12: Representation of different commodities (Source: AgriSETA, 2019)

2.11 Research Paradigm

The paradigm is the departure point from where the researcher views the world and uses it as background knowledge to describe the reality. A paradigm is a set of *"basic beliefs (or metaphysics) that deals with ultimate's or first principles. It represents a worldview that defines, for its holder, the nature of the 'world', the individual's place in it, and the range of possible relationships to that world and its parts, as, for example, cosmologies and theologies do"* (Guba & Lincoln, 1994). Mertens (2012) states that paradigms can be described in terms of assumptions related to ethics, reality (ontology) and epistemology that allows different assumptions about the nature of systematic inquiry (Mertens, 2012).

In mixed methods research, three paradigmatic stances are important: dialectical pluralism, pragmatic paradigm and transformative paradigm (Nuijten, 2011; Mertens, 2012) . The dialectic stance allowed the use of more than one paradigmatic tradition or model to interact and adheres to the beliefs of the post-positivist paradigm in conducting quantitative-oriented data collection and the constructivist in qualitative-orientated data collection, and to allow interaction or communication between the two. The aim is to allow for a deeper understanding based on the coming together and disagreement found in the approaches (Mertens, 2012).

2.11.1 Reliability of research

Reliability deals with consistency, dependability and replicability of the results. The reliability of the research instrument is important to ensure consistency and accuracy in data collection (Dooley, 2007). Researchers need to agree on the data collection, and that the findings and results are constant and dependable and replicable (Zohrabi, 2013).

The reliability or dependability of the results can be ensured through an audit trail of the data collection where the process is recorded in detail, as well as a triangulation process via the use of different instruments and from different sources, and an explanation of the investigator's position and actions (Zohrabi, 2013).To increase the internal validity of mixed method research, triangulation is suggested. Miles and Huberman (1994) identified five kinds of triangulation (Cited in Meijer *et al.*, 2002), namely triangulation by source (data collected from different persons, or at different times, or at different places); triangulation by method (observation, interview, documents, etc.); triangulation by researcher (comparable to interrater reliability in quantitative methods); triangulation by theory (using different theories, e.g. to explain results); and triangulation by data type (combining quantitative and qualitative data).

External reliability is concerned with the replication of the study or findings and is dependent on factors such as the status of the researcher, the choice of the informants, the social situation and conditions, analytic constructs and premises. It is also concerned with the applicability in other settings or with other subjects, how generalisable is the research (Burns,1999; Onwuegbuzie & Johnson, 2006)

2.11.2. Validity in Mixed methods research.

The validity of a research study is a measure of the quality of the research. Validity deals with the resemblance of the research findings with the reality and also deals with the degree of observation and measurement of the researcher (Zohrabi, 2013). The researcher should try to remain as impartial and clear as possible throughout the research process. Lynch (1996) added the utility criteria that refers to the degree of usefulness of the research findings (Dooley, 2007; Zohrabi, 2013). Validity also needs to determine if a research study as a whole, inclusive of its different parts, conclusions and or applications, is of high, medium or low quality (Onwuegbuzie & Johnson, 2006).

In mixed methods research where both qualitative and quantitative methods are used it is important to consider the validity of both. Qualitative research starts with assumptions based on a worldview and is looked at through a theoretical lens. According to Denzil and Lincoln, as cited in Dooley (2007), “Qualitative research can be defined in general terms as multi-method in focus, involving and interpretive, naturalistic approach to subject matter … Qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them” (Dooley, 2007, p.32). In Qualitative research the primary aim or focus of the researcher is to record the practices of people (Onwuegbuzie & Johnson, 2006).

Supporters of the mixed method research methodology is propose a re-conceptualisation of traditional quantitative validity concepts and use more qualitative acceptable labels such as credibility versus validity, transferability versus external validity, dependability versus reliability and confirmability versus objectivity (Onwuegbuzie & Johnson, 2006). The term legitimacy is proposed for mixed research studies as well as inference quality.

The aim of Table 8 (below) is to link the quantitative and qualitative concepts of validity with the terminology used in mixed methods research. Methods of data collection and analysis – quantitative data is analysed through descriptive statistics and qualitative data by means of descriptive and thematic interpretations (Zohrabi, 2013). It includes Shadish’s (2001) classified research validity in quantitative research and Maxwell’s (1992) five types of validity in qualitative research.

Principal component analysis for mixed data is a mixture of qualitative and quantitative variables. Principal component analysis is a powerful method for mixed data to interpreted the variable status for different data sets. This process was done to reduce the number of variables that describe the problem, and to select the components that explain 80% of the variance of the data selected (Kalantan & Alqahtani, 2019).

Table 8: Quantitative and mixed method terminology

Quantitative research terminology	Description	Mixed method terminology
Validity	A measure of the quality of the research and deals with the resemblance of the research findings with the reality.	Legitimacy or inference quality
Statistical conclusion validity	Is the degree to which conclusions about the relationship among variables based on data are correct or reasonable? Conclusion validity is a measure of how reasonable a research or experimental conclusion is. [3]	Inference quality [4]
Internal validity	Internal validity refers to how well a piece of research was done.[5]	Credibility
Construct validity	Is the extent to which the measurements used, often questionnaires, actually test the hypothesis or theory they are measuring? [6]	Confirmability
External validity	The answer to the question: Can the research be applied to the real world? Can it be replicated?[7]	Transferability
Qualitative terminology	**Description**	**Mixed method terminology**
Descriptive validity	Factual accuracy of the accounts as documented by the researcher.	Transparent reporting
Interpretive validity	Interpretation of the account represents and understanding of the perspectives underlying the meaning attached by participants.	Subjective claim deals with the individuals subjective states feeling and thinking
Theoretical validity	The degree to which a theoretical explanation develop from the research findings.	Objective claim is the claim about the

[3] www.statisticshowto.com/statistical -conclusion-validity.
[4] Tshakkori A & Teddlie C 2008: Advances in Mixed Methods Research: Theories and Applications
[5] www.indiana.edu
[6] www.Link.springer.com
[7] www.statisticshowto.com

		features of the physical world
Evaluative validity	The extent to which an evaluation framework can be applied to the objects of the study.	Normative validity claim about a social world with consensual norms and values
Generalisability	Researcher can generalise the account of a situation.	Inference transferability

Source: Onwuegbuzie & Johnson, 2006; Long, 2017.

2.11.3 Data-collection process.

Purposeful sampling method was used to collect data. According to Merriam (1998) as quoted in Dooley (2007), “purposeful sampling is based upon the assumption that the investigator wants to discover, understand and gain insight; and therefore, must select a sample from which the most can be learned” (Dooley, 2007). Different purposeful sampling strategies are available to compare and contrast or analyse data. These strategies include the following; typical, unique, extreme, or deviant; maximum variation or heterogeneity; convenience; and snowball, chain, or network.

Patton (2002) as quoted in Palinkas (2015) describes the purpose of the different strategies as, “the purpose of a stratified purposeful sample is to capture major variations rather than to identify a common core, although the latter may also emerge in the analysis. Each of the strata would constitute a fairly homogeneous sample” (Palinkas, 2015).

2.12 Conclusion

This chapter provided an overview of related and academic framework related to the research question and objectives. It provides an overview of the different types of learning, competence and focused on VOAE and pedagogy. It set the scene for the research that follow and also highlighted the complexity of agriculture in South Africa.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction – study area

The reasoning behind this study is the question about employability of diploma graduates and the influence of quality of teaching and learning on the employability of the diploma graduates. Transformation of agricultural education and training is one of the main discussion points in the industry and at various levels at the HEIs (Swanepoel, 2017; Rudman & Meiring, 2018). The main problem investigated in this study is the perceived gap that might exists between the competence of the agricultural diploma graduates from the HEIs in South Africa, versus the competence required by the agricultural industry, and how the closure of the gap is addressed by the HEIs offering the vocational-orientated agricultural diploma. The research question was formulated as: *"What are the competencies required by the South African agricultural industry for agricultural diploma graduates? Is there a gap between the competencies of agricultural diploma graduates? And how do the diploma graduates measure up to the requirements?"*

The three main role players in this triangular study are as follows: The agricultural industry of South Africa with its various components. The 21 HEIs offering the diploma in agriculture as a vocational-orientated qualification. The diploma graduates who graduated with a diploma in agriculture from the various HEIs.

3.2. Approach and design of the study

The study aims to focus on the real entity, to have a holistic view of the study area to get an answer to the research question regarding the competence required by the Agricultural industry. The ontological questions asked in this study are: What does the agricultural Industry requires from an Agricultural Diploma graduate? What is the form and reality of VOAE at the HEIs of South Africa offering the Agricultural diploma as a qualification? How does it really function? How does it address the perceived competence gap? Similarly, the epistemological question asked is: what is the nature of the relationship between the different role players to be able to understand the relationship? This should be a very objective real-world view to understand the nature of VOAE.

From a transformative outlook or paradigm, the current situation was observed and data was collected from the agricultural industry, the HEIs and the diploma graduates via the mixed method methodology. Through the transformational paradigm, the study object/s were viewed not just from a political transformation stance but, more importantly, from a curriculum and a teaching and learning perspective, to ensure quality graduates who will meet the industry requirements. New innovative thinking is needed, linked to a will to transform and a continuous drive to ensure quality.

As a methodological question, the question is how can the truth be uncovered? What can be known about VOAE, what approach should be followed to uncover the truth (Guba & Lincoln, 1994)? The hermeneutic methodological approach was followed to investigate the study field in a holistic way (Dooley, 2007). The aim of using the hermeneutical approach to the interpretation of text is to expose the deeper meaning and to establish the significance of the work. The research goal was to interpret how the people involved in the different segments of VOAE understand the diploma as vocational-orientated qualification and how the qualification, teaching and learning and the practical experience should contribute to a graduate who will have the competence required by the industry and therefore be employable (Paterson & Higgs, 2005).

The phenomenon investigated in this research was whether the competence of agricultural diploma graduates meets the requirements of the agricultural industry and all the factors influencing the competence of the graduates. The study also focused on the transformation of VOAE.

Included in the research focus is the notion of education for sustainability (Winter *et al.*, 2015) and sustainable agricultural education. According to Wals and Bawden (2000), the current or prevailing paradigm for agricultural development has a narrow focus on production and productivity; and this is inadequate – the search for a new more sustainable approach is needed. Another question that needs to be answered is whether VOAE in its current format is sustainable and whether they apply education for sustainability to prepare the graduates to understand and be able to apply sustainability for future food security.

3.3. Critical theory

Critical theory is a foundational perspective from which analysis of social action, politics, science and other human endeavours can proceed. Research drawing from critical theory has critique (assessment of the current state and the requirements to reach a desired state) at it centre (Sage) – hence, its application to investigate critically the current VOAE. This theory is adequate if it meets the three criteria set out in Horkheimer's definition: it must simultaneously be explanatory, practical and normative (cited in Bohman, 2005). Applying the critical theory to the research on VOAE, it must explain what the current social reality is, identify the role players to change it, and provide clear norms for criticism and achievable practical goals for transformation of VOAE.

3.4. Justification for using the mixed method approach

The mixed method was used as a research methodology because of the advantage in that ;1) both qualitative and quantitative research highlight different perspectives. It provides an opportunity to examine the study field from different angles and provide better understanding and insight into the research (Onwuegbuzie & Johnson, 2006; Creswell, 2014). 2) It allowed the researcher a wider and deeper understanding of the topic through the mixing of quantitative and qualitative data and 3) it also allows the offsetting of the weaknesses of the different approaches in answering the research questions. Onwuegbuzie and Johnson (2006) state that the aim of the mixed methods research is not to replace qualitative and quantitative research, but rather to emphasise and use their strengths to minimise the weakness of the different approaches

This evaluative descriptive study use information from a wide variety of individuals and the data produced valuable information on various aspects of VOAE (Borg & Gall, 1980). The qualitative data was collected through semi structured-interviews and surveys from the key role players and analysed using the NVivo12 qualitative analysis programme, multiple forms of data were collected through the open-ended and closed questions in the questionnaires.

The interest of the study is primarily interpretive and critical to understand the current situation (Dooley, 2007); and to make suggestions based upon the research and good

practices. The data was analysed through statistical and test analysis using SPPS and Excel to determine mean values, standard deviation, effect size(Ellis & Steyn, 2003) and the ranking of the competence.

3.4.1. Qualitative or quantitative

Purposive sampling method was used, because it is a selective, non-probability sampling method used to identify participants from whom specific information is required (AgriSETA, 2018). The intended samples sizes were 50 responses form each of the three components. Agricultural Industry Because of the focus of the study, data had to be collected from the current role players. Form the agricultural Industry the intention was to get a large response therefore AgriSETA was approached to distribute the questionnaire. Because of the limited number of institutions, the aim was to personally collect data form all the different institutions, time and financial constraints however limited the personal contact with all the institutions and had to rely on the response to the questionnaire. The HEI were approached to send out the Graduate questionnaire to 10 or more of their graduates.

3.4.2 Establish face validity

After drafting the questionnaires, they were given to colleagues who are well conversant with the development of questionnaires. The questionnaires were also sent to the researcher's supervisor for comments and corrections. The agricultural industry questionnaire (AIQ) was given to a group of farmers at a farmers' meeting and their request was that it should be translated into Afrikaans. This was done and a bilingual questionnaire was sent out to the farmers (Annexure 5).

Reliability is one of the characteristics of a valid questionnaire and is the degree with which an instrument accurately measures something free of error (Bertrán, 1990). Reliability of the instrument is determined through **internal consistency**, i.e. the items that measure the same attribute are consistent among themselves (ibid.) and each question needs to be evaluated using the Cronbach's alpha with values between 0 and 1 (ibid.). Cronbach's alpha was used to test for internal consistency, Cronbach's alpha is a measure of internal consistency that is used to indicate the close relationship of different items in a group. It is a coefficient of reliability or consistency. The

Cronbach's alpha measures reliability or internal consistency and was used to see if multiple questions Likert scale surveys are reliable. [8] The questions were revised according to the validity testing as well as the outcomes of the pilot study.

Pilot test

It is advisable to test the questionnaire on a small sample. In this case, the AIQ was given to five colleagues with experience of VOAE to answer. There were no suggestions for improvement except that it was too long; some of the questions were then combined in an attempt to shorten the length without losing important information. The HEIs questionnaire was completed by colleagues at two HEIs as a pilot test and changes were made to the questions where they were deemed confusing; in addition, the open-ended questions were added to get the feedback from the institutions which the researcher could not visit (Annexure 6). Due to the similarity between the diploma graduate's questionnaire (DGQ) and the other questionnaires, no pilot testing was done among diploma graduates (Annexure 7).

A large number of respondents submitted incomplete responses; they only completed the questions regarding the research permission and left out the rest of the information. In the analysis of the data, all the completely blank data sets were taken out and not included into the analysis to present a clean data set.

3.5. Population of the study, sample size and sampling techniques

3.5.1. Population of the study

A research population is a large collection of individuals or objects that is the main focus of a scientific query. In this study, three different populations were used for the data collection, the agricultural industry, the HEIs and agricultural diploma graduates.

The ideal was to involve as many participants as possible. Due to the geographic distribution and the diversity of farming activities, there were no specific group on which to focus. A 'shotgun approach' was followed by distributing the questionnaires a widely as possible and using the date from the returned questionnaires. The questionnaires were sent out in the hope of getting a sufficient number back. AgriSETA

[8] https//www.statisticsshowto.com/cronbachs-alpha-spss

was approached to send out the questionnaire to the farmers registered on their database. The questionnaire was also sent to five randomly selected individuals, involved in the agricultural industry with a request to send it to 10 farmers.

Twenty-six Higher Education Institutions in South Africa offer an agricultural diploma. All of them were approached and the only way of getting a possible result was by direct contact with the head of the institution or the head of the school. The intention was to get three to five responses from each institution.

The population for the diploma graduates comprises all the diploma students who graduated from the HEIs offering the diploma in agriculture. This is a very large group of graduates; and again, due to the lack of cooperation, a general request was send out using available emails and contacts at the different HEIs.

3.5.2. Sample and sampling of the research participants

The data and information for this study were collected by means of structured interviews with relevant stakeholders at agricultural colleges and universities and online surveys sent to the agricultural industry, HEIs and diploma graduates. Various collection methods and participants were used to achieve triangulation by method and source (Meijer, Verloop & Beijaard, 2002).

To collect the data, questionnaires were used for the Agricultural Industry and the Diploma Graduates. A combination of semi-structured interviews and questionnaires were used to collect data from HEI's. Qualitative data was collected through semi-structured interviews and open-ended questions in the questionnaires. The quantitative data was collected via questionnaires where participants had to indicate on a Likert scale the important of certain competences. To ensure the validity of a questionnaire, there are steps to follow to validate the questionnaire, as summarised below

3.5.2.1. Agricultural industry

Kirsten and Sihloba (2019) are of the opinion that there are about 60 000 commercial farmers and, forming an estimate based upon the results of the 2011 census, that there are 280 000 smallholder farmers. In an attempt to reach as many farmers as

possible, the Agricultural Industry Questionnaire (AIQ) was forwarded electronically, using Survey Monkey as platform, to AgriSETA for distribution to all the farmers (+-1 900) on their database. The distribution took place at the end of November 2019 and the response was very poor.

The AQI was also sent to five randomly selected individuals working in the industry, located in various regions of South Africa, who were requested to assist with the collection of the data by sending the request letter and hyperlink to farmers and people in the agricultural industry. This was an attempt to get representativeness from the different agricultural industries. To increase the number of respondents two popular weekly agricultural publications (*Farmers Weekly* and *Landbouweekblad*) were used to collect e-mail addresses of farmers and other role players involved in the agricultural industry, who were reported on in different articles, and the questionnaire was send out to them.

An article was placed in a weekly agricultural magazine, *Landbouweekblad,* on 31 January 2020, in which the nature of the research was explained and readers were requested to assist by completing the questionnaire; the weblink for all three the questionnaires were provided. From the weblink for the AIQ, 38 responses were received from the letters send out through AgriSETA and the five collectors. In response, to the feedback received from them a reminder was send out on 30 December 2019 via email to all respondents who had not responded yet. One person requested to be excluded, as he was not interested. One person responded to the article in the agricultural magazine. The larger majority of respondents only opened the questionnaire, and completed the first research question before submitting the questionnaire. List of respondents is attached as Annexure 9. The sample group comprised of male and female participants, representing different components of the agricultural industry and at different levels of management.

3.5.2.2. Higher education institutions (HEI)

There are 21 HEIs in South Africa that offer a diploma in agriculture or horticulture. Data collection was done through personal interviews with senior staff members at seven HEIs, five agricultural colleges and two comprehensive universities and one university of technology. The sample group comprised both male and female subjects,

representing different components of the agricultural industry and at different levels of management in the diploma programme. The interviews were a semi-structured interview to measure the response on the same questions and similar question were included in the questionnaire to get responses from staff not interviewed. Structured interviews were conducted with 24 staff members at five agricultural colleges and two comprehensive universities, the group that were interviewed consisted of a mixture of lecturers, senior lecturers and management. Personal interviews conducted with the lecturers were transcribed and analysed using the NVivo12 programme. The list of the interviewees is attached as Annexure 10.

A questionnaire with similar questions as the one for the agricultural industry was sent out to the 21 institutions and 18 responses were received. Responses from universities and universities of technology were very limited. The questionnaire was sent out a second time, with open-ended questions similar to the ones discussed in the interviews. Nineteen responses were received, of which five were complete. The revised HEIs questionnaire combining open-ended and closed-ended questions. Nineteen responses from the second batch, were received from the HEIs, of which five (26,3%) were complete and 14 (73,7%) skipped all the questions. The respondents who completed the questionnaire were one from an agricultural college and two from universities of technology. The data collected on the questionnaires was captured on MS Excel and SPSS for data analysis. The response on the open ended questions was analysed with NVivo12.

Difficulties were experienced in collecting the data and to date data was collected at three universities and five agricultural colleges. Electronic surveys were sent to all the remaining colleges and the lecturing staff of the researcher's resident university.

3.5.2.3. Diploma graduates

All HEIs that offer an agricultural diploma were requested to send the questionnaire to at least 30 of their graduates. This was a very idealistic thought and, in an environment based on collaboration, it was considered a fair request. Unfortunately, there were only a few who assisted, hence the poor response rate. Where email addresses were available, the questionnaire was sent directly to the graduates. Another 135 questionnaires were also sent out to graduates by email. Some 53 responses were

received and four emails were returned. Of the 53 responses, 22 (41,5%) were completed and 31 (58%) were incomplete.

The initial aim was to get five to 10 responses from each HEI, which would calculate to between 105 and 210 responses. This did not materialise – only 58 responses were received, representing the following: 14,29% from agricultural colleges, 9,52% from universities of technology, 66,67% from comprehensive universities and 9,5% did not specify the HEIs where they graduated. A different method of data collection should be considered for further research. It will also be beneficial if HEIs can have a tracker system for their agricultural diploma graduates. With qualitative research, the sample size is small and the design is emergent and flexible (Dooley, 2007). List of respondents is attached as Annexure 11.

3.5. Survey design

The survey was designed based on the tasks a person should be able to perform in the registered occupational qualifications of the QCTO (QCTO, n.d.). These tasks were used as a guideline for the competence captured in the questionnaires. The focus was also on occupations in levels, applicable to the diploma qualification, level 6-8, as applicable to the Organising Framework for Occupations groups 1, 2, 3, 6 and 7 (DHET, 2013). The competence described in their areas of specialisation of the different occupation groups were used and grouped together in eight main areas.

These areas are: 1) planning and management competence,2) crop production vocational or production skills, 3) animal production vocational or production skills ,4) administrative skills, 5) technical and mechanical competence, 6) irrigation management, 7) processing and value-adding skills and 8) professional, personal and ethical skills. Examples of the questionnaires are included as annexures 6,7 and 8.

The questionnaires were checked by colleagues at the UMP and the researcher's supervisors for face-value validity (Collingridge, 2014), and minor corrections were made. The AIQ was translated into Afrikaans for better understanding by the farming community. The answer to these questions will assist with the transformation of agricultural education and teaching at diploma level, and will hopefully assist to increase the competence level of the graduates and raise their employability.

Question 1 cover the permission and consent to participate in the study. In Questions 2 to 5 the participants were asked questions regarding the qualifications they would look for when employing graduates and their reasons for the preference.

3.6.1 Research question 1. What are the competencies required by the South African agricultural industry and how are they rated in terms of importance?

Questions 6 to 14 of the AIQ addressed the competence required by the agricultural industry. The questions were based upon the job profiles of agricultural workers compiled by the QCTO and participants the participants had to indicate their view on the 73 competencies or combinations of competencies listed in the questionnaire on a Likert scale (1-5), where 1 = 'Not important', 2 = 'Recommended', 3 = 'Advisable or preferred', 4 = 'Important' and 5 = 'Very important'. Provision was made for additional responses to add competence not covered from the list.

The objective of this subquestions is to,1) to identify the competencies required by the agricultural industry.2) to rank it according to importance based on the expectations of employers, 3) to determine if there is a difference between the competence requirements of the various components/role players in the agricultural industry, and 4) to rank the different competencies using factor analysis and factor loading.

The Quantitative data was analysed using SPSS programme and an Excel spreadsheet, to calculate and determine the weighted average of the different competence. Qualitative responses were obtained from the open-ended questionnaire's, and responses from Questions 15 to 22 recorded the bibliographic information of the respondents.

The South African agricultural industry is complex and there is not a fit one fit all solution. The agricultural industry comprises 41 subsectors (AgriSETA, 2018), therefore the approach was to focus holistically on the industry, as it is not possible to focus on all the different component individually. The duality of South African agriculture, was acknowledged and a distinction was made between the different type of farmers consisting of subsistent farmers, emerging commercial farmers, small,

medium and large commercial farmers, and mega farmers, to ensure the overall validity of the information (Hornby & Cousins, 2016; Kirsten & Sihlobo, 2019). Information regarding the agricultural industry was also collected from agribusiness and the national and provincial departments of agriculture (AgriSETA, 2016).

3.6.2 Research question 2: What is the perception of the academic staff of HEI regarding the competence needed by their graduate students, and how are these competences assessed at HEI level.

The Higher Education questionnaire was designed to address research question 2 and contained questions similar to questions 6 -14 of the AIQ. Open-ended questionnaire questions were added to obtain input and was included in the qualitative data. The responses were given on a Likert scale similar to the one used for the AIQ. Semi- structured interviews were used to obtain further information from HEI, after the semi-structured interviews the HEIs staff were asked to respond on the assessment of competence and to complete the questionnaire. The views of the students were also collected regarding the assessment. The answer to the question is provided through the perceptions of the industry and the experience of the graduates. It is also important to take note of the views of the HEIs.

The study is about the competence needed by the agricultural industry and it is therefore critical to understand how competence is assessed at the HEIs. Are there systems in place to ensure that the students are competent and which competencies are being assessed? The question is also what informs those specific competence? The questions regarding the assessment of competence were included during the interviews with the lecturers and in the open-ended question on the HEIs questionnaire. The views of the HEIs offering a diploma in agriculture or horticulture were investigated. The HEIs were approached regarding their view on graduate competencies required by the agricultural industry, how the competence is address by the curriculum, practical work sessions and WIL. Data was collected from two comprehensive universities, two universities of technology and five agricultural colleges. Personal interviews were conducted with 24 staff members and the qualitative data was analysed using the NVIVO12 programme.

3.6.3 What measures are put in place by HEI's or industry to address or bridge the skills/competency gap?

To understand the graduate skills, it was necessary to create and determine a profile of the national diploma in agriculture graduates, with regard to their background, their current competence and the reasons why they studied a diploma in agriculture. The graduates were requested to respond on a questionnaire to provide their views on the competence required and their career expectations. Lecturing staff also contributed regarding the background of students. Once again, the cooperation from HEIs was a limiting factor. Responses from graduates of all HEIs were requested and yet a limited response was received.

3.6.4 What is the opinion of the Agricultural Diploma graduate regarding the influence of their competence on their employability and what is their inputs to close the competence gap?

Lack of competence and skill have a negative effect gap on the employability of graduates. It also contributes to a perception of the qualification offered and the institutions offering the qualification. The responses of graduates to the open-ended Questions 2 and 9 of the graduate questionnaire collected, data regarding their employment and the provision of competence. Questions 11 to 19 were used to collect data regarding the graduate's perception of competence needed. A comparison between the graduate and industry response indicate the competence required. Compare the results of the questionnaires completed by all three the role players and identify the difference between what the agricultural industry requires and the information collected for the other two components. The weighted averages of each competence were compared and plotted on a line graph to illustrate the difference. All three the components of the study were asked for recommendations on the improvement of the current system and will be answered in the conclusion of the study. Suggestions obtained from the various role players will be discussed in their respective chapters .

3.6.5 What is the position regarding vocational agricultural training at higher education institutions in the SADC region?

In Chapter 8, a desktop study regarding agricultural education and training in the SADC countries was done to place the South Africa vocational-oriented agricultural education and training (VOAE&T) in perspective in regard to what is being done in the neighbouring SADC countries, providing an overview of the VOAET landscape in Southern Africa. It is also important to take note of the different programmes, the good practices identified and the challenges and pitfalls.

3.7. Data analysis

The following analysis was done on the raw data received from the various sources. Factor analysis using statistical software, SPSS Version 25, to reduce the number of variables, external validity – is the validity of applying the conclusion of a scientific study outside the context of that study. It is the extent to which the results of a study can be generalised to and across other situations. SPSS Version 25 was also used to analyse the data by using frequency counts, percentages, mean and standard deviation values, difference in means to test statistical significance (Rainsbury *et al.*, 2002), and to test the validity of the data collected. The data from all three components was also analyse for effect size using Cohen's D to indicate the practical significance (Ellis & Steyn, 2003) and a Kruwalski-Wallis H test was done to verify the ranking.

Borich's (1980) Mean Weighted Discrepancy Score was used to prioritise employability skills. The available data of all three components were screened and calcified according to weighted average calculated, each of the competencies were categorised according to their importance based on the mean rating scale contained in Table 9 below. Lack of competency in graduates can be attributed to poor education background, too theoretical training, uncoordinated and irregular in service training (Melak, 2012). Competency acquired at colleges/HEIs is subject to change depending on the workplace and continued requirements. This view corresponds with the feedback from the agricultural industry and the HEIs. Competence with a rating value lower than 2,5 were not considered in all cases.

Table 9: Mean rating value table (Melak, 2012)

Mean rating value	Description	Importance
0,00 – 1,49	Not competent or not important	Very low
1,50 – 2,49	Less than average	Low
2,50 – 3,49	Average competence or importance	Medium
3,50 – 4,49	Above average competence or importance	High
4,50 – 5,00	Very competent or important	Very high

3.7.2 Triangulation

The qualitative, open-ended responses of the three questionnaires were imported from Survey Monkey into NVivo12 Qualitative analysis programme, to triangulate the data and determine the validity thereof. One method to do the triangulation is to use the Pearson's correlation coefficient to determine the strength of linear association between two variables. The Pearson's correlation (r) is also a measurement of effect size. The limits and values of the Pearson's correlation coefficient is explained in Table 10 below.

Table 10: Pearson's correlation coefficient limits and values

Limits		+1	O	-1
High Degree		If the value lies between 0,5 and 1 said to be a strong correlation		
Moderate degree		If the value lies between 0,3 and 0,49 medium correlation		
Low degree		Value lies below 0,29 to be a small correlation		
Pure number		Value does not change in different measurements		
Symmetric		Correlation of the coefficient between two variables is symmetric. This means between x and y or y and x the coefficient value will remain the same		
Perfect		If the value is near +1 then it is said to be a perfect correlation – positive or negative relation		
No Correlation		When it value is zero there is no correlation		

Source: Statistics, 2013

3.8. Ethics clearance

To protect the dignity and safety of individuals and institutions, ethical considerations was an important consideration when conducting this research.

An application for ethical clearance to conduct the research was submitted to the ethics committee of Unisia and the University of Mpumalanga, and was approved. Unisa ethics approval ref, 2017/CAES/018 issued on 16 February 2018 and renewed, University of Mpumalanga ref no UMP/Viljoen/1/2019. The formal ethical procedure was followed and permission was obtained from the participants prior to their participation. Permission to conduct the interviews were obtained from the relevant authorities. Participants were informed that they had the right to withdraw from the study. The identity of the individuals and the institutions is protected to prevent discrimination and reputational risks.

3.9. Summary and conclusion

This research uses the three paradigmatic stances of mixed methods research – dialectical pluralism, pragmatic paradigms and transformational paradigms – as the research paradigm to conduct the study. Data was collected through structured and semi-structured interviews and a set of questionnaires.

This chapter outlined how the research was conducted, illustrating the process and methods used for data collection. The instruments or software tools that were used in the research were Microsoft Excel, SPSS, NVIVO 12 and the electronic survey platform Survey Monkey.

CHAPTER 4: RESULTS AND DISCUSSION OF THE COMPETENCE REQUIREMENTS OF THE AGRICULTURAL INDUSTRY

4.1. Background

"South Africa's agricultural sector is characterised by dualism: a modern commercial farming sector, using hired farm workers, alongside small-scale farmers, mostly in the former homeland areas. In addition, land reform is creating thousands of new farming opportunities for emerging black farmers throughout the country and across the scale from large commercial to smallholder production" (AgriSETA, 2018). It is this dualism in the South African agriculture that make VOAE challenging. The question asked by HEIs are "What should be the focus?" The two components, commercial and subsistent or smallholder, have different skills requirements (AgriSETA, 2016). The commercial farmers require skilled workers and managerial positions with the required competence to function in the modern high-level technical environment of agriculture (AgriSETA, 2018). The smallholder farmer requires basic skills, mentorship, and personal development to become a successful farmer. Both sectors will benefit from vocational-orientated qualifications and the transformation of the VOAE in South Africa. It is worth noting that the commercial farming component is the sector which employs most of the agricultural diploma graduates.

4.2. Results of the study regarding competence requirements of the agricultural industry

4.2.1 Data collection using a questionnaire

The data from the Agricultural industry was obtained by sending out the Agricultural Industry questionnaire as per the detail captured in table 11 below

The results/feedback of questionnaires distributed through collection agents and the AgriSETA are as presented in Table 11. The questionnaires were distributed from February 2019 and the closing date for submission was 30 January 2020. Several reminders were sent to respondents with the aim of increasing the response rate; however, out of 173 questionnaires sent out, 60 responses (34,68%) were received

back, of which 34 (19,96%) were complete and was used for the analysis. Information regarding the agricultural industry respondents are presented in Table 12

Table 11: Agricultural industry questionnaire distribution and responses

Agricultural Industry Questionnaire Distribution and Responses				
Activities	Sent	Responses	Bounced	Total
2018: Sent out the questionnaire at a farmers' meeting in Mpumalanga with a request to complete. Intended as pilot sample. Feedback – request to translate the questionnaire.	20	0		
2019: Sent link to five collectors with the request to send it to 10 farmers (Web link 1)	50	38	0	
2019: Sent the questionnaire via email to farmers and role players involved in agriculture (Email 3)	1	1	0	
2019: Sent the questionnaire via email to farmers and role players involved in agriculture (Email 4)	21	6	1	
2019: Collected the email addresses of farmers who received coverage in agricultural magazines (E-mail 5)	83	7	4	
2019: Sent the questionnaire via email to farmers and role players involved in agriculture (Email 6)	8	2	0	
Sent reminders to non-respondents (twice)				
Article published in *Landbouweekblad* 31 January 2020		1		
Total:	173	60	5	
Response rate	34.68%			
Fully completed questionnaires	34	20%		

Reasons for the low response rate could be that 1) The time of the year when the AIQ was sent out was not the right time to obtain results as it coincided with the planting/harvest season and the holiday period. 2) The aim was to reach a wide spectrum of commercial farmers through the use of an electronic platform; unfortunately, email systems are sometimes set up to designate documents containing the words "Survey Monkey" to the spam or junk mail folder. 3) The version of the platform used by the researcher could not change the name or "white mail" it. This is something researchers should consider to get a better response rate.

Table 12: Information regarding agricultural industry questionnaire respondents.

Description	**Study Participants**	**Percentage**
Male	30	88,24%
Female	4	11,76%
Age < 35	11	31,43%
35-55	8	22,86%
Over 55	16	45,07%
Average age	50,9 years	
Average years of farming experience	24,14 years	
Qualifications – Grade 12	4	10,5%
Diploma	5	13,2%
Description	**Study Participants**	**Percentage**
B Degree	9	23,7%
Honours degree	9	23,7%
Master's degree	6	15,8%
PhD	5	13,1%
Farming operations of respondents (n=30)		
Subsistence farmer	2	6,67%
Small holder farmer	1	3,33%
Emerging commercial farmer	0	
Small-scale commercial farmer	6	20,0%
Large commercial farmer	18	60,0%
Mega farmer	3	10,0%
Position of the respondents in the farming operation (n = 30)		
Owner	14	46,7%
Managing director	7	23,3%
Manager	6	20,0%
Section manager	3	10%

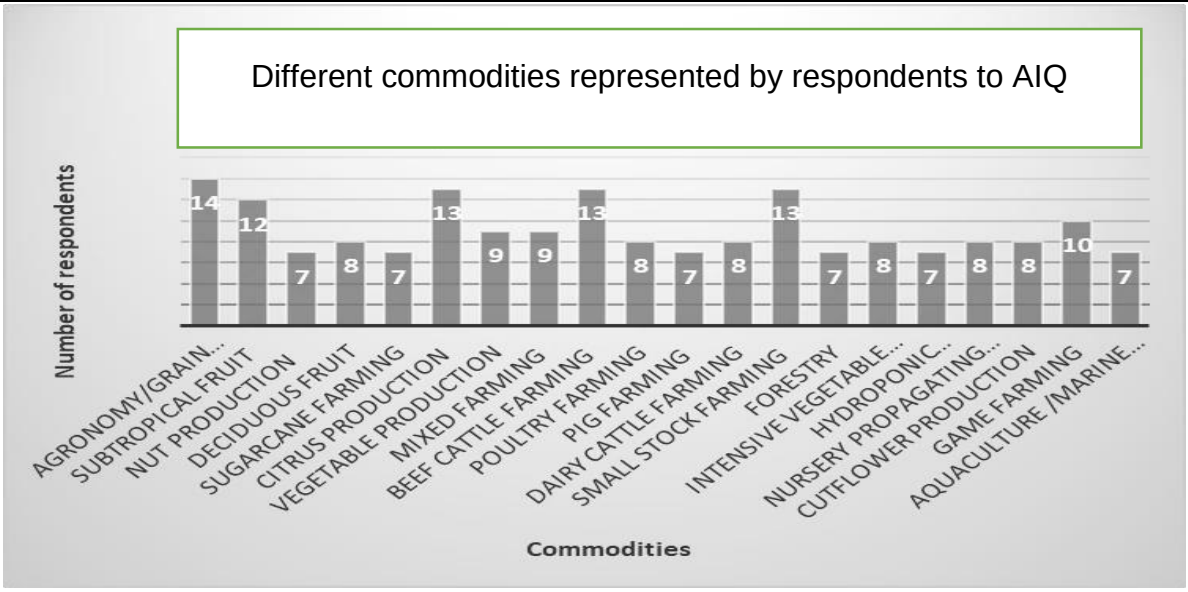

Figure 13: *Graph indicating the different commodities involved in the study*

Figure 13 above indicates the different commodities in which the respondents are involved and provide an overview of the diversity of the respondents. The data collected represent 20% or 50% of the different commodities (41) of the South African agricultural sector (AgriSETA, 2018).

4.2.2. Validity

Instrumental reliability of all data was checked using the Cronbach's alpha coefficient, the most widely used statistical test to measure internal constancy (Melak, 2012). Cronbach's alpha is a coefficient of reliability used to measure internal consistency, the reliability coefficient should be between 0,839 and 0,922 with a cut-off point of 0,64. It is a way to gauge how well a test or survey is actually measuring what you want it to measure. The different questionnaire data were tested for reliability using Cronbach's alpha and the results are indicated in Table 13 below.

Table 13: **Validity assessment of the agricultural industry questionnaire**

Question	Cronbach's alpha	Reliability
6	0,507671	Poor
7	0,827764	Very good
8	0,833952	Very good
9	0,699944	Acceptable
10	0,839969	Very good
11	0,924331	Excellent

12	0,903274	Excellent
13	0,900248	Excellent

The results of Question 6 need to be treated with caution due to poor reliability.

4.2.3. Competence required by the agricultural industry

Quantitative assessment of the competence required by the agricultural industry was obtained from the responses given to the questionnaire. The participants had to indicate their view on the 73 competencies or combinations of competencies listed in the questionnaire on a Likert scale (1-5), where 1 = 'Not important', 2 = 'Recommended', 3 = 'Advisable or preferred', 4 = 'Important' and 5 = 'Very important'. The weighted average of the different competence was determined on the Excel spreadsheet.

4.2.3.1 Responses from the agricultural industry as expressed in their response to the agricultural industry questionnaire

The agricultural industry was asked that if they were to employ an agricultural diploma graduate/s, in which position would they employ them (Question 2). In their response, 20% indicated that they would employ the graduate as a team leader; 30% indicated they would employ them as a junior foreman, 40% indicated that they would be employed as junior manager and 10% indicated they would employ then as a manager. The correct balance between theory and practical need to be achieved and the HEIs should ensure that their graduates have the necessary competence for employment in the industry. The agricultural industry believes firmly that the graduate should start at the lower levels and gain experience through the work they do and further in-service training. The industry also indicates that (77%) of the role players prefer to employ graduates (Question 2.3) with a diploma from an agricultural college or an ATI and 22% prefer graduates from a university of technology. None indicated interest in students from comprehensive universities. Their reasoning for this preference is that college graduates have more practical experience and that the university curriculum is more focused on theory than practical, while Agric Colleges strive for a 50 /50 or 40/60 balance between theory and practical. Experience is a critical factor for employment and employability.

4.2.2.2. Experience is a critical factor for employment and employability.

About 60% of the respondents are of the opinion that there is a difference between a diploma obtained from an agricultural college (Question 2.4) and a diploma obtained from a university of technology or a comprehensive university. The rest (40%) believes it to be the same. The difference is the level of practical experience and the application of the theory. One agricultural industry respondent (AIR) stated (translated from Afrikaans): *"The quality of the education and the diploma as such, depends more on the quality of the teaching and practical experience obtained than the type of institution where it was obtained."* (AIR54)

The results of the other closed-ended questions, 6 to 14, are indicated in the tables 14 – 16 below as competence the Agricultural Industry deem necessary what a diploma graduate should be able to do.

Table 14: Response of AIQ, providing the weighted average of different competence

Q6: Planning and Management Competence	Average	Standard Deviation
Manage his/her time optimally	4.63	0.54
Observe time limits and deadlines	4.51	0.65
Plan and direct or oversee farming operations	4.26	0.94
Draft and implement project plans	4.03	0.91

Source: Data from study

The importance of time management and planning out of the Agric Industry perspective is highlighted by the results and link to the overall view of practical experience and competence.

Table 15: Crop and animal production competence

Q7: Crop Production Vocational or Production Skills or Competence	Mean	Standard deviation
Monitor and control efficiency of production	4.68	0.55
Maintain and care for agricultural crops	4.66	0.55
Scout for pest and diseases	4.61	0.88
Handle mix and store agrochemicals correctly	4.54	0.90
Correctly plant and cultivate plants	4.52	0.48

Practise different soil cultivation methods to prepare a proper seedbed for planting	4.45	0.63
Identify, monitor and control weeds chemically and mechanical	4.45	0.87
Control pest and diseases chemically and biological	4.21	1.03
Perform plant production related farming operations.	4,55	0,63
Plan and construct an orchard or a vineyard	3.92	1.13
Propagate and cultivate trees or plants	3.85	1.13
Prune trees and scrubs	3,96	1.22

Q8: Animal Production Skills or Competence	**Mean**	**Standard Deviation**
Perform animal production related farming operations.	4,62	0,57
Classify animal products	4,48	0,87
Provide health care for animals,	4,46	0,90
Perform routine production tasks	4,46	0,81
Harvest animal products	4,40	0,82
Be a stockman	4,38	0,70
Cleaning and disinfecting production facilities	4,31	0,93
Do selection of animals.	4,20	0,76
Perform basic veterinary practices	3,84	1,14
Operate and clean a milking machine	3,71	1,40
Perform artificial insemination.	3,65	1,09
Other: (specified by respondents) Collaborate with specialist regarding feeding, breeding and chemistry		

The respondents added the following competence: 1) Stockmanship; “To be a stockman is the ideal, but not possible for everybody, mostly it is transferred through generations, nonetheless environmental factors and love for animals play a critical role in the development.” (AIR5).2) Pasture management; “Pasture management, knowledge about grasses and pastures, environment and climate change are critical.” (This was omitted in the questionnaire). “A farmer must understand the natural resources and know how to use it effectively, to farm with nature.” (AIR9). 3) Comments on other competence the AIR regarded as important; “Teach the students the basic competence [that] is the most important, [instead of focusing on].” (AIR40), “Different animal enterprises (dairy etc.) follow the industry lead and rather specialise.” (AIR15), “Keep in mind that many of the animal production task are performed by specialist in the field, such as specialists for feeding, breeding and agro-chemicals,

contracted by the farmer/s." (AIR42), "Life skills will be picked up along the way." (AIR40)

Table 16 : Outcomes of Question 9 to Question 14 of the AIQ

Q9: Administrative skills	**Mean**	**Standard Deviation**
Keep accurate production records,	4,73	0,45
Do stock control,	4,53	0,57
ICT skills , operate a computer and software programmes.	4,31	0,90
Keep accurate financial records.	4,13	1,01
Perform administrative work,	4,06	1,05
Provide technical support,	3,91	1,09
Other: (Specified by respondents)		
Oral and written communication is important. His/her task will be to support the admin staff (bookkeepers) and rather focus on the production		

With regards to administrative competence the agricultural industry respondents (AIR) are of the opinion that, diploma graduates should have knowledge of admin, financial management (ARI 15) be able to do stock control and monitoring of equipment (AIR4), have good verbal and non-verbal communication (AIR52), sound knowledge of human relations and labour management (AIR44). Some were of the opinion that they should focus on production and let the support staff do the admin. (AIR55)

Q10: Technical or Mechanical Competence	**Weighted Average**	**Standard Deviation**
Drive a vehicle with a valid driver's licence (minimum code B or EB),	4,73	0,57
Use an apply new technology	4,23	0,84
Drive and operate mechanical equipment,	4,21	0,81
Set, adjust and operate farm machinery and equipment	4,12	0,81
Perform minor repair work , replace warn parts and/or re-assembles components,	3,77	1,09
Other: (Specified by respondents)		
Understand and apply basic mechanical principles: gears, wheels, levers, pulleys and structures		
The person does not have to be a specialist on every area. Rather support the manager or the owner and through that expand their knowledge and competence.		

It is interesting to note that the in question 10, technical and mechanical competence, the ability to drive a vehicle and a valid driver's licence were rated at the top. The remainder of the competence as well as what is added emphasise the importance of the practical component of the training. Although not all farmers practise irrigation, the scheduling of irrigation is regarded as highly important, especially with reference to the availability of water for irrigation.

Q11: Irrigation Management	**Weighted Average**	**Standard Deviation**
Do fault finding and follow standard operating procedure	4,06	1,06
Do irrigation scheduling	4,03	1,09
Maintain an irrigation system	3,82	0,98
Operates a manual irrigation system	3,79	0,99
Install irrigation systems	3,13	1,20
Other (please specify)		
Ways of using less water with the same or better results on productivity		

The respondents explained that: *"Irrigation is not a general practice and should rather be a separate programme. Include [it] an introductory programme."* (AIR15), *"Irrigation systems are designed and maintained by irrigation companies, who advise the farmer, however, students should relate to what is known practical. and have knowledge of different irrigation tools and parts and their use."* (AIR42), *"Knowledge of effective water use to achieve the same production with less water, get better results and productivity."* (AIR52)

Product process is not practised on every farm and thus the lower average scores

Q12: Processing and Value-Adding Skills	**Mean**	**Standard Deviation**
Clean and disinfect and maintaining biosecurity standards in processing facilities	4,22	1,07
Supervise activities in the processing plant or pack house	3,88	0,94
Marketing of Agricultural products produced or processed	3,41	1,16
Knowledge and skills for the processing of agricultural products	3,24	1,03
Other (please specify) Support specialists with regard to planning and implementation		

Q13: Professional, Personal and Ethical Skills (Soft Skills/21st Century Competence)	Weighted Average	
Honesty	5,00	0,00
Trustfulness	4,97	0,18
Responsibility - being able to accept responsibility for his/her own actions	4,91	0,29
Hard working or diligence	4,91	0,29
Professional discipline	4,91	0,28
Work Ethic	4,88	0,33
Good human relations	4,62	0,55
Ability to collaborate with other people	4,62	0,55
Critical thinking ability	4,57	0,70
Ability to solve problems	4,57	0,65
Ability to diagnose or identify problems	4,57	0,56
Ability to see the big picture (holistic view)	4,57	0,61
Internal motivation	4,53	0,71
Good verbal and written communication	4,53	0,56
Decision making skills	4,49	0,70
Brainstorming and creation of new ideas - innovative	4,44	0,70
Inductive and/or deductive thinking	4,32	0,77
Other: (specified by respondents) He/she must develop these competencies, as it cannot develop fully during the study period of the diploma		

It is noteworthy that the top three soft skills identified by the agricultural Industry in question 13, are Honesty, Trustfulness, Responsibility - being able to accept responsibility for his/her own actions, hard working or diligence and Professional discipline. They are related and are an expression of moral and ethical convictions as sign of integrity, diligence and hard work, work ethic and discipline are rated very highly. These characteristics that will aid employability and should be part of the attributes of the diploma graduate. This highlights the importance of the 21st century competence and warrants inclusion into the curriculum.

Personal competence. The respondents trust that: *"He/she [the student] needs [practical exposure] to develop competence, it cannot be done completely during the diploma study."* (AIR54). Graduates have the *"Ability to merge old and current farming*

methods and to deal with situations," (AIR3). Most important graduates who want *"To perform all these [work] need to have [a] heart for agriculture."* (AIR26)

Q14: Respondents Rated the Different Competence Groups According to What They View as Most Important on a scale of 1 – 10.	**Mean (Sale 1 -10)**	**Standard Deviation**
Administrative skills	6,97	2,42
Technical or mechanical skills	6,35	2,76
Planning skills.	4,80	2,75
Problem solving skills	4,62	2,61
Production skills,	4,25	2,23
Personal ethical skills,	4,18	3,15
Professional ethical skills	4,06	3,34
Management skills,	3,83	2,46

Source: Data from study

4.2.3. Rating of the different competencies

The responses from the AIQ were analysed using SPSS and Excel to obtain a clear perspective of the respondents thinking about competence in the agricultural industry. The responses were divided into soft skills or 21st century and production or technical skills and rated, using the value of the weighted average of each competence, as 'Very important' (4,5-5,0), 'Above average importance' (3,5-4,49) and 'Average importance' (2,5-3,49) (LaCharite,2015).The rating of the competence is indicated in the Table 17 and 18 below

Table 17: Soft skills or 21st century competence identified by the Agricultural Industry

Soft skills or 21st century competence identified by the Agricultural Industry			
Rank	**Very Important Competence (Mean value 4,5-5,0)**	Mean	Std. Deviation
1	Honesty	5,00	0,00
2	Trustfulness	4,97	0,18
4	Professional discipline	4,91	0,28
4	Hard working or diligence	4,91	0,29
4	Responsibility - being able to accept responsibility for his/her own actions	4,91	0,29
6	Work Ethic	4,88	0,33
7	Keep accurate production records,	4,73	0,45
8	Manage his time optimally.	4,63	0,55
9,5	Good human relations	4,62	0,55

9,5	Ability to collaborate with other people	4,62	0,55
12,5	Critical thinking ability	4,57	0,70
12,5	Ability to solve problems	4,57	0,65
12,5	Ability to diagnose or identify problems	4,57	0,56
12,5	Ability to see the big picture (holistic view)	4,57	0,61
15	Do stock control,	4,53	0,57
16,5	Internal motivation	4,53	0,71
16,5	Good verbal and written communication	4,53	0,56
18	Observe time limits and deadlines.	4,51	0,66
	Above Average Important Competence (Mean value 3,5 -4,49)		
19	Decision making skills	4,49	0,70
20	Brainstorming and creation of new ideas - innovative	4,44	0,70
21	Inductive and/or deductive thinking	4,32	0,77
22	ICT skills , operate a computer and software programmes.	4,31	0,90
23	Plan and directs or oversee farming operations .	4,26	0,95
24	Keep accurate financial records.	4,13	1,01
25	Perform administrative work,	4,06	1,05
26	Draft and implement project plans.	4,03	0,92
27	Provide technical support,	3,91	1,09

The soft skills or 21st century competence that the Agricultural Industry regarded as very important, value 4.5 -5.0, are honesty, trustfulness, responsibility, hard work or diligence, professional discipline, work ethic, good human relations, the ability to collaborate with people, good verbal and written communication, time management, critical thinking, problem solving, the ability to identify or diagnose problems, the ability to see the big picture and Innovation. Some 29,17% of the competence covered in the AIQ is soft or 21st century skills and 70,83% is regarded as practical or technical skill or competence. The industry value 15 of the 21 soft skills as 'Highly important' and many of them relate to character and ethical considerations.

Only six of 21 soft skill competence (28,57%) is classified as above average with a rating 3.50 – 4.49. (LaCharite, 2015), The soft skills are; observe time limits and deadlines; decision-making skills; internal motivation; inductive and/or deductive thinking; operate a computer and software programmes, should have ICT skills and perform administrative work. The lower rating of decision making skills and inductive or deductive thinking is interesting.

The production competence that the AIR regarded as very important (4.5- 5.0) are; drive a vehicle with a valid driver's licence (minimum code B or EB); correctly plant and cultivate plants; maintain and cares for agricultural crops; perform production-related farming operations; provide healthcare for animals; perform routine production tasks; cleaning and disinfecting production facilities; classify animal products; perform production-related farming operations. practice different soil cultivation methods to

prepare a proper seedbed for planting, monitor and control efficiency of production, monitor quality and the conformation to standards, harvest animal products and keep accurate production records. About 70,83% of the competencies included into the questionnaire can be classified as production or technical competence and the agricultural industry emphasises the importance of the practical competence. The ability to drive a vehicle with a valid licence is regarded as a very important production competence with a mean value of 4.73.

Out of the 37 production or technical competence eight (21.6%) was classify as very important (4.5 – 5.0) and 26 or 70.27 % were rated as above-average by the agricultural industry. The reason for the high number might be in the fact that the importance of the production or technical competence differs between the different commodities and the generic competence were rate as very important.

Table 18: Production of technical competence ranked by the Agricultural Industry

Agricultural Industry Production or Technical skills			
Rank	**Very important competence (mean value 4,5 - 5.0)**	**Mean**	**Std. Deviation**
1	Drive a vehicle with a valid driver's licence (minimum code B or EB),	4,73	0,57
2,5	Correctly plant and cultivate plants.	4,68	0,48
2,5	Monitor and control efficiency of production.	4,68	0,55
4	Maintain and cares for agricultural crops.	4,66	0,55
5	Perform animal production related farming operations.	4,62	0,57
6	Scout for pest and diseases.	4,61	0,88
7	Perform plant production related farming operations.	4,55	0,63
8	Handle, mix and store agrochemicals correctly.	4,54	0,90
	Above average important (Mean value of 3,5 - 4,49)		
9	Classify animal products	4,48	0,87
10,5	Provide health care for animals,	4,46	0,90
10,5	Perform routine production tasks	4,46	0,81
12,5	Practice different soil cultivation methods to prepare a proper seed bed for planting.	4,45	0,63
12,5	Identify , monitor and control weeds chemically and mechanical.	4,45	0,87
14	Harvest animal products	4,40	0,82
15	Be a stockman	4,38	0,70
16	Cleaning and disinfecting production facilities	4,31	0,93
17	Use an apply new technology	4,23	0,84
18	Clean and disinfect and maintaining biosecurity standards in processing facilities	4,22	1,07
19,5	Control pest and diseases chemically and biological.	4,21	1,03

19,5	Drive and operate mechanical equipment,	4,21	0,81
21	Do selection of animals.	4,20	0,76
22	Set, adjust and operate farm machinery and equipment	4,12	0,81
23	Do fault finding and follow standard operating procedure	4,06	1,06
24	Do irrigation scheduling	4,03	1,09
25	Prune trees and scrubs.	3,96	1,22
26	Plan and construct an orchard or a vineyard.	3,92	1,13
27	Supervise activities in the processing plant or pack house	3,88	0,94
28	Propagates and cultivates trees or plants.	3,85	1,13
29	Perform basic veterinary practices	3,84	1,14
30	Maintain an irrigation system	3,82	0,98
31	Operates a manual irrigation system	3,79	0,99
32	Perform minor repair work , replace warn parts and/or re-assembles components,	3,77	1,09
33	Operate and clean a milking machine	3,71	1,40
34	Perform artificial insemination.	3,65	1,09
	Average Important		
35	Marketing of Agricultural products produced or processed	3,41	1,16
36	Knowledge and skills for the processing of agricultural products	3,24	1,03
37	Install irrigation systems	3,13	1,20

The production and technical skills include the following calibrate and monitor planters and sprayers, use an apply new technology, do stock control, scout for pest and diseases, identify, monitor and control weeds chemically and mechanically, apply and maintain hygiene and bio-security measures at the production facilities, clean and disinfect the production facilities, handle, mix and store agrochemicals correctly. Technical competence such as drive and operate mechanical equipment, set, adjust and operate farm machinery and equipment, service mechanical equipment (change oil), perform minor repair work, replace worn parts and/or re-assembles components, maintain farm implements and infrastructure. Plan and construct an orchard or a vineyard, prune trees and scrubs, propagates and cultivates trees or plants are activities that are mainly done on fruit farms and again commodity specific

The respondents had a choice to answer the plant or animal production questions therefore the lower rating of competence such as, be a stockman, do selection of animals, train or handle animals, perform basic veterinary practices, operate and clean a milking machine not all the respondents were livestock farmers but might had some back ground knowledge and experience. Not all farms are practicing irrigation and it is only applicable to certain commodities where competence such as, do irrigation

scheduling, do fault finding and problem-solving on irrigation systems, maintain an irrigation system, operates a manual irrigation system and operate a computerised irrigation system are of importance. Supervise activities in the processing plant or pack house, plan and directs or oversee farming operations and draft and implement project plans might be above the operational level for the first time employed diploma graduate and therefore also rated lower.

Due to the complexity and diversity of the South African agriculture, it is difficult to draft a generic profile of the ideal diploma graduate, as can be seen from the results of the production or average production and technical competence. Therefore, the suggest*ion which will be elaborated on later will be that commodity organisations and the HEIs collaborate to draft profiles suited for the specific commodities in the agro-ecological region of the HEIs.*

Competence such as, install irrigation systems, apply vegetative reproduction in plants (budding and grafting), process agricultural products, handle the marketing of the products produced or processed and perform artificial insemination were rated average production of technical competence, not due to their importance but due to the fact that it is specialist operations that is normally performed by specialist in that fields and not by the graduates.

In conclusion the rating of the production skills will differ between agricultural industry members depending on the different commodities they are involved in, as the frame of reference of the different competence differ and they value certain competence differently. As stated by one of the respondents, *"you cannot compare the production competence for maize with that of citrus"* (AIR53). A clearer picture will be provided if the different commodities list and value the production competence they will require. There are generic competencies, such as soil cultivation, management, etc., that will overlap between the different commodities.

4.3 To identify the gap between the agricultural industry and the diploma graduates and measures to close the gap

The strength of the relation between the agricultural industry responses and HEIs responses were measured using the Pearson correlation coefficient and the result was

measured at r = 0,413. The value lies between the moderate degree indicators of 0,3 and 0,49, and thus indicates a medium correlation between the variables.
The strength of the relationship between the agricultural industry responses and diploma graduates' responses were also measured for word similarity using the Pearson's correlation coefficient, and was measured as r = 0,637, which lies between the high degree parameters of 0,5 and 1, which indicates a strong correlation.

The word similarity between higher education responses and diploma graduates were tested and the Pearson correlation coefficient is r = 0,497, which indicates a medium correlation. The mean for the responses to the most important softs skills and production skills of the three main components, agricultural industry, HEIs and the diploma graduates, were compared by drawing a scatter plot graph in Excel. The mean of the top five soft skills competence as selected by the agricultural industry were compared with the mean of the HEI and the diploma graduates, and is indicated in the triangular graph in Figure 14 below.

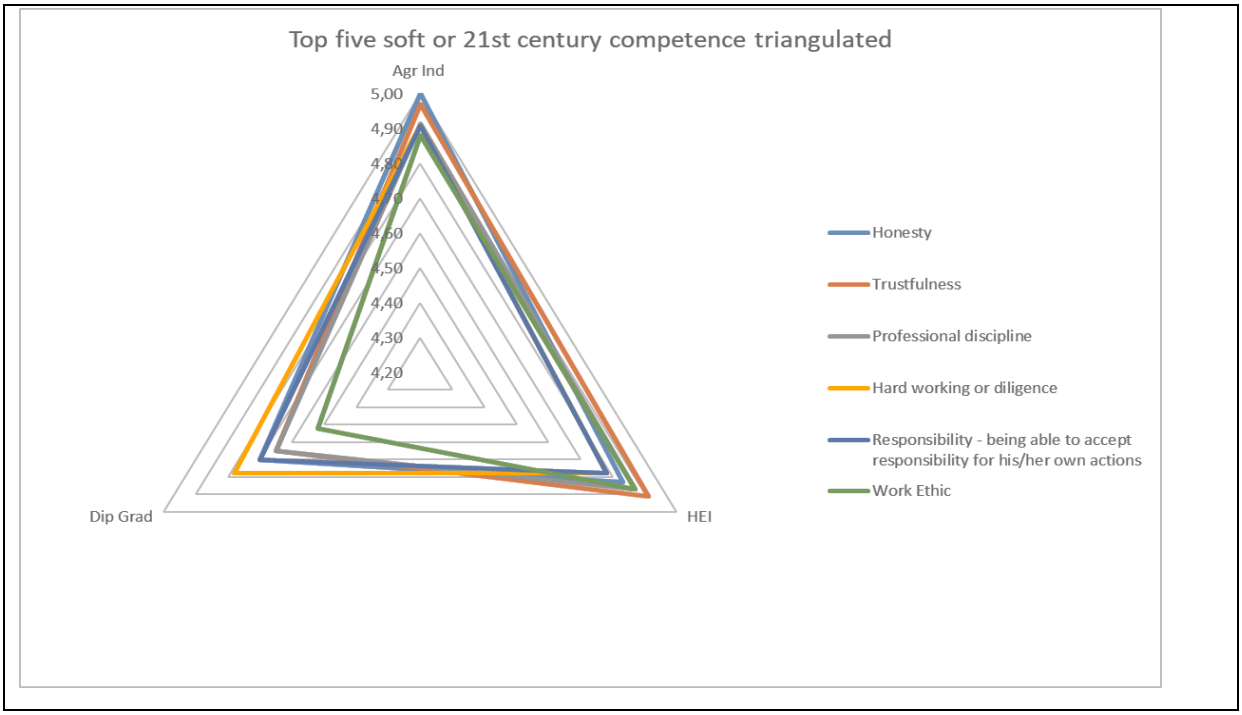

Figure 14: Triangulation of the most important soft skills identified by the Agricultural Industry (Source: Data from study)

Figure 14 indicates a slanting movement towards HEIs due to the lower values allocated by HEIs, which indicates that there is a lower level of importance. The relation between the node 'Reason why agricultural industry appoint graduates from

specific institution/s' and the node, 'Preferred HEIs for the agricultural institution' was measured and the Pearson correlation coefficient is r = 0,64, which indicates that there is a very strong correlation between the two.

The line graph in Figure 15 indicates the presence of a gap between HEIs and the diploma graduates in terms of the soft skills identified by the agricultural industry. the mean of HEIs is higher than that of the agricultural industry with regards to 8) Manage time optimally, 9) Good human relations, 11) Critical thinking ability and 12) Abilities to solve problems, indicating more emphasis on them, and below average with 1) Honesty ,5) Responsibility, 7) Keep accurate production records,
14) Ability to see the Big Picture and 15) Do stock control, indicating areas for attention.

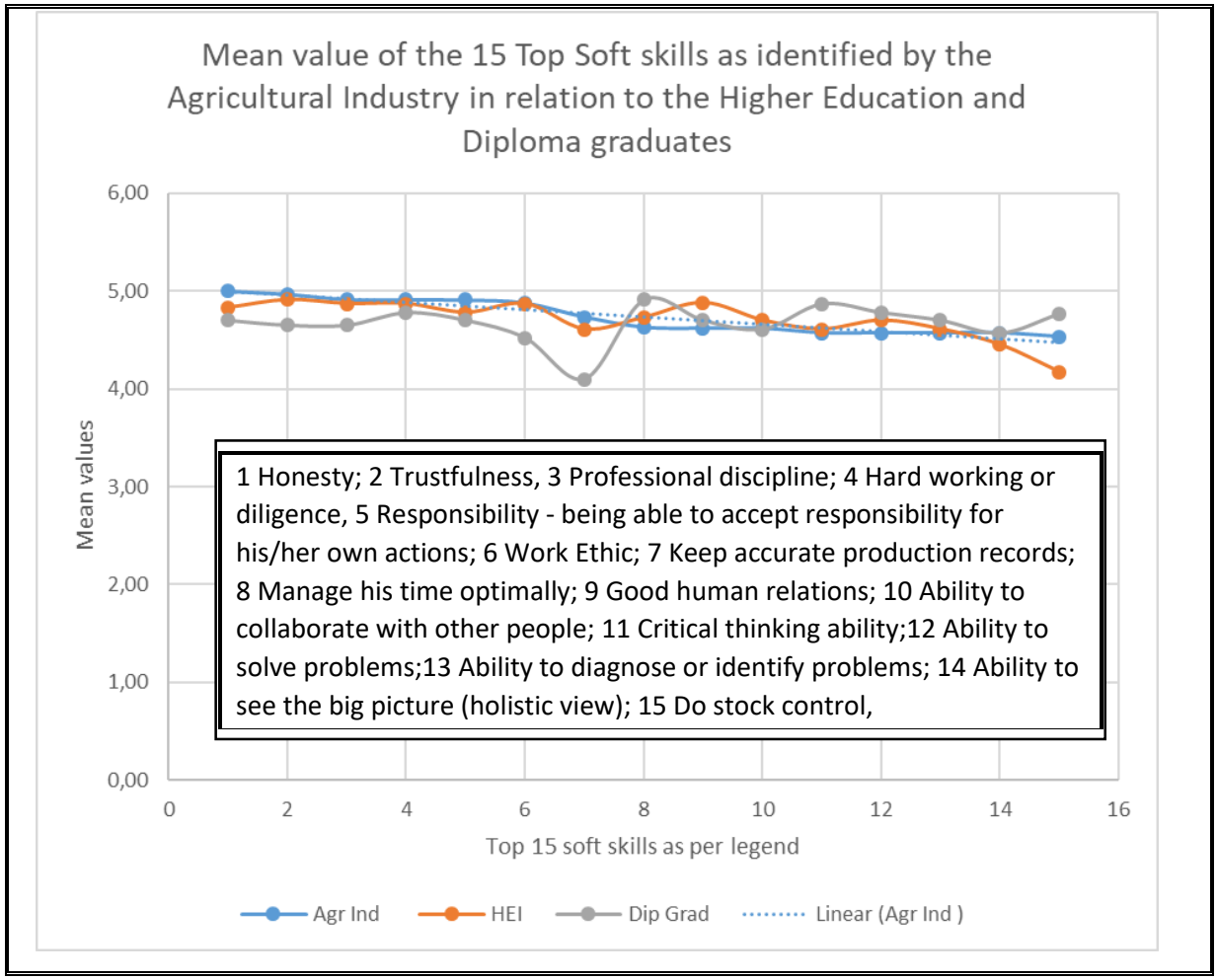

Figure 15: Line graph showing the comparison of soft skills between the agricultural industry, higher education institutions and diploma graduates.

The diploma graduates are below average in terms of 1) ‘Honesty’, 2) ‘Trustfulness’, 3) ‘Responsibility – being able to accept responsibility for his/her own actions’,4), Hard working or diligence, 5) ‘Professional discipline’, 6) ‘Work ethic’, 7)Keep accurate production records and 15) Do stock control. The graduates are above average with 8) ‘Manage his time optimally’, 11) ‘Critical thinking ability’, 12) ‘Ability to solve problems’, 13) ‘Ability to diagnose or identify problems’, and 15) Do stock control.

The production competence indicated in Figure 16 indicates a different scenario where HEIs is below the Agric Industry trend line with 1) Drive a vehicle with a valid driver’s licence (minimum code B or EB), 2) Correctly plant and cultivate plants, 3) Monitor and control efficiency of production, 4) Maintain and cares for agricultural crops, 5) Perform animal production related farming operations, 6) Scout for pest and diseases, 9) Classify animal products, 12) Practice different soil cultivation methods to prepare a proper seed bed for planting, 13) Identify, monitor and control weeds chemically and mechanical, 14) Harvest animal products and 15) Be a stockman. The difference or gap between the HEI and AI is clearly visible with 10 out of 15 competences below the Agric industry expectations.

The graduates rate their competence above the industry expectations, with regards to 1) Drive a vehicle with a valid driver’s licence (minimum code B or EB), 4) Maintain and cares for agricultural crops, 5) Perform animal production related farming operations, 7) Perform plant production related farming operations. 9) Classify animal products, 10) Provide health care for animals, 11) Perform routine production tasks and 14) Harvest animal products.

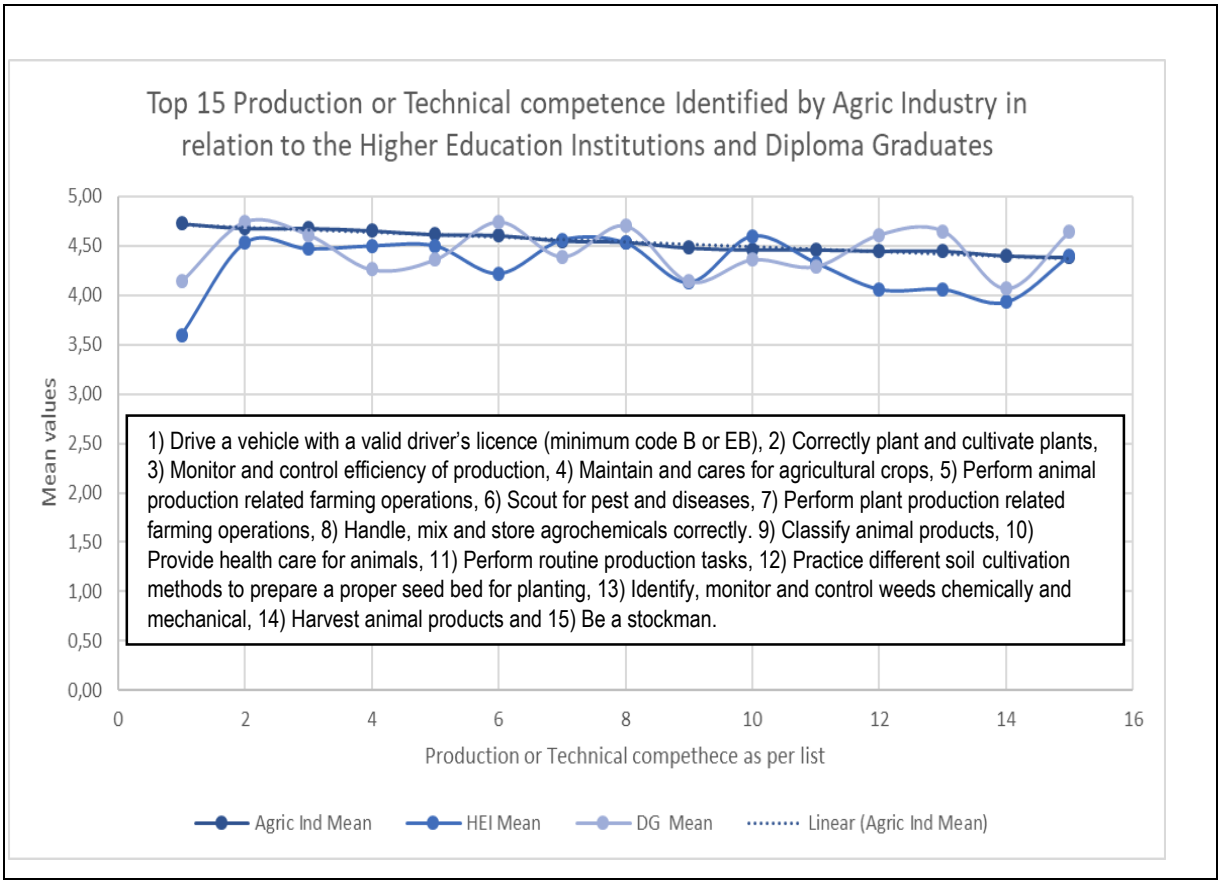

Figure 16: Line graph showing the rating of production and technical competence by the different components.

They also rate the following competence above the trend line of the Agric Industry 2) Correctly plant and cultivate plants, 6) Scout for pest and diseases, 8) Handle, mix and store agrochemicals correctly. 12) Practice different soil cultivation methods to prepare a proper seed bed for planting, 13) Identify, monitor and control weeds chemically and mechanical, and 15) Be a stockman. Their rating can be attributed to several factors, one of which can be the fact that they have just completed their WIL period and can be overconfident.

Role players in the agricultural industry were asked to indicate if they have a preference to employ graduates for one of different types of HEIs; they were also asked what their opinion was regarding a professional body that can assist with the establishment and monitoring of competence standards of the graduates. The relationship between the nodes 'Reasons for HEIs preference' and the 'Motivation for professional body' was tested with the Pearson correlation coefficient and the result was r = 0,67, indicating a strong relation. The agricultural industry requires graduates who have relevant practical experience suitable for their purpose.

4.4. Industry advice and proposals for improvement of competence in the diploma qualification received from the respondents of the study

4.4.1. Industry recommendations

About 72,7% of the AIQ respondents suggested that more attention should be given to practical work, practical training to improve the students' competence and make them more acceptable for the industry to employ. Respondents' responses were translated from the original Afrikaans and is states: *"Make the course tough! If only the best have a diploma, you will have competent graduates."* (AIR60). *"More practical and less theory."* (AIR59), *"More practical knowledge and experience."* (AIR58), *"[Knowledge of] agricultural management."* (AIR57), *"Practical case studies [to be used] and the discussion thereof should play a bigger role in the training."* (AIR56), *"Real practical embedded or rooted training should take place, that is effectively controlled and on par [with industry]. Students need to show the application of the theory."* (AIR47).

About 73% of the respondents also suggested and commented on the practical facilities and suggested that training farms at the institutions be geared to provide students with practical experience; and become mini-farms where the students work their own plot on different crops, doing the planning, budget and the work: *"Some suggested practical work during the holiday."* (AIR52). Others suggested and promoted the placement of students within the industry and the involvement of industry in the offering of practical training. The vocational-oriented education has Work integrated learning (WIL) as a compulsory component and is one of the areas where the industry and HEIs can meet to ensure mentorship and strengthening of practical experience. It must be noted that WIL is not a replacement for skills training and HEIs need to ensure that students have the necessary competence before they are placed for WIL. The researcher is of the view that WIL starts at day one of the programme as all the teaching and learning should be embedded in the work situation.

4.4.2 Internships and work-integrated learning.

Internships was mentioned three times (AIR31, AIR3 and AIR35); learnerships and short skills [programmes] are suggested as ways of improving the graduate's competence. Work integrated learning(WIL) within companies that can take in

students for eight months or more and allow them to work on farms under the guidance of a mentor or agriculturalist was mentioned four times (AIR54, AIR42, AIR35 and AIR6). In-service training by industry role players to strengthen the vocational-orientated experience WIL as part of the transformation is supported by a number of researchers (Orrell, 2004; Ley *et al.*, 2008; Winberg, 2011). Graduate must, after their training, be able to train others, depending on the type of production field in which the student is trained.

4.4.3. Practical experience

In relation to practical experience the respondents indicated that students should be exposed to different operational situation to achieve the same learning outcome, e.g. learners handling free range chickens must also understand the handling of layers as well as broilers. It was recommended that a possibility can be for students to do online studies and spend more time in the field.

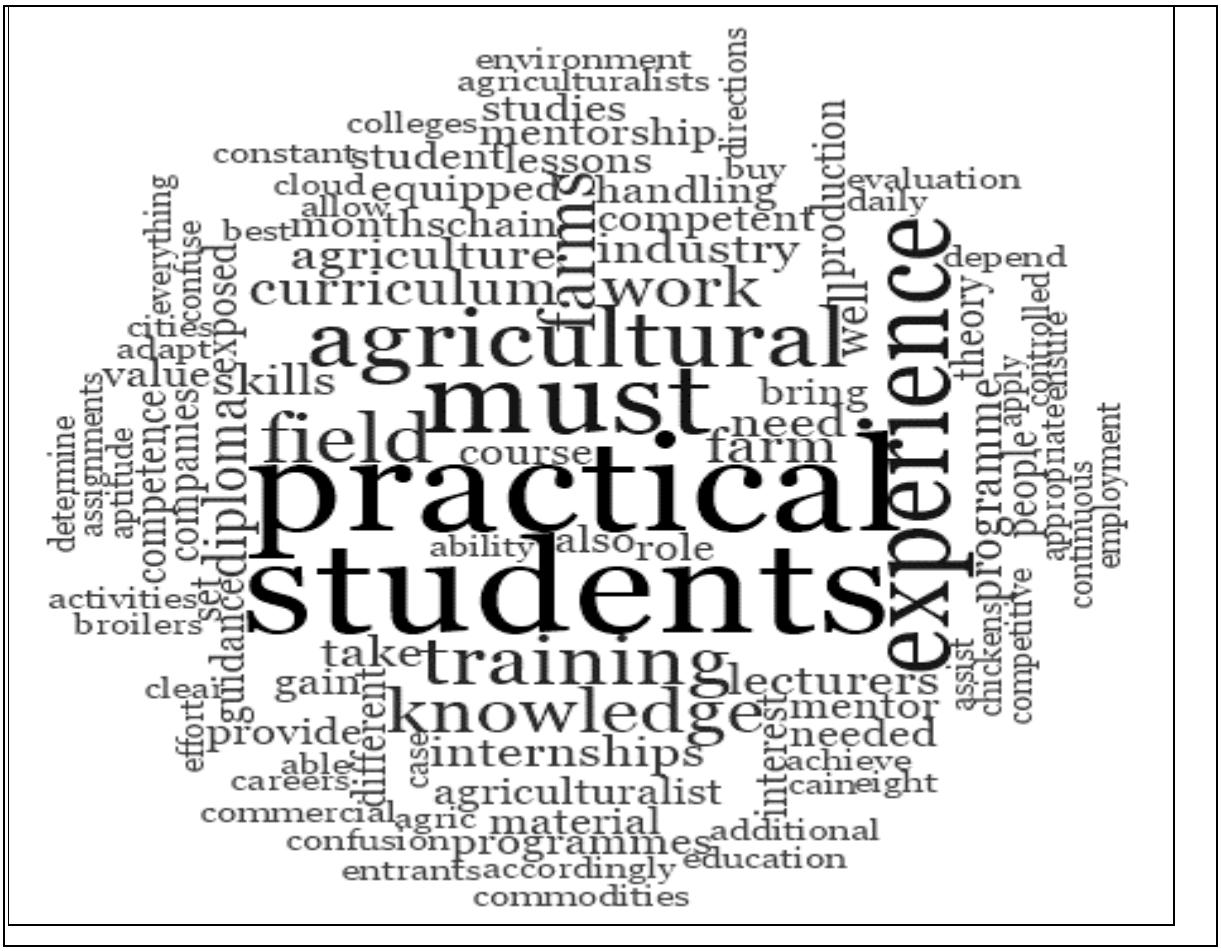

Figure 17: Word cloud suggestions to improve agricultural education (Source: Data from study)

Using the NVIVO 12 plus qualitative analysis programme, a word cloud was formed to indicate the important key words and concepts that were used by the Agricultural

industry respondents (Figure 17). The collection or cluster of word in a word Cloud are depicted in different sizes and positions, the bigger and bolder a word appears the more frequent it was mentioned in the interviews and on the questionnaire and is an indication of its importance. Standing out from the word cloud are the emphasis on practical, students experience, training and knowledge that the graduates should have and the importance of the curriculum and the inclusion of practical work therein. In the AIQ and responses, the word 'practical' was used 222 times (NVIVO12 word count), indicating how strongly the industry feels about the practical experience and competence needed

Students must be more exposed to the total value chain of the different commodities of their interest. This will give them directions for future careers. Include the secondary agricultural industry value chain also, to assist with employment. The agricultural industry along with many other researchers (Bawden, 1991; Davis et al., 2004; Deegan et al., 2016; Monaghan et al., 2017.), emphasise the need for practical experience and the development of competence.

The recommendation is that students need more practical knowledge and experience to bridge the competence gap. They must receive more exposure to practical work, practical lessons must be presented in the field where the students can gain experience. Practical work must form part of the diploma curriculum and should be monitored and signed off by a competent person. Students must be placed at well-functioning farms. Researcher support the notion for more and improved practical to ensure competence (Marshall et al., 1998 Deegan *et al.*, 2016; Mojarradi & Karamidehkordi, 2016;).

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4.4.4. Observations and experience

Students and lecturers should more frequently visit farms and agricultural input providers, observing the daily production activities and adapt the curriculum and assignments accordingly, to stay in tune with the Agricultural Industry. The build-up of practical experience, regarding agricultural production, by the lecturers is supported by Rudman and Meiring (2018) and Monaghan *et al.* (2017).

HEI's should endeavour to select students for the study of agriculture, who have aptitude and a will to be involved in agriculture, supporting them then with knowledge

and allow them to gain practical experience. New entrants into the agricultural field mostly do not have the view of staying on a farm far from the cities (Ohe, 2012.; Supnui *et al.*, 2013;; Monaghan *et al.*, 2017).

4.4.5. Curriculum

Industry response to the curriculum included: *"Guarantee [that] students get an appropriate introductory programme to introduce them to the agricultural landscape or environment."* (AIR13), *"Ensure that the course material for all the modules is at a higher level than agricultural schools. Lecturers must have enough knowledge and skills to stimulate the students*." (AIR13), "*The workload of students should be of such a nature that they will put in effort to master the subjects."* (AIR13),

Constant continuous evaluation is needed to determine the understanding and progress. Study material needs to stimulating and clear to prevent confusion and lack of interest. *"Make the course tough! If only the best has a diploma, you will have competent graduates."* (AIR60), *"When programmes are set [up] must do set things [in such a way that it] do not cloud (with) everything [and] to confuse. The programme must [be] strictly on agriculture. Agricultural management to be included."* (AIR28)

Curriculum should be more practical than theory. Truly practical-founded training should take place which is well controlled and at a high standard. Students should provide evidence that they can apply the theories. More practical knowledge and experience is needed. Practical lessons should be outside in the field and students need to gain more experience in the field. Practical case studies and the incorporation thereof should play a larger role in the training. Many studies were done on the transformation of the curriculum and it supports the view of the agricultural industry (Wals, 2005; Parr et al., 2007; Supnui *et al.*, 2013; Boughey, 2018;).

4.4.6. Mentorship

There are many able retired agriculturalists and technical people who can be involved in mentorship. Money cannot buy years of knowledge and experience. Use the people with practical knowledge to bring together the theory and practice. Agricultural companies can take in students for a period of eight months to perform agricultural practices on farms under the guidance of a senior mentor or an agriculturalist.

4.4.7. Lecturers

[Quality education] starts with the training staff. Are they equipped to prepare students for the commercial agriculture? Good practical training by experts in the fields is needed. The competence of the lecturers can be enhanced using a learner-centred approach (Nakelet *et al.*, 2017). The transformation of the HEIs depends largely on the lecturing staff, and Rudman and Meiring (2018) mentioned this in the article "Transform vocational education: One lecturer at a time". This will be further discussed in Chapter 5.

4.4.8. Facilities

Institutions' farm/s must be equipped to provide practical experience to students during holidays, over weekends and perhaps an additional (practical) year over and above the 3rd year of the diploma in the form of an internship. The farm is an extension of the classroom, where students can practically apply what they have learned (Kensinger & Muller, 2006; Oladele et al., 2011; LaCharite, 2015a; Monaghan et al., 2017).One of the responses was that *"a mini farm where students do the work and run the operations at each of the colleges [and universities] should be considered*" (AIR52).

4.5 Professional body that can set and monitor standards of competence of agricultural graduates

In response to the question whether the respondents think the creation of a professional body representing the different role players to regulate, and quality assure the practical component (skills, competence and capabilities) of the diploma programmes, the industry responded both positive and negative feedback. Some 88% responded positively and commented as follows. *"A professional organisation[body] will assist to regulate the standard of training and of qualifications, to ensure that graduates are on par and the qualification they achieve is at the right [competence] level."* (AIR47), *"Such an organisation must collaborate with the different commodity organisations and organised agriculture. Must be done per commodity, citrus and grain do not have the same requirements."* (AIR53), *"The body is a good building block towards quality education, but its activities must be well structured to provide specific learning outcomes, e.g. templates must speak to specific learning situations but not be generalised. A learner assessed on irrigation on commercial farm can't be assessed on the same tool[level] with the learner practicing on the irrigation scheme*

(farrow irrigation)." (AIR5), *"I think it will pave the way in agriculture. As technology and farming practices change the HEI need to adapt their programmes [to keep up with the change]."* (AIR9) , *"The different agricultural value chains require different competence and sometimes special competence that will allow workers to integrate and adjust quicker to the workplace. In a specific value chain, broad general knowledge of the commodity is regarded as a bonus that most often lead to preference in appointments."* (AIR6), *"It can be of value, the purpose and functioning thereof will depend on the quality of people who serve on the board. Yes, the people involved must be experts in the theory and practice of agricultural education and farming practice."* (AIR54), *"It can contribute to uniformity and better control."* (AIR52), *"Yes, I support it, it will allow for standardisation and ensure a standard for the training. It will be fantastic and ensure that standards are equitably monitored and will normalise standards. I think it can work and ensure uniform standards of training."* (AIR5). The last comment captures the essence of the industry sentiment: *"Skill is magic, if you can work with your hands you can do anything."* (AIR50)

Not all were in favour of the proposal. Four of the 34 respondents were not in favour of the creation of a professional body for agricultural competence. Their views included that: *"[A] professional body will just create red tape. Students must be screened at class level to be of outstanding character! Low standards create problems that must be regulated."* (AIR60), *"It will only [be] functional, [if it] adds value to participants and set standards with minimum entry levels."* (AIR27), Others felt that *"there are too many hoops to jump through to realise this, even if it could potentially be useful"* (AIR42) and questioned *"more regulation and m*ore *professional bodies"* (AIR17).

To summarise, the majority of the respondents (88%) are of the opinion that a professional body for VOAE or for agricultural competence standards, similar to the Veterinary Council of South Africa, would assist with quality control, setting standards for competence based on the skills required as defined by role players in the different commodities. It will also be included as one of the measures to bridge the competence gap.

4.6 The value of vocational-orientated agricultural education to the agricultural industry

The value of vocational-orientated education in agriculture was highlighted through the responses to the AIQ. In their response on the employment of diploma graduates, 15,63% indicated that they would employ the graduate as a team leader; 21,88% indicated they would employ them as a junior foreman, 3,13% as foreman and 43,7% indicated that they would be employed as junior manager and 10% indicated they would employ then as a manager. One respondent stated (translated from Afrikaans): *"The quality of the education and the diploma as such, depends more on the quality of the teaching and practical experience obtained than the type of institution where it was obtained."* (AIR54)

4.7 Chapter summary

The feedback from the agricultural industry is that they require graduates who have practical experience, theoretical knowledge and will be able to perform the function in the agricultural industry. The agricultural industry prefers students with practical background and this is a challenge to HEIs to ensure their product meets the requirements of the agricultural industry. Collaboration between the agricultural industry and the HEIs is critical and is the only way to ensure the graduates will meet the needs of the industry. Partnerships need to be developed and strengthened.

CHAPTER 5: PERCEPTIONS OF HIGHER EDUCATION INSTITUTIONS REGARDING THE AGRICULTURAL DIPLOMA AS VOCATIONAL-ORIENTATED QUALIFICATION

5.1. Introduction

Higher education is regarded as an important pillar of sustainable development that assists with creation, dissemination and application of knowledge as well as the building of professional and technical capacity, according to the World Bank as reported by Paterson and Cloete (2018). The same view can be applied to agricultural development in South Africa, where higher education needs to stand out as a pillar that strengthens the promoting of and assisting with the development, upliftment of the smallholder farmers and the preparation of the commercial farmers for the technological developments in the future. Over time, this divide needs to be reduced, having only farmers or agriculturalists with the required technical and professional competence starting point in the profession.

The aim with this chapter is to present the view of the different HEIs with regard to VOAET, how the academic staff of HEIs view competencies, how are competencies assessed at HEIs, what measures are in place to address the skills or competency gap and whether the VOAE offered at South African HEIs meets the industry requirements regarding the competence needed. Qualitative and quantitative analysis will be done; attention will also be given to vocational-orientated pedagogy.

The focus of this chapter is on HEIs offering agricultural diploma programmes as one of the key components in the triangle of VOAET. It is, therefore, particularly important to consider the approach of HEIs with as education provider in the vocational-orientated agricultural programme. This chapter also address the research objectives 2 and 3: To identify and analyse the perception of academic staff of the HEIs on the competence needed and deemed necessary for their graduate students, and how the competence is assessed at the HEI's. and 3) To identify and analyse measures that HEI's and the Agricultural industry are putting or can put in place to address the skills/competency gap in Agricultural Diploma graduates. Understanding the VOAE landscape in higher education is necessary to discuss transformation and how the

competence required by the agricultural industry can be developed in the agricultural graduates.

5.2 Background to vocational-orientated agricultural education

Salmi (2018), the retired coordinator of tertiary education at the World Bank, stated the following with regard to the future development of higher education (cited in Paterson, 2018): Technology rather than labour or even capital has become the main driver of growth globally. That in this rapidly evolving economic climate, alternative modes of higher education are needed. The traditional public university sector and traditional pedagogies for imparting of knowledge in classrooms will be replaced by dynamic models supported by interactive technologies that aim at equipping students with generic competence and attributes promoting lifelong learning.

Two things come to the fore, namely transforming the current practice to meet the requirements and what is the sustainability of the current system? Salmi also presented a yardstick to quantify the relative performance of the higher education system. This includes: enrolment rates, equity in terms student access to the institution, the completion of the programmes, actual learner achievements, labour market outcomes, research outputs and technology transfer (cited in Paterson, 2018). The employability and employment percentage of graduates need to be added.

Miettinen (1999, cited in Winberg *et al.*, 2011) states that, *"to achieve a productive alignment between higher education and workplaces, academic staff should develop an understanding of how to integrate experiences across different areas of learning, both within and outside academic contexts"* (Winberg, 2011). Nakelet *et al.* state the following: *"Universities have the responsibility to produce graduates with competences to facilitate development in general. Graduates from agricultural based universities in this case have a responsibility of driving agriculture and rural transformation"* (Nakelet *et al.*, 2017).

In the article "Benchmarking agricultural education: Achieving consistent labelling of degrees" (Naylor, 2003), the author states the need for a quality-assurance body that can do the benchmarking and to describe the expectations about the standards for awarding a qualification at different levels and to present the attributes and capabilities

that graduates possessing such qualifications should be able to demonstrate (ibid.). This benchmarking corresponds with the concept of a professional body propagated by the agricultural industry in the previous chapter.

5.2.1. Understanding the nature of vocational-orientated education

The WWF states the following in their report on South African agricultural industry: *"Agriculture is the foundation of developing economies. As one of these economies, South Africa needs to ensure a healthy agricultural industry that contributes to the country's gross domestic product (GDP) food security, social welfare, job creation and ecotourism. But the health of the agricultural sector depends on the sustainable farming methods. Farming practices must therefore not only protect the long-term productivity of the land, but must also ensure profitable yields and the wellbeing of farmers and farm workers"* (Golblatt, 2010).

To achieve the above, VOAE must be functional and produce graduates who are employable, innovative and productive, targeting respondents who can assist to achieve the above specific objectives of the study. They are the major role-players in the VOAE in the country. For further understanding of the South African agriculture, and the role of agricultural education, a closer look is taken at the role players in VOAE.

5.3. Role players in vocational-orientated agricultural education

Role players, such as public schools offering Agricultural Sciences, agricultural high schools, AgriSETA, private training providers, NPO and TVET colleges, are involved in agricultural education and training at the lower NQF levels (levels 1-4). The higher levels (NQF5 and above) is the focus area of agricultural colleges (training institutes) and universities, who focus on the NQF levels 5-10. This study focused on the agricultural colleges and the universities offering the agricultural diploma as vocational-orientated qualification in the NQF6 band.

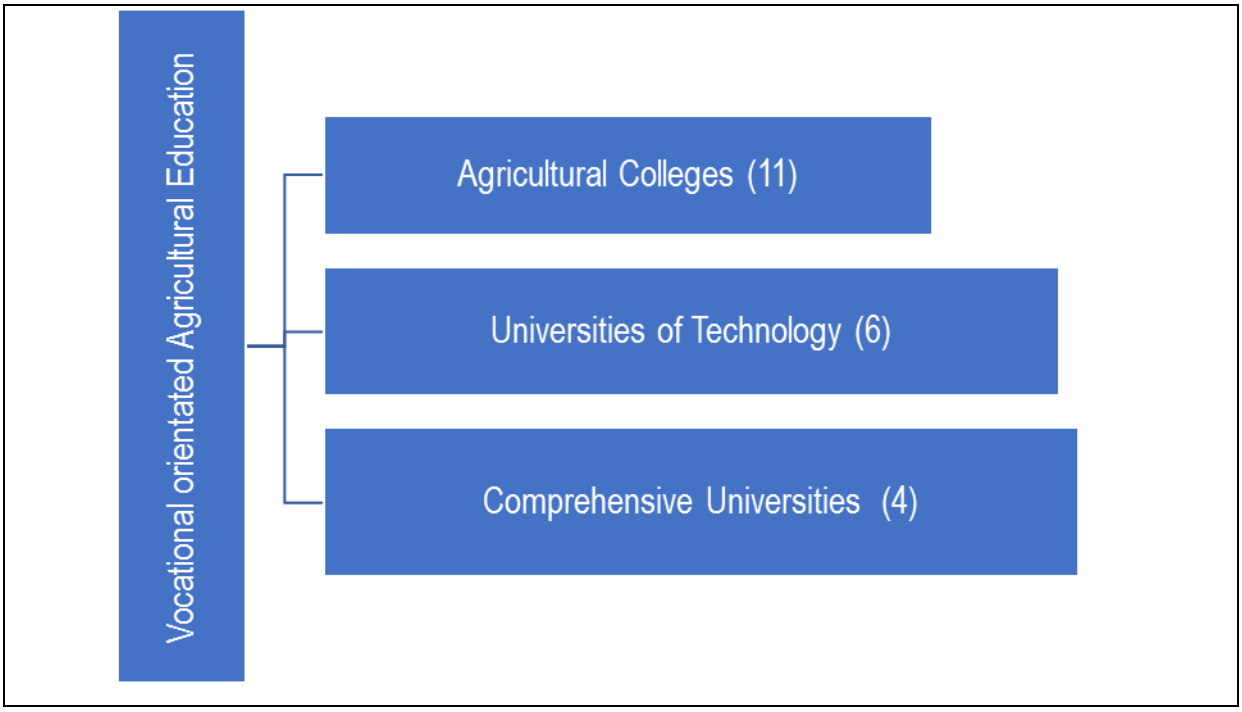

Figure 18: Role players in vocational-orientated agricultural education (Diagram: Researcher's own design)

The VOAE landscape in South Africa consists of 11 agricultural colleges, six universities of technology and four comprehensive universities as illustrated in Figure 18 above. The HEI's are all offering VOAE in the form of an agricultural diploma at NQF6 level. The different role players are discussed below.

5.3.1. Agricultural colleges

The first agricultural college in South Africa was established in 1898 at Elsenburg as an agricultural training centre. Colleges of agriculture offer qualifications, part qualifications and short courses from NQF levels 1-7, predominantly in some aspect of primary agriculture. Ten of the colleges operate currently under the mandates of provincial departments of agriculture and one is managed through the DAFF. Negotiations are currently being finalised to elevate all the colleges, to a national competency (as with all other such institutions), with joint governance by the DHET and DAFF. They will also be granted greater operational autonomy. This shift that started in 2012 is still not completed and the delay does not promote the transformation.

Enrolment at the agricultural colleges is normally small, due to limited facilities and resources available to accommodate the practical groups, and because of the practical

nature of the programmes. The demand for higher education and training at this level, is, however, very high and put pressure on enrolment at the other HEIs. The increase in numbers negatively affect the offering of structured practical, it become difficult, ineffective, and neglected due to the size of the practical groups and the availability of facilities (interview responses). Bailey (1905) emphasised the importance of practical work back then, saying that *"if we study ploughing in the classroom, we must also study it in the field … we must determine and test relation of ploughing to moisture, aeration, microbial life and many other questions"* (cited in Parr *et al.*, 2007).

The Vocational Education and Training Strategy for Agriculture, Forestry and Fisheries (2018) state the following: *"Consultations with stakeholders revealed that training and education for occupations related to agriculture, forestry and fisheries has become increasingly theoretical and disconnected with the practical knowledge and skills requirements demanded by the workplace"* (DAFF, 2018).

The curriculum varies from college to college, based upon the agro-ecological region of the college. Some of the colleges divide their training programmes with FET, farmer training and higher education training at the college being the main focus. The learning framework is essentially vocational-orientated, with a variety of WIL applications (DAFF, 2018). Agricultural colleges traditionally used the ration of 60% theory and 40% practical work – and in some cases 40% theory and 60% practical – in the diploma programmes.

Small practical groups are formed to provide the college students, who are expected to be involved in daily routine practical activities, hands-on experience. The routine practical work simulates farm activities, giving the students a better understanding of true nature of agriculture and the importance of certain actions (Deegan *et al.*, 2016). The structured practicals provide the students with the production knowledge and skills required and life skills in collaboration and leadership. More about practicals later in the chapter.

Tables 19-21 below list the different HEIs involved in vocational-orientated qualifications.

Table 19: Agricultural colleges in South Africa

	Agricultural Colleges (ATIs)	**Area of Specialisation**	**Town + Province**
1	Western Cape Agricultural Training Institute Elsenburg Agricultural College (Established 1898)	Higher Certificate in Agriculture Diploma in Agriculture: Cellar Technology Diploma in Agriculture Diploma in Extension	Elsenburg Western Cape
2	Fort Cox Agriculture and Forestry Training Institute (Established in 1930)	Diploma in Agriculture: (specialising in) Agribusiness; Animal Production or Crop production Diploma in Forestry	Middledrift Eastern Cape
3	Tsolo Agricultural Training Institute	Diploma in Animal Health	Tsolo Eastern Cape
4	Grootfontein Agricultural Training Institute (Established 1911)	Diploma in Agriculture - Small stock farming	Middelburg, Eastern Cape
5	Glen Agricultural College (Established 1919)	Diploma in Agriculture –Mixed farming Highveld region	Glen, Bloemfontein, Free State
6	Taung Agricultural College	Diploma in Agriculture - Irrigation	Taung – North West
7	Potchefstroom Agricultural College (Established 1909)	Diploma in Agriculture – Mixed farming Highveld region	Potchefstroom North West
8	Cedara Agricultural College (Established 1904)	Diploma in Agriculture Mixed farming in high rainfall area	Hilton KZN
9	Owen Sithole Agricultural College (Established 1968)	Diploma in Agriculture – Coastal Sugarcane and mixed farming	Empangeni, KZN
10	Tompi Seleka Agricultural College (Established 1960)	Diploma in Agriculture –mixed farming Highveld region	Marble Hall, Limpopo
11	Madzivandila Agricultural College (Established 1982)	Diploma in Agriculture mixed farming and subtropical fruit	Thoyondou Limpopo

Source: GG. General notice 880 of 2014

Since 1982, no new public agricultural college has been established, except for the Marapyane Campus of the Lowveld Agricultural College, which was opened in 2013 and closed in 2015, after the incorporation of the Lowveld Agricultural College into the University of Mpumalanga.

5.3.2. Universities of technology

The CTP team report on universities of technology state that: *"The primary mission of a University of Technology (UoT) is to give students the workplace skills and knowledge to meet the needs of industry, business and community"* (Swart *et al.*, 2017). Universities of technology developed from the old technikons with the focus on vocational-orientated education. They are primarily based on an occupation or employment. They offer programmes that prepare students for specific careers of trades. The programmes are considered more "hands-on". Universities of technology, as captured in Table 20 can only offer applied degrees.

Table 20: Universities of technology offering agricultural diploma qualifications

Universities of Technology Offering Agricultural Diploma Qualifications			
	University of Technology	**Area of Specialisation**	**Town + Province**
1	Cape Peninsular University of Technology	Diploma in Agriculture Diploma in Agricultural Management	Worcester, Western Cape
2	Central University of Technology	National Diploma: *Agricultural* Management	Bloemfontein, Free State
3	Tshwane University of Technology	National diploma: Agriculture: Crop Production National Diploma: Agriculture: Development and Extension National Diploma Agriculture: Animal Production National Diploma Equine Science	Pretoria, Gauteng
4	Mangosuthu University of Technology	Diploma in Agriculture: Animal Production Diploma in Agriculture Diploma in Agriculture: Extended curriculum programme	Durban, KZN

		Diploma in Agriculture: Animal Production: Extended Curriculum	
5	Durban University of Technology	Diploma in Sustainable Horticulture and Landscaping	Durban, KZN
6	Vaal University of Technology Upington Campus	Diploma in Agriculture	Upington, Northern Cape

Source: Websites of the institutions

5.3.3. Comprehensive universities

Comprehensive universities are a new institutional type in the South African higher education system, offering a combination of academic and vocationally orientated diplomas and degrees comprehensive universities, on the other hand, are mergers between former technikons and traditional universities and can offer programmes and degrees in the traditional arts and sciences, in addition to the applied programmes offered by technikons/universities of technology (DOE, 2004).

Comprehensive universities, indicated in Table 21 below, were created to strengthen applied research, increase access to technical higher education throughout the country, and facilitate mobility between different types of academic and technical programmes.

Table 21: Comprehensive Universities offering Agricultural Diploma qualifications

Comprehensive Universities offering Diploma Programmes in Agriculture			
1	Nelson Mandela University	Diploma in Agricultural Management	George Campus Western Cape
		Diploma in Agricultural Management Diploma in Agriculture Management Extended programme	Port Elizabeth campus – Eastern Cape
2	University of South Africa (Unisa)	National Diploma in Agricultural Management National Diploma in Animal Health	Florida Campus Gauteng
3	North West University	Diploma in Animal health Diploma in Animal Science	Mafikeng campus North West University

4	University of Mpumalanga	Diploma in Agriculture in Plant Production Diploma in Agriculture in Animal Production	Mbombela Mpumalanga Province

Data source: Institutions' websites

5.3.4. Other role players in agricultural education and training

AgriSETA provides an annual overview of what is needed in the agricultural industry based upon inputs received through submitted workplace skills plans and annual training reports from the agricultural industry. From these documents, the basic needs for agricultural training at the various levels is determined (AgriSETA, 2016). This data and other information were used to determine the impact of the agricultural diploma on the skills need in the agricultural sector. With this background knowledge, the following specific objectives can be addressed.

5.4 Data collection

The data and information for this objective of the study were collected by means of structured interviews with relevant stakeholders at agricultural colleges and universities and online surveys send to the agricultural industry, HEIs and diploma graduates. Various collection methods and participants were used to achieve triangulation by method and source (Meijer *et al.*, 2002).

The questionnaires were sent out with a cover letter explaining the purpose of the research and a link to the Survey Monkey platform for the questionnaire. The objective was to collect information from all the 21 institutions offering a diploma in agriculture, diploma graduates and the agricultural industry, requesting their informed opinions on competence required at the level of the agricultural diploma (NQF6). Table 22 below indicate the actions in the distribution of the questionnaire and the responses of the respondents.

Table 22: Data collection at higher education institutions.

Higher Education Institution Questionnaire				
Actions and activities	Sent	Responses	Bounced	Total
Sent letter to all HEI by email	21	19		19

Sent emails direct to emails of HEI staff	24	2	2	2
All HEI	21	16		16
2nd round emails	12	1	1	1
Total:	78	38	3	38
Response rate:		48,7%	3,8%	48,7%
Completed questionnaires		24		

Source: Survey Monkey report and own records

Information regarding the participants were as follows. The total of 28 staff members, from five agricultural colleges, two universities of technology and two comprehensive universities, responded either as part of an interview or by the completion of the questionnaire. Some 24 completed the questionnaires in full. Biographical information of the participants is captured in Table 23

Table 23: Biographical information of HEI respondents.

	Gender (n = 28)	**Number**	**%**
	Male	21	75,0
	Female	7	25,0
	Age (n = 28)		
	> 35	3	10,71
	35-55	17	60,71
	Over 55	8	28,57
	Average number of years of experience at HEI's	13,07 years	
	Qualifications (n = 26)		
	Diploma	2	7,69
	Bachelor's degree (including BSc and BvSc)	4	15,38
	Honours degree	4	15,38
	Master's degree	11	46,15
	PhD	4	15,38
	Positions (n = 27)		
	Lectures	6	22,22
	Senior lecturer	11	40,74
	HOD	6	22,22
	Head of school of college	2	11,11
	Other	1	3,70
	Institution (n = 27)		

	Agricultural college	19	70,37
	University of technology	2	7,41
	Comprehensive university	6	22,22
	Population Group (n = 23)		
	African	18	78,26
	Asian	0	
	Coloured	0	
	White	5	21,74

5.6. Data analysis

The data obtained through interviews and questionnaires was analysed to determine how the competencies are assessed at HEIs, and how to identify and describe the measures put in place to address the skills/competency gap. The data form the Higher Education Questionnaire, was captured on an Excel spreadsheet and imported into SPSS for analysis. The mean, standard deviation and effect size was calculated using Cohen's D test to determine practical significance.

5.6.1. Validity

The validity of the Question in the HEQ was tested using Cronbach's alpha and the results of the validity testing are reflected in Table 24, below the levels of the question ranged from good to excellent with ά = 0,71 to 0.91

Table 24: Validity assessment of the higher education questionnaire

Level of Reliability of Questionnaire Questions for Higher Education Institutions		
Question	Cronbach's Alpha	Level of reliability
9	0,776273	Good
10	0,750009	Good
11	0,918036	Excellent
12	0,715997	Good
13	0,844290	Very good
14	0,846887	Very good
15	0,752924	Good
16	0,859886	Very good

Source: Data from study

The Cronbach's alpha for all the questions is above 0,7 indicating good to excellent level of reliability.

5.6.2. Analyse the perception of the academic staff of the HEI regarding the competence needed by their graduate students

The respondents interviewed at HEIs were given a questionnaire that was similar to that which the agricultural industry and the diploma graduates to complete. Just as with the agricultural industry, the responses were ranked using the mean values , as 'Very/highly important' competence (mean > 4,5), 'Above average important' competence (mean 3.5-4,49) and 'Important' competence (2,5-3,49) (LaCharite, 2015a). The response of higher education is tabulated in Table 25

Table 25: Rated responses for higher education institutions

Soft Skills or 21st Century Competence			
Very/Highly Importance/Competence	**Ranking**	**Mean**	**SD**
Trustfulness	1	4.91	0.29
Good human relations	2	4.88	0.33
Work ethic	3.5	4,87	0.34
Professional discipline	3.5	4,87	0.34
Honesty	5	4,83	0.49
Internally motivated	6	4.78	0.42
Responsibility – ability to accept or take responsibility	6	4,78	0.42
Hard-working and diligence	6	4,78	0.42
Plan and directly oversee farming operations	9.5	4.73	0.55
Manage his/her time optimally	9.5	4,73	0.55
Problem-solving ability	10.5	4,70	0.56
Ability to collaborate with others (teamwork)	10.5	4.70	0.47
Keep accurate production records,	13.5	4,61	0,72
Decision-making	13.5	4,61	0.50
Critical thinking skills	13.5	4,61	0.50
Ability to diagnose a problem	13.5	4.61	0.58
Draft and implement project plan	16	4.52	0.60
Observe time limits and deadlines	18	4.50	0.61
ICT skills , operate a computer and software	18	4.50	0.63

Good verbal and written communication skills	18	4.50	0.71
Total		94.01	
Above Average Competence (3.5-4.49)			
Ability to see the big picture (holistic view)	19	4,45	0,67
Inductive and/or deductive thinking	20	4,43	0,79
Brainstorming and creation of new ideas - innovative	21	4,39	0,78
Provide technical support,	22.5	4,30	0,76
Keep accurate financial records.	22.5	4,30	0,76
Do stock control,	23	4,17	0,98
Perform administrative work,	24	3,96	0,88
Total		30.02	

Source: Data from study

Of the 87 competencies, 27 31.03%) of the competencies were classified as soft/21st century competencies. The top five of the competencies contain the some of the competencies as the agricultural industry, but in a different order. 'Honesty' is rated number 1 by the agricultural industry, whereas HEIs rate it at number 5. The same competence is regarded as 'Highly important', although the ranking differs.

From the above, the following stands out. From the 22 soft skills/21st century competencies, 18 were ranked 'very important', seven ranked 'above average Important' by the HEIs respondents.

The ranking of the soft skills/21st century competence was compared to that of the agricultural industry in the graph below. Three differences are indicated where HEIs ranked the competence substantially lower than that of 'Applying artificial insemination', they are 'Good verbal and written communication', 'Ability to see the big picture' and 'Innovation'.

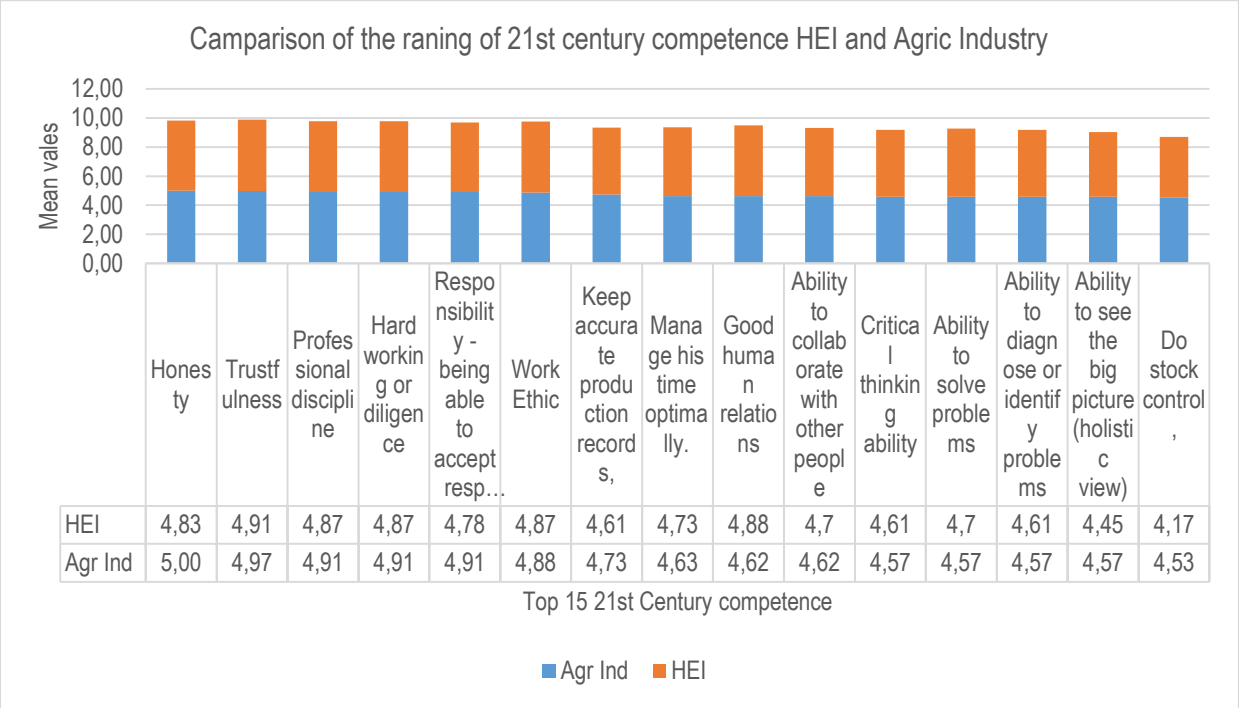

Figure 19: Comparison of the ranking of soft skills between higher education institutions and the agricultural industry (Source: Data from study)

The production or technical competence indicated in Table 26 below are mostly commodity-driven. From the 'Very important' category (4,5-5), seven of the 3563,6%) can be regarded as universal, applicable to all commodities. From the 'Important' category (3,5-4,9), 18 out of 37 (48%) competencies can be classified as universal, in that they are applicable to most commodities. This result strengthens the notion that the commodity organisations need to be involved in drafting the profile of competence needed for a specific qualification

Table 26: Production, *technical and mechanical skills as rated by higher education institutions*

Higher education respondents ranking of Production or Technical Competence			
Rank	Very Important Competence (mean 4,5 - 5,0)	Mean	Std. Deviation
1	Provide health care for animals,	4,60	0,74
2	Perform plant production related farming operations.	4,56	0,73
3,5	Correctly plant and cultivate plants.	4,53	0,72
3,5	Handle, mix and store agrochemicals correctly.	4,53	0,72
6	Maintain and cares for agricultural crops.	4,50	0,73
6	Perform animal production related farming operations.	4,50	0,76
6	Do fault finding and follow standard operating procedure	4,50	0,79
	Above Average Importance (Mean 3,5 - 4,49)		
8,5	Monitor and control efficiency of production.	4,47	0,72
8,5	Cleaning and disinfecting production facilities	4,47	0,74

10,5	Perform artificial insemination.	4,40	0,91
10,5	Be a stockman	4,40	0,83
12,5	Perform routine production tasks	4,33	0,82
12,5	Use an apply new technology	4,33	0,73
13	Do irrigation scheduling	4,32	0,89
14	Scout for pest and diseases.	4,22	0,67
15	Operates a manual irrigation system	4,21	0,85
16	Perform basic veterinary practices	4,20	1,01
17	Classify animal products	4,13	1,13
18	Control pest and diseases chemically and biological.	4,12	0,70
19	Clean and disinfect and maintaining biosecurity standards in processing facilities	4,09	1,23
20	Practice different soil cultivation methods to prepare a proper seed bed for planting.	4,06	0,83
21	Identify , monitor and control weeds chemically and mechanical.	4,06	0,90
22,5	Set, adjust and operate farm machinery and equipment	4,00	1,00
22,5	Marketing of Agricultural products produced or processed	4,00	0,82
24,5	Harvest animal products	3,93	1,10
24,5	Operate and clean a milking machine	3,93	1,14
26	Supervise activities in the processing plant or pack house	3,91	1,06
27	Plan and construct an orchard or a vineyard.	3,90	0,88
28	Drive and operate mechanical equipment,	3,86	1,11
29	Propagates and cultivates trees or plants.	3,82	0,88
30	Prune trees and scrubs.	3,81	0,91
31	Maintain an irrigation system	3,79	1,13
32	Install irrigation systems	3,68	1,00
33	Knowledge and skills for the processing of agricultural products	3,64	0,90
34	Drive a vehicle with a valid driver's licence (minimum code B or EB),	3,60	1,27
	Important (Mean 2,5 - 3,49)		
35	Perform minor repair work , replace warn parts and/or re-assembles components,	3,29	1,31

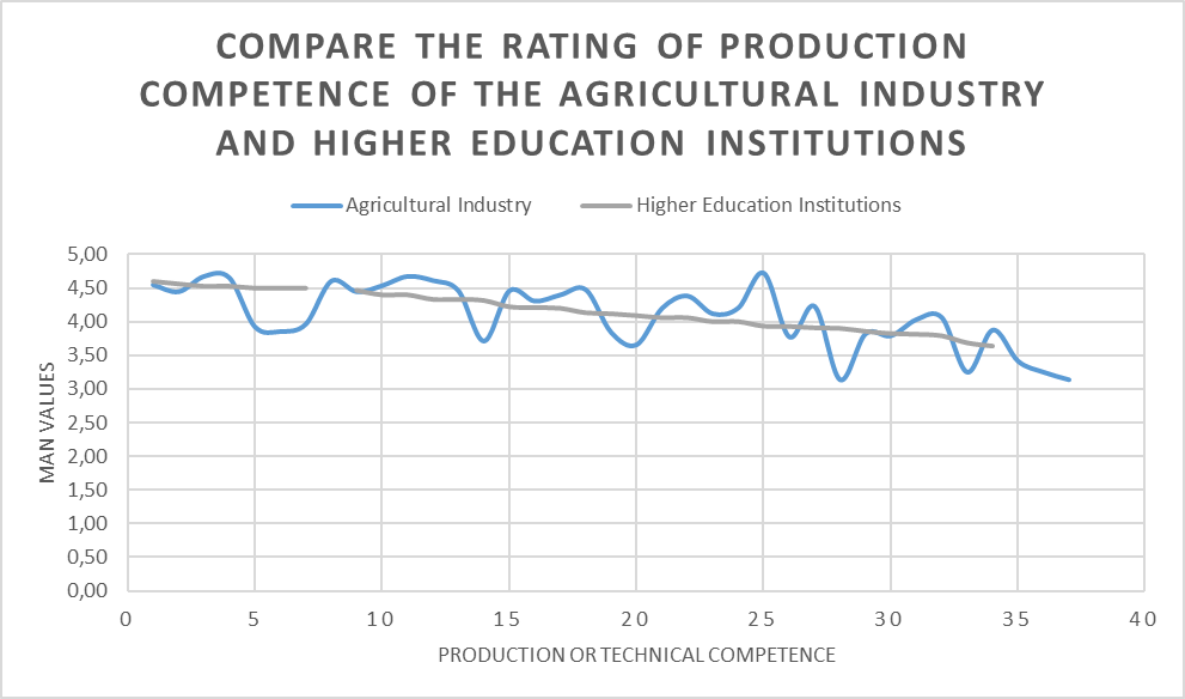

Figure 20: Production competence rating higher education institutions vs the agricultural industry (Source: Data from study)

Figure 20 indicates that the AI and HEI are in agreement in some of the areas but also areas of dissonance between HEIs and the agricultural industry. There are areas where the HEIs rated the competence higher that the agricultural industry; indicated by the peaks above the AI line, there are also seven instances where the HEI dips substantially below the AI

Two possible explanations for the difference are 1) lack of focus from the HEI's on practical competence needed, 2) the lack of collaboration between HEI and the Agricultural industry and 3) that the emphasis of HEIs is more on the management aspects than on the production and technical skills. HEIs stated that they train farmers or managers and not labours and according to them these skills are applicable.

5.6.2. Perception of higher education staff on competence needed

Competence was discussed in Chapter 2 and a number of definitions were given as a working definition competence in the workplace is define as *"the ability to perform roles and tasks required by one's job to the expected standard"*. From the information collected at the HEI's the perception is evident that the standard of competence expected at any given time will vary in relation to experience and responsibility considering the need to keep up to date with changes in practice. Competence is,

therefore, a relative term and increasing levels of competence will be expected throughout the professional career.

To promote the focus on competence the Agricultural colleges through the TACATI project formed a competence-based learning community of learning and action (COLA), focusing on teaching methodology and assessment (Chaminuka *et al*., 2016). The competence-based learning principle on assessment require that knowledge, skills and attitudes need to be integrated in the assessment process and that the learner needs to demonstrate the competence acquired. The use of self and peer assessment was also promoted.

One of the respondents provided a very fitting definition of agricultural competence as "the ability of an individual to use a coordinated, synergistic combination of tangible resources (e.g. technology, production inputs and equipment) and intangible resources (e.g. knowledge, skills and experience) to achieve efficiency and/or effectiveness in agricultural production." (HEI)

Other important observations made were that 1) minimum professional standards for different post levels general worker, section leader, etc. need to be established. The minimum standards increase with the management intensity of each level and the emphasis shifts from physical skills at the lower levels to larger application of soft skill at the higher levels. Improved knowledge and soft skills are required based upon a strong foundation of production skills. 2) The purpose of the diploma qualification need to be defined, and it can or will differ from institution to institution. Without a clear purpose of the qualification, it will be very difficult to set minimum standards or outcomes.

5.6.3 Other competence highlighted by Higher Education Institutions

The Higher Education Respondents expanded on the competence provided for in the questionnaire and emphasise the importance of management and financial management. The practical and hands-on skills are emphasised in the additional production skills they added. The information contained in Table 27 and 28 is the

competence that was mentioned by the interviewees and the respondents of the HEIQ and was recorded.

Table 27: Additional soft skills competence added by HEI respondents

Soft skills or 21st Century Skills		Reasons for Preference
Competence related to Management	Ability to draft a management programme	A person must be first of all … be able to set up a management programme because you can't just get to [be] a farmer, a management programme is like your work plan … you can't just pitch up at work and not know what you're going to do for the day.
	Management skills	Must be able to manage a unit successfully, strategic management, production management
	Time management	You see that they are struggling keeping their time management, change student behaviour [to] keep to deadlines
	Decision-making and collaboration skills	I think those are important for students who are coming from the agricultural institutions because they are going to work with people there and then now, they need to have that background in such instances
	Problem-solving skills	Need to apply thinking to solve problems
Competence related to financial management	Financial management	Able to keep financial records and interpret them
	Financial record-keeping	Must be able to keep production and financial records The bookkeeping of financial records is important as a farmer to know how to calculate all your cash flow and as well cash out flow
	Calculations	Agriculture is so risky you should be able to calculate a lot of the things
Personality	Work ethic	How you carry yourself. Passion for the job Energetic in doing work
Competence related to Human resource Management	Conflict management	Handle conflict effectively
	Communication	Must be able to communicate with workers and management, communication in workplace
	Human relations	Must have the ability to do the work Labour management People management Working on racism, people or workers must be treated equally
Records and admin	ICT skills	Computer application administration work

Table 28: Additional production, technical and mechanical competence added by HEI respondents

Production Technical and Mechanical Competence added by HEI respondents		
Practical orientation	Use his/her hands	Practical orientated and able to use their hands
	Ability to do the work	Must know how to use the tools of the trade
Production competence	Production skills	Animal handling , injection, dehorning, and weighing
	Seedbed preparation	They should be able to farm sustainably like your production practices and techniques, your swab preparation – your seedbed preparation Crop rotation is recommended to avoid other diseases in the soil
	Integrated pest management	Identify and control pest, this is important if you are to farm profitably and sustainably
	Quality control of the harvest and packaging process	Knowledge of quality control standards and the application thereof.
	Competence as described by the professional council	For Animal Health Programmes, the SA Veterinary council prescribe what the students should be able to do
Technical and mechanical	Tractor driving course	Farmers expect them to know what a tractor is and at least have the minimum knowledge of how to operate it.
	Machine operator skill	Must know how to use mechanical equipment
	Testing the efficiency of the irrigation system	Able to do fault finding and test the efficiency

5.6.4. Assessment of competence in higher education institutions

Assessment of competence is regarded as a process of gathering evidence on performance in more than one way in order to make a judgement of an individual's competence based on the evidence available (Watson, 1994). The day one competence is the ability of the graduate to be functional from the first day on the job and will differ depending on the position he/she will occupy, in other words to be work ready from the start. At some of the HEI's the day one competence is part of the curriculum, *"They [the students] are taught the most common things that are required by every animal technician to know, that the competency they must possess when they go to the field, and those actually become the kind of daily activities that they will be able to meet in the field."* (HER)

5.6.4.1 Assessment of soft skills

Not all the HEIs pay attention to the development of soft skills for various reasons. Feedback from the respondents highlight the fact that the soft skills do not get the necessary attention: *"[We] do not give enough attention to soft skills – communication, conflict handling."* (HER) and *"The only thing that we do is when the students come in as first years they are being given some sort of a test to measure their competency, how far do they know on different subjects. But we did not really tailor our approach to meet those shortcomings that we identified in this."* (HER). The lecturers need to

The lecturing staff also need to be made aware of the importance of the soft or 21st century competence to transform and find ways of incorporating these skills into the curriculum and assessment. The perception of one of the HER is: *"Those are soft skills that I don't think they necessarily come up very strongly in a diploma, because your focus is on production; your focus is to get a student that can plan, a student that can you know, take care of animals."* (HER)

Attention to the 21st century competence will improve the image of the institution, as it is dependent on the competence of its graduates. A respondent stated: *"It is important that we also work on that one to ensure that as we sent out students, we must also know that they are going to represent the institution, whatever that they are doing there, represents the image of the institution. So, it goes back to culture then. What culture do we instil to our students in terms of these learning and practicals?"* (HER)

Higher Education institutions need to identify the applicable soft skills fitting for their graduates and adapt their pedagogy to include the strengthening these competence through the day to day work of the students, or by means of additional programmes (Nakelet *et al*., 2017). When the students go out for WIL, these competencies should already be part of their 'toolbox' and they will then use and strengthen it during the time at the workplace (King, 2012; Romagosa *et al*., 2015; Cedefop, 2019)

5.6.4.2 Assessment of production or technical competence

Production and technical competence can only be assessed through doing as it was made clear by the competence assessment models explained in the literature review. Very little evidence could be found of specific models being used and it should become

a focus area. The lack of practical experience as indicated by the Agricultural industry is evident that practical competence assessment might be a challenge

The lecturers or higher education respondents (HERs) at the HEIs commented as follows on the importance and assessment of production or technical competence.

> *"…. Knowing those specific industries that they will be working in, but I mean if I look back at our own diploma that is mixed agriculture, then of course you would want to tap into various areas because you would want to come up with this graduate that can either go from planned to rural in any area or any enterprise. So, you must bring in all that kind of information and all that kind of experiences and theoretical exposure to that student because they can fit in anywhere in the industry."* (HER)
>
> ,*"… the current trends in the field of production are influencing our content at most. We are influenced by what the industry requires to always adjust our content, and this is what we are doing."* (HER)

There is also a misconception of the importance of competence as this respondent stated *"… they must definitely have insight to what's expected in the industry but be able to apply that in a supervisory role not necessary again being the operator but rather being the supervisor with the specialised knowledge for the, for the different enterprises which they would be involved in."* (HER). How can you supervise if you do not have the competence (Skills, knowledge and attitude) to know how to do the work of the operator and can show how it should be done? This notion is supported by the following comments of lecturers *"… at a far lower level they must know how to dehorn and how to brand, not necessarily stand in the kraal all day, be able to train their labourer and supervise correct procedures and be able to distinguish when the operation is not done to expectation."* (HER), *"… during exposure to the industry, the way it is happening, for instance if there is a new field on planting citrus, they do go there to support the operation. But the operation is happening, if there is planting going on, they [the students] will go there and participate in the operation. Obviously, you would not expect them to do a diligent job if they had not been shown in the first place."* (HER)

The assessment of the production and technical competence should be formalised and made available that the industry will be able to make the last judgement and improve the sustainability of the institution.

5.7. What measures are put in place to address the skills gap?

The research objective, to identify and describe the measures put in place to address the skills/competency gap, implies that transformation of the current system is needed. Roberts (2016) identifies three barriers that prevent the implementation of hands-on instruction in the agricultural education and training curriculum. The barriers are 1) appropriate facilities, 2) staff and their competence, and 3) the linkage between practical and theory (Roberts, 2016a). From this view point, to transform VOAET, the bridging of the skills gap should be approached at four levels, namely the curriculum, the training staff, the facilities and the students attending the programme. The four levels are discussed below, combined with suggestions that originates from the interviews held with staff at HEIs and from literature that supports the thinking.

5.7.1. Define the purpose of the diploma qualification

Before measures to address the skills gap can be addressed, it is important to have clarity about the purpose of the agricultural diploma as VOAE. Worth (2014) in his presentation at the SASAE conference (2014), presented his study, "The development of curricula for a diploma in agriculture in South Africa's colleges of agriculture" (SASAE, 2014). The study was conducted at three agricultural colleges using focus groups, and they defined the purpose of the agricultural diploma as follows:

"Historically the diploma was designed either to produce farmers (in the former 'white' colleges) or extension practitioners (in the former 'black' colleges) ... The focus group suggested that training future farmers should remain one of the four 'first-stop' career streams; the others were entry-level farm production manager/supervisor, private sector extension and agricultural education – the latter two with further training" (SASAE, 2014).

The higher education respondents supported the statement above and provided further input on the purpose of the diploma. They provide training to become farmers and entrepreneurs. *"What I'm doing is vice versa because we, the college, inherently is training the students that we are training most of them will be farmers some of them are agricultural extension officers and some of them are will be research technicians and some will work in the agri businesses."* (HER), *"But they should be able to, to over*

I'm teaching them to be commercial farmers, but they should be able to function with, if they were to be subsistence also or smallholder farmers." (HER), *"Our main focus is to train them to become their own, employers, like become farmers, but then as an individual I have realised that most of these students that come to the college to get this knowledge for employment."* (HER)

A further purpose of the Agricultural diploma is to enable the graduates to work in the private of government sector as Agricultural advisors, *"They will be there in the industry looking for a job. Not in the industry of a farm manager but a job of being like an office bound within the industry. But then of course quite a number of them have shown interest in getting farms. Unfortunately, there are no farms available for them now, we don't have any from the department. But we are looking for some for them, yes."* (HER). The HEI's train students to take up advisory positions in government, agri-business, training providers or NPOs. The graduates get the wrong perception of what the work of an agricultural advisor entail from the lecturing staff and governmental officials: "*the lecturing staff and those they meet in the field of agriculture look like those in the white-collar field. That is where you now can see people starting to change, they are focussing on white collar jobs*." (HER), the practical side of the work is negated by the wrong perceptions.

Training for middle management or supervisor level is also deemed to be the purpose of the diploma: *"I accede that we should aim at let's call it rather more a middle management, junior management exit rather than just educating labourers, so I think that the vocational orientation whether it is specialising or general should aim at a junior management level."* (HER), *"on a practical but on a supervisory level not on a labourer level. So I definitely believe that we don't use educated labourers we produce people with potential to become managers."* (HER)

The responses of the HERs correspond largely to what Worth (2014) describes as the purpose of the diploma to train farmers of first level managers who have first day-job competence: *"We are training our students, so they can be able to apply whatever theoretical information that we give. So, we make sure that they are able to apply, we call it Day One Competency. If they are employed, they must be able to do it."* (HER).

Although the intention of the diploma programme is to train farmers or middle management farm managers there is also the unique South African challenge that should be kept in mind and expressed by one of the participants. *"… but then as an individual I have realised that most of these students that come to the college to get this knowledge for employment. Some 50% of them come here to learn about agriculture, but 50% come here to get a steppingstone to further their education. Not all of them [will end up on the farm]."* (HER)

5.7.2. The curriculum

Worth (2014) recommends a flexible curriculum that make provision for first day competence consisting of knowledge, skills attitudes and behaviours expected of a diploma graduate on the first day on a job (SASAE, 2014). His focus group developed the following description of a graduate as *"a technically competent graduate with knowledge and skills to manage livestock or crop production with minimal supervision in the context of a profit making farm business"* (ibid). The focus group proposed further that all diploma programmes should be organised around the following key learning areas (ibid.): Agricultural production, Farm business management, Natural resource management and Farm engineering

Michele Dominique Raymond, Assistant Secretary-General of the ACP group, stated the following in the foreword of the publication *Changing Agricultural Education from Within*: *"Universities are well placed to spearhead this change, but to effectively do so they need to update courses' content and change the way they are delivered. In particular, changes at an institutional level are required to transform the long-held negative image of universities as backwaters populated by egotistical academics and bureaucratic administrators. The African university must become better positioned to be a facilitator of agricultural innovation, technology, institutions and development"* (Ochola & Heemskerk, 2013).

One of the recommendations of the ASSA report on the revitalisation of agricultural education and training in South Africa (2017) is that, *"curriculum alignment between institutional types is inadequate and governance structures do not support articulation*

and mobility within [the] agricultural education and training system" (Swanepoel, 2017).

HEIs need to align their curriculum as a measure to bridge the gap, and review where necessary. They also need to develop apart from a vocational-orientated pedagogy also a vocational identity (Rudman & Meiring, 2018). The starting point of the curriculum review is that what the diploma graduate needs to do, the job profile. Involve the commodity organisations, in the agricultural ecological region of the HEIs (Chaminuka *et al*., 2016; DAFF, 2015; DAFF, 2018), in the review to ensure that the HEIs will be able produce the graduates with the competence that will be excepted by the industry. This thinking is supported by respondents for HEIs.

"The industry is the receiving end of the students that we produce. What we do should be informed by what the industry is expecting to get. So now it's … we must ensure that the industry has an input in developing our curriculum in the programs that we offer." (HER)

It is also necessary that the essence of vocational-orientated education is understood and implemented, more about that in Chapter 7.

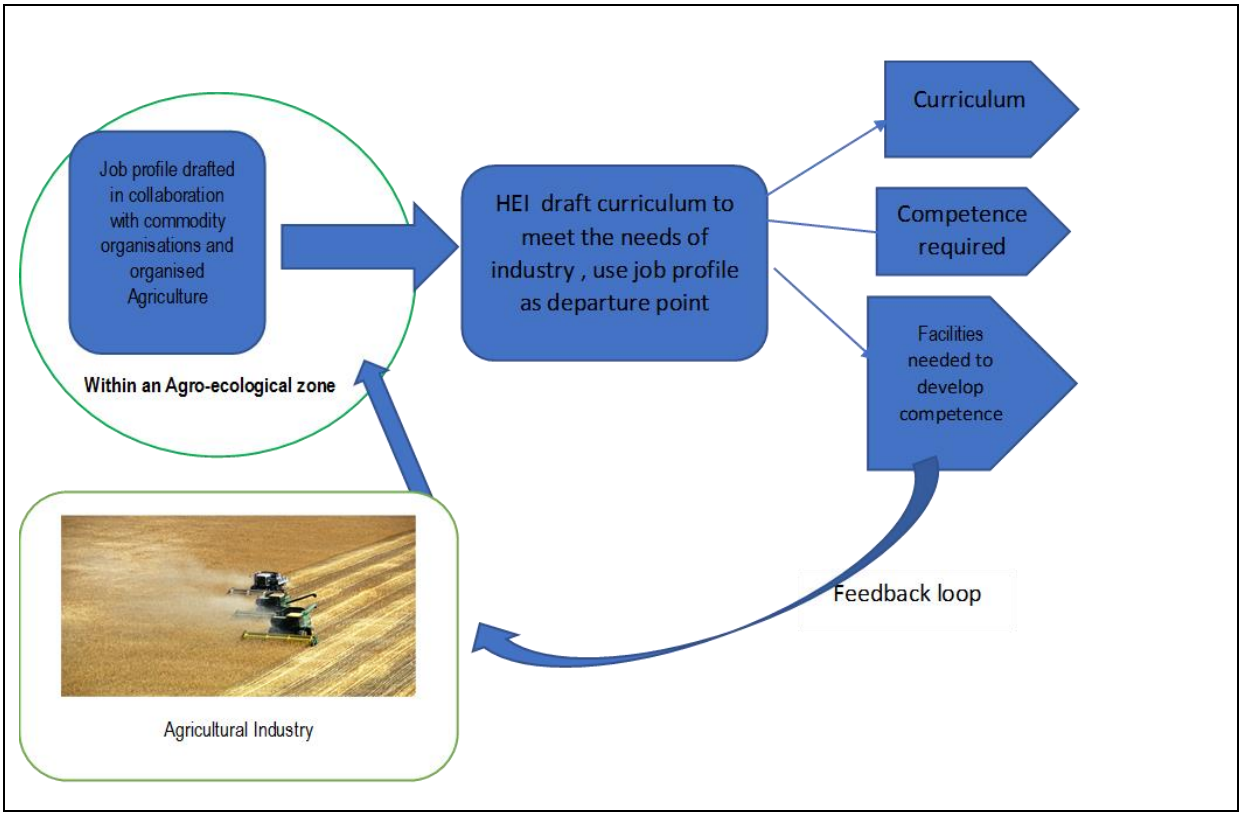

Figure 21: Elements for curriculum review (Source: Researcher's own diagram)

The HEIs should also take stock of the facilities available, that can be used to develop the competence. If it is not available, can it be put in place? The collaboration with the industry can be truly relevant here to help with the required facilities.

Important additional consideration for the curriculum development are the laddering facilitated by the level descriptors for each NQF level (CHE, 2013; DAFF, 2018) and the articulation and prior learning of the students. Students from some of the agricultural high schools may already have some of the competence and HEIs need to ensure that their teaching is above that or the school level.

Laddering, as illustrated in Figure 22, and the advancement of learning is facilitated by the level descriptors. The level descriptors give a clear indication of what the graduates should be able to do at the end of that level, combined with the industry requirements will result in a curriculum that will address the needs of the industry and bridge the skills gap.

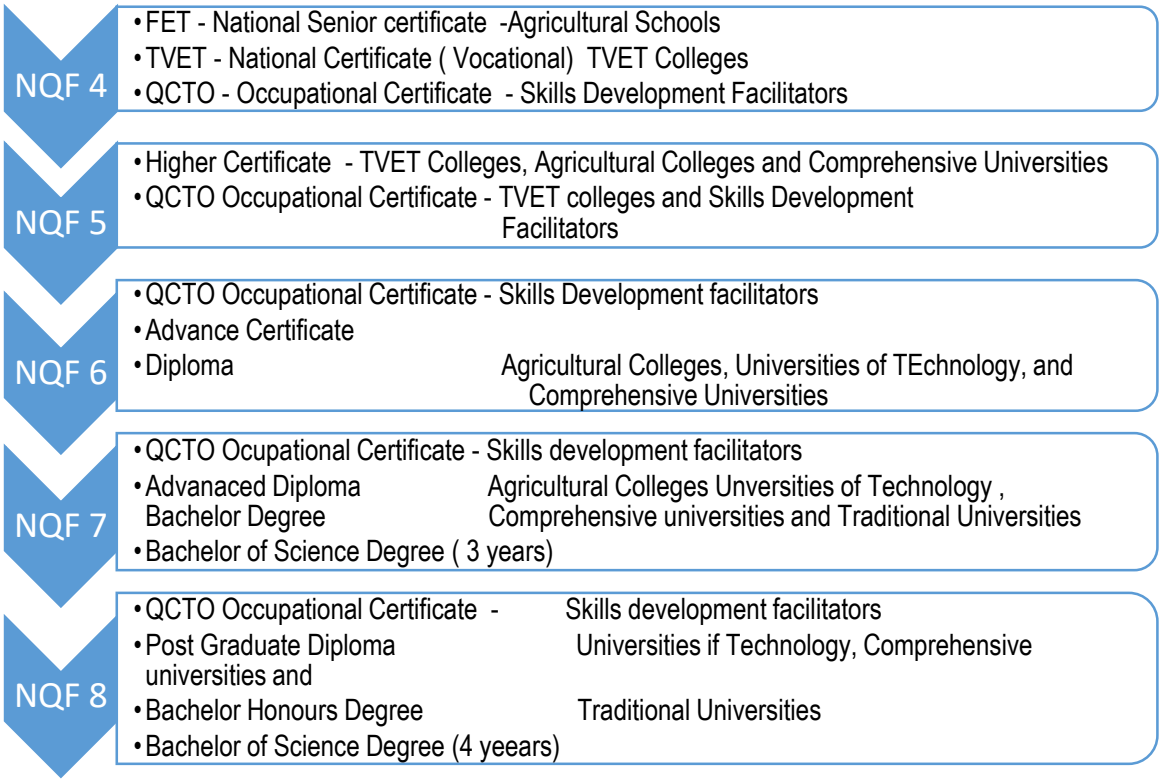

Figure 22: Laddering of qualifications on the NQF (Source: Researcher's own diagram)

Ratio between theory and practical is an area that need to be defined once again – it will differ from one institution to the other, but a clear guideline will assist with the

credibility of the qualification and a balance of 50% theory and 50% practical is what is advocated in the proposed model for VOAE in Chapter 7. The views of the HEIs participants on the curriculum are captured under the following themes identified from their responses.

Theory and practical. There should be a good balance between theory and practice. *"I am getting here about vocational training is that it is mostly practical work, so with that being said you cannot just go and train a diploma education like you are training a handler because a handler is strictly practical, so you just train them this is how you inject this is how you did this, with this one you have a balance a good balance between theory and practical."* (HER)*, "So to mean that before you tell people this is where you inject you explain why you are injecting only in the muscle, only in the veins or why under the skin, the consequences with the drug being made to mostly absorbed in these specific areas together with drugs that can go into the veins and drugs that cannot go into the veins, now you are educating someone who has gone into higher education institution."* (HER), *"It is in terms of how do we deliver the training to the students should not necessarily be more theoretical, and there must be a balance between theory and practice and that training also has to be informed about what is happening in the industry."* (HER). What is clear from the above that the balance between theory and practical need to be found and it will differ form programme to programme and innovative ways need to be found where the theory can be taught through practical and the students use their practical experience to have a deep understanding of the theory.

On the question what should the balance be between theory and practice? The respondents reflected as follows: *"We concentrate more on the learner; the students being hands on at the fields in most cases than being in their classes."* (HER), *" In our institution right now, because actually in our institution, right now, our emphasis is, that most of the work should be practical. The theoretical concepts they get that in the training, in the course, but most of the work is practical. For example, we have from the second year there is a Wednesday dedicated for primary healthcare where they actually participate in, and we organise some vaccination campaigns for example and they participate in vaccinations, and injections and so on and inoculations, and those functions."* (HER), *"I think; the training does not entirely put aside the theoretical component. We still offer a theoretical component, but up to a certain percentage. So,*

it is true that small percentage, where we try, by all means, to bring the element of better understanding to the students, with regard to the training and what they should be able to know, versus the skill that they are gaining as well." (HER), *"I can say [they]50/50."* (HER), *"Yes, the theory teaches them the basics and why and how and give them the basic information on hygiene and all that and the precaution that they need to do."* (HER), *"Then again, even in our exams, you find that we have given a practical for each module, but you normally see that in every exam there is an integrated practical whereby they are examined on all their practical knowledge that they have gained so far in that semester, in that course, in that year, you see, and our practical carries more weight than the theory. It is 60% practical and 40% theory."* (HER)

From the above, it clearly emerges that although practical work is done, there is no consensus on the ratio between theory and practice. What is also of importance is the quality of the practical work and the assessment there off. The integration of theory and practical necessitate investigate into the development of vocational-orientated agriculture pedagogy.

5.7.3. The teaching of lecturing staff.

The teaching staff is one of the critical areas for success. Teaching vocational-orientated agricultural programmes requires a high level of competence from the lecturers, who must disseminate knowledge and demonstrate the practical work step by step to the students (Deegan *et al*., 2016). Rudman and Meiring in their article "Transforming vocational education; one lecturer at a time" advocate a professional development programme for vocational-orientated programme lecturers to prepare them for the unique challenges of vocational-orientated education (Rudman & Meiring, 2018).

The HERs responded to practical experience of lecturers as follows: *"Many of the lecturers that are employed come from the industry and then also number two, we constantly … interacting on a continuous basis with the industry like we go to farmers, we go on excursions, we even take our notes to send to GrainSA to see if it is really aware what we are doing is it in line with what they are needing because we're having in mind that the students should be employable."* (HER). On engagement with the

Industry they remarked as follows: *"you need to engage with people in the industry as well. And also, because we need to belong to society as well, if you're in production you need to either belong to the society or your, what is it, your crop society as well. And that is a way of actually staying abreast of what is happening because there are articles and journals coming out in your own field, then you are invited to conferences and there you are able to actually engage in the topics of what is relevant, what is actually happening in your field."* (HER). They also remarked on their own involvement in the industry; *"I am actively still involved as a consultant. I used to be an extension officer as well so I in my personal capacity but officially on … with an official time are active at presenting at farmer's days, I have eleven farmers that I still consult on their herd selection etcetera. I am involved with a few companies, so I try and keep an active involvement."* (HER).

In a study at the School of Agriculture of the Makerere University (2017), it was found that the lecturing method of teaching remains the most dominantly used mode of teaching, causing universities to appear rigid (Nakelet *et al*., 2017). As the transforming agents, lecturers and lecturing supports staff need to rethink their teaching approach and pedagogical competence. Nakelet *et al*. (2017) suggest in the study that there should be a continuous building of the individual's lecturers' capacity in basic pedagogy and adult learning concepts.

To consolidate the information provided it is evident that agricultural teaching need to take emphasise both theory and practical to develop competence. There is however a fine balance between knowledge and experience, subject knowledge as well as pedagogical knowledge, practical agricultural experience and experience in teaching how to ensure the knowledge and skills are transferred. Another important aspect to remember is that you are not competent if you did something once.

5.7.3.1 Pedagogical competence of the lecturers and other training staff

Most of the lecturers at HEI's are agriculturalist who became lecturers and do not necessarily have an educational background or qualification. Very few of the HEI's have a clearly defined pedagogy for their vocational orientated teaching. Form resent studies in VOE it is evident that, there should be a strong focus on practise-orientated learning methods and particularly on workplace learning (Cedefop, 2019). The strong

focus on work-based learning suggests that teachers and trainers in vocationally orientated education have a professional background or gain work experience more often than lectures in more academic programmes (ibid.). The practical knowledge of the lecturer is also emphasised by Deegan *et al.* (2016) when they state that *"teaching vocational-orientated agricultural programmes requires a high level of competence from the lecturers, who must disseminate knowledge and demonstrate the practical work step by step to the students"* (Deegan *et al*., 2016).

It is clear from the responses' and literature that a holistic approach to the development of a pedagogy for VOAE and the improvement of pedagogical skills is to be considered, consisting of three dimensions, namely: 1) Defining of pedagogical competence of a lecturer in VOAE; the minimum professional standards which should enable a person in fulfilling this particular role. 2) Development of representative taxonomies and highlight current competencies. The taxonomic classification refers to the basic competence involved in the role of the graduate to perform tasks or lead a work group and 3) to narrow down the framework of a holistic representation of competencies for an agricultural career, with the two broad categories of general competencies and special competencies.

5.7.3.2. Facilities to implement vocational-orientated education through supervised and routine practical

Quality VOAE is not possible if the facilities to do the practical work is not available. During the semi-structured interviews with the staff from the various institutions, the role and format of practicals at the institution was discussed at length. The focus in this discussion was more on what was the current situation at agricultural colleges and might be bias towards them, since limited cooperation was received from universities of technology. The aim of practical work in any form is as one of the respondents said: *"We try to expose them to the practice and to keep them up to how it's done these days."* (HER)

5.7.4. Different forms of structural practicals

The following forms of practicals emerged from the interviews and is summarised below.

Structured practical training

Structured practical training (SPT) is generally a practise-based training requirement needed for registration in different occupations. It is an assessed practical where students receive marks for their practical work and are assessed if competent. The students in the Animal Health programmes need to do practical work and demonstrate competence as listed by the South African Veterinary Council. A SPT programme allows applicants/candidates to develop their competence and demonstrate the competence. A good example of SPT is a training programme/course in artificial insemination.

Lecturers responded as follows on SPT: *"We have what we call structured practical training like your production planning where you would teach them to set up management programs to do fertiliser recommendations and those. But for the animal production we do that and also for some of the production practices because what we do in theory for agronomy we'd do, if we did the calculations for a yield estimate in, in theory or in the practical we also go out on the field and do the actual yield estimate*. *So now with structured practicals we touch on certain areas that we think are key that they might not have covered during that time and obviously those aspects that are subject-specific now that you want to cover*." (HER). The STP is incorporated into the teaching programme: *"That goes hand in hand with what's happening in class or an extension of what is happening in class*. *First, I do the lesson plan. I created a term [plan] for the class attendance and the time for practical field lessons and student participation in practicals."* (HER)

At another institution they had a different programme: *"What we do is every lecturer has a way of how to handle the course. Firstly, in the beginning of the year, they state how are they going to do it; and the practical comes the end after theories. After lunch, they do the practicals inside the college or outside so those practicals are counted on their marks. This is prepared before they start."* (HER)

Practical training class

Practical Training Class (PTC) is the practical extension of the classroom; where the theory is explained in a practical situation and skills are developed in the field, laboratory or workshop. *"[This is] the structured one that I reflected on the timetable. You must go to class, of course, we need to cover the theory part; but we need to*

expose them to more of what's happening in the field. The practical exposure of things and them being able to do it themselves. You cannot talk about a vegetable in class and not be able to plant a vegetable yourself. Normally, much of the work happens in the field of practice done in the class." (HER). The purpose of PTC is to demonstrate the skills needed and to allow the students to do it themselves. *"… they do that. But before they can do that, it is always expected that those people who are based on the farm, make sure how it is done in my presence … and also, so that these students know exactly what is being done there; the farm workers play a critical role in the practical work of the students."* (HER)

Field practical training

This is a form of experiential learning where students are learning by doing in addition to the theoretical work (Oladele *et al*., 2011). At some HEIs, they use external environments to allow the students the opportunity to gain the practical skills and competence. They explained as follows: *"Our research division owns the herds. We don't own our own herd at the college, so we try and be very active in doing the actions for the research divisions so when they are busy weighing."* (HER),
and *"The private vets are scarce this side – very few – but what we normally do, is we take our students to those farms, where the farms are, just for practical, we send them for practical, but not for placement."* (HER)

Prior arrangements and planning is necessary for successful practical sessions. *"Before they (the students) go to [the] piggery, they (the lecturer) make arrangements with whoever the technicians are at site. So, it is incorporation of knowledge, the lecturer taught them in class and what is [applied] there."* (HER)

Service-learning practical

Service-learning practical (SLP) is where students studying in a specific programme render programme-related services to the community and thereby gain valuable experience and insight. Examples of SLP at agricultural HEIs were given by the respondents: *"We have from the second year; (there is) a Wednesday dedicated for primary healthcare where they actually participate, and we organise some vaccination campaigns for example and they participate in vaccinations, and injections and inoculations, and related functions."* (HER). *"[The] animal technician out in the field, for example, [performs] those simple castrations, [on] the cattle and the sheep and*

goats – those are the simple ones that they normally perform in the field. But not for horses, the dogs, not for the cats, not for the horses. Then, also the other procedures that they learn, they must come here and do all the animals and like how to apply certain medications. Simple medications." (HER), *"They [the students] get exposed and participate in the simple procedures like taking the temperatures and the pulse rate, the heart rate and respiratory rate of the animals as well as taking the history of the animal from the farmer, and then they get exposure to the procedures that we perform in the clinic. Then there is also when it comes to primary healthcare, there are some of the procedures that we organise within the clinic, so that they get to participate in that simple things like dosing, injections. The simple injections which are not putting a danger to the animal. Those are the ones they participate in. Everything is under supervision."* (HER).

Routine practical

Routine practical (RP) is practical activities that is done continuously in the mornings or afternoons for a period of time at a specific section of the institution's farm or agricultural facilities; doing the routine work that is required and related to daily production activities. The students are normally working in groups doing the routine practical work, and they need to improve their practical skills, as more and more student study agriculture without an agricultural background (Kensinger & Muller, 2006). RP is a form of social learning where people learn from and with each other and as a result, they individually and collectively become more competent (Barth & Rieckmann, 2012).

Although the RP work is done differently by the different agricultural colleges and universities, certain characteristics and requirements was picked up: Facilities to do the routine practical is essential and the students need to be close to the facilities: *"... if it is [the] feeding of the pigs, let them do the feeding. If it's maybe in the morning, but, like I've said normally, it's in the afternoon and the cleaning part is done, it's either the feeding of the pigs, maybe the cleaning of the compartments late in the afternoon."* (HER). An induction programme is followed to give background: *"The first one to two months of their entry into the subject, they're working with the farm workers and the lecturers showing them how to do it. Thereafter they are allowed to do the work on their own."* (HER).

The practical takes time at set periods daily to understand the activities and the rhythm of the farm: *"... in the mornings from 06:00, they go for the farm skills, so that they can look after the animals."* (HER), *"… because every afternoon our students must be at the fields and from 8 to 12 they are attending their classes; after 12 all of them should be at the farm."* (HER), and "…*they leave at 17:00 depending on work, basically 14:00 to 17:00."* (HER).

The students learn observation skills and the importance thereof: *"… they can detect whatever they find in the animals, whether the animals need to be sent to a bull if it's a cow or heifer. If the animal is sick, they can be able to detect it. So, if the animal is sick, they do; they quarantine the sick animal from the rest of the flock."* (HER)

Provide an opportunity to apply theory in a practical situation: *"... our students are definitely applying some of the practicals or doing some of the practicals at the farm and as well as taking them outside to the industry."* (HER)

Provide an opportunity for specialisation: *"They [second-year students] do other practicals, maybe for nutritional, but, when they are first years, two hours in the morning, two and a half or three hours. They must work in the farm, feeding chickens, doing this, maybe doing the cropping. [During] the first years, they do everything."* (HER)

Observation practical

Observation practicals (OBPs) take place where students observe what is done and normal linked with excursions, or visits to other farms or agri-businesses such as feedlots or processing plants. The students can ask questions, but are not physically involved. OBPs can also take place when students attend farmers' days, demonstrations, shows, auctions or exhibitions. *"With my third years, I very strongly promulgate attendance of farmers' days and I try to get there when there's a farmers' day in their region to assist them. I take them to auctions; whenever there's an auction I try to be there with the students so that they can see what's going on today, especially when using blood figures, etc. So it's the hands-on approach."* (HER). OBPs can also be used when it is not possible, risky, to costly or not practical to allow students to do physically be involved. *"That is where the practical side comes in. I mean for a*

company, if you are teaching them about castration, they must look for the specific procedures you know to be able to perform that practical." (HER)

Simulations can also be used for practicals, where students can practise on models or use equipment in simulation before it is done in a real-life situation: *"We even have the structures for anatomy and physiology; we even have the models."* (HER)

5.7.4.1. Practical facilities and alignment

The concept of the teaching farm has been embedded in agricultural education over decades and is still truly relevant to provide hands-on education, where students can learn by doing. The value of the teaching farm is that it plays an important role in the education programme to achieve higher cognitive thinking and to integrate the different academic programmes for VOAE, which cannot provide graduates with the required competence if there is no place where they can get practical farming experience (Monaghan *et al*., 2015). The work of Bloom, Dewey and Kolb emphasise the importance of learning by doing (all cited in Monaghan *et al*., 2015).

The use of the teaching farm as an extension of the curriculum and classroom is advocated by many (Kensinger & Muller, 2006; Oladele et al., 2011; LaCharite, 2015; Monaghan *et al*., 2017; Swanepoel, 2017). The provision of facilities that are addressing the practical need and keep up with rapid technological changes is essential; and it is an area where cooperation and collaboration between the institutions, commodity organisations and the agricultural industry need to be developed. The teaching facilities play an enhancement role; it provides complementary activities to complement primarily classroom-based programmes.
The accessibility of practical teaching facilities is of importance in order to allow students the opportunity to visit it frequently, and can – without big logistical planning – be used as a learning facility; an off-campus farm curiously limits its role as a utility in the earning process (Monaghan *et al*., 2015).

All the agricultural colleges are situated on farms which makes routine practicals possible, as the students are on-site. *"What we do is we have the component of the farm and the academic component, so the academic person both talk to the farm manager, this time we will be doing this part of the curriculum, they should be aliening*

of what they are taught in the class room. When the teacher goes that side, let's say they talk about the pests, they should be prepared by the farm manager to talk about pests." (HER)

Student managed mini-farm/practical farm. A number of HEIs have a mini-farm – a small demonstrative mini or student farm unit – where practical work can be done without it negatively affect commercial farming activities. The mini-farm can be student managed units or project based units (e.g. broiler project) that are operational for the production period. As a respondent said; *"It is on a very small scale. It's unlike any farm where now they are going to be exposed to all those challenges, maybe with diseases because the livestock, there is large stock you need, then you find that the challenges there, which are more, and the students would be getting more and more experience in being hands-on."* (HER), and *"We do have our farm where the students are conducting their practicals."* (HER)

Work-integrated learning

Work Integrated Learning (WIL) is a structured practical approach where the students are place in the workplace situation for periods ranging from six to 12 months, to apply what they have learned and to gain further practical experience. It is explained by the respondent that *"WIL normally happens during the final year. In the third year, its only it is strictly practical because [the students] have to be on a farm, preferably a commercial farm, but they can even go to research institutions like your ARC, where some of them are working as agricultural technicians."* (HER). Other HEI's do it similarly in that the *"Students in the third year are placed in different farms or agricultural enterprises and agricultural industry where now they gain their hands-on experience and practically on what the farm is involved in. They spend a whole year there and they are monitored by their mentor who is the farm manager or the owner as well as lecturers who visit them at their workplace. There's a checklist that is being followed to determine whether all the aspects that they are expected to, to get will be checked yes."* (HER)

- Critical information regarding the WIL practice was highlighted during the interviews and is stated below:1) **Duration of WIL:** At some institutions, the WIL programme *"… runs for the whole year and the student must be on the farm for a minimum period of 11 months"* (HER), other HEI do a six month or eight-month placement,

the rest of the year the students complete on campus finalising the reports and outstanding assignments. 2) **Visitation of the on-farm-students:** Students are visited at least *"… two times; the first time we go to check if the student is properly placed … during [the second visit]"* (HER), the farm visits provides opportunity for feedback from the student to discuss challenges at work or with the assignments but also for feedback from the mentor on the performance and behaviour of the student. 3) **Student support:** *"… from the day that they start with their third year, I created a WhatsApp group and we have active interaction with them"* (HER). It is very necessary to provide a support structure where the students can communicate and get advice. 4) On-farm mentor: *"… that the mentor on the farm knows what we expected of them"* (HER). WIL is a learning process and the students need a mentor that can provide guidance, support and encouragement. The Mentor will also assist with the assessment or capturing of competence. 5) **Assessment of the student:** *"During the WIL period, the student has to do six assignments; two are compulsory and then four are electives. They also need to keep a logbook of activities"* (HER). The learning that takes place need to be assessed and the assignments need to be externally examined as it is the final year of a qualification. 6) **Placement venue:** *"Students are responsible to find space for placement".* The institution is responsible for the accreditation of the workplace. There are also difficulties in placement as there are not enough farms and they *"are struggling to get some of the weaker students placed; there's still some of them still not placed on farms"* (HER). HEI's with large numbers of student's experience problems with the placement of students and the visitations, and 7) Nature and purpose of workplace placement is for the students to **gain experience** and not to be abused. *"I am very strong on it that we're not training educated labourers and that I don't actually want the farmers to use them as such"* (HER).

Workplace placement is for many students a reality check because **f**or many of them, the WIL period is where they experience first-hand what farm work and agriculture are about. *"Now you sit in third-year level where they are shocked now, a lot of them are on farms where you are working throughout"* (HER). This is a first time work experience and for many the pressure of work and study is an unknown. During the WIL period the students get to do with reality of the workplace and need the support from the workplace and their Institution of Higher learning.

4.8. Comment regarding challenges with facilities to do practical work at higher education institutions

The lack of facilities is one of the most critical factors determining the quality of learning and negatively affecting the competence of the graduates. The following were identified as challenges regarding the facilities at the HEIs interviewed and are captured in Table 29 below. This comment from an HER summarise the discussion regarding facilities. “I have just indicated that we do not have sufficient facilities to compliment the critical need of the classes, of the subject.” (HER)

Table 29: Challenges at higher education institutions regarding facilities

Challenge	Explanation or reasons
Availability of internet	Availability just in certain facilities, irregular availability, bandwidth. Availability after hours.
Availability of ICT facilities	Only one venue, problems after hours.
ICT programmes	No electronic farm management and financial management programmes available for teaching and record keeping purpose, such as Pastel
Payment of service providers	Irregular payment of service providers and the procurement process.
Availability of funds	Not enough funds, no control over funds, no income from produce.
Availability of new technology	Affordability of new technology vs the training need.
Procurement process	Procurement process hampers the procurement of the latest technology. Not understanding the training needs. Price escalation on tender procedure.
Ownership of facilities	College facilities are shared by other government departments.
Bio-security issues	To do practical at other facilities is difficult due to bio-security issues, also the loss of production can become problem “*the difficult part in terms of your piggery and poultry, at this stage, your biosecurity. So, rather to say to the industry, instead of us going to your place, help us to develop ours*.” (HER)
Specialised practical facilities	Facilities such as processing facilities – abattoir, or pack house not feasible at the HEI and need a collaboration agreement.
	Availability of laboratories for analysis and research. Pest and disease identification. Availability of workshops for technical and mechanical training.
Number of students	The facilities need to be sufficient for the number of students, large groups cannot be accommodated due to safety risks, time spent at the different facilities also become an issue with large groups.

Labour and staffing	Appointment of farm management and technicians is a problem, farm labour problems with working hours and employment conditions. Age of farm workers.
Outdated equipment	*"Old but are still very usable."* (HER); *"The planter that we use, we may use the planter which is still working, functioning properly."* (HER)
Different commodities	It is not possible for the HEIs to have all the commodities available for practical; therefore, collaboration with farmers in close vicinity where students can do practical visits.
Political and financial constraints	*"But because of the political and the financial constraints, it has not been able to happen yet. But still there are talks that are being put up."*

Source: Data from the study

5.8.1 Possible solutions to compensate for the lack of facilities

The HEI respondents provide possible solution and suggested the following; 1) Simulations, through internet connectivity the students can, *"do get in touch with the latest developments and that is helping education and training"* (HER). Computer aided learning to show models and how equipment work will contribute to better understanding but should not replace hands on experience. 2) The use of observation practicals, all HEIs do not have access to the latest technology used in agriculture, but with good relations with the input providers' observational practical can be used to expose the students to the high-tech equipment: *"Normally addressing the high-tech equipment/technologies we take our students to these industries so that [they] can see; unfortunately, they not be allowed to be hands-on on those technologies/machines/equipment, but they are able to see the advancement of these technologies when we take them to these industries. We do go to these industries a lot"* (HER). Through collaboration between the HEI and the Industry a workable cost effective solution can be found

- Partnering with commercial farmers and other farming units to make practical opportunities possible: *"We are utilising the outside facilities, we are also utilising the dairies outside the campus like the Amadlelo, we use them for the dairy, we are also taking our students to other farms, so that they can be exposed to certain things that we don't have. Then also the commercial piggery, commercial poultry [unit] that is being run in Umtata by Correctional Services. We normally take our students there, so they get that exposure"* (HER). This collaboration provides a short term solution as the students and not fully exposed to the rhythm and activities of the farm. 4) Establish a mini farm for practicals*: "We have a mini unit that is up to the*

standard of the industry. Then we can put the students through the practical here without the danger of biosecurity problems on that side" (HER). Practical demonstration units or sites allow for hands on experience and can be used successfully. 5) Seminars and guest lecturers: *"… we also conduct the student seminars where we invite the industry to come and share with us the latest developments taking place in the environment that agriculture is operating in"* (HER). Furthermore, *"we do this symposium as referred to in second year, because that also, you need to go out as individual lecturers to go out and come up with topics, what is it that you are talking about in the industry?"* (HER). To explain and verbalise what the learner is doing promote learning and strengthen competence

5.8.3 Measures put in place to improve competence

A need exists to benchmarking agricultural education (Naylor, 2003), the need for a quality-assurance body that can do the benchmarking of competence and describe the industry expectations regarding the standards for awarding a qualification at different levels. To formulate the attributes and capabilities that graduates who possess such competence should be able to demonstrate to achieve the qualification (Naylor, 2003). The purpose of a benchmark statement is to provide a consistent reference point for programme content. The suggestion of a professional body for VOAE will be further discussed in Chapter 9.

5.9 Collaboration between Higher Education Institutions

Collaboration possibilities for the ATIs and universities offering a diploma or degree qualification in agriculture is possible by linking the HEIs as per Table 30. The different role players – HEIs, the agricultural industry and students (grouped together) – is in a symbiotic relationship or partnership to warrant effective VOAE programmes (Orrell, 2004). All of the partners need to take responsibility for activities and action. The agricultural industry, through the link with commodity organisations, draw up the competency standards for the different commodities and partner with the HEIs to provide support and feedback to promote quality education and training.

Table 30: Possible collaboration between higher education institutions based upon their location and agro-ecological area.

Collaboration Possibilities for Agricultural Colleges and Universities in the Different Provinces of South Africa	
Agricultural Colleges .	**Universities Offering Agriculture Qualifications**
Western Cape	
Western Cape Agricultural Training Institute	University of Stellenbosch
	Nelson Mandela University (George Campus)
	Cape Peninsular University of Technology
Eastern Cape	
Fort Cox Agricultural Training Institute	Fort Hare University
Tsolo Agricultural Training Institute	Nelson Mandela University (Port Elizabeth campus)
	Unisa (Diploma Animal Health)
Grootfontein Agricultural Training Institute	Central University of Technology
	University of Free State
Free State	
Glen Agricultural Training Institute	University of Free State
	Central University of Technology
North West	
Taung Agricultural Training Institute	North West University – Mafikeng campus
Potchefstroom Agricultural Training Institute	North West University – Potchefstroom campus
	Unisa (Diploma Animal Health)
Gauteng	
No agricultural college or ATI in Gauteng	UNISA – Florida campus
	Tshwane University of Technology
	University of Pretoria
Limpopo	
Tompi Seleka Agricultural Training Institute	University of Limpopo
Madzivandila Agricultural Training institute	University of Venda
KwaZulu-Natal	
Cedara Agricultural Training Institute	University of Kwazulu-Natal
Owen Sithole Agricultural Training Institute	Durban University of Technology
	University of Zululand
	Mangosuthu University of Technology
Mpumalanga	

No Agricultural College or ATI in Mpumalanga	University of Mpumalanga
Northern Cape	
No Agricultural College or ATI in Northern Cape , consider collaboration with Grootfontein Agricultural training Institute	Sol Plaatje University, Kimberly
	Vaal University of Technology – Upington Campus

HEIs, with the input of the agricultural industry and the students, should develop VOAE pedagogy, as the instrument that will be used to provide the students with the necessary competence to meet the industry standards.

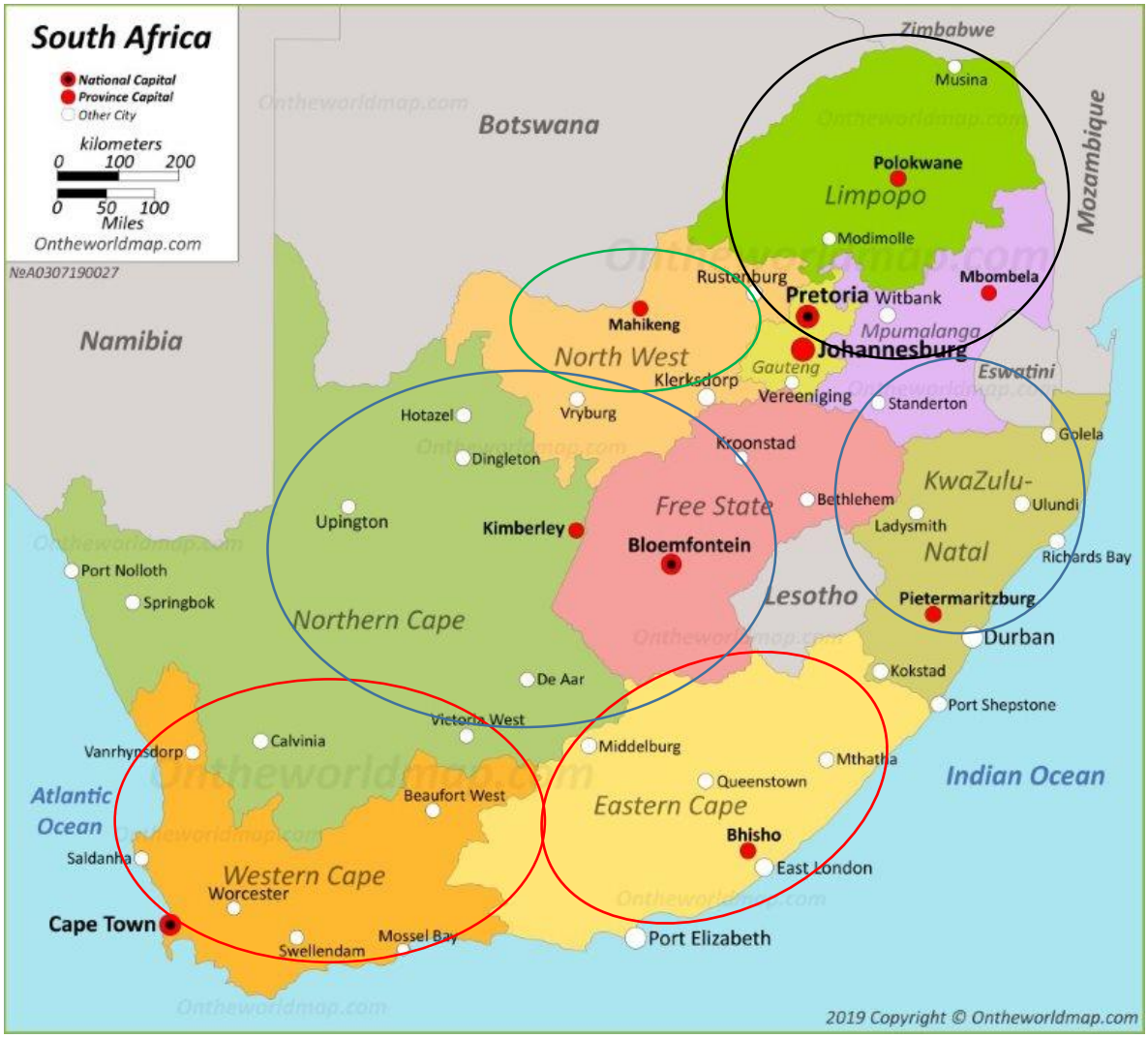

Figure 23: *Map of South Africa indicating the possible collaboration for VOAE&T*

HEIs should strive to form communities of practice, supporting each other and research teaching and assessment methods that will meet the challenges of the changing higher education environment.

5.10 Chapter summary

The role of the different HEIs in vocational-orientated agricultural training is highlighted in this chapter as well as the need to transform the sector. The role of the curriculum, the lectures and the facilities is critical for successful teaching and learning. The difference between the view of the agricultural industry and the HEIs was highlighted and the ways to bridge the gap between the different views were suggested and will be further discussed in the last chapter.

CHAPTER 6: COMPETENCY PROFILE OF DIPLOMA GRADUATES

6.1. Introduction

Brayn Garton stated the following in his lecture on the Implications of trends and challenges on agricultural education (Garton, 2019), *" … let us renew our belief that a college degree is still one of the best tickets to well-paying jobs and the middle class".* Kivinen and Silvennoinen (2002) supported Garton, stating that *"for any given individual, skills are the single best source of escaping from underprivileged"* (Kivinen & Silvennoinen, 2002, p. 53), These statement is also the aspirations of many young South Africans and they regard a diploma programme as a gateway to employment, or a steppingstone to other higher education qualifications and, a brighter future. In response, HEIs must do the responsible thing and make the expectations become a reality, as Robinson stated, *"in its purist form, human capital is an investment in the skills and knowledge of people*" (Robinson *et al*., 2007).

In this chapter the third component of VOAE, namely the diploma graduates will be evaluated, addressing the study objective; to identify how Diploma graduates view their own competence, how it effects their employability and what is their suggestions to close or bridge the competence gap

6.2. Graduates – profile

The ideal agricultural diploma graduate is a person who has the required attitude towards and a passion for agriculture, who understands that agriculture is a sustainable way of living (Wals & Bawden, 2000), who is competent (Lieblein *et al*., 2000), useful (Romagosa *et al*., 2015), responsive to change, reflective about their experience and the natural and social environment, and aware of quality work (Nakelet *et al*., 2017). The idea graduate will work well with others, functioning well in stressful situations, and have the ability to work independently (Robinson *et al*., 2007).

The same question needs to be asked: what does the industry expect diploma graduates to do when they start to work? A few expectations are listed below: Employers are looking for well-grounded graduates (Ruforum, 2017), that understand the concept of scholarship as it is part of lifelong learning. In agriculture, scholarship need to continue looking for better production, reduction of cost and improvement of

productivity (Kumar & Kumar, 2014) , that are dynamic, skilled, and proactive (Ruforum, 2017), and that can evolve with and within the rapidly changing labour market.

The ideal profile was illustrated above but, the reality is unfortunately different. The background of students studying the agricultural diploma changed dramatically over the last number of years not just in South Africa but over the world it is experienced, America, India, Europe and Africa (Marshall *et al*., 1998; Atchoarena & Holmes, 2005; Lucas, 2014). The changes took place due to various reasons such as the demographic distribution of learner that changed from rural to urban, students enter the diploma programmes with limited practical experience or background knowledge. The diversity in the new generation agricultural diploma student also provides new opportunities, the diversity drives innovation, creativity and excellence (Garton, 2019). Agricultural education need to make pedagogical (Lotz-Sisitka *et al*., 2015), ethnic and cultural shifts. All the components need to grow together to ensure sustainability and food security.

If a profile of the respondents to the diploma graduate questionnaire is drawn it is reflected in Table 31 roughly a 50/50 split between male and female, 8,7% grew up on commercial farms with farming background, 56,5% grew up in the rural farming communities, 8,7% hails from towns and 21,74% from townships, (diploma graduate's responses). This is a clear indication of the background knowledge and experience when they start their diploma studies. About 69% of the respondents attended secondary school offering Agricultural Science as a subject, 4,3% attended and agricultural high school and the rest were from schools without agricultural subjects. Some 80,95% enrolled for the diploma because as the respondents stated, it is their love for agriculture. As some diploma graduates (DGs) stated: *"Because I love farming and I come from a less advantaged area where people are too dependent on what the government offers, so my interests are at teaching them what to do with their soil and how they can grow their flocks and herds."* (DG1), another respondent stated: *"My love for plants has sparked my enthusiasm to engage in these studies...given coming from a rural community plant production (also animal) is practised on daily basis throughout the whole year."* (DG2)

Some 19,05% enrolled for other reasons, such as to get their foot in the door for further studies as stated in their response, *"I enrolled because I wanted to be employed at the*

end of the training to be honest it was all the talk on TV about the youth not choosing agriculture and the opportunities that the industry has...so I thought that by choosing agriculture I stood a better chance of being employed." (DG3). At the completion of the questionnaire, only 58,33% of the graduates were employed: 23,08% as farmworkers and the same percentage as interns, 30,7% as section mangers, 7,69% were self-employed as a farmer, and 15,38% were employed in secondary agriculture or other occupations. The rate of unemployment of the graduates is 41% and can even be higher. The large percentage is a big concern and one of the reasons for this study. The majority if the respondents are from comprehensive universities (72,76%, 18,19% from agricultural colleges and 9,09% from universities of technology (diploma graduate questionnaire responses). Table 31 provides a summary of the background information of the diploma graduates.

Table 31: Background information of diploma graduates who responded to the questionnaire.

Student background	**No**	**%**
Gender		
Male	13	56,52%
Female	10	43,48%
Total	23	
Grew up on/in		
Commercial farm	2	8,7%
Rural farming community (formal homelands)	13	56,52%
Town	2	8,7%
Township	5	21,74%
Other area not specified	1	4,35%
Total	23	
Secondary school attended		
Secondary school without agricultural subject	4	17,39%
Secondary school with agricultural subject	16	69,57%
Agricultural high school	1	4,35%
Technical high school	1	4,35%
Private school	1	4,35%
Total	23	
Employment at the time of the questionnaire		
Unemployed	10	41,67%
Employed	14	58,33%

Total	24	
Position in employment		
Intern	3	23,08%
Farm worker	3	23,08%
Section manager	4	30,77%
Farmer	1	7,69%
Other positions	2	15,38%
Total	13	
Reason for studying agricultural diploma		
Because of the love or passion for agriculture	17	80,95%
Other reasons	4	19,05%
Total	21	
Graduates from		
Agricultural college	4	18,18%
University of technology	2	9,09%
Comprehensive university	16	72,73%
Total	22	

Data source: Used data from the study

6.3. Data collection

A questionnaire similar to the agricultural industry and higher education was developed based on the QCTO profiles (AgriSETA, 2015) of agricultural jobs, to collect data (Annexure 8). The questionnaire consists of 83 competencies that will be needed for employment in the Organising Framework for Occupations groups 1, 2, 3, 6 and 7 (AgriSETA, 2015) as applicable to the diploma qualification.

The questionnaire was sent out by e-mail to alumni of the researcher's resident university and other HEIs were asked to send the questionnaire to their diploma graduates. The response to the electronic questionnaire was poor and is indicated in Table 32. Two reminder emails were sent to the graduates who did not respond to the initial call to action. Fifty-eight responses were received back on the electronic survey platform Survey Monkey – a response rate of 32,2%. About 24 (41,37%) of the 58 responses received were usable. It will be of great assistance to any future tracer studies if the HEIs can, through their alumni office, have the contact details of the diploma graduates available.

Table 32: Distribution and response of diploma graduate's questionnaire

Agricultural Graduate Questionnaire				
Actions and activities	Sent out	Responses	Bounced	Total
Sent letter to all HEI by e-mail with weblink	21	7		7
Sent second round of emails with weblink 2	24	10		10
Sent by direct emails	135	41	6	41
Total	180	58	6	58
Response rate		32,2%	3,33%	32,2%
Completed questionnaires		24	41,37% of responses received	

Source: Data from study

The relatively low response rate (32,2%) by the graduates underlined the difficulties in using electronic self-completion questionnaires and suggested that the data needed to be interpreted with some caution (Rainsbury *et al.*, 2002).

Validity of the questions. The validity of the DGQ was tested with the Cronbach's alpha test and the results are reflected in Table 33 below.

Table 33: **Validity assessment of the diploma graduate questionnaire**

Agricultural graduates		
Question	**Cronbach's Alpha**	**Level of reliability**
11	0,122449	Not reliable
12	0,905099	Excellent
13	0,966136	Excellent
14	0,732218	Good
15	0,723749	Good
16	0,820093	Very good
17	0,742720	Good
18	0,917475	Excellent

Source: Data from study.

Question 11 is not reliable (ά = 0.12) as the alpha is below 0,6 that is the minimum level of reliability, the rest of the questions are between 0,7 and 0,96 – indicating good to excellent reliability.

6.4 Research objectives

One of the objectives of this part of the study is to determine how the agricultural graduates measure up to the requirements of the agricultural industry as it was determined in Chapter 4, and to identify any difference in ranking of competence between graduates and the agricultural industry (Rainsbury *et al.*, 2002). The feedback from the diploma graduates is used as a self-assessment of their competencies or abilities, and the feedback from the AIQ as the employer's requirements. To complete the picture, the responses of all three components were combined and a total mean was calculated for each of the competence. The effect size was also calculated to determine the practical significance of the data.

6.4.1 Analyse the ability/competencies of the agricultural diploma graduates in relation to employability

The question can be asked, what is the influence of competence on employment? The answer seems quite simple, the person with the most competence will be employed, but is that what happens in reality? Competency should be relevant to the job for which the person is applying as well as the post level. To understand relevance, the difference between competence and capability need to be understood. Stephenson (1997) links capability to employability (Hoskins & Newstead, 2009) and sees it as follows: *"Competence delivers the present based on the past and is dealing with familiar problems in familiar situations. Capability imagines the future and helps to bring it about as a holistic concept, an integration of knowledge, skills and personal qualities used effectively and appropriately in unfamiliar as well as familiar situations"* (Rainsbury *et al*., 2002).

Rudman (1995, cited in Rainsbury *et. al.* 2002) promotes capability as *"a precursor to competency, where the individual has the capability to perform a specific task because they have the necessary knowledge and skills, but individuals do not become fully competent in the task until they have had some experience"* (ibid.). Capability precedes competence in the ability of the person, but when the knowledge and skills have been applied a number of times, it becomes competence and the person will have the confidence to use it in both familiar and unfamiliar situations.

Stephenson (1997) explains further that capability allows a person to act where outcomes are uncertain and that it requires courage, initiative, intuition, creativity, emotional stability and a belief in one's power to perform. Staying capable in a world of change requires confidence in one's ability to manage one's own learning. The development of capability is best achieved by improving the processes by which people learn (ibid.).

The above provide guidance and highlight the different factors involved in employability. The summary below hopes to provide an understanding of competence and answer at least in part the competency levels of graduates in relation to the industry requirements (Robinson & Garton, 2008). Skills are divided into behavioural (soft skills) and cognitive (hard) skills, as indicated in the Table 34.

Table 34: **Behavioural and cognitive skills relevant to employment**

Behavioural Skills (Built up from personal characteristics)	**Cognitive Skills** (Attributes used to perform tasks competently)
Personal skills – How one responds and handles various situations. **Interpersonal skills** – Securing outcomes through interpersonal relationships. **Organisational skills** – Securing outcomes through organisational networks.	**Technical skills** – The application of technical knowledge with certain expertise. **Analytical/constructive skills** – Problem identification and the development of solutions. **Appreciative skills** – Evaluating complicated situations and making creative and complex judgements.
Soft Skills	**Hard Skills**
Complementary to the hard skills; are required for successful workplace performance.	Associated with technical aspects of performing the job, usually include the acquisition of knowledge (Page, Wilson & Kolb, 1993).
Refer to **interpersonal, human, people or behaviour skills**, with the emphasis on personal behaviour and managing relationships between people.	**Primarily cognitive in nature** Technical skills Analytical skills Appreciative skills
Primarily affective or behavioural in nature; are associated with emotional quotient (EQ). EQ is regarded as a blend of innate characteristics and human/personal/interpersonal skills (Kemper, 1999).	Influenced by an individual's intelligence quotient (IQ). Technical skills and knowledge as a threshold in that they represent a minimum level necessary to be able to perform (Spencer & Spencer, 1993).

	Hard skills are essentially equivalent to cognitive skills as categorised by Burkett (1993).

Source: Rainsbury et al., 2002; Zegwaard & Hodges, 2003; Robinson et al., 2007;

From other studies it has emerged that a willingness to learn is the most important competence with regard to graduates. This correlates with a study in New Zealand by Burchell *et al.* (1999), where the willingness to learn was also rated as the most important competence. An individual's perception of the importance of competencies is not static; it changes as the individual progresses from tertiary studies into the workplace.

6.4.2 Analysis of competence

The response of the diploma graduates (n = 24) on their assessment of the importance of the competence given was categorised into soft skills (behavioural skills) and hard production and technical skills (cognitive skills) (Rainsbury *et al*., 2002), as per Table 35 and Table 36 below. Of the 64 competencies, 27 were classified as soft skills and 37 as hard or production skills. Each category was again classified using the weighted average into 'Very important' with a weighted average of between 4,5-5,0, 'Important' with a weighted average of 3,5-4,49. Of the soft skills, 17 were rated as 'Very important' and 20 as being 'Above average importance Important'. 'Time management (4,91) has the highest weighted average of the soft skills, while 'Keep accurate production records' (4,10) was the lowest. Among the production and technical skills, 17 were classified as 'very important' and 20 as 'above average Important', with 'Maintain an irrigation system (4.86) being the highest together with Irrigation scheduling (4.86) and cleaning and disinfecting production facilities (4.86) and the 'Operate and clean a milking machine (4,00) the lowest.

Table 35: **Response of Diploma graduates' response to the questionnaire**

Ranking of Soft skills by Diploma Graduates			
Rank	Very important competence (Mean 4,5 - 5)	Mean	Std. Deviation
1	Manage his time optimally.	4,91	0,29
2	Critical thinking ability	4,87	0,34
3	ICT skills , operate a computer and software programmes.	4,82	0,59
5	Draft and implement project plans.	4,78	0,42
5	Decision making skills	4,78	0,52

5	Ability to solve problems	4,78	0,42
7	Hard working or diligence	4,78	0,42
8,5	Provide technical support,	4,77	0,43
8,5	Do stock control,	4,77	0,53
9	Internal motivation	4,74	0,45
10,5	Perform administrative work,	4,73	0,55
10,5	Brainstorming and creation of new ideas - innovative	4,73	0,46
13,5	Honesty	4,70	0,63
13,5	Responsibility - being able to accept responsibility for his/her own actions	4,70	0,56
13,5	Ability to diagnose or identify problems	4,70	0,47
13,5	Good human relations	4,70	0,47
17	Observe time limits and deadlines.	4,65	0,78
17	Professional discipline	4,65	0,65
17	Trustfulness	4,65	0,65
19	Ability to collaborate with other people	4,61	0,50
21	Plan and directs or oversee farming operations .	4,57	0,73
21	Ability to see the big picture (holistic view)	4,57	0,73
21	Good verbal and written communication	4,57	0,59
22	Work Ethic	4,52	0,73
	Above average Importance (mean 3,5 - 4,49)		
23	Keep accurate financial records.	4,45	0,74
24	Inductive and/or deductive thinking	4,43	0,66
25	Keep accurate production records,	4,10	0,79

The means were ranked from the highest to the lowest and divided into two categories according the means 4,50 - 5,0 as 'Very important' and 3,50 - 4,49 as 'Important'. (LaCharite, 2015a).

Table 36**: Production and technical competence of Agricultural Diploma graduates in South Africa.**

Diploma graduates.			
Rank	**Very Important Competence (mean 4.50 - 5,00)**	**Mean**	**Std. Deviation**
2	Maintain an irrigation system	4,86	0,35
2	Do irrigation scheduling	4,86	0,35
2	Cleaning and disinfecting production facilities	4,86	0,36
4	Propagates and cultivates trees or plants.	4,78	0,42
5	Set, adjust and operate farm machinery and equipment	4,77	0,53
7	Correctly plant and cultivate plants.	4,74	0,69
7	Scout for pest and diseases.	4,74	0,54
7	Do fault finding and follow standard operating procedure	4,74	0,54
9.5	Handle, mix and store agrochemicals correctly.	4,70	0,70
9.5	Clean and disinfect and maintaining biosecurity standards in processing facilities	4,70	0,47

11.5	Control pest and diseases chemically and biological.	4,65	0,71
11.5	Identify , monitor and control weeds chemically and mechanical.	4,65	0,65
12	Be a stockman	4,64	0,63
14	Practice different soil cultivation methods to prepare a proper seed bed for planting.	4,61	0,78
14	Monitor and control efficiency of production.	4,61	0,58
14	Marketing of Agricultural products produced or processed	4,61	0,58
15	Drive and operate mechanical equipment,	4,55	0,51
	Above average Importance (mean 3,50 - 4,49)		
16	Install irrigation systems	4,48	0,90
17.5	Perform minor repair work , replace warn parts and/or re-assembles components,	4,45	0,67
17.5	Use an apply new technology	4,45	0,67
18	Supervise activities in the processing plant or pack house	4,43	0,79
21	Perform plant production related farming operations.	4,39	0,72
21	Knowledge and skills for the processing of agricultural products	4,39	0,72
21	Perform animal production related farming operations.	4,36	0,74
21	Provide health care for animals,	4,36	0,74
21	Perform artificial insemination.	4,36	0,93
24	Perform routine production tasks	4,29	0,91
25.5	Maintain and cares for agricultural crops.	4,26	0,86
25.5	Prune trees and scrubs.	4,26	1,01
26	Do selection of animals.	4,21	1,05
28	Classify animal products	4,14	1,03
28	Drive a vehicle - a valid driver's licence (minimum code B or EB),	4,14	0,99
28	Operates a manual irrigation system	4,14	1,08
29	Plan and construct an orchard or a vineyard.	4,09	1,31
30.5	Harvest animal products	4,07	1,54
30.5	Perform basic veterinary practices	4,07	1,14
31	Operate and clean a milking machine	4,00	1,04

The data collected and indicated in the tables above showed that the graduates rank competencies which are part of their curriculum higher than they did competence which received less attention in the curriculum. This does not mean these competencies are less important; the graduates do not have the practical experience to form the links.

6.5. To identify the gap that exists between the industry and the students and measures to close the gap

The gap between the agricultural-industry and the diploma graduates with regard to employability and employability skills is discussed briefly below.

6.5.1. Employability

Employability is a term with multiple definitions. People interpret employability differently – some see it as being about skills, while others regard it as an activity which prepares individuals for long-term employment. The Enhancing Student Employability Coordination Team combined different views to form a working definition of employability as: *"A set of achievements – skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations"* (Knight & Yorke, 2003, p.5 as quoted in Hoskins & Newstead, 2009).

The role of HEIs is to prepare the students throughout their study period for employment, ensure academic success, provide quality learning experiences, engage with industry and assist students in obtaining "good jobs" (Garton, 2019). Students, on the other hand, need to realise the importance of acquiring both soft and hard skills and accept that mastery of technical skills within a discipline will assist them with the transferability of those skills (Robinson *et al*., 2007).

According to Billing and Schmidt (2003), the employability skills most desired by the industry are problem-solving, effective communication, teamwork, critical thinking and interpersonal skills. These are all behavioural skills that will influence the person's work relations and attitude. As indicated above, the graduate should be able to transfer the employability skills – also referred to as transferable skills – to the workplace and to various situations; the graduates need transferable skills as the workplace differs and they need to be flexible enough to adapt (Billing & Schmidt, 2003).

The development of soft skills is neglected due to the various reasons such as; The difficulty in their measurements (Georges, 1996); It is seen to be problematic to demonstrate a link between soft skills and desired work outcomes (Arnold & Davey, 1994); The difficulty to develop soft skills as compared to hard or technical skills (Rainsbury *et al*., 2002);

In a study done by Kensinger and Muller (1989), which took place among faculty members at universities teaching Dairy Science and the industry, and aimed to rank skills and experiences, the top five of these were all soft skills such as communication

skills, verbal and written communication, critical thinking, computer skills and team problem-solving skills. This correlates with what Lucas *et al.* (2012) call the four Cs: communication, critical thinking, collaboration and creativity – all higher order thinking (Lucas *et al.*, 2012).

It is important to note that the pursuit of a career in agriculture requires more than just the specialised knowledge and the technical skills of the trade (Bandura, 1986). Success in the workplace may also depend on the self-efficacy of the individual in dealing with the social realities of the workplace. Self-efficacy is an individual's perception of their ability to perform specific tasks. The production and technical competence is built on the foundation of soft skills; and the transferability takes place through system thinking and reflection, as well as production technology and organisation (Viljoen & Haas, 2019).

It is suggested that students, new graduates and employers perceive hard skills as more important than soft skills (Zegwaard & Hodges, 2003). This statement will likely influence the study habits of students and skills development attempts. It may result in students focusing more on the technical or content aspects of their studies than on the development of personal and interpersonal skills. In vocational-oriented education, the balance between the two types of skills needs to be in place to maintain a 50:50 ratio between theory/personal development and production/technical skills. To rephrase, there should be an equal balance between behavioural skills and cognitive skills.

6.6.2. Employability skills, identifying employability skills needed

The responses of the diploma graduates (n = 24) was taken as a self-assessment of their employability competence, where the employability competence was then rated as a total response from 1- 64 using the mean importance values, and classified into soft and hard skills, again rated according the mean importance value. The same was done with the responses of the agricultural industry (n = 34). It was taken as the employers' requirement and the graduates' response with regard to their employment ability (Robinson *et al*., 2007).

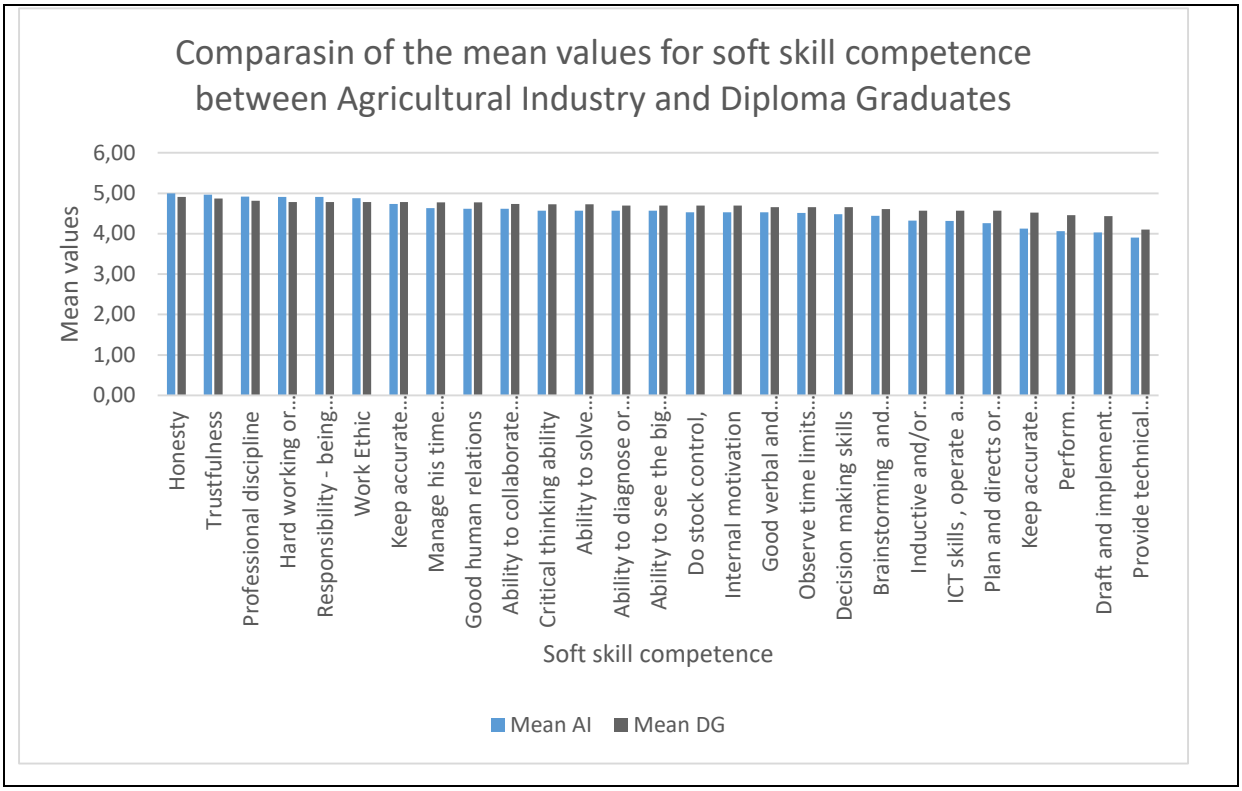

Figure 24: Mean importance of soft skills competence between Agricultural-industry and Diploma graduates in South Africa.

Figure 24 indicates that there is small gap between the industry as the employer and the self-assessment of the graduates with regards to the soft skills required.

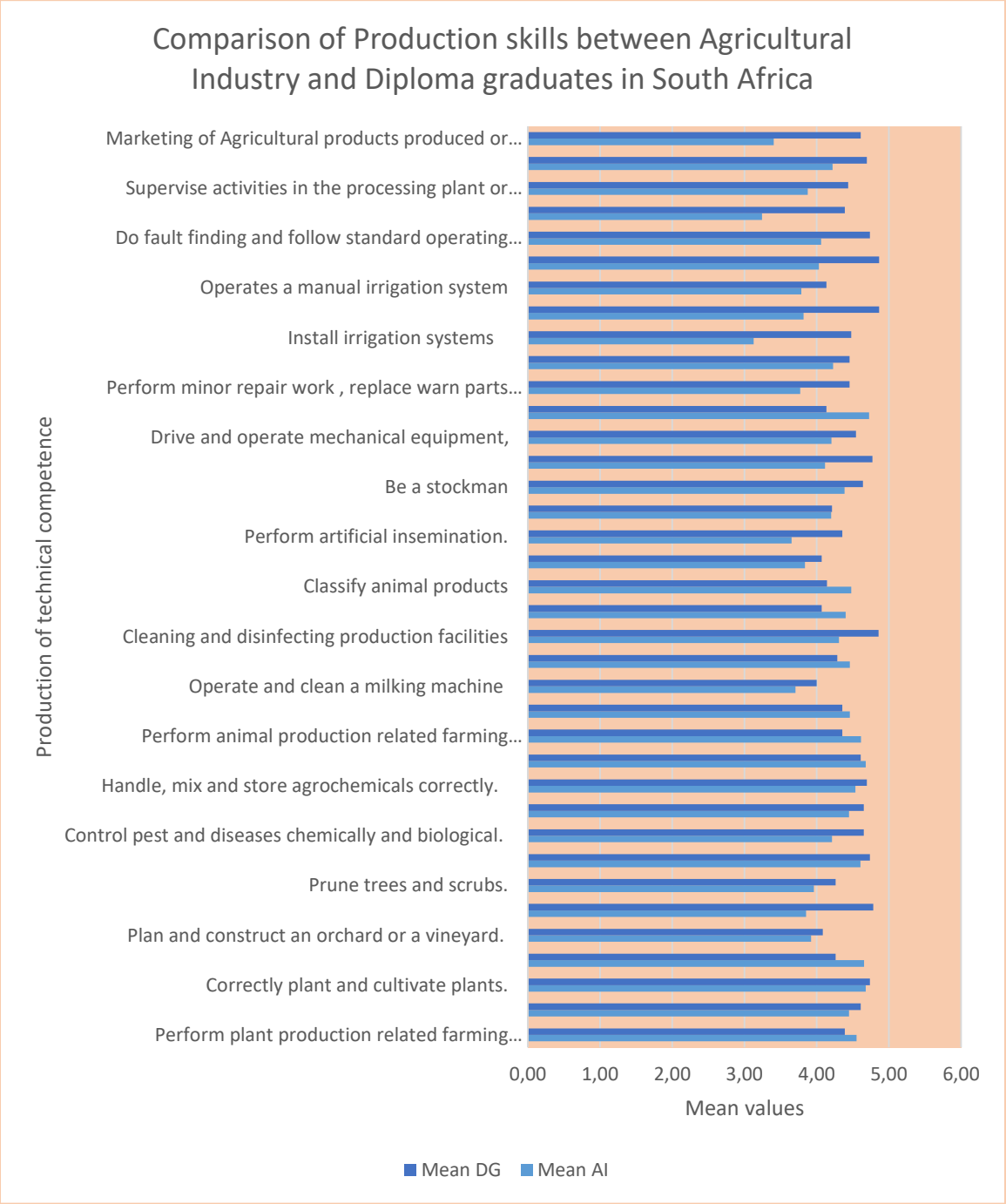

Figure 25: Comparison of perceived hard skills between agricultural-industry and diploma graduates in South Africa. (Source: Data from the study)

Figure 25 indicates the self-assessment of the diploma graduates in all the production competence. This will differ from institution to institution depending on the emphasis of that specific institution. A true reflection of the importance of these competence will be in a combination of all there the components. An example of this is that the agricultural industry's requirement for the top employability skill (number 1) is being in possession of a driver's licence (4,86) while the graduates rate this competency at

(4,14) is ranked at number 28 of the production skills. Maintaining of an irrigation system is ranked by the agricultural industry (3.82) in the thirtieth place, but by the diploma graduates as number 1(4.86); the reason for this is probably that the commercial farmers will use contractors for this type of work or that the skill is regarded above the post level the graduates will be employed on.

The procedure as described in Rainsbury *et al*. (2002) to do the data analysis for ranking of competence was applied. The competencies as ranked by the agricultural industry and diploma graduates were ranked as an overall ranking for all 62 competencies. The competence was then categorised into soft skills and production skills, and again ranked from the highest to the lowest mean value. Each competence has two sets of rankings: the overall ranking and the category ranking.

6.7. Research findings

Combining the three components will provide a holistic picture of which competence is the most relevant and have practical significance. (Ellis & Steyn, 2003). The results of the Agricultural Industry, Higher education and Diploma graduates were all combined to get an average mean value. An Anova *p*-value was also obtained to measure significance, although the p-value is reported the fact that no purposeful sampling was done and a non-randomized sample was used, it will be better to report on the effect size and the practical significance thereof. Effect size indicate a large enough effect to be important in practice and is described as the difference in means. (Ellis,2003)

The ranking of the competence was based on total mean value of all three the components of the study to provide a holistic view and high light the importance of the competence. Honest, truthfulness, recordkeeping, ICT skills, Stock control, drafting and implementation of production plans, provision of technical support and perform administrative was indicated statistical significant (*p= 0.005*) using the Kruskal-Wallis H test. Cohen's d-value was used to indicate the effect size between the different components Agricultural industry with the Diploma Graduate and Higher education and Diploma Graduates with Agricultural Industry and Higher education as indicated in table 37and 38

Table 37: Soft skills ranked according to the total mean value of all three components indicating, p-value, effect size and assumed significance in ranking

Rank according to Total Mean	Soft Skills or 21st Century Competence Very important Competence (mean < 4,5)		Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal-Wallis H
						Agric with	DG with	Statistical Significance
2	Honesty	Agric Industry	5,00	0,00				
		DG	4,70	0,63		0,48①		
		HEI	4,83	0,49	0,040	0,35	0,21	0,029*
		Total	4,86	0,45				
2	Trustfulness	Agric Industry	4,97	0,18				
		DG	4,65	0,65		0,49①		
		HEI	4,91	0,29	0,014	0,19	0,40①	0,025*
		Total	4,86	0,42				
3	Hard working or diligence	Agric Industry	4,91	0,29				
		DG	4,78	0,42		0,31		
		HEI	4,78	0,42	0,310	0,31	0,00	0,306
		Total	4,84	0,37				
4	Professional discipline	Agric Industry	4,91	0,28				
		DG	4,65	0,65		0,40①		
		HEI	4,87	0,34	0,073	0,13	0,34	0,152
		Total	4,83	0,44				
5	Responsibility - being able to accept responsibility for his/her own actions	Agric Industry	4,91	0,29				
		DG	4,70	0,56		0,38		
		HEI	4,78	0,42	0,171	0,30	0,16	0,209
		Total	4,81	0,43				
6	Work Ethic	Agric Industry	4,88	0,33				
		DG	4,52	0,73		0,49①		
		HEI	4,87	0,34	0,017	0,03	0,48①	0,051
		Total	4,77	0,51				
7	Manage his time optimally.	Agric Industry	4,63	0,55				
		DG	4,91	0,29		0,52①		
		HEI	4,73	0,55	0,101	0,18	0,34	0,085
		Total	4,74	0,50				
8	Good human relations	Agric Industry	4,62	0,55				
		DG	4,70	0,47		0,14		
		HEI	4,88	0,33	0,191	0,48①	0,40①	0,201
		Total	4,70	0,49				
9	Ability to solve problems	Agric Industry	4,57	0,65				
		DG	4,78	0,42		0,32		
		HEI	4,70	0,56	0,375	0,19	0,16	0,483
		Total	4,67	0,57				

Ranking continue			Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal-Wallis H
						Agric with	DG with	
10	Critical thinking ability	Agric Industry	4,57	0,70				
		DG	4,87	0,34		0,43①		
		HEI	4,61	0,50	0,127	0,05	0,52①	0,133
		Total	4,67	0,57				
11	Internal motivation	Agric Industry	4,53	0,71				
		DG	4,74	0,45		0,30		
		HEI	4,78	0,42	0,197	0,36	0,10	0,375
		Total	4,66	0,57				
12	Ability to collaborate with other people	Agric Industry	4,62	0,55				
		DG	4,61	0,50		0,02		
		HEI	4,70	0,47	0,812	0,14	0,17	0,825
		Total	4,64	0,51				
13	Ability to diagnose or identify problems	Agric Industry	4,57	0,56				
		DG	4,70	0,47		0,22		
		HEI	4,61	0,58	0,693	0,06	0,15	0,729
		Total	4,62	0,54				
14	Decision making skills	Agric Industry	4,49	0,70				
		DG	4,78	0,52		0,42①		
		HEI	4,61	0,50	0,190	0,18	0,34	0,144
		Total	4,60	0,61				
15	Observe time limits and deadlines.	Agric Industry	4,51	0,66				
		DG	4,65	0,78		0,18		
		HEI	4,50	0,61	0,700	0,02	0,20	0,338
		Total	4,55	0,68				
16	Ability to see the big picture (holistic view)	Agric Industry	4,57	0,61				
		DG	4,57	0,73		0,01		
		HEI	4,45	0,67	0,788	0,17	0,15	0,693
		Total	4,54	0,65				
17	Good verbal and written communication	Agric Industry	4,53	0,56				
		DG	4,57	0,59		0,06		
		HEI	4,50	0,71	0,942	0,04	0,09	0,955
		Total	4,53	0,60				
18	Keep accurate production records,	Agric Industry	4,73	0,45				
		DG	4,10	0,79		0,80①		
		HEI	4,61	0,72	0,004	0,17	0,65①	0,006*
		Total	4,52	0,69				
19.5	ICT skills , operate a computer and software programmes.	Agric Industry	4,31	0,90				
		DG	4,82	0,59		0,56①		
		HEI	4,50	0,63	0,060	0,21	0,50①	0,023*
		Total	4,51	0,78				
			Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal-Wallis H

						Agric with	DG with	
19.5	Brainstorming and creation of new ideas - innovative	Agric Industry	4,44	0,70				
		DG	4,73	0,46		0,41①		
		HEI	4,39	0,78	0,191	0,06	0,43①	0,269
		Total	4,51	0,68				

Above average Important Competence 3,5 - 4,49			Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal-Wallis H
						Agric with	DG with	
21	Do stock control,	Agric Industry	4,53	0,57				
		DG	4,77	0,53		0,43①		
		HEI	4,17	0,98	0,021	0,36	0,61①	0,039*
		Total	4,49	0,74				
22	Plan and directs or oversee farming operations .	Agric Industry	4,26	0,95				
		DG	4,57	0,73		0,32		
		HEI	4,73	0,55	0,083	0,49①	0,22	0,122
		Total	4,48	0,81				
23	Inductive and/or deductive thinking	Agric Industry	4,32	0,77				
		DG	4,43	0,66		0,14		
		HEI	4,43	0,79	0,805	0,14	0,00	0,793
		Total	4,39	0,74				
24	Draft and implement project plans.	Agric Industry	4,03	0,92				
		DG	4,78	0,42		0,82①		
		HEI	4,52	0,60	0,001	0,54①	0,43①	0,002*
		Total	4,38	0,79				
25.5	Provide technical support,	Agric Industry	3,91	1,09				
		DG	4,77	0,43		0,80①		
		HEI	4,30	0,76	0,002	0,37	0,61①	0,001*
		Total	4,27	0,91				
25.5	Keep accurate financial records.	Agric Industry	4,13	1,01				
		DG	4,45	0,74		0,33		
		HEI	4,30	0,76	0,388	0,18	0,20	0,503
		Total	4,27	0,87				
26	Perform administrative work,	Agric Industry	4,06	1,05				
		DG	4,73	0,55		0,64①		
		HEI	3,96	0,88	0,008	0,10	0,88①	0,006*
		Total	4,22	0,93				
P-value <0.005 * is statistical significant ; *d* = 0.5 medium effect,: *d*=0.8 large effect.								

From the Cohen's D test the effect size of the following is noted: Honesty is regarded more practically important by the Agricultural industry (5.0) than the Diploma graduates (4.7), similarly with truthfulness (AI 4.97 vs DG 4.65) and the Higher

Education respondents regard it also more practical important than the Diploma Graduates. The AI attached more practical value to Professional discipline (4.91) than the DG (4.65). The AI and HE regarded work ethic (AI (4.88) and HE (4.87) more practical than the DG (4.52). The DG attached more practical significate to optimal time management than the AI (4.63). The HEI place more emphasis on Good Human relations (4.88) with a practical value of 0.48 with the AI and 0.40 to the DG.

Kruskal-Wallis H Test - fail to meet the assumption if one-way ANOVA Mean ranks of the levels are equal. Elements Distance between the observation is meaningful, Distance between the ranks

Table 38: Production *and Technical skills ranked according to the total mean value of all three components indicating, p-value, effect size and assumed significance in ranking*

Production , Technical and Mechanical Skills								
Rank	**Very important competence mean 4,5 - 5,0**		Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d) Agric with①	DG with②	Kruskal - Wallis
	Correctly plant and cultivate plants.	Agric Industry	4,68	0,48				
		DG	4,74	0,69		0,09		
		HEI	4,53	0,72	0,562	0,21	0,29	0,395
1		Total	4,66	0,61				
	Scout for pest and diseases.	Agric Industry	4,61	0,88				
		DG	4,74	0,54		0,15		
		HEI	4,22	0,67	0,209	0,44①	0,78②	0,046
2,5		Total	4,60	0,74				
	Monitor and control efficiency of production.	Agric Industry	4,68	0,55				
		DG	4,61	0,58		0,12		
		HEI	4,47	0,72	0,538	0,29	0,19	0,614
2,5		Total	4,60	0,60				
	Handle, mix and store agrochemicals correctly.	Agric Industry	4,54	0,90				
		DG	4,70	0,70		0,17		
		HEI	4,53	0,72	0,735	0,01	0,23	0,643
4		Total	4,59	0,78				

Rank	Above average important competence according to total mean (3,5 -4,49)		Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal - Wallis
						Agric with①	DG with②	
	Perform animal production related farming operations.	Agric Industry	4,62	0,57				
		DG	4,36	0,74		0,35		
		HEI	4,50	0,76	0,509	0,15	0,19	0,556
5		Total	4,52	0,67				
	Perform plant production related farming operations.	Agric Industry	4,55	0,63				
		DG	4,39	0,72		0,22		
		HEI	4,56	0,73	0,647	0,01	0,24	0,603
6		Total	4,50	0,68				
	Maintain and cares for agricultural crops.	Agric Industry	4,66	0,55				
		DG	4,26	0,86		0,46①		
		HEI	4,50	0,73	0,148	0,21	0,28	0,253
7.5		Total	4,49	0,72				
	Cleaning and disinfecting production facilities	Agric Industry	4,31	0,93				
		DG	4,86	0,36		0,59①		
		HEI	4,47	0,74	0,109	0,17	0,53②	0,108
7.5		Total	4,49	0,79				
	Provide health care for animals,	Agric Industry	4,46	0,90				
		DG	4,36	0,74		0,12		
		HEI	4,60	0,74	0,728	0,15	0,33	0,524
9		Total	4,47	0,81				
	Be a stockman	Agric Industry	4,38	0,70				
		DG	4,64	0,63		0,37		
		HEI	4,40	0,83	0,529	0,02	0,29	0,479
10		Total	4,45	0,72				
	Identify, monitor and control weeds chemically and mechanical.	Agric Industry	4,45	0,87				
		DG	4,65	0,65		0,23		
		HEI	4,06	0,90	0,078	0,43①	0,66②	0,061
10		Total	4,42	0,83				
	Practice different soil cultivation methods to prepare a proper seed bed for planting.	Agric Industry	4,45	0,63				
		DG	4,61	0,78		0,20		
		HEI	4,06	0,83	0,067	0,47①	0,66②	0,041
11		Total	4,41	0,75				
	Perform routine production tasks	Agric Industry	4,46	0,81				
		DG	4,29	0,91		0,19		
		HEI	4,33	0,82	0,792	0,16	0,05	0,749
12.5		Total	4,38	0,83				

Rank	Above average important competence according to total mean (3,5 -4,49)		Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kruskal - Wallis
						Agric with①	DG with②	
	Do fault finding and follow standard operating procedure	Agric Industry	4,06	1,06				
		DG	4,74	0,54		0,64①		
		HEI	4,50	0,79	0,015	0,41①	0,30	0,012
12.5		Total	4,38	0,90				
	Do irrigation scheduling	Agric Industry	4,03	1,09				
		DG	4,86	0,35		0,76①		
		HEI	4,32	0,89	0,004*	0,26	0,62②	0,005*
14		Total	4,36	0,93				
	Control pest and diseases chemically and biological.	Agric Industry	4,21	1,03				
		DG	4,65	0,71		0,42①		
		HEI	4,12	0,70	0,099	0,09	0,75②	0,030
15		Total	4,34	0,87				
	Clean and disinfect and maintaining biosecurity standards in processing facilities	Agric Industry	4,22	1,07				
		DG	4,70	0,47		0,45①		
		HEI	4,09	1,23	0,096	0,10	0,49	0,169
16,5		Total	4,32	1,01				
	Use an apply new technology	Agric Industry	4,23	0,84				
		DG	4,45	0,67		0,27		
		HEI	4,33	0,73	0,558	0,12	0,17	0,652
16,5		Total	4,32	0,76				
	Classify animal products	Agric Industry	4,48	0,87				
		DG	4,14	1,03		0,33		
		HEI	4,13	1,13	0,452	0,31	0,01	0,442
17		Total	4,30	0,98				
	Set, adjust and operate farm machinery and equipment	Agric Industry	4,12	0,81				
		DG	4,77	0,53		0,81①		
		HEI	4,00	1,00	0,003*	0,12	0,77②	0,002*
18		Total	4,27	0,85				
	Drive a vehicle with a valid driver's licence (minimum code B or EB),	Agric Industry	4,73	0,57				
		DG	4,14	0,99		0,60①		
		HEI	3,60	1,27	0,000*	0,89①	0,42②	0,000*
19		Total	4,25	1,03				
	Drive and operate mechanical equipment,	Agric Industry	4,21	0,81				
		DG	4,55	0,51		0,42①		
		HEI	3,86	1,11	0,031	0,31	0,62②	0,075
20.5		Total	4,21	0,86				
	Do selection of animals.	Agric Industry	4,20	0,76				
		DG	4,21	1,05		0,01		
		HEI			0,961			0,694
20.5		Total	4,21	0,86				

Rank	Above average important competence according to total mean (3,5 -4,49)		Mean	Std. Deviation	ANOVA p-value	Effect Sizes (Cohen's d)		Kriuskal - wlles
						Agric with①	DG with②	
	Harvest animal products	Agric Industry	4,40	0,82				
		DG	4,07	1,54		0,21		
		HEI	3,93	1,10	0,408	0,42①	0,09	0,411
21		Total	4,19	1,12				
	Propagates and cultivates trees or plants.	Agric Industry	3,85	1,13				
		DG	4,78	0,42		0,82①		
		HEI	3,82	0,88	0,000*	0,02	1,09②	0,000*
22		Total	4,16	0,98				
	Maintain an irrigation system	Agric Industry	3,82	0,98				
		DG	4,86	0,35		1,06①		
		HEI	3,79	1,13	0,000*	0,03	0,95②	0,000*
23		Total	4,12	1,01				
	Supervise activities in the processing plant or pack house	Agric Industry	3,88	0,94				
		DG	4,43	0,79		0,59①		
		HEI	3,91	1,06	0,071	0,03	0,49②	0,059
24		Total	4,05	0,96				
	Perform artificial insemination.	Agric Industry	3,65	1,09				
		DG	4,36	0,93		0,64①		
		HEI	4,40	0,91	0,035*	0,68①	0,05	0,033*
25		Total	4,04	1,05				
	Prune trees and scrubs.	Agric Industry	3,96	1,22				
		DG	4,26	1,01		0,24		
		HEI	3,81	0,91	0,413	0,12	0,44②	0,236
26		Total	4,03	1,08				
	Operates a manual irrigation system	Agric Industry	3,79	0,99				
		DG	4,14	1,08		0,32		
		HEI	4,21	0,85	0,253	0,43①	0,07	0,195
27,5		Total	4,00	0,99				
	Perform basic veterinary practices	Agric Industry	3,84	1,14				
		DG	4,07	1,14		0,20		
		HEI	4,20	1,01	0,590	0,31	0,11	0,442
27,5		Total	4,00	1,10				
	Plan and construct an orchard or a vineyard.	Agric Industry	3,92	1,13				
		DG	4,09	1,31		0,12		
		HEI	3,90	0,88	0,861	0,02	0,14	0,551
28		Total	3,98	1,15				
	Marketing of Agricultural products produced or processed	Agric Industry	3,41	1,16				
		DG	4,61	0,58		1,04①		
		HEI	4,00	0,82	0,000*	0,51①	0,75②	0,000*
29		Total	3,94	1,04				
P-value <0.005 * is statistical significant ; d = 0.5 medium effect: d=0.8 large effect								

If the total mean is used the top 10 competence is a mixture of soft and production competence in the ration of 4:6. The majority of the top scoring competence is production competence to indicate the top ten competence for soft and production skills, they were tabulated in table 39 and 40 below

Table 39: Top 10 ranked soft skills competencies by all three the components the agricultural industry, Higher education and diploma graduates in South Africa

	Soft Skills with the highest combined mean value as identified by Agricultural industry , Higher education institutions and diploma Graduates	Combined Total mean
2	Honesty	4.86
2	Truthfulness	4.86
3	Hard working or diligence	4.84
4	Professional discipline	4.83
5	Responsibility - being able to accept responsibility for his/her own actions	4.81
6	Work Ethic	4.77
7	Manage his time optimally.	4.74
8	Good human relations	4.70
9	Ability to solve problems	4.67
9	Critical Thinking ability	4.67

Table 40 below indicate the top ten overall competence using the total mean score and it is a more balanced representation of the competence required for diploma graduates.

Table 40: Overall top ten Production competence using the total mean

Ranking	**Ranking of the total mean for Production skills by as rated by the Agricultural industry , Higher Education Institutions and the Diploma Graduates .**	**Total Mean**
1	Correctly plant and cultivate plants.	4.66
2	Scout for pest and diseases.	4.60
3	Monitor and control efficiency of production.	4.60
4	Handle, mix and store agrochemicals correctly.	4.59
5	Correctly plant and cultivate plants.	4.52
6	Perform animal production related farming operations.	4.50
7	Perform plant production related farming operations.	4.49
8	Maintain and cares for agricultural crops.	4.49
9	Cleaning and disinfecting production facilities	4.47
10	Provide health care for animals,	4.47

This information, ranking or outcome will differ depending on the commodities the specific HEI is focusing on and what commodities are the most prevalent in the area of the HEI, therefore the recommendation that with regards to production competence

it should be commodity based to address the needs of these specific commodities. When a generic approach is followed mechanisms must be in place to fill the gaps.

Cohen's D test was done on the mean values of all the competence as rated by the different components to indicate the effect size where there is a difference in the rating. The result of this test is indicated in Table 41 below. The relationship was tested with the Kruskal-Wallis H test to determine if there is a statistical significant difference between the medians of the three independent groups, statistical significance is indicated by p-vale of not less than 0.05. The test shows that there was a statistical significant difference in the mean value between the competence, the competence with the statistical difference, as well as *d*-value larger than 0.40 is listed in table 40 below.

Table 41: The results of the Cohen's D test and the Kruskal-Wallis H test performed on the mean values of the different competence.

Competence	**Accentuating Component Mean value**	**Cohen's D**	**Areas where it is lacking (mean value)**	**Kruskal-Wallis test**
Soft skills	**Agricultural industry**			
Honesty	50	0.48	DG (4.70)	0.029*
Trustfulness	4.97	0.49	DG (4.65)	0.025*
Professional discipline	4.91	0.40	DG (4.65)	0.152
Work ethic	4.88	0.49	DG(4.52)	0.051
Keeping of accurate production records	4.73	0.80	DG (4.10)	0.006*
		0.65	HEI (4.61)	
Production Competence	Agric Industry			
Maintain and cares for agricultural crops	4.66	0.46	DG (4.26)	0.253
Drive a vehicle with a valid drives licence	4.73	0.60	DG (4.14)	0.000*
		0.89	HEI (3.60)	
Harvest animal products	4.40	0.42	HEI (3.93)	0.41*
Scout for pest and disease	4.61	0.44	HEI (4.22)	0.046*
Practice different soil cultivation methods to prepare a proper seed bed for planting	4.45	0.47	HEI (4.06)	0.041*
Comments: The difference between the means of AI and DG/HEI is of such a nature (>0.4) that show a strong practical significance, which indicate a gap between the components. Agricultural industry places a higher importance on the soft skill competences than the Diploma Graduates and in one case HEI. With regards to practical competence is there a practical significance between AI and DG in two competences and 3 between AI and HEI. A very strong practical significance is show towards Driving a vehicle with a valid licence, showing the importance to the AI. The AI show an affinity for more practical production skills and character focused soft skills.				
21st Century competence	Higher Education Institutions			
Trustfulness	4.91	0.40	DG (4.65)	0.025*
Work Ethic	4.87	0.48	DG (4.52)	0.051
Good human relations	4.88	0.48	AI (4.62)	0.201
		0.48	DG (4.70)	
Plan and directs farming operations	4.73	1.49	AI (4.26)	0.122
Production Competence	Higher Education Institutions			

Perform Artificial insemination	4.40	0.68	AI (3.65)	0.033*
Operates a manual irrigation system	4.21	0.43	AI (3.79)	0.195
Marketing of Agricultural products	4.00	0.51	AI (3.41)	0.000*

Comments: The difference between the means of HEI and AI/DG is of such a nature (>0.4) that show a strong practical significance, which indicate a gap between the components. Higher Education Institutions places a higher importance on the soft skill competences than the Diploma Graduates in three areas and in two case than AI. With regards to practical competence is there a strong practical significance on four competences with the AI where HEI place more emphasis on theses than AI. The most of the soft skills are similar to that of the AI showing alignment but the practical competence a tendency towards management and more advanced skills.

Soft Skills	**Diploma Graduates**			
Manage time optimally	4.91	0.52	AI *4.63)	0.085
Critical Thinking	4.87	0.43	AI (4.57)	0.133
		0.52	HEI (4.67)	
ICT skills , operate a computer and software programmes.	4.82	0.56	AI (4.31)	0.023*
		0.50	HEI (4.50)	
Decision making skills	4.78	0.42	AI (4.49)	0.144
Brainstorming and creation of new ideas	4.73	0.41	AI (4.53)	0.269
		0.43	HEI (4.39)	
Stock control	4.77	0.41	AI (4.53)	0.039*
		0.43	HEI (4.17)	
Draft and implement project plans	4.78	0.82	AI(4.03)	0.002*
		0.43	HEI (4.52)	
Provide technical support	4.77	0.82	AI (3.91)	0.001*
		0.61	HEI (4.30)	
Perform admin work	4.73	0.64	AI (4.06)	0.006*
		0.88	HEI (3.96)	
Production competence	**Diploma graduates**			
Cleaning and disinfecting production facilities	4.86	0.59	AI (4.31)	0.108
		0.53	HEI(4.47)	
Do fault finding and follow standard operational procedure	4.74	0.41	AI (4.06)	0.012*
Scout for pest and disease	4.74	0.78	HEI (4.22)	0.046*
Do irrigation scheduling	4.86	0.76	AI (4.03)	0.005*
		0.62	HEI (4.32)	
Control pest and diseases chemically and biologically	4.65	0.42	AI (4.21)	0.030
		0.75	HEI (4.12)	
Clean disinfect and maintain bio-security standards in processing facilities	4.70	0.45	AI (4.22)	0.169
Set adjust and operate farm machinery and equipment	4.77	0.81	AI (4.12)	0.002*
		1.77	HEI (4.00)	
Drive a motor vehicle with a valid driver's licence	4.55	0.52	HEI(3.86)	0.000*
Propagates and cultivates trees or plants	4.78	0.82	AI (3.85)	0.000*
		1.09	HEI (3.82)	
Maintain an irrigation system	4.86	1.06	AI (3.82)	0.000*
		0.49	HEI (3.91)	
Supervise activities in the processing plant or pack house	4.43	0.59	AI (3.88)	0.59
		0.49	HEI (3.91)	
Perform artificial insemination	4.36	0.64	AI (3.65)	0.033*
Practice different soil cultivation methods to prepare a proper seed bed for planting	4.65	066	HEI (4.06)	0.041*

Comments: The means of the Diploma Graduates rating differs in 9 soft skill competence and 13 production skill competence from both the AI and the HEI. The soft skills show indications that the difference in ranking can be due to the age difference between the two groups the DG being of a different generation and focusing on different skill sets. With regards to the difference in production skills the indication is that the approach is different. The DG did their WIL on farms and view these competence different form the HEI, they rate is higher than the HEI. The production competence where they differ from the AI is also more managerial than practical physical work.
• Indicates significance at 0.05 d-0.40 indicate strong practical significance

6.8. Diploma graduates' recommendations for improvement

The responses of the graduates to the open-ended questions were coded and analysed using the NVIVO12 qualitative analysis programme. The responses of the graduates were coded in four nodes or main codes, namely employment, experiential training, innovation and practical. The summarised feedback is discussed below.

6.8.1 Practical work

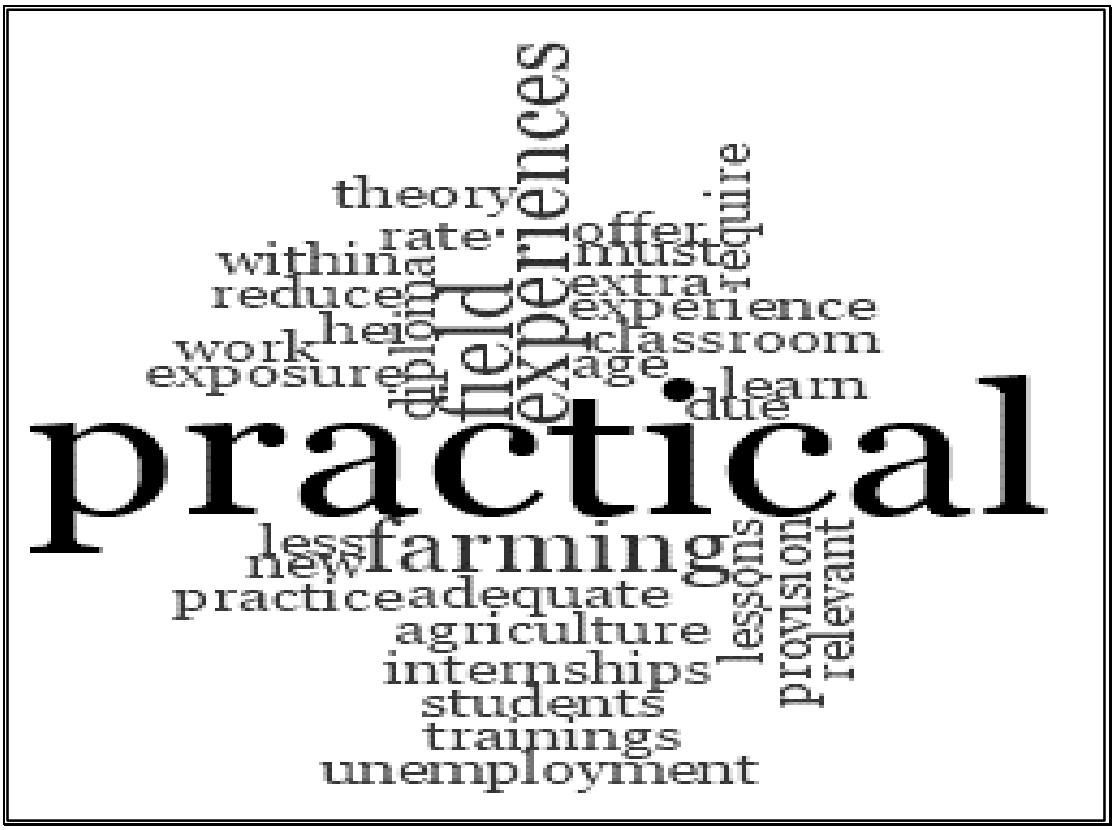

Figure 26: Word cloud of key words used by graduates.

The graduates echo the same sentiments as the other two role players, the agricultural-industry and HEIs – there is a need for more practical, relevant and

adequate practicals, as can be seen from the word cloud of key words regarding practicals in Figure 25. The larger the word in the word cloud the more important it is.

The delivery of practical training implies the correct functional modern facilities and staff that are competent. Requests regarding the plight for more experience and employable competence included: *"Provision of adequate practice on the field to reduce the rate of unemployment due to less experience."* (DG3), *"More practical experiences that are relevant within the new age of farming."* (DG4), *"More practical work and experiences and internships."* (DG5)

Their reasoning for the request is that *"farming is more practical than theory, all I can say is, on the field you can learn more than in the classroom exposure"* (DG6) and that their statement ties up with the other proposals to improve VOAE, through curriculum transformation, assessment of competence and the development of vocational-orientated agricultural pedagogy.

In terms of transformation, Vandenbosch of ICRAF (2006) stated: *"Curricula and teaching, training and learning methods and materials are very often outdated and not adequate. Many agricultural education and training institutions are not linked to each other even though it is obvious that their activities and overall goals are closely interrelated and interdependent and that the activities of each necessarily affect those of others"* (Vandenbosch, 2006).

6.8.2 Experiential training

Farmer are providing an invaluable service to take in students for experiential learning or work-integrated learning (WIL, see previous chapters). There is a need to support the workplaces by providing guidance and mentorship training. The feedback from the workplaces need to be taken seriously and used to adjust the programmes annually. The graduates stated: *"They [the HEI] must try to make the farmers understand the importance of students to gain experience as it is important for the country as a whole."* (DG7), and *"… we lack mentorship on how we go about doing it, yes we have the idea from the theory part but we fail to implement it."* (DG8). The support for the students at the workplace is critical important and as the graduates said: *"… I think it must ensure that students are assisted towards getting proper experiential training."* (DG9)

The farms used for WIL need to select carefully that they can add value to the students' learning: *"Institutions of higher learning must select all competent agricultural institutes/farms for students to do their experiential training at because some farms lack resources which leads to failure of students to accommodate the necessary knowledge required by the corporal world."* (DG5) The graduates also raised concerns about the following: The duration of the WIL period: *"I would say the one-year practical is truly short; there's a lot to learn of which needs a student to be hands-on, more especially when it comes to start your own business in agriculture."* (DG10), The work that they are supposed to do at WIL placement: *"It would really mean a great deal if the HEI listened to our [outcries] as we are never given an opportunity to practise what we have learnt in university when we are in the farm."* (DG12), The conditions that the students need to endure at some of the workplace sites: *"Racism in farms towards black graduates is the main reason for graduates to seek alternatives" and "We are exploited when it comes to salary. We are made to work for wages below minimum regardless of our qualification."* (DG15)

6.8.3. Employment

Figure 27*: Word cloud contain key word of graduate's recommendation regarding employment.*

The word cloud in Figure 26 highlights the key words of the graduates' response regarding employment. Some 58,3% of the respondents were employed; therefore, the importance of the graduate's proposals regarding employment should not be taken lightly. 1) Collaborate with organised agriculture, commodity organisation and farmers to assist with youth employment*: "Encourage farmers to create more job opportunities and let graduates use their theoretical skills practically."* (DG10). 2) Provide support for final-year students and graduates to find employment: *"They [HEIs] must at least further assist graduates with job experience by helping them with another two years of experience and they should really consider it because the industry requires previous work experience – if you have one year it is not enough."* (DG20). 3) The training purpose or focus of the HEI need to change to provide more focus on entrepreneurship and owner-farmers: *"Well first this system of training students to be employees must stop ... we need graduates that will come out of tertiary to go work."* (DG5), 4) Agricultural diploma graduates should be considered a beneficiaries of land redistribution, as they have the knowledge and skills to do the job under the guidance of qualified and competent mentors: *"Provision of land by the government special for agricultural graduates to work on after completing study ... government also needs to really take agricultural students seriously and in the same light as engineers and teachers in this country, because we suffer a lot after school when looking for employment."* (DG19), 5) Collaboration with departments of agriculture to promote employment of graduates: *"Get programmes or suggest to the department on how to help their graduates to ensure that their dreams are accomplished."* (DG12)

The views of the graduates and other role players are in line with Vandenboch (2006), who stated that: "*Post-primary agricultural education and training has not been re-oriented towards entrepreneurship and the private sector. As a result, it is increasingly difficult for many graduates to find employment"* (Vandenbosch, 2006).

6.8.4. Innovation

The sustainability of agricultural education depends on factors such as innovation, ideology and context (Wals & Jickling, 2002). Previous discussions on sustainable education highlighted the fact that agricultural education and training cannot be stagnant, but need to renew itself through innovation in order to keep up with the

innovations in agricultural production and practices (Wals & Bawden, 2000; Wals & Jickling, 2002; Kumar & Kumar, 2014; Romagosa *et al*., 2015).

The diploma graduates share the same thinking in the statements of the respondents: *"The study of agriculture should be based mostly on the things we experience as a country; it should be modern and relevant as the world on its own is revolving."* (DG3) and *"They can try to give out accurate studies of what is happening in the industry as mostly things change drastically due to the economy so statistics should improve."* (DG5)

They also advocate for a *"curriculum review or update, to meet the current standard of the agricultural industry"* (DG6) and, *"since the agricultural industry is vast, lectures must provide information that will be useful."* (DG8). The diploma graduates added that it had to be kept in mind during the preparation of the students in the first two years that *"students [are] affecting their image [and that of their HEI] when embarrassed by farmers if asked on problems that he did not study at school [HEI].*" (DG19)

6.9. Qualitative assessment

The NVivo12 qualitative analysis programme was used for the codification of the qualitative part of the mixed methods research. To analyse the response of the graduates to the open-ended questions in the questionnaire, all the responses were captured in a MSWord document and imported into the NVivo12 programme. The responses were auto-coded and eight themes were identified.

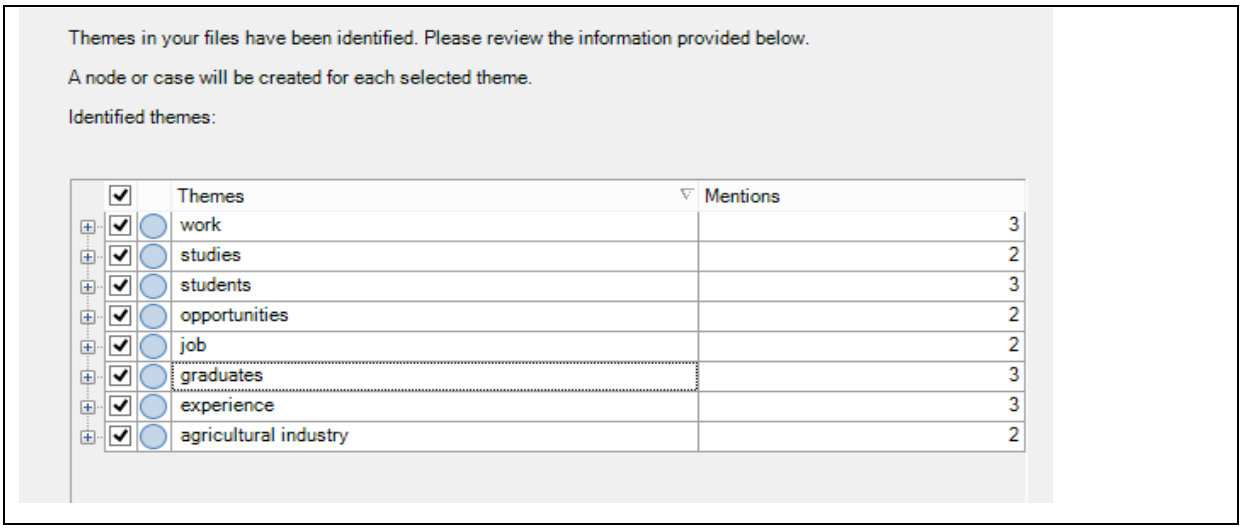

Figure 28: Screenshot of the auto code themes of the graduate response (NVivo12)

The themes were then combined into four nodes, namely practical, experiential learning, innovation and employability. The correlation between the nodes were then calculated based on word frequency. The result of the Pearson's correlation coefficient is as per Table 42. The relation between employment and experiential learning is a small correlation, while the other relations are moderate. The small number of responses suggested that the data needed to be interpreted with caution.

Table 42**: Correlation between nodes used in analysis of graduate responses**

Pearson's correlation coefficient, based on word frequency between the different nodes used to code the graduates responses, to open-ended questions on the diploma graduate's questionnaire		
Nodes	t-value	Correlation
Practical and the experiential learning	0,32	Moderate correlation (0,30-0,49)
Employability and practical	0,36	Moderate correlation (0,30-0,49)
Employment and experiential learning	0,21	Small correlation (below 29)
Employability and innovation	0,43	Moderate correlation (0,30-0,49)

6.10. Chapter summary

The study objectives, namely 1) analyse the ability/competencies of the agricultural diploma graduates in relation to employability, and 2) identify the gap that exists between the industry and the students, and 3) [provide] measures to close the gap were addressed in this chapter. The focus was on the competencies needed and how it links with the competencies needed by the agricultural industry.

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CHAPTER 7: VOCATIONAL-ORIENTATED AGRICULTURAL EDUCATION (DIPLOMA IN AGRICULTURE) AT HIGHER EDUCATION LEVEL

7.1. Introduction

The aim with this chapter is to discuss VOAE and training, the diploma qualification and how it can bridge the gap between the agricultural industry and higher education to ensure that graduates meet the competence requirements of the industry. The World Bank regards higher education as an important pillar of sustainable development that assists with creation, dissemination and application of knowledge, as well as the building of professional and technical capacity (the World Bank as reported by Paterson & Cloete, 2018). The same view can be applied to agricultural development in South Africa, where higher education needs to stand out as a pillar that strengthens, promotes and assists with the development and upliftment of smallholder farmers as well as new or emerging commercial farmers, and the preparation of the commercial farmers for future technological developments. Over time, this divide between emerging and existing farmers needs to be reduced to having only farmers or agriculturalists with the required technical and professional competence.

This chapter addresses the study objectives: to identify and describe the measures put in place to address the skills/competency gap and to develop a pedagogical framework for VOAE. Vocational-orientated pedagogy and a model for VOAE will be discussed to address transformation.

7.2. Definitions and concepts

Competence

"*The ability to perform roles and tasks required by one's job to the expected standard".*

Sustainability

The quality of being able to continue over a period of time (Cambridge Dictionary, n.d.).

Praxis

The synthesis of theory and practice, without presuming the primacy of either (definitions.net)

Vocational-orientated pedagogy

Lucas (2014) defines vocational pedagogy as *"the science, art and craft of teaching and learning vocational [-oriented] education*" or more simply *"vocational pedagogy is the sum total of the many decisions which vocational teachers take as they teach, adjusting their approaches to meet the needs of learners [students] and to match the context in which they find themselves*" (Lucas, 2014, p.2)

7.3. Bridging the gap

Salmi (2018), the retired coordinator of tertiary education at the World Bank, stated the following with regard to the future development of higher education (cited in Paterson, 2018): Technology rather than labour or even capital has become the main driver of growth globally. In this rapidly evolving economic climate, alternative modes of higher education is needed. The traditional public university sector and traditional pedagogies for imparting of knowledge in classrooms will be replaced by dynamic models supported by interactive technologies that aim at equipping students with generic competence and attributes promoting lifelong learning.

With this in mind, two things come to the fore, namely transforming the current practice to meet the competence requirements, and what is the sustainability of the current system? (LaCharite, 2015; Naylor, 2003; Davis *et al*., 2007; Teferra & Altbach, 2004).

To quantify the relative performance of a higher education system, a yardstick comprising enrolment rates, equity in terms student access to the institution, the completion of the programmes, actual learner achievements, labour market outcomes, research outputs and technology transfer is required (Paterson, 2018). The employability and employment percentage of graduates need to be added as measuring instrument, because the graduates' employment will depend largely on the quality of their education and the competence they possess. This yardstick should be used to evaluate the current system and the results should then be used to make the necessary changes.

Agricultural education at the higher-education level in South Africa is under-researched; compared to other countries, where it is debated extensively and many publications on agricultural education exist, debating the importance and the application thereof (Betru & Hamdar, 1997; Wals, 2005; Davis *et al*., 2007; Atchoarena & Holmes, 2005; Reimers & Klasen, 2012). Vocational-orientated education is regarded as a mixed practice between vocational and theoretical education; and it is, therefore, necessary to be discussed and to develop a mixed pedagogy to incorporate the elements from both theory and practice.

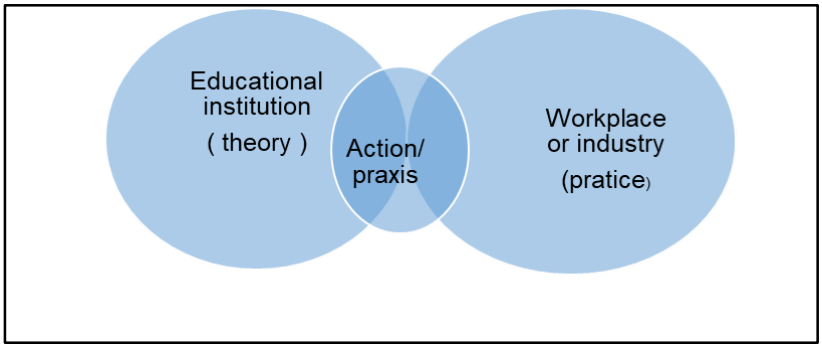

Figure 29: Dual world of vocational-orientated education

The CHE (2013) defines the purpose of a diploma qualification as *"a vocational-orientated qualification, which includes professional, vocational or industry-specific knowledge that provides a sound understanding of general theoretical principles as well as a combination of general and specific procedures and their application"* (CHE, 2013).

In the same definition, the CHE stated the purpose of a diploma *"… is to develop graduates who can demonstrate focused knowledge and skills in a particular field. Typically, they will have gained experience in applying such knowledge and skills in a workplace context. A depth and specialisation of knowledge, together with practical skills and experience in the workplace, enables successful learners to enter a number of career paths and to apply their learning to particular employment contexts from the outset. Diploma programmes typically include an appropriate work-integrated learning … component"* (ibid.).

Understanding the true nature of a vocational-orientated qualification will contribute to the improvement of teaching and learning and assessment. Transformation in VOAE is needed to address the lack of previous experience or background knowledge of the current students, to increase their employability and to prepare graduates who can play a role in the land transformation actions and provide food security and promote sustainability.

A vocational-orientated qualification is a mixed entity with a unique balance between vocational and theoretical education. The term 'vocational-orientated' needs to be unpacked to understand the purpose of the qualification and to develop an appropriate pedagogy.

The *Merriam Webster* dictionary defines vocational education as *"training for a specific occupation in agriculture, trade or industry through a combination of theoretical teaching and practical experience provided by many high schools in their commercial and technical divisions and by specialised institutions of collegiate standing (as a college of agriculture, a school of engineering or a technical institute"*. The Skills Portal (theskillsportal, 2018) refers to vocational training as a phrase often used by education and training institutions and which defined by Businessdictionary.com as *"training that emphasises skills and knowledge required for a particular job".*

Considering the meaning of the word **oriented,** it indicates the concept 'directed towards', 'showing the direction in which something is aimed'.

When put together, therefore, 'vocational-orientated qualification' can be defined or described as *"a qualification that is directed towards or showing the direction towards training for a specific occupation as a combination of theoretical teaching and practical experience that emphasise skills and knowledge that is required for a particular job function*" (CHE, 2013).

Vocational-orientated programmes can subsequently not be delivered in the same way as academic programmes, as it need to focus on practical realities. There should be a balance between theory and practice. Responses from the interviews conducted at HEIs offering an agricultural diploma indicate that in the diploma programme, this

ration is normally 60:40 – while usually 60% theory and 40% practical work, some indicated it as 60% practical and 40% theory.

City and Guilds and others state that *"vocational education needs to be taught in the context of practical problem-solving, and that high-quality education always involves a blend of methods. The best vocational education learning is broadly hands-on, practical, experiential, real-world as well as, and often at the same time, something which involves feedback and, when required, theoretical models and explanations"* (cited in Lucas *et al.*, 2012).

Cedefop (2011) drafted a working definition for vocationally orientated education as *"Vocationally oriented education and training at higher qualifications level means education and training that can contain aspects of both academic and vocational areas typically with the majority of vocational aspects. It is usually located at levels equivalent to levels 6 to 8 of the European qualifications framework"* (Cedefop, 2011).

From the above, it stands out that the relation between theory and practical is one of the main focus areas of vocational-orientated qualifications and is one of the strengths of this type of qualification. It provides the students with hands-on experience that could lead to employment. It is, however, a common struggle for many HEIs to provide relevant theoretical and practical instruction(Roberts, 2016a). Lieblein *et al*. (2000) state the following *"Our agricultural universities have based programmes on the principle that the gap between ignorance and knowing is more important than the gap between knowing and doing"* (Lieblein *et al*., 2000).

Roberts (2016b) argues that knowledge and comprehension levels are associated with the recall and understanding of concepts, which he would identify as three barriers for agricultural education and training, namely facilities, staff and the linkage between practical and theory. These dynamics surrounding the conceptualisation of the relationship between theory and practice is not new – the struggle between science and practice existed as far back as 1871 (Barrick, 1989).

There is also the view of Boughey (2018), who argues that vocational programmes disadvantage students in two ways, namely that the theoretical knowledge is often neglected in the focus on skills in outcomes-based approaches, and that it restricts

students into a specific programme of study (Boughey, 2018). Contrary to her view, Zaglul and others, at the 2015 International Conference on Agricultural Higher Education (Romagosa *et al*., 2015, p.81), argue that transformation is needed in agricultural education; that the traditional method of agricultural education that is primarily theory-based is not providing the skills needed. At the conference, various presenters raised issues regarding the redefinition of learning outcomes. It includes, among others, increased focus on higher order learning skills (soft skills) and balancing the breadth and depth of knowledge to understand the whole system (Romagosa *et al*., 2015). Monaghan *et al*. (2015) argue that *"students must synthesise knowledge across disciplines and draw upon core knowledge gained prior to entering professional study for them to be able to create the kind of location-specific, comprehensive solutions that sustainable agriculture envisions"* (Monaghan *et al*., 2015).

7.4 Model for vocational-orientated agricultural education

The model for VOAE was designed as an attempt to unpack the essence of the diploma programme and to unpack VOAE. It aims to incorporate the various schools of thought and to support the transformation of VOAE in South Africa. Vocational-orientated agricultural qualifications (agricultural diplomas) is offered at 11 agricultural colleges (ATIs), four comprehensive universities and six universities of technology in South Africa.

VOAE, as illustrated in the diagram below, is founded on three core elements, namely **formal instruction or teaching**, **supervised practical teaching** or **supervised agricultural experience and practical application**, and **work-integrated learning (WIL, an authentic work experience[9])**. Each core element plays a specific role in developing a graduate who will fit the profile of the agricultural industry. In a recent survey, the agricultural industry indicated strongly that it requires diploma graduates with practical experience and that HEIs should focus more on the practical aspects of agricultural education.

The ratio between theory and practical is proposed to be 50:50, to ensure adequate knowledge and practical competence. In a flipped learning environment, the learning

[9] QCTO – occupational qualification components

of theory can also be done through supervised practical teaching or service learning, where students discover the knowledge through work they do in the 'field' or the farm as an outside learning laboratory (LaCharite, 2015b; Deegan et al., 2016).

The rationale behind the model is competence-based learning, creating a balance between 1) personal competence/qualities all that will promote employability as the foundation upon which 2) production and technical competence/skills are developed. 3) Production technology and organisation as well as 4) systems thinking (Bawden *et al*., 1984) and reflection provide students with the ability to bridge the gap and overcome the restriction (Boughey, 2018), applying their basic training into a different production fields or contexts.

The pedagogical departure point for the model is based on the following. Twenty-first century competence is forming the foundational competence upon which production and technical competence are built, in a reversed t-shape. Combining it with production technology and organisation, and using systems thinking and reflection, it provides a bridging effect that will enable the diploma students to be more versatile and overcome the assumed disadvantages of vocational-orientated qualifications, (Hass, 2019)[10]. It enables students to use the vocational-orientated training and apply it to different fields because the students have the necessary 21st century competence as a sound foundation, upon which the technical and production competence is added.

The diagram below illustrates the bridging to become more relevant and apply or transfer the foundational learning to different fields. It is then critically important to include production technology and organisation into the curriculum and use systems thinking as a learning process.

[10] Personal Communication

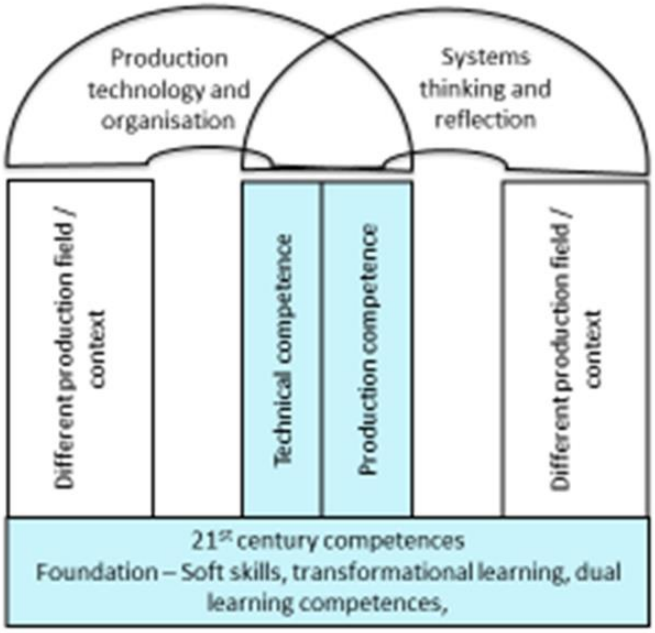

Figure 30: Curriculum design for transformation to other professional fields (Viljoen & Haas, 2019)

7.5 Agriculture signature pedagogy

Flowing from the above is the need for a VOAE pedagogy. The importance of such an pedagogy is emphasised by many (Lucas, 2014; Rudman & Meiring, 2018; Mertens, 2012; Jjuuko *et al*., 2019; Kumar & Kumar, 2014; Lotz-Sisitka *et al*., 2015; and Mulder, 2017) – hence the need to elaborate on a pedagogy for the VOAE.

Addressing the question regarding the need for a vocational pedagogy, Lucas *et al.* (2012) state the following: *"The effectiveness of all education systems depends critically on the quality of teaching and learning in the classrooms, workshops, laboratories and other spaces in which the education takes place. While outstanding teachers (including lecturers, trainers, tutors, and coaches), engaged students, well-designed courses, facilities which are fit for purpose, and a good level of resources are necessary if any kind of educational provision is to be excellent, they alone are not sufficient. The real answers to improving outcomes from vocational education lie in the 'classroom', in understanding the many decisions 'teachers' take as they interact with students"* (Lucas *et al.*, 2012, p.14).

Shulman (2005) uses the term 'signature pedagogy' and describe it as the characteristic forms of teaching and learning, the types of teaching that organise the

fundamental ways in which future practitioners are educated for their new profession (Shulman, 2005). The complex agriculture study field, with a variety of interlinked core subject, needs to be more responsive to the challenges of the 21st century (Wals, 2005; Romagosa *et al*., 2015) and developing a signature pedagogy for the teaching of agricultural subjects, will highlight the different categories or basic elements of the study field and the need to reflect upon it.

A signature pedagogy, according to Shulman (2005), has three dimensions. The **surface structure** consists of the real, functional acts of teaching and learning, acts of showing and practical demonstrations, of getting response from learners through question and answers, the interaction with the learners and the learning material. The signature pedagogy also has a **deep structure**; the departure paradigm of the educator and the set of assumptions about best practice to pass on or convey a certain body of knowledge and know-how. The last dimension is the **implicit structure,** the moral dimension that is founded on the beliefs, attitude and values.

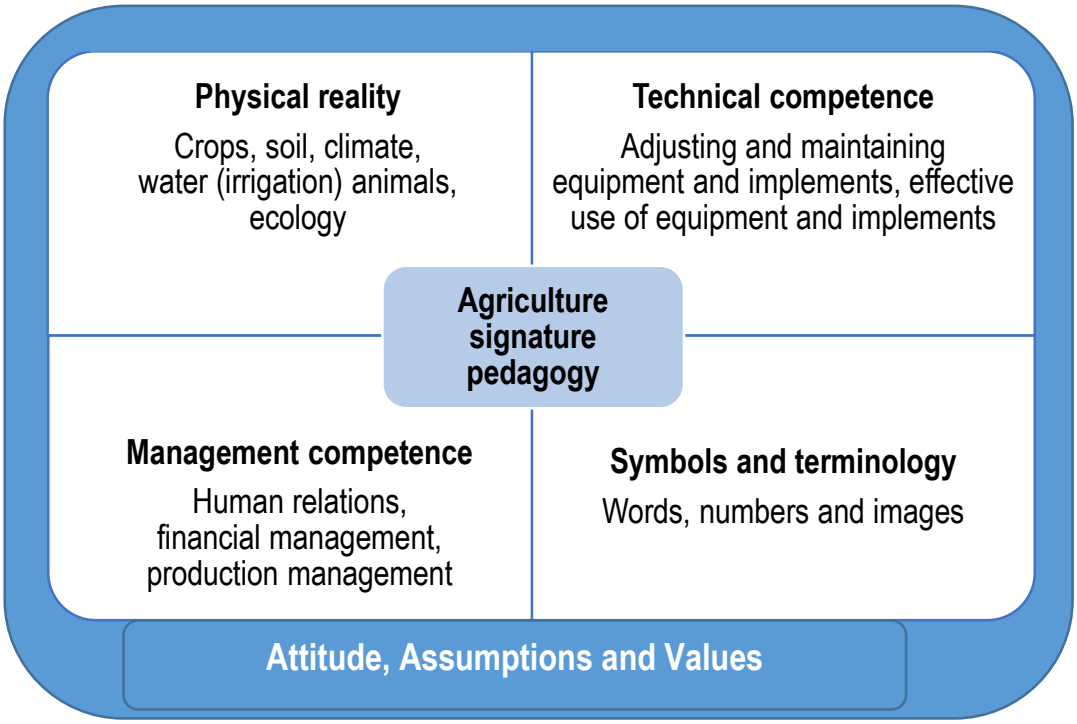

***Figure 31*:** Factors influencing quality education (Researcher's own design)

A signature pedagogy involves choices and selection of different approaches to highlight and support the outcomes a unique way of teaching that strive to be innovative and ensure that learning takes place. Figure 30 is a diagram capturing all

the factors influencing quality education. LaCharite (2015) advocates that the teaching of agriculture should also be a method to teach knowledge and skills, and develop selfless feelings towards social and environmental sustainability (LaCharite, 2015a).

7.6. The pedagogical model for vocational-oriented agricultural education

The model consists of three core components, namely formal instruction, supervised practical teaching and learning, and work-integrated learning (WIL, see previous chapters) to ensure quality competence-based learning and is illustrated in Figure 31.

7.6.1. Formal instruction/education

Formal instruction/education is characterised by: 1) The transfer of knowledge as per the curriculum using the methodology of Mezirow's transformational learning theory (Francis, Jordan, Porter, Breland, Lieblein, Salomonsson, Sriskandarajah, Wiedenhoeft, DeHaan, Braden & Langer, 2011; Kitchenham, 2008). 2) The incorporation of the concept of sustainable education introduced by Wals and Jickling (2002). 3) A shift from expert ('know-it-all') to a facilitator of community-based learning (Wals, 2007).4) The knowledge and soft skills theory of Dewey (quoted in Parr *et al*., 2007). 5) Systems thinking theory of Bawden (1992), to provide a holistic systemic approach, for the observation and analysis of the complex situations agriculture and food systems (Francis *et al*., 2011).

The formal instruction is complemented by supervised practical teaching and learning to strengthen the understanding of the theory and to illustrate the application thereof. This is the head cognitive part of vocational-orientated education. It is important to understand the role of the head (cognitive), heart (emotive) and the hand (skills) in the development of competence.

The balance between theory and practice plays a crucial role to ensure that graduates will have the required knowledge and the associated competence. HEIs should not rely on the WIL to master the skills. WIL starts on day one of the first year – if what the students will learn is not integrated in the world of work, then there is a big gap.

7.6.2. Supervised practical teaching and learning the second core function

Experience is the core of the vocational-orientated education and embodies the following: 1) Action education based on a philosophical pragmatism learnt by integrating theory with action (Romagosa *et al.*, 2015). 2) Development of skills and competence as advocated by Kolb (1984), Miller (1990), Mulder *et al.* (2007) and Chaminuka *et al*. (2016).3) Social learning in groups and networks (Lotz-Sisitka *et al.*, 2015).4) Experiential learning and production knowledge using learning by doing (Dewey, quoted in Parr *et al.*, 2007; Monaghan *et al.*, 2017). 5) Blended learning (Dewey, quoted in Parr *et al.*, 2007; Baily, quoted in Parr *et al.*, 2007; Deegan *et al*., 2016). 6) The role of campus agriculture initiatives in sustainability education (LaCharite, 2015).

Supervised practical teaching can be done in different forms such as routine daily practical activities on the institution's farm or campus, and practical sessions in the laboratories, workshops, centres or the farm. Agricultural campus projects are one of the many terms used for the practical activities, according to LeCharite (2015).

The supervised practical teaching and learning is fundamental to assist with deep learning and to develop the production, technical and academic competence needed. A practical programme or vocational-orientated programme, such as the agricultural diploma, cannot be studied in a classroom alone; there must be sufficient practical exposure and involvement for the students to understand the heartbeat of agriculture. Kolb (1984) highlighted the relation between doing and learning through active engagement with the learning material to give meaning to the learning (cited in Parr *et al*., 2007). In this context, the facilities for the supervised practical component is essential and the university farm should be the extension of the classroom. It is the laboratory for practicals where the learner will come to understand the different systems involved in agriculture (Parr *et al*., 2007). Bailey (1905, as cited by Parr *et al*., 2007) emphasised this when he said, *"a farm justified from the university or pedagogical point of view must be made a true laboratory to collate and articulate with theoretical instruction"* (Parr *et al*., 2007). This view is supported by Monaghan *et al*. as it is still very valid and important 110 years later (Monaghan *et al*., 2015).

Monaghan *et al.* (2015) emphasise the fact that *"students must synthesise knowledge across disciplines and draw upon core knowledge gained prior to entering professional study for them to be able to create the kind of location-specific, comprehensive solutions that sustainable agriculture envisions"* (Monaghan *et al.,* 2015). In most current cases, students entering in the diploma programmes do not have the 'knowledge gained prior the study' and this necessitates the emphasis on the supervised practical teaching to gain the required practical knowledge and experience; and it is wrong to assume that it will be gained during WIL.

The supervised practical teaching use learning by doing and experimental learning (Monaghan *et al.*, 2017) to develop the cognitive (head) competencies, the emotive competence (heart) and the skills (hand) (Wals, 2007) using the additional senses to enhance deep learning.

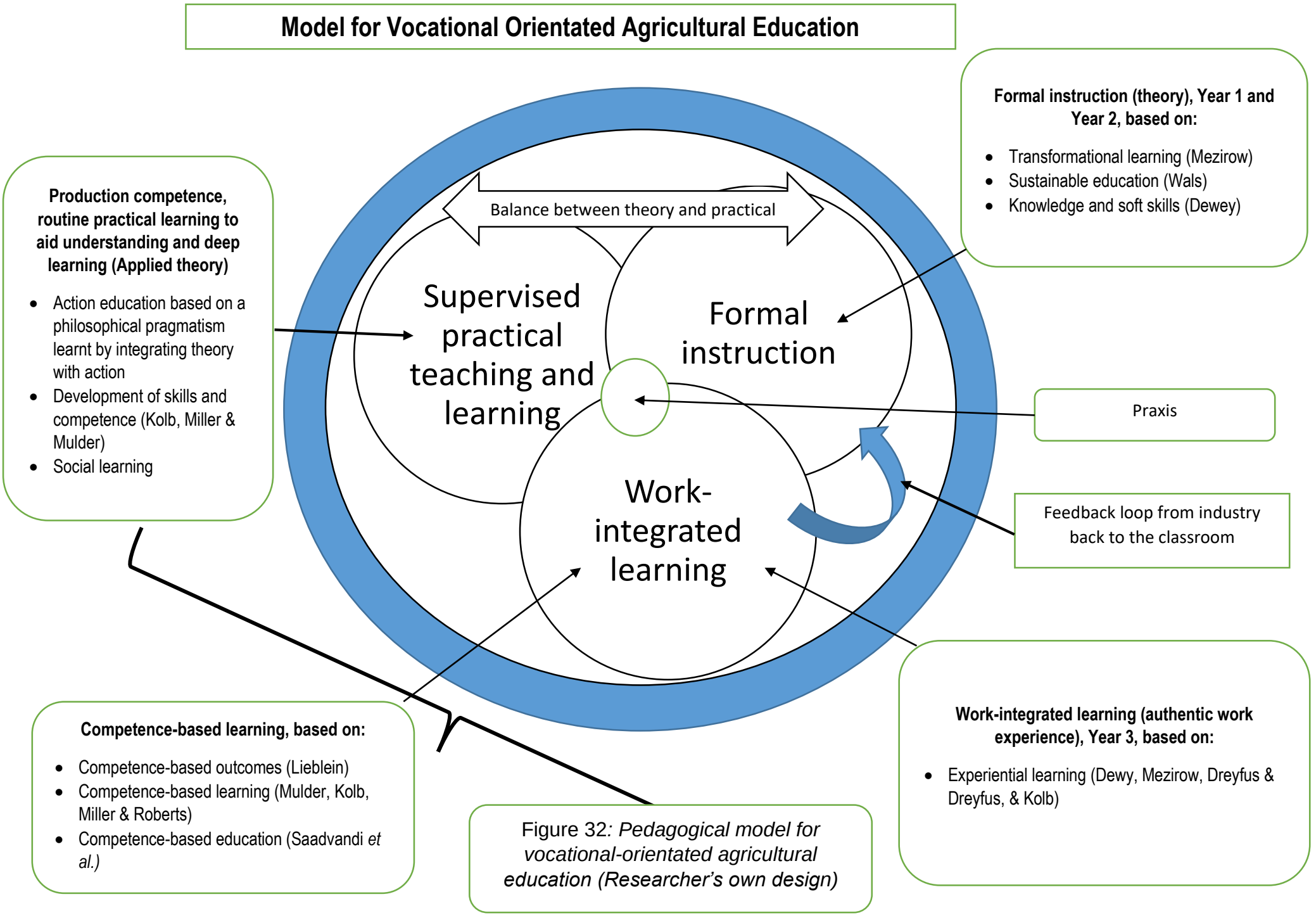

Figure 32*: Pedagogical model for vocational-orientated agricultural education (Researcher's own design)*

Provision must also be made for technical laboratories or workshops where students can gain much-needed practical competence. The university or college farm is an extension of the classroom and plays a vital role in the structured practical learning component (LaCharite, 2015b; Monaghan et al., 2017; DAFF, 2018). HEIs also need to assess the competence of student and declare them competent or not.

Roberts (2016a) identifies three barriers for agricultural education and training: facilities, staff, and the linkage between theory and practical.

These barriers, illustrated in Figure 32, is also a reality in the South African VOAE, and will negatively affect VOAE if not attended to and remedies are found to ensure quality education. Suggestions for the improvement of VOAET is covered in Chapter 9.

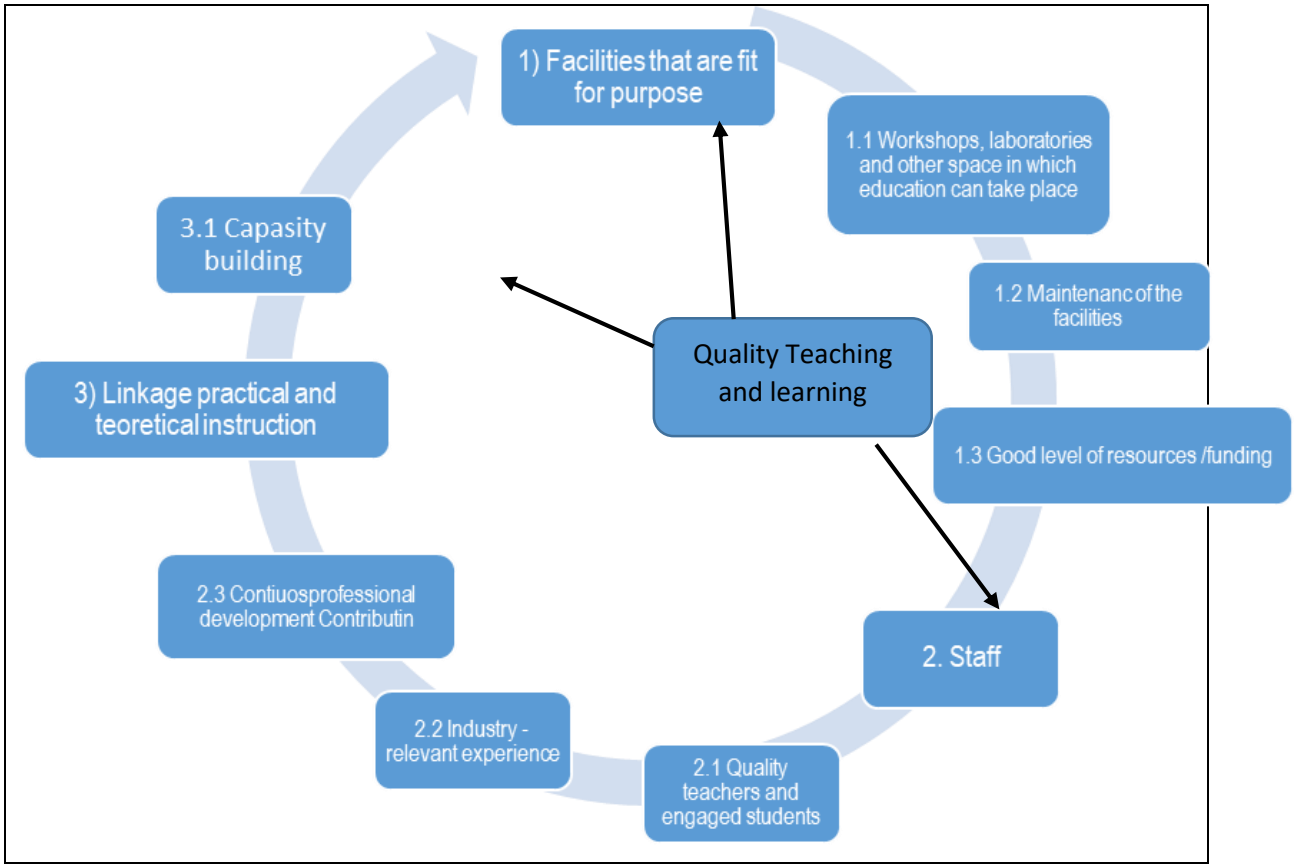

Figure 33: Essential elements for agricultural education and training according to Roberts (2016a) (Source: Researcher's own design)

7.6.3. The third core function, work-integrated learning

WIL does not, as is generally believes, start only in the last year of the diploma or the period the student will be placed at the workplace (Orrell, 2004; Ley et al., 2008) DAFF, 2018). WIL starts the first day in the classroom, because all that the students will be taught throughout the diploma years must be work-related; lecturers cannot teach content that is not valid, authentic, current and sufficient. The only way it can be done is if the lecturer/s are up to date with what is happening in the industry.

Students should be taught the practical production skills as well as the fundamental soft skills required. What must be kept in mind are the changes in the background experience of the current students – very few of them grew up on commercial farms or have a background of agriculture; it is also noted that the agricultural was not the first choice for a number of students (Win & Legg, 1992; Kensinger & Muller, 2006; Swanepoel,et.al. 2017). It is against this background that the role of the HEI is to fill this gap or find ways to fill the gap and provide the students with the necessary experience and understanding.

If this approach is followed, the period of WIL can be used to expand on, and to consolidate learning and allow the students to put the theories into practice. The WIL period is there to improve their competence and it should not be where the students will learn the basic skills, which is the responsibility of the HEI.

The teaching of workplace skills through the practical components and WIL can or should be done using the different models of teaching and learning, to ensure first-day workplace competency. New and innovative training models need to be developed to provide for vocational skills training and the assessment thereof, taking into account the increasing number of students at university level. Miettinen (1999) stated: *"To achieve a productive alignment between higher education and workplaces, academic staff should develop an understanding of how to integrate experiences across different areas of learning, both within and outside academic contexts"* (cited in Winberg *et al.*, 2011).

7.7. Chapter summary

The model for VOAE proposed in this chapter attempts to capture the elements necessary to transform the current practice and aim at providing quality education with the focus on producing graduates with the competence that will assist them to be employed by the industry, or be self-employed in the agricultural industry for those who are so inclined, too make a contribution to food security and good agricultural practices.

CHAPTER 8: VOCATIONAL AGRICULTURAL EDUCATION AT HIGHER EDUCATION INSTITUTIONS IN THE SADC REGION

8.1. Introduction

The objective of this part of the study is to form a link between what is happening in South Africa's neighbouring countries and to promote dialogue and understanding or their unique situations and challenges. The movement of students and lecturing staff between the different countries is a reality, as is the work and business opportunities. South Africa plays a leading role in the development of agriculture in the SADC region through skills transfer, practical experience and entrepreneurship.

The aim of this desktop study is also to facilitate communication and collaboration between the various HEIs and to link what has been done in other parts of the continent with the objectives of the study.

Some 61% of the people of the SADC region is dependent on agriculture as the primary source of subsistence, employment and income. Agricultural growth and productivity have remained low over the past two decades despite the diversity in natural resources. To set the SADC member states on a path of rapid economic growth and poverty reduction, programmes need to be implemented to turn around the decline in agricultural production and make agriculture a central priority of the SADC member states (Davis et al., 2007; Of et al., 2007; Jere, 2014) The diversity of the region's farming and livelihood systems, the different agro-ecological regions, and diverse education system presents challenges to policymakers in formulating sound agriculture development strategies. Many of the SADC countries share similar problems and opportunities. Cooperation in some of these key areas can yield significant benefits – as can greater economic integration by taking advantage of natural comparative advantages (Jere, 2014).

Cooperation between the SADC members at educational level is part of the new and programmatic approach to agricultural transformation (ibid) and focuses on areas with potential for development such as: Pool resources to address areas of common

interest more effectively and take advantage of the economy of scale. Develop mechanisms for sharing knowledge, building capacity and contribute towards regional integration. Development of human resource capacity through the improvement of basic education, vocational and vocational-orientated training at institutions of higher learning and resource centres. And establishment of high-quality regional training institutions and joint training programmes to strengthen national capacity and improve regional specialisation (ibid).

8.2. SADC overview

Figure 34: Map of the SADC countries (Source: SADC)

The SADC comprises, in addition to South Africa, the member states of Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, United Republic of Tanzania, Zambia and Zimbabwe.

The SADC is a regional economy that comprises the above-mentioned 16 member states. The main objectives of the organisation are to achieve development, peace and security, economic growth, the alleviation of poverty, to enhance the standard and

quality of living, support the socially disadvantaged through regional integration and built on democratic principles and equitable and sustainable development.

8.3. The study objectives

The study objective to achieve in this chapter is to discuss the position regarding vocational-orientated agricultural training at HEIs in the SADC region.

A desktop study was conducted to gain information related to the transformation of vocational agricultural education in the SADC region. The reason for selecting the SADC region is its proximity to South Africa and the fact that South Africa is part of the SADC grouping, and as such it can or is already assisting with the process of transformation.

8.3.1 Transformation of vocational [-orientated] agricultural education in the SADC region

Through the New Partnership for Africa's Development (Nepad), the Comprehensive African Agricultural Development Programme (CAADP) and the Agricultural Education and Skills Improvement Framework (AESIF) 2015–2025, the African Union aims to transform agricultural education and to improve on the quantity and quality if the skilled work force. Through the CAAP projects, the aim is to improve the required skills to advance agricultural growth.

The International Food Policy Research Institute (IFPRI) also advocates for the improvement and strengthening of agricultural education and training in the sub-Saharan region (Davis *et al.*, 2007). At the start of the new millennium, the World Bank had already recognised the necessity of transformation of the HEIs in Africa to meet the demand of the new knowledge era wherein HEIs must play a critical role (Teferra & Altbach, 2004). Warnings were issued about the imbalance between theory and practice in agricultural education and training. This is an imbalance between content and competencies as well as the designing and implementation of the training programmes.

The transformation of vocational education and training in Africa involves a sustained effort in capacity development through the improvement in basic education, vocational

training, institutions of higher learning, universities and/or research centres (Unesco, 2016; McGrath *et al.,* 2019). The establishment of high-quality training programmes through regional training institutions will benefit and strengthen national capacity and regional specialisation in agricultural research and extension. There are also important opportunities to learn from experiences in reform and improvement in delivery systems of services to smallholders across the region (ibid.).

A brief overview of VOAE at HEI in the SADC is provided to give a glimpse of what is being done, how it is done and what are the possibilities of collaboration to aid the transformation of VOAE.

8.4. What is being done?

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) was formed to coordinate agricultural research and development in the SADC region and the establishment charter was signed on 5 November 2010. One of the objectives of CCARDESA is to *"improve agricultural technology generation, dissemination and adoption in the region through collective efforts, training and capacity building"* (SADC, 2010).

In the establishment charter of CCARDESA, Article 5 stipulates the functions of CCARDESA as follows (Davis *et al*., 2007): 1) To coordinate, harmonise, promote and advocate R&D policy among state parties. 2) To update regional agricultural R&D priorities and to coordinate joint programmes among stakeholders, including promotion and development of agri-based value-adding technologies.3) To mobilise and generate resources for the SADC region and to foster partnership and collaboration with regional and international agricultural research organisations. 4) To empower and strengthen farmers and their organisations or groups into effective partners in agricultural development and enhance their access to markets and negotiating skills. 5) To facilitate regional capacity-building of agricultural and natural resources scientists in terms of training, development and management.6) To facilitate the development of sustainable education, training and learning systems that contribute to farmer-oriented innovation and technology transfer systems for the region, and 7) To promote cooperation, consultation and exchange of scientific and

technical information on best practices in agricultural research and advisory services in the SADC region.

The improvement of agricultural education and training is supported by other vocational [-orientated] education and training in southern Africa. Vocational education and training has been badly neglected in southern Africa; information on vocational education and training is scarce (Akoojee, Gewer & Mcgrath, 2005). This is now changing, as there is a greater focus on vocational education and training, and specifically on agricultural training and development. Some governments consider agriculture as the key to social and economic prosperity (Ngugi, Isinika, Temu & Kitalyi, 2002) and others regard Africa as the new breadbasket of the world to produce food for a growing world population.

Facing the challenges in education and skills improvement in agriculture, Nepad developed the AESIF to address (CAADP, 2015): The need to transform agricultural education and training, and improve outdated training systems. The mismatch between agricultural education and training and skills required in the industry and public institutions, and improve the outdated curricula, and to decrease of agricultural education and training financing, and address the lack of funding.

The AESIF addresses three strategic areas, namely reforms and governance and management policies, reform and update curricula and teaching methods, and public and private partnerships (CAADP, 2015).

This chapter aims at providing a snapshot of VOAE in the SADC countries as per Table 43, and in not a comprehensive detailed study. There is opportunity for further research on the topic.

8.5. A snapshot of vocational-orientated agricultural education in SADC countries

Table 43: A snapshot of Vocational Orientate Agricultural Education in SADEC countries.

Country	Secondary School Agricultural Curriculum [11]	Post-Secondary School Agricultural Education [12]	Programmes	Qualifications [13]	Importance of Agriculture [14]	Private Sector Involvement in Training [15]
Angola	Agricultural training school	University of Angola – Faculty of Agricultural Science at Huambo Agostino Neto University Agricultural Research Institute	Agronomy, veterinary and forestry, promoting crop and animal production	Certificate, diploma and degree programmes in agriculture	Agriculture contributes 12% of GDP	Farmers field schools with FOA, Agrisud-Angola, ADPP, World Vision ADR and churches
Botswana	Taught in lower primary and upper primary Core subject at junior school from grades 8 to 10 and at senior school level	Botswana College of Agriculture, Botswana University of Agriculture and Natural Resources, University of Botswana, Tonota College of Education, Borlong Institute of Agriculture and Ramathabama	Agriculture, animal health and production, agricultural education, agricultural engineering and	Certificate, diploma and degree programmes in agriculture	1999/2000 agriculture contributed 2,6% to the GDP	Permaculture and private farmers organisations

[11] Source: International Bureau of Education: World data on Education: Seventh edition 2010 -11

[12] Regional Agricultural Policy: Country Summary Agricultural Policy review reports, SADC, 2011

[13] Review of Agricultural Technical Vocational Education and Training (ATVET) in Africa, Nepad, 2013

[14] VVOB website www.vvob.org and www.rdc.vvob.org

[15] Simons, 2014)

		Ranch Training Centre, which provides vocational training	diploma in forestry and range			
Country	**Secondary School Agricultural Curriculum**	**Post-Secondary School Agricultural Education**	**Programmes**	**Qualifications**	**Importance of Agriculture**	**Private sector Involvement in Training**
Comoros	Mandatory education between 6 and 16 years. Primary school (6 years), secondary school (7 years) modelled on the French system	University of Comoros	Agricultural education	N/A	Agriculture is the largest employer average of 31,6% of GDP – small family-owned farms	FAO involved in agricultural training
Democratic Republic of Congo	System consists of a pre-primary (3 years), primary (6 years), secondary school with long (6 years) and short cycle or vocational training (2-3 years) Agricultural education in the long cycle of secondary schools	Universite Catholoque De Bukava University Evangelique en Afrique University de Kisangani University Officielle de Bukava 52 institutes and universities, 25 public and 27 private, are exclusively devoted to technical agricultural education TVET colleges	Agricultural science, rural development and veterinary science	Diploma and degree programmes	2007 contributed 28,4% to the GDP	VVOB supports Quality Agricultural Education Farmer Field School (FFS) and initiative of Food and Agriculture Organisation of the United Nations (FAO) SVN Netherlands Development organisation

Country	Secondary School Agricultural Curriculum	Post-Secondary School Agricultural Education	Programmes	Qualifications	Importance of Agriculture	Private sector Involvement in Training
Kingdom of Eswatini	Early Childhood Basic education 7 years and 3 years of junior secondary Upper secondary 2 years	University of Eswatini Nlangano Farmers 'training Centre	Agronomy, animal production	Certificate in Agriculture BSc in Agriculture Crop and Animal Science	Smallholder agriculture is the backbone of rural livelihood contribute about 6,5% to GDP	FAO farmer field school provide training and IFAD
Lesotho	Follow the Cambridge system Primary education (7 years), secondary education (5 years) Agriculture a practical subject as an elective for junior secondary phase	National University of Lesotho Lesotho Agricultural College	Agricultural economics, agricultural extension, animal science, crop science, soil science	BSc in Agriculture master's degree PhD degree Diploma in forestry and resource management, diploma in agricultural engineering, land and water management	Agriculture accounts for 10% of GDP provides employment for 63% of the country's inhabitants	Leribe Agricultural Training centre, Serumula Development Association, GROW and PELUM Lesotho

Country	Secondary School Agricultural Curriculum	Post-Secondary School Agricultural Education	Programmes	Qualifications	Importance of Agriculture	Private sector Involvement in Training
Madagascar	Primary school for 5 years' secondary school, junior secondary (4 years) and senior level (3 years)	University of Antananarivo, University of Toliara, Zurcher Adventist University, Higher Vocational Agricultural School of Bevalala. Four agricultural colleges and training centres	Agronomy Animal Production Veterinary health	B degree in Agriculture Diploma in Agriculture	Agriculture is the main sector for employment 50-90% of total house hold income comes from agriculture	Several stakeholders (farmers, extension service agents, technology developers, traders)
Malawi	Equip learners with requisite knowledge, skills and attitudes for them to engage in agriculture as an occupation in their communities Provide a foundation for those proceeding to tertiary levels of agricultural education and related fields	Nkhoma University, Lilongwe University of Agriculture and Natural Resources, (Bunda College of Agriculture), Mzuzu University	Agricultural engineering, animal science, basic science, crop and soil sciences & horticulture	BSc, MSc and PhD programmes	The mainstay of the Malawi economy with 31% contribution to GDP	Several stakeholders (farmers, extension service agents, technology developers, traders)

Country	Secondary School Agricultural Curriculum	Post-Secondary School Agricultural Education	Programmes	Qualifications	Importance of Agriculture	Private sector Involvement in Training
Mauritius	Colonial system 6 years primary, 5 years lower secondary and 2 years secondary	University of Mauritius	Agronomy and animal husbandry, processing of agricultural products	BSc programme and BSc Honours programme Agricultural science and technology	Contributes about 6% to the GDP	World bank, FAO
Mozambique	Three-year technical vocational education in agriculture and other Nine Escolas Tecnica Basicas (ETBs) for Agriculture	Universidade Catolica de Mozambique Eduardo Mondlane University University Zambeze **TVET:** Two Institutos Technicos Medios (ITMs) for Agriculture	Agronomy, agro-processing, animal science, production veterinary medicine fishery production vegetable production degree in rural development	Diploma at ITMs and degrees at the universities	Agriculture amounts to 22% of the economy	Several stakeholders (farmers, extension service agents, technology developers, traders)
Namibia	12 years of schooling	University of Namibia Namibia University of Science and Technology	Animal and crop husbandry, animal health and wildlife management and ecotourism	Higher certificates, diploma courses, BSc, MSc and PhD degrees	Agriculture and forestry 29,3% of GDP	Several stakeholders (farmers, extension service agents, technology developers, traders)

Country	Secondary School Agricultural Curriculum	Post-Secondary School Agricultural Education	Programmes	Qualifications	Importance of Agriculture	Private sector Involvement in Training
Seychelles	Primary education (6 years) secondary education (5 years)	Seychelles Institute of Agriculture and Horticulture (Polytechnic)	Agronomy, horticulture, animal production	Apprenticeship certificate in agriculture and horticulture Advance certificate in general agriculture	Agriculture, forestry and fisheries contribute about 205% to GDP	NEPAD and CCA programmes
United Republic of Tanzania (Ngugi *et al.*, 2002)	Agriculture as a subject with practical skills in primary and secondary school. Primary school from Grade 3 to Grade 7. At secondary school level agriculture is taught as a vocational subject and an examinable subject in O-level Only few school offer it at A-level	Sokoine University of Agriculture and Technology Ministry of Agriculture training institutions (MATIs) and livestock training institutes (LITIs) + farmer training centres (FTCs) Monduli Teachers Training College and Vikindu TTC	Two-year agricultural teaching diploma to train teachers for secondary schools and retrain teachers Study fields food science, horticulture, farm management, animal husbandry, animal health and crop production	Certificate, diploma, BSc and postgraduate qualifications	Contribute to 30% of the GDP 70-80% of labour involved in agriculture	USAID assist with financial support Canadian International Development agency (CIDA)

Country	Secondary School Agricultural Curriculum	Post-Secondary School Agricultural Education	Programmes	Qualifications	Importance of Agriculture	Private sector Involvement in Training
Zambia	School system consists of pre-school education up to 6, lower basic education (Gr1-4), middle basic (Gr5-7) upper basic (Gr8-9) high school (Gr10-12) or vocational training programmes Agriculture is a subject in senior secondary schools	ATVET in Zambia is organised in two levels: the continuing professional training and the life-long learning at grassroots level for farmers Zambia College of Agriculture, Natural resources Development College, Zambia Centre for Horticulture, Palabana Dairy Training Institute, Mulungushi	Several institutes at different levels training areas: Animal science, crop science and agribusiness management, fisheries, agricultural engineering, and food and nutrition	Bachelor degree of Agricultural Science, Master of science, Bachelors of Agricultural Science with Education	40% of countries GDP and 67% of employment	Several stakeholders (farmers, extension service agents, technology developers, traders)
Zimbabwe	School system consists of preschool, primary school (seven years), lower secondary (4 years at O level) and higher secondary (2 years at A level) that give access to university or college At O level, a minimum of 2 practical subjects during the first 2	Chinhoyi University of technology Lupane State University Bindura University of Science Education Great Zimbabwe University University of Zimbabwe Midlands State University	Animal production, agricultural engineering, food science and technology, biotechnology, environmental science, crops	Diploma at the Agricultural colleges, degrees such as BSc, BSc Hons, MSc at the universities	Contributing 19,5% to GDP (2010) employment for about 66% of labour force	Several stakeholders (farmers, extension service agents, technology developers, traders)

	years of secondary school, this include study of agriculture	Marondera University of Agricultural Sciences and Technology Africa University Agricultural College	science and horticulture			

(Source of data: Researchers' own compilation based on literary review of various sources)

8.6 Chapter summary

The need to address the sustainable development goals and to eradicate hunger and poverty emphasises the rapid changes needed in VOAE in the SADAC region. Agriculture is one sector that can address food security and employment, provided that the education and training is correct and recent information is provided.

The chapter highlighted the diverse nature if VOAE and addressed the study objective, to discuss the position regarding vocational-orientated agricultural training at HEIs in the SADC region.

CHAPTER 9: CONCLUSION AND RECOMMENDATIONS

9.1. Introduction

Wrapping up and highlighting the findings of the research in addressing the research outcomes is the aim of the last chapter. Answering the question of how to bridge the gap between the agricultural industry and the HEIs is the one element of the research; the second question is how to improve the employability of the diploma graduates. The following suggestions emanated from the research can be considered, going forward, either as research topics, but rather activities to be implemented as part of the transformation of the VOAE.

It is important to emphasise that a part of the education at a university is performed through conducting research. Therefore, the level or content of the research, basic science or practical science will definitely influence the education. Assanuma (2015, as published in Romagosa *et al.*, 2015) provides an analysis of the word 'agriculture'. It has two meanings: *"practice of farming"* and *"science of farming"* (*Longman Advanced American Dictionary*, 2000) or *"the science or art of cultivating the soil, producing crops, and raising livestock and in varying degrees the preparation of these products for man's use and their disposal (as by marketing)"* (*Webster's New Collegiate Dictionary*, 1979). Using this explanation of agriculture, the VOAE or diploma can be regarded as the 'practice of farming' and the more academic study such as BSc as the 'science of farming'.

Assanuma (2015) states the following: *"Agriculture is supposed to be a practical science led to the development of agricultural technologies and so it is expected to solve the practical farming and livestock problems, aiming to improve plant and animal performance and ultimately improve profitability and sustainability of the entire enterprise"* (2015, as published in Romagosa *et al.*, 2015).

With this explanation in mind, the achievement of the research objectives is considered.

9.2. Research Objective 1a: To investigate, identify and analyse competencies required by the agricultural industry of South Africa and rate them in terms of importance.

Chapter 4 described the competence required by the agricultural industry, indicating which competencies are ranked the highest in Table 17 and Table 18; subsequently competencies were added by the agricultural industry respondents. The challenge is that with the different commodities, different competence is required in addition to the generic competencies already identified.

The agricultural industry rating of competence were also compared with that of the Higher Education Institutions and the diploma graduates in Chapter 6; the results thereof are captured in Table 36 and Table 37. It clearly shows 1) the most important competence when all responses are combined, 2) that there is limited correlation between the agricultural industry and the diploma graduates and 3) that there is a difference in the rating of the more practical competence.

The main concern or theme that came out from all three these components are the fact that graduates are in need of practical experience. What must be kept in mind is that with of the majority of the students not coming from a farming background, the HEIs need to take note of that and put measures in place to remedy the lack of experience, focusing on methods and practices that can assist the students to obtain the background knowledge and skills.

9.3. Research Objective 1b: How does the agricultural industry rate competencies in terms of importance?

The agricultural industry respondents rated the competencies provided on the AIQ. The mean or the responses was used to classify the competence and rated them as very high or very competent, above average and average

competence. The competence was also split between soft skills or 21st century competence and the production, mechanical or technical skills or hard skills. The results of the rated competence are captured in Table 17 and Table 18. The top 10 competence of each category were identified as Soft skills; Honesty, trustfulness, responsibility- being able to accept responsibility for his/her actions, hardworking or diligence, professional discipline, work ethic, good human relations, ability to collaborate with other people, good verbal and written communication and time management. The top 10 Production or Technical skills were identified as ; drive a vehicle with a valid driver's licence, correctly plant and cultivate plants, maintain and care for agricultural crops, perform production related farming operations, provide healthcare for animals, perform routine production tasks, cleaning and disinfecting of production facilities, classify animal products, perform production-related farming operations and practice different soil cultivation methods to prepare a proper seedbed for planting .

The top 10 soft skills are all competence that relate to the work itself and people relations, and it is clear that the agricultural industry value these highly. The diploma graduates need to take note of that in terms of possible employment. The top 10 production or technical skills are related to practical skills, yet it is interesting to note that the highest ranked competence is the ability to drive a motor vehicle with a valid driver's licence.

The HEIs and the diploma graduates need to take note of the importance of practical skills and the ability to apply the theoretical knowledge in a practical situation. It is also important to note that the production and technical skills will differ between commodities and should rather be based on each commodity as a generic competence therefore more work needs to be done on the production skills based on the commodity requirements.

9.4. Research Objective 2a: To identify and analyse the perception of academic staff of the HEIs on the competence needed and deemed necessary for their graduate students. (how to assess the competence)

The academic staff of the HEIs rated the softs skills different from the agricultural industry, but had almost the same competence in the 'top 10' group, but in a different rank order. The difference was with the production competence where there were certain areas of agreement but also areas where there are big differences. The HEIs rated some of the competence higher that the agricultural industry, the academic staff members added additional competence that were captured in Table 26 and 27.

The difference could be due to 1) the agriculture industry that use professionals/ contractors to perform these functions and, therefore, it is not relevant to the employment of graduates or 2) that the task emphasised are no in line with the post level at which the graduates will be employed.

The perception of the purpose of the diploma qualification can also differ between the agriculture industry and the HEIs, and need to be aligned to create a better understanding and quality. HEIs stated that they train farmers or managers and according to them these skills are applicable. This is one of the reasons why profiles based on commodities will assist with curriculum planning to align the qualifications with the profiles developed in collaboration with the commodity organisations.

9.5. Study objective 2b: How are competencies assessed at higher education institutions?

The assessment of competence is a very controversial issue based on the pedagogy and interpretation of vocational-orientated education but also a very important aspect of the teaching and learning. The level descriptors for an NQF 6 qualification is a guideline of the content and how it should be assessed, but the practical application thereof and the assessment tools used, are the areas

where the big difference lies. Further research and discussion is needed on the pedagogy of VOAE and to have a common understanding of the essence of VOAE and how the competence of the students are assessed and certified. This is urgently needed to regain the credibility with the industry.

Collaboration between HEIs and the agricultural industry through the commodity organisations will assist in establishing competence profiles that can be used for the assessment. More emphasis must be placed on the practical components and the assessment of if the student is competent in doing the practical work. To do something once is no sign of competence. The assessment tools used in other study fields can be adapted to meet the assessment needs of VOAE; they can be used on their own or in combination with each other.

9.6 Research Objective 3: To identify and analyse measures that HEI's and the Agricultural industry are putting or can put in place to address the skills/competency gap in Agricultural Diploma graduates

From the different responses it is clear that the higher education institutions are capable to teach the theoretical components but that there is a lack of practical experience and the assessment of competence. To address the competence gap HEI and the Agricultural industry need to combine resources and collaborate and form partnerships that will contribute to the training of graduate that will be able to meet the identified needs and required skills required. It must also be kept in mind that transformation is a continuous process to keep up with the rapid technical advances.

Suggested measures to address and bridge the competence gap between HEI and the agricultural industry are: 1) The drafting of profiles of the different management positions in the agricultural farming business together with the

commodity organisations. The profiles will give a clear indication of the competence required. 2) Ensure more practical work and experience through the change in thinking, provision of facility and the support from the industry. 3) Creating a professional agricultural body that can prescribe what competence are needed and to take up the role of quality assessment of the competence. 4) Develop closer collaboration between the different HEIs, and between HEIs and the agricultural industry, and 5) the creation of a community of practice between the different HEIs to share information and best practices.

9.7. Research Objective 4: To identify how Diploma graduates view their own competence, how it effects their employability and what is their suggestions to close or bridge the competence gap

The competence required by the industry was investigated and the soft and production skills were identified and rated. The task to close the gap is now upon the HEI's and the students to take responsibility and ensure attention is given to the practical aspect developing competence but also to promote and develop the 21st century competence that will provide a balanced graduate ready for employment.

Attention should be given to the level descriptor for NQF 6 qualification, to ensure that the students are competent or have the cognitive and behavioural skills, what a person on this level should be able to do (SAQA, 2015, p.9). Similar competence was identified by the different role players in the research.

The study indicated clearly that there is a gap between what the industry requires and what is on offer, hence the high unemployment rate. HEIs must align their teaching and curriculum to provide for the needs of the industry, but also involve the industry in the decision-making; the gap can only be addressed by having more hands-on practical experience and soft as well as hard skills.

The skills gap between agricultural industry and HEIs can be bridged in three ways: 1) Creation of a professional body or bodies to set standards for competence and draft job profiles. 2) Formation of community of practices/learning cycles or other form of linkage between HEIs. 3) Development or implementation of pedagogy of VOAE included the incorporation and assessment of competence.

9.7.1. Formation of community of practices/learning cycles or other forms of linkage between higher education institutions.

The commodity organisations most relevant in the different communities of practices should be part of the learning network and work together in drafting a profile of competence needed for the different commodities. The HEIs can then narrow their focus to ensure the students are exposed to the practice and develop the required competence.

The purpose of a benchmark statement is to provide a consistent reference point for programme content. Benchmarking is thus a subject community making explicit the nature and standards of awards in the subject. Benchmarking is not the development of a national curriculum. Instead, it is the subject community providing an explicit definition of the boundaries of the topic, the range of provision and the diversity of programmes on offer (Naylor, 2003).

Possible linkage between ATIs and universities can be beneficial for both institutions and promote scholarly collaboration at various levels such as: 1) Research, 2) Teaching and learning ,3) Subject knowledge and curriculum, 4) Engagement, 5) WIL practices and assessment, 6) Facilities (sharing) and 7) Staff development

9.8. Research Objective 5: To investigate and briefly report on the position of HEI's in the SADAC region regarding Vocational Orientated Agricultural Training.

The study took note of what is happening in the SADC region, further study and collaboration is needed as the SADC countries are also in a transformation phase and the different countries can and should learn from each other through collaboration. Using advanced virtual techniques communication and collaboration become easier and cost-effective.

9.9. Key points for further consideration and research

The following key points were identified for consideration and further research, 1) Further defining and developing Vocational Orientated Agricultural Education in South Africa. 2) Through collaboration with the commodity organisations and organised agriculture, develop job profiles for the different employment levels in the farm business. Develop the curriculum in line with the profiles. 3) Establishment of networks between the different HEIs and between the commodity organisations as well as between the different HEIs. 4) Create links with counterparts, other HEI's, in Africa, Europe, North and South America, and form international networks for learning and assessment of vocational orientated agricultural education and 5) Harmonise the assessment of competence and learning outcomes to create a framework that will promote competence and increase the employability of the graduates. 6) That the study be repeated after a few years to indicate the changes in perception and to determine the impact of proposed transformation.

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Annexure 1: Alignment of research problem, research questions and research objectives

Alignment of Research Problem, Research Questions and Research Objectiv **Topic:** ***Evaluation of the competence gap between South African vocational agricultural education and training (agri requirement***			
Research Problem	**Research Question**	**Align With**	**Research Meth**
The problem that will be investigated in this study is: 1) The perceived gap that exist between the competence of the agricultural diploma graduates from the HEI in South Africa. 2) The competence required by the agricultural industry. 3) How the closure of the gap can should be addressed by the HEI.	**Sub Question 1**. What are the competencies required by the South African agricultural industry for agricultural diploma graduates and how are they rated in terms of importance? **Sub question 2** . What is the perception of the academic staff of the HEI's regarding the competence needed by their graduate students , and how are these competencies assessed at HEI level ? **Sub Question 3** Which measures are put in place by HEI's or Industry to address or bridge the skills or competence gap? Sub Question 4 What is the opinion of the Agricultural Diploma Graduates regarding the influence of their competence on their employability and what is their inputs to close the competence gap? **Sub-question 5:** What is the position regarding Vocational Orientated Agricultural training at HEIs in the Southern Africa Development Community (SADC) region?	Cht. 3 Methodology Cht 4 Agricultural industry Cht 5. HEI'S Cht. 4+ 5+ 7 Chapter 6 Chapter 8	• To determine by mea experimental researc which competence a the agricultural indus • To determine by mea experimental researc exist in the competen by the agricultural in competencies displa diploma graduates.

Research Objectives of the Study	Subquestions/Activities		Methods and Simila
Research objective 1: To investigate, identify and analyse competencies required by the agricultural industry of South Africa and rate them in terms of importance Chapter 4	**Sub Question 1**. What are the competencies required by the South African agricultural industry for agricultural diploma graduates and how are they rated in terms of importance? . To rank the competence according to importance based on the expectations of employers Practical value vs importance Competence level	Chapter 2 , 5, 6 and 9	• To identify the comp required by the agric industry. • To determine if there difference between t competence requirer various components/ in the agricultural ind • Dependent variable - agricultural industry's or view of competen scale 1-5). • (Plot on y-axis). • Independent variable different competence
Research objective 2 To identify and analyse the perception of academic staff of the HEIs on the competence needed and deemed necessary for their graduate students. (how to assess the competence)	How does the academic staff of the HEIs view competencies? The views of the HEIs (11 agricultural colleges and 9 universities) regarding competencies of the graduate students, how it is addressed through the curriculum, practical work sessions and work integrated learning? To investigate how competencies are assessed at HEIs? The characteristics of the diploma programmes to determine a baseline of practice with regards to theory: practical ratios, general competence, technical competence and production competence.	Chapter 5 Chapter 2 and 7	• To rank the different competencies using analysis and factor lo • Use mean values.

3 Research objective 3 To identify and analyse measures that HEI's and the Agricultural industry are putting or can put in place to address the skills/competency gap in Agricultural Diploma graduates**.**	• To do an evaluation of the vocational agricultural programmes (Diploma in Agriculture (NQF 6)) offered at the HEIs of South Africa to determine: • If it fulfils the need for vocational agricultural education and training and meets the expectations of the agricultural industry.	Chapter 5	• To investigate the pe HEI management an competence required agricultural industry. • To investigate how c addressed in their cu • To investigate how th assessment of comp takes place. • Use a questionnaire structured interviews required information from UT, get 30+ res of 2 staff members p provide a sample of
To identify and describe the measures put in place to address the skills/competency gap.	What measures are put in place to address the skills or competency gap?	Chapter 5	Analysis of interview dat NVivo 12 programme Examples of assessmen practices
		Chapter 9	1) Importance rating of c plotted graph (For all 3/c 2) Identify measures to a gap – pedagogy, teachin CBL, evaluation of comp Campus of institutional f pedagogical objectives c agricultural project/s

Research Objectives	Research Question/Subquestions	Align With	Research Objec
Research objective 4 To identify how Diploma graduates view their own competence, how it effects their employability and what is their suggestions to close or bridge the competence gap	What is the ability/competencies of the agricultural diploma graduates in relation to employability?	Chapter 4, 5, 6 & 7	To identify the current (p competencies of agricult graduates for the HEIs i Effect size – Pearson pr moment correlation coef Cohen's interpret effect
	To create of determine a profile of the current students studying the national diploma in agriculture with regard to: • Their background knowledge. • Their current competence. • The reasons why they are studying a diploma in agriculture. • What are their career expectations.		
To identify the gap that exist between the industry and the students and measures to close the gap.	How can the cap between Industry and HEI be bridged? To identify the gap that exists between the expectations of the industry and the reality of the students. Provide solutions to bridge the gap between industry and the curriculum if it exists. The negative effect of this gap on the employability of graduates and the perceptions of the qualification and institutions offering the qualification.	Chapter 6 Recommend-actions and conclusions Chapter 7	To provide possible solu can assist to bridge the industry and HEI. Suggestions form: Agricultural industry, gra HEI + literature Is there a gap that exist industry and students? How can the cap betwee and HEIs be closed?
Research objective 5 To investigate and briefly report on the position of HEI's in the SADAC region regarding Vocational Orientated Agricultural Training **To do a brief synopsis of the position regarding vocational agricultural training at HEI in the SADC region/countries.**	What is the position regarding vocational agricultural training at HEIs in the SADC countries?	Chapter 8	To provide an overview Vocational Agricultural E Training at HEI in the SA countries.

Provide an overview of the offering of Vocational Agricultural Higher Education in the SADC region.			

(Updated 27 November 2019, after discussion with Prof Antwi)

Annexure 2: Ethical Clearance from Unisa

UNISA university of south africa

CAES RESEARCH ETHICS REVIEW COMMITTEE

National Health Research Ethics Council Registration no: REC-170616-051

Date: 16/02/2018

Ref #: **2017/CAES/018**
Name of applicant: **Mr GP Viljoen**
Student #: **8076308**

Dear Mr Viljoen,

Decision: Ethics Approval Renewal after First Review for period 01/02/2018 to 31/01/2019

Proposal: Evaluation of the competence gap between South African vocational agricultural education and training (Agricultural Diploma) and agricultural industry requirements

Supervisor: Prof FN Mudau

Qualification: Postgraduate degree

Thank you for the submission of your progress report to the CAES Research Ethics Review Committee for the above mentioned research. Approval is granted for the continuation of the project.

Please note that the approval is valid for a one year period only. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 31 January 2019

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 01 February 2017.

The proposed research may now commence with the proviso that:

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*
3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

Note:
The reference number [top right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CAES RERC.

Kind regards,

Signature
CAES RERC Chair: Prof EL Kempen

Signature
CAES Executive Dean: Prof MJ Linington

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
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www.unisa.ac.za

Annexure 3 – Ethical clearance University of Mpumalanga

UNIVERSITY OF MPUMALANGA

RESEARCH ETHICS CLEARANCE LETTER

Ref: UMP/Viljoen/1/2019

Date: 30 January 2019

Name of Researcher: Mr G.P. Viljoen

Address of Researcher:

Engagement Division

University of Mpumalanga

RE: APPROVAL FOR ETHICAL CLEARANCE FOR THE STUDY:

Evaluation of the competence gap between South African vocational agricultural education and training (Agricultural Diploma) and Agricultural Industry requirements.

Reference is made to the above heading.

Please note that the Ethics Review Committee of UNISA (where the researcher is registered for his PhD) only gave ethical clearance for a one year period (2018) after which the researcher was required to submit a progress report, upon which ethics clearance could have been renewed for another year. The researcher should therefore submit proof of ethical clearance for the year 2019. After reception of this letter, the chairperson, on behalf of the University of Mpumalanga's Research Ethics Committee, **will grant ethical clearance** for the above mentioned study. The researcher also needs permission from the Vice Chancellor to use UMP students as part of his sample.

Please provide the Research Office / Vice Chancellor with the following documentation

1. Ethical clearance letter from UNISA for 2019.
2. Research proposal.
3. Copy of consent form(s) and questionnaires.
4. Letter to the Vice Chancellor requesting permission to use UMP students as part of your sample.

UNIVERSITY OF MPUMALANGA

Research Ethics Clearance Letter *UMP*

Prof Estelle Boshoff

Chairperson: University of Mpumalanga's Research Ethics Committee.

Annexure 4: Letter to Higher Education institutions requesting permission for participation in the study

From: Gerhard.Viljoen
Sent: Friday, 04 October 2019 21:52
To:
Subject: Vocational orientated Agricultural Education and training , your perceptions

Good day Dr/Mrs/Mr ……

I, Gerhard Viljoen, am doing research with Prof F Mudau, a Professor in the Department of Agriculture towards a PhD degree at the University of South Africa. We want to invite role players in vocational orientated Agricultural Education to participate in a study entitled;

"Evaluation of the competence gap between South African vocational orientated Agricultural education and training (Agricultural Diploma) and Agricultural industry requirements."

Agricultural Education and training is one of the current issues of the day, specially seen against the background of unemployment and graduate unemployment, land redistribution, lack of economic growth and the establishment of new farmers. As person involved at a Higher Education institution, that is offering a vocational orientated qualification, your assistance is requested to provide inputs and your insight into the different role players in Higher education institutions, the Students and Lecturers. Your contributions is valuable and will add value to my study.

The aim of the study is to determine the competence required by the Agricultural Industry and how the vocational oriented Agricultural Education and training (Diploma programmers) provided by the Higher Education institutions of South Africa address it. The study also focusses on how the gap (if it exists) can be bridged, to provide graduates that will meet the Industry requirements.

I need feedback form all the role players such as, **the Diploma graduates**, who graduated from Agricultural Colleges, Universities of Technology and Comprehensive Universities. **The Agricultural Industry** as well as **the Higher Education Institutions**. As a lecturer in Agriculture your experience, your subject knowledge as well as pedagogical knowledge formed your opinion regarding Agricultural Education and Training (AET). The fact that you can interact with a vast number of role players with experience in agriculture is of critical importance to the envisaged study. Your input will contribute to the accuracy and validity of the study. The study will provide valuable information that can be used in the provision of education and training in the sector.

This Triangular study will entail collecting data from three sources, **the Agricultural Industry**, **Higher Education Institutions offering a Diploma in Agriculture** (Lecturing staff) and **the graduates** from these Higher education institutions. Through the data collected the competence required by the industry will be determined and measured against what is provided by the Higher Education institutions and exhibited by the graduates.

The benefits of this study are that gaps can be identified and measures to bridge the gaps will be suggested to bring the different role players together. The study will also give direction to Higher Education institutions and other training providers on what the industry requires.

As an academic you will know that a potential risk is low feedback and response for participants and how it can affect the validity and accuracy of the data collected. Therefore the request for your cooperation in the completion and dissemination (to colleagues or graduate students) of this electronic questionnaire.

The feedback and insights obtained from the study and the results, will be published in various academic journals and a copy of the thesis can be made available on request.

It will take about 20 minutes to complete the electronic questionnaire, please take the time and complete it. The collaboration of the various role players will assist to get a clear indication of the view of the Agricultural Industry

I would appreciate it if you as an important stakeholder could complete the questionnaire and return it to me on or before **21 October 2019**. The questionnaire can be opened by clicking on the link below (Higher Education).

Higher Education Institutions : https://www.surveymonkey.com/r/889KX8S

It will assist me greatly, If you can forward the questionnaire for the Diploma Graduates (link below) to some of your Diploma graduates.

Diploma graduates : https://www.surveymonkey.com/r/FH5VMG3

Please take a few minutes out of your busy schedule to complete the questionnaire. You are also welcome to contact me to provide further inputs, discussions or comments.

Thanking you in advance,

Yours sincerely

Gerhard Viljoen

Mr. G.P. Viljoen
Deputy Director: Continuing Education Services
Tel: (013) 002 0185 / 082-372-0775
Email: Gerhard.viljoen@ump.ac.za

UNIVERSITY OF MPUMALANGA
Creating Opportunities

Addressing lifelong learning through Continuing Education Programmes
Website: www.ump.ac.za

Annexure 5: Letter to Agricultural industry

7 November 2019.

Ethics clearance reference Number: 2017/CAES/018

Research permission reference number:

Vocational Orientated Agricultural Qualification survey questionnaire.

***Beroeps georiënteerde Landbou-kwalifikasie vraelys*.**

Request for assistance with research. ***U samewerking en inligting word verlang vir navorsing.***

Good day. *Goeie dag*

I, Gerhard Viljoen, am doing research with Prof F Mudau, a Professor in the Department of Agriculture towards a PhD degree at the University of South Africa. We have partial funding from ETDP SETA for this PhD study. We are inviting you to participate in a study entitled;

Ek is, Gerhard Viljoen, en is besig met navorsing ,onderleiding van Prof F Mudau, 'n professor aan die Departement van Landbou by die Universiteit van Suid Afrika . Die PhD-studie word gedeeltelik gefinanseer deur die ETDP SETA. Ons wil U graag uitnooi om deel te neem aan die studie oor;

"Evaluation of the competence gap between South African vocational orientated Agricultural education and training (Agricultural Diploma) and Agricultural industry requirements".

The aim of the study is to determine if there is a gap between the competence required by the Agricultural Industry and the vocational oriented Agricultural training (Diploma programmers) provided by the Higher Education institutions of South Africa and how the gap can be bridged, to provide graduates that will meet the Industry requirements.

Die doel van die studie is om vas te stel of daar 'n gaping of verwydering is tussen die vaardigheids-vereistes and die Landbou-industrie en die beroeps georiënteerde landbou–opleiding aan Hoër Onderwys instellings(HOI) in Suid Afrika. Indien dit wel bestaan hoe die gaping oorbrug kan word.

You have been selected because you are major role players in Agricultural Industry. The fact that you have vast experience of the competence needs of the Agricultural industry is of critical importance to the envisaged study. Your input will contribute to the accuracy and validity of the study. The study will also provide all Higher Education Institutions with valuable information that can be used in the provision of education and training in the sector.

As Landbouer is U is een van die belangrike rolspelers in die Landbou-industrie. U ondervinding en kennis van die landbou-industrie is van kritiese belang vir die studie

aangesien u die bedryf ken en weet watter vaardighede nodig is in die landbouindustrie. U insette sal bydrae to die akuraatheid en geloofwaardigheid van die studie. Die inligting wat deur die studie bekom sal word is belangrik vir Hoër Onderwys instellings wat dit sal kan gebruik vir die ontwikeling en aanpassings aan die kurikulum

This Triangular study will entail collecting data from three sources, the Agricultural Industry, Higher Education Institutions offering a Diploma in Agriculture (Lecturing staff) and the graduates from these Higher education institutions. Through the data collected the competence required by the industry will be determined and measured against what is provided by the Higher Education institutions and the graduates.

Die driehoekige studie versamel data van drie bronne, die Lanbou-industrie, Hoër Onderig Instellings wat beroeps georiënteerde Landbou kwalifikasies aanbied, en die gegradueerdes van die HOI. Uit die versamelde data sal gepoog word om te bepaal watter vaardighede is die belangrikste vir die Landbouidustrie en in watter mate die deur die HOI onderig en aangespreek word.

The benefits of this study are that gaps will be identified and measures to bridge the gaps will be suggested to bring the different role players together. The study will also give direction to Higher Education institutions and other training providers on what it is the industry require.

Die voordele van die studie is dat gapings geidentifiseer kan word en oorbrugings maatreëls gevind kan word, om te verseker dat HOI die behoefte van die Landbou-industrie aanspreek

Potential risks are low feedback and response for participants in the agricultural industry that can affect the validity and accuracy of the data collected. Therefore, the request for your cooperation in the completion of this electronic questionnaire.

'n Potensieële risiko vir die studies is lae response of terugvoer van deelnemers , wat die geldigheid en korrektheid van die inligting bëinvloed. Daarom word u vriendelik versoek om die elektronies vraelys te voltooi en daardeur by te dra tot die studie.

The feedback procedure will entail publication of the results of the study in various academic journals and a copy of the thesis can be made available on request.

Die resultaat van die studies sal in vaktydskrifte gepubliseer word en 'n afskrif van die verhandeling kan beskikbaar gemaak word op versoek.

It will take you about 20 minutes to complete the electronic questionnaire, please take the time and complete it. Your collaboration will assist to get a clear indication of the view of the Agricultural Industry

Dit neem ongeveer 20-minute om die vraelys te voltooi, en U word virendelik versoek om dit asseblief te doen. U bydrae sal bydrae tot 'n duidelike perspektief oor watter vaardighede die Landbou-industrie, verlang van die Diploma Gegradueerde.

I would appreciate it if you could complete the questionnaire and return it to me **by 6 December 2019**. The questionnaire could be accessed by the link below (Ctrl+Click)

Die vraelys is beskikbaar deur te klik op die skakel hier onder, en ek sal dit baie waardeer indien u dit kan voltooi e naan my terugstuur voor of op **6 December 2019**. (Ctrl + Click op die link)

https://www.surveymonkey.com/r/VY55VC9.

If you need any further information or want to provide more information you are welcome to contact me at the email address below

Indien u verder inligting wil bekom of inligting wil byvoerg, is u welkom om my te kontak by die onderstaande e-pos addres..

Thanking you in advance, *Baie dankie byvoorbaat*

Yours sincerely. *Best groete*

G.P.Viljoen

G.P.Viljoen

PhD student Unisa

Cell number: 082-372-0775

Office no. +27 13 002 0185

E-mail address: Gerhard.viljoen@ump.ac.za

Annexure 6: Agricultural Industry Questionnaire.

1. Competence required by the Agricultural Industry . *Vaardighede benodig deur die Landbou-industrie*

Good day / *Goeie dag*

I am, Gerhard Viljoen, and I am doing research with Prof F Mudau , a professor in the Department of Agriculture, towards a PhD degree at the University of South Africa (Unisa) We are inviting you to participate in a study entitled " *Evaluation of the competence gap between South African vocational orientated Agricultural Education and training (Agricultural Diploma) and the Agricultural industry requirements.* The aim of the study is to determine if there is a gap between Higher Education and the Industry requirements, the extend of the gap and how it can be remedied.

Ek ,Gerhard Viljoen, ek doen navorsing onder toesig van Prof Mudau , 'n professor in die Landbou Department aan die Universitiet van Suid Afrika , vir 'n PhD kwalifikasie . U word uitgenooi om deel te neem aan die navorsingstudie met die titel "Evaluation of the competence gap between South African vocational orientated Agricultural education and training (Agricultural Diploma) and the Agricultural Industry requirements ". Die doelwit met die studie is om te bepaal of daar 'n gaping (verwydering) is tussen Hoër Onderwys instelings (HOI) en die vaardigheids-behoeftes van die Landbou-industrie , die grootte van die verwydering en hoe dit oorbrug kan word.

As an experienced Farmer or Farm Manager employing graduates at diploma level and beyond , you are a role player in Agricultural Education and Training and your input will contribute to the accuracy and validity of the study, Please take a few minutes (about 20 minutes) of your valuable time and complete the questionnaire

U deelname aan die studie as 'n Landbouer/Boer of Plaasbestuurder , wat in sommige gevalle gegradueerdes met Landbou-diploma's in diens neem , of wat ondervinding het van die vaardighede benodig in die industrie, sal bydrae tot die geldigheid en akkuraatheid van die studie. Ek versoek 20 minute van u kosbare tyd om die vraelys te voltooi. .

The focus of this study is to determine how skills or competence are addressed in vocational orientated qualifications at the various Higher Education institution of South Africa that offer a Diploma in Agriculture. This is one part of the triangular study involving Higher Education institutions , the Agricultural Industry and the Agricultural Diploma graduates

Die fokus van die studie is om te bepaal hoe vaardighede of bevoegdheid, aangespreek word in beroeps-georienteerde landbou-onderig aan Hoër Onderwys Instellings in Suid Afrika . Hierdie is een deel van ;'n driehoekige studie wat Hoër Onderys Instellings, Landbou-industrie en die Diploma gegradueerdes insluit.

Your assistance and information will assist in the completion of the study and the transformation of vocational orientated Agricultural Education . Please answer all the questions and submit on or before 7 February 2020

U hulp en inligting sal bydrae tot die volledigheid van die studie en ook uiteindelik die transformasie

van beroepsgerigte Landbou-onderig en opleiding in Suid Afrika. Beantwoord asb al die vrae en stuur voor of op 7 Februarie 2020

You are welcome to contact me should you have any concerns or want to provide further inputs .

* 1. Deceleration:. Please complete the deceleration before you proceed
Verklaaring : Voltooi asb die onderstaande verklaaring en gaan dan voort om die res van die vrae te beantwoord. Voltooi asb al die vrae .

- [ ] I understand the nature of the research. *Ek verstaan die aard van die navorsing*
- [ ] I participate in this research voluntarily . *Ek neem vrywilliglik deel aan die navorsing*
- [ ] I am aware that I can with draw from the research at any time. *Ek is bewus daarvan dat ek ten enige tyd kan ontrek*
- [ ] By proceeding with this questionnaire I except the conditions set out above. *Deur voort te gaan met die vraelys aanvaar ek die voorwaardes wat gestel is.*

Indien U toestem tot deelname aan die navorsing , voltooi nou asb die res van die vraelys.

Questions related to Diploma graduates . Vrae in verband met diploma gegradueerdes

2. If you employ a graduate /person with an Agricultural diploma in your farming business or organisation , where would you place that person in your business or organisation ? Please select

Indien U 'n persoon met 'n landbou-diploma sou aanstel in u besigheid , in watter een van die hoedanighede sou die persoon aanstel?

Please motivate your answer . Motiveer asb u antwoord

3. Do you prefer a graduate with and Agricultural Diploma obtained from ....
Verkies U 'n persoon met 'n Landbou-diploma vanaf 'n ..... (maak u keuse)

Other (please specify)

4. In your view is there a difference between a diploma obtained form a) An Agricultural College , b) An University of Technology and c) a Comprehensive university .
Volgens U meening is daar 'n verskil tussen 'n diploma verwerf van a) 'n Landboukollege , b) 'n Universiteit van Tegnologie of c) 'n komprehensiewe Universiteit ?

Yes or No / Ja of Nee

Please motivate your response

* 5. Please provide your view on the following . *Gee asseblief u meening oor die volgende*

The creation of a professional body representing the different role players to regulate and quality assure the practical component (skills , competence and capabilities) of the diploma programmes. *Die skep van 'n professionele liggaam ,verteenwoordegend van al die verskillende rolspelers ,wat die praktiese komponent van die diploma's (handvaardighede, vaardighede en bevoegdheid) kan reguleer, evalueer en kwaliteits kontrole kan toepas.*

What is your proposal to promote skills and competence training in the Diploma Programme? *Watter voorstelle het U om handvaardighede en algemene vaardigede of bevoegdheid te bevorder in die Diploma Program?*

Competence is defined as a combination of skills , knowledge and attitudes. As an experienced person, involved in agriculture and farming , you have your view of the competence a diploma graduate should have , to meet the requirements of the Agricultural industry, Please assist by rating the competence mentioned below in terms of its importance and add where you feel important competence were left out.

Vaardigheid word gedefinieer as 'n kombinasie van handvaardighede(skills) , kennis en ingesteldheid . As 'n persoon met beroepsondervinding en met betrokkenheid in landbou en boerdery, gee asb u meening oor die vaardighede wat 'n diploma gegradueerde volgens U moet hê om te voldoen aan die minimum vereistes van die Landbou-industrie. Beoordeel asb die onderstaande vaardighede volgens hulle belangrikheid en voeg by enige vaardigheid was dalk uitgelaat mag wees.

6. **Planning and management competence**. A diploma graduate should be able to ....
Beplanning en bestuurs vaardighede. *'n Diploma gegradueerde sal instaat wees om .....*

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
plan and directs or oversee farming operations . *Boerdery bedrywighede te beplan , implementeer en bestuur.*	○	○	○	○	○	○
manage his time optimally. *sy/haar tyd optimaal bestuur*	○	○	○	○	○	○
draft and implement project plans. *projekplanne op te stel en te bestuur*	○	○	○	○	○	○
observe time limits and deadlines. *te hou by tyds beperkinge en afsnytye.*	○	○	○	○	○	○

Other (please specify)

Vocational competence or production skills . Only complete Question 10 **or** 11 , unless you are involved in or have knowledge about mixed farming then you must please complete both the section on Plant and Animal Production.
Beroepsvaardighede of produksievaardighede . *Voltooi slegs vraag 10* ***of*** *11 , behalwe wanneer u betrokke is by of kennis het van gemengdeboerdery , dan moet u asb beide die Plant (V10) en Diereproduksie (V11) vrae voltooi*

7. **Crop production vocational or production skills or competence**. A diploma graduate should be able to ...
Gewasproduksie beroeps of produksievaardighede. *'n Diploma gegradueerde moet in staat wees om .....*

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
perform production related farming operations. *uitvoer van boerdery aktiwiteite wat verband hou met produksie*	○	○	○	○	○	○

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
set, adjust and operate farm machinery and equipment, *implemente en toerusting te kan instel, verstel en hanteer.*	○	○	○	○	○	○
calibrate and monitor planters and sprayers, *planter en spuit-toerusting te kalibreer en te monitor*	○	○	○	○	○	○
drive and operate mechanical equipment, *meganiese toerusting te kan bestuur en beheer*	○	○	○	○	○	○
drive a vehicle with a valid drivers licence (minimum code B or EB), *'n voertuig te kan bestuur met 'n geldige bestuurslisensie (minimum kode B or EB)*	○	○	○	○	○	○
service mechanical equipment (change oil), *meganies toerusting te diens (veranging van olie)*	○	○	○	○	○	○
perform minor repair work , replace warn parts and/or re-assembles components, *klein herstel take uit-te-voer , slyt parte te vervang en komponente weer aanmekaar te sit.*	○	○	○	○	○	○
use an apply new technology, *nuwe tegnologie te gebruik en toe te pas*	○	○	○	○	○	○

Other (please specify)

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Identify , monitor and control weeds chemically and mechanical. *identifiseer, moniteer en beheer onkruid chemies en meganies*	○	○	○	○	○	○
handle, mix and store agrochemicals correctly. *landbouchemikalie op korrekte wyse. te hanteer, te meng , toe-te-dien, en te stoor.*	○	○	○	○	○	○
monitor and control efficiency of production. *produksie effektiewiteit te monitor en beheer*	○	○	○	○	○	○
monitor quality and the conformation to standards. *kwaliteits kontrole toe te pas , kwaliteit te monitor en standaarde toe te pas*	○	○	○	○	○	○

8. **Animal Production Skills or competence.** A diploma graduate should be able to .....
Diereproduksie vaardighede . 'n Diploma gegradueerde moet in staat wees om .....

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
perform production related farming operations. *produksie verwante boerdery aktiwiteite uit-te-voer*	○	○	○	○	○	○
train or handle animals, *diere af te rig en te hanteer*	○	○	○	○	○	○
provide health care for animals, *gesondheidsorg aan diere te verskaf.*	○	○	○	○	○	○
operate and clean a milking machine, *'n melkmasjien korrek gebruik en was*	○	○	○	○	○	○

9. **Administrative skills.** An agricultural diploma graduate should be able to ....
Administratiewe vaardighede. *'n Landbou -diploma gegradueerde moet in staat wees om .....*

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very important	N/A
keep accurate production records, *akkurate produksie rekords by te hou*	○	○	○	○	○	○
operate a computer and software programmes ,should have ICT skills, *rekenaar en sagteware te kan hanteer,.Moet oor ICT vaardighede beskik*	○	○	○	○	○	○
keep accurate financial records. *akkurate finansieële rekords by te hou*	○	○	○	○	○	○
provide technical support, *tegniese ondersteuning te verskaf*	○	○	○	○	○	○
perform administrative work, *administratiewe take te kan verrig*	○	○	○	○	○	○
do stock control, *voorraad kontrole te kan doen*	○	○	○	○	○	○

Other (please specify)

10. **Technical or mechanical competence** . An agricultural diploma graduate should be able to .....
Tegniese of meganiese vaardighede. *'n Landbou-diploma gegradueerde moet in staat wees om .....*

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
maintain farm implements and infrastructure , *plaas implemente en strukture te onderhou.*	○	○	○	○	○	○

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
set, adjust and operate farm machinery and equipment, *implemente en toerusting te kan instel, verstel en hanteer.*	○	○	○	○	○	○
calibrate and monitor planters and sprayers, *planter en spuit-toerusting te kalibreer en te monitor*	○	○	○	○	○	○
drive and operate mechanical equipment, *meganiese toerusting te kan bestuur en beheer*	○	○	○	○	○	○
drive a vehicle with a valid drivers licence (minimum code B or EB), *'n voertuig te kan bestuur met 'n geldige bestuurslisensie (minimum kode B or EB)*	○	○	○	○	○	○
service mechanical equipment (change oil), *meganies toerusting te diens (veranging van olie)*	○	○	○	○	○	○
perform minor repair work , replace warn parts and/or re-assembles components, *klein herstel take uit-te-voer , slyt parte te vervang en komponente weer aanmekaar te sit.*	○	○	○	○	○	○
use an apply new technology, *nuwe tegnologie te gebruik en toe te pas*	○	○	○	○	○	○

Other (please specify)

11. **Irrigation management** . An Agricultural graduate ill be able to ....
Besproeiings bestuur . 'n Landbou-diploma gegradueerde behoort in staat te wees om ....

	Not important	Might be considered or recommend	Advisable or preferred	Important	Very important	N/A
Install irrigation systems , *besproeiings stelsels te instaleer*	○	○	○	○	○	○
maintain an irrigation system, *besproeiingstelsels te onderhou*	○	○	○	○	○	○
operates a manual irrigation system, *'n nie-geoutomatiseerde besproeiingstelsel te bestuur en beheer.*	○	○	○	○	○	○
operate a computerised irrigation system ,*'n gerekenaariseerde besproeiings stelsel te kan bestuur en beheer.*	○	○	○	○	○	○
do irrigation scheduling, *besproeiings skeduleering te doen*	○	○	○	○	○	○
do fault finding and problem solving on irrigation systems, *fout-op-spooring en probleem-oplossing te kan doen ten opsigte van besproeingstelsels*	○	○	○	○	○	○

Other (please specify)

12. **Processing and value adding skills**. An Agricultural diploma graduate should be able to .....
Prosesseering en waarde toevoeggings vaardighede. 'n Landbou-diploma gegradueerde moet in staat wees om .....

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
process agricultural products. *landbouprodukte te kan verwerk*	○	○	○	○	○	○
supervise activities in the processing plant or pack house , *toesig te hou oor pakhuis of verwerkings aanleg .*	○	○	○	○	○	○
handle the marketing of the products produced or processed. *die bemarking van die produkte of geprosesseerde produkte te doen*	○	○	○	○	○	○
maintain hygiene and bio-security standards, *higiene en bio- sekuriteis standaarde te onderhou en te implementeer*	○	○	○	○	○	○
clean and disinfect the production facilities . *produksie-fassiliteite skoon te maak en ontsmet.*	○	○	○	○	○	○

Other (please specify)

13. **Professional, personal and ethical skills (Soft Skills)** . Skills an Agricultural diploma graduate should have .
Profesionele, persoonlike en etiese vaardighede *(Sagte vaardighede) wat 'n Landbou -diploma gegradueerde moet hê ....*

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Decision making skills, *besluitnemings vaardigheid*	○	○	○	○	○	○

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Critical thinking ability, *kritiese denk vaardigheid*	○	○	○	○	○	○
Ability to solve problems, *probleem oplosings vaardighede*	○	○	○	○	○	○
Internal motivation , *interne motiveering*	○	○	○	○	○	○
Work Ethic , *werksetiek*	○	○	○	○	○	○
Honesty , *eerlikheid*	○	○	○	○	○	○
Responsibility - being able to accept responsibility for his/her own actions, *Verantwoordlikheid, bereidheid om verantwoordelikheid te aanvaar vir sy/haar aksies .*	○	○	○	○	○	○
Hard working or diligence , *hardwerkendheid en toegewydheid.*	○	○	○	○	○	○
Professional discipline . *profesionele disipline*	○	○	○	○	○	○
Trustfulness , *Betroubaarheid*	○	○	○	○	○	○
Ability to diagnose or identify problems. *vermoë om probleme te identifiseer en analiseer.*	○	○	○	○	○	○
Ability to see the big picture (Holistic view) ,*vermoë geheel beeld te sien*	○	○	○	○	○	○
Inductive and/or deductive thinking, *induktiewe en deduktiewe denkvermoë*	○	○	○	○	○	○
Good human relations, *goeie menslike verhoudings*	○	○	○	○	○	○

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Ability to collaborate with other people, *vermoë om met ander persone saam te werk.*	○	○	○	○	○	○
Good verbal and written communication, *goeie verbale en nie-verbale kommunikasie*	○	○	○	○	○	○
Innovative - ability to create new ideas, *innoveerend, vermoë om nuwe idees te skep.*	○	○	○	○	○	○

Other (please specify)

14. Please **rank** the following in your **order of preference form 1 , the most important to 10 the least important.** You must rank all of the statements and cannot rank them the same or use the same number more than once. The most important competence an Agricultural Graduate should have is ....
Rangskik asb die volgende vaardighede in ***u rangorde van belangrikheid, waar 1 die mees belangrike en 10 die minste belangrik is.*** *U moet asb al die stellings rangskik en kan nie twee vaardighede dieselfde plaas in dieselfde rangorde . Die mees belangrikste vaardigheid van 'n Landbou-diploma gegradueerde is ....*

	Most important	2nd most important	3rd most important	4th most important	5th most important	6th	7th	8th	9th	Least imported
professional ethical skills , *profesionele etiese vaardighede*	○	○	○	○	○	○	○	○	○	○
personal ethical skills, *persoonlike etiese vaardighede*	○	○	○	○	○	○	○	○	○	○
technical or mechanical skills, *tegniese of meganiese vaardighede*	○	○	○	○	○	○	○	○	○	○
production skills, *produksie vaardighede*	○	○	○	○	○	○	○	○	○	○
management skills, *bestuurs vaardighede*	○	○	○	○	○	○	○	○	○	○
planning skills , *beplannings vaardighede*	○	○	○	○	○	○	○	○	○	○
administrative skills, *administratiewe vaardighede*	○	○	○	○	○	○	○	○	○	○
ICT skills, *rekenaar vaardighede*	○	○	○	○	○	○	○	○	○	○
Interpersonal skills, *interpersoonlike vaardighede*	○	○	○	○	○	○	○	○	○	○
Problem solving skills , *probleem oplossings vaardighede*	○	○	○	○	○	○	○	○	○	○

Please provide the following biographical information
Verskaf asb die volgende biografiese inligting

15. Please indicate your age / *Gee asb u ouderdom*

0 100

16. Please indicate your gender ./ *Dui asb u gelag aan*

17. Please indicate your years of experience in the agricultural industrty ? Dui asb u jare ondervinding in die Landboubedryf aan.

0 50

18. Please indicate the main activities that will best describe your farming operation . Please indicate the % of each of the different components. (your % should add up to 100%)

Agronomy/grain crops. *Akkerbou gewas verbouing*	
Subtropical fruit . *Sub-tropiese vrugte*	
Nut production , N*eut produksie*	
Deciduous fruit , *Sagtevrugte*	
Sugarcane farming , S*uikerriet produksie*	
Citrus production , *Sitrus verbouing*	
Vegetable production, *Groente verbouing*	
Mixed farming , *Gemengdeboerdery*	
Beef Cattle farming , B*eesboerdery*	
Poultry farming , P*luimveeboerdery*	
Pig farming , V*arkboerdery*	
Dairy cattle farming / M*elkbeesboerdery*	
Small stock farming , K*leinveeboerdery*	
Forestry , B*osbou*	
Intensive vegetable production, *Intensiewe groenteverbouing*	
Hydroponic vegetable production, H*idroponiese groenteverbouing*	
Nursery propagating plants, *Kwekery, vermeerdering van plante*	
Cutflower production , S*nyblom produksie*	
Game farming, W*ildboerdery*	
Aquaculture /Marine culture, *Akwakultuur of marinekultuur*	

19. Please indicate your highest qualification. Dui asb u hoogste kwalifikasie aan

- [ ] Graad 12 /Matriek
- [ ] Diploma
- [ ] Bachelors degree, B graad
- [ ] Other (please specify)
- [ ] Honours degree , Honneursgraad
- [ ] Masters degree, Meestersgraad
- [ ] PhD

20. Please classify your farming operation according to the following criteria
Klasifiseer asb u boerdery onderneming volgens die onderstaande kriteria.

- ( ) Subsistant farmer, Bestaansboer
- ( ) Microscale or small farmer, Kleinboer of mikro-boer
- ( ) Emerging commercial farmer, Opkomende kommersiëleboer
- ( ) Small commercial farmer, Kleinskaal kommersiëleboer
- ( ) Large commercial farmer, Groot kommersiëleboer
- ( ) Mega farmer , Megaboer

21. Please indicate your position in the farming business
Dui asb u posisie in die landboubesigheid aan

- ( ) Owner . *Eienaar*
- ( ) Managing Director , *Bestuurende Direkteur*
- ( ) Manager, *Bestuurder*
- ( ) Section Manager , *Afdelings bestuurder*

Classification of farmers . Klasifikasie van Boere

22. Please indicate your population group. Dui asb U bevolkings groep aan

- ( ) Asian , Asiaties
- ( ) African (Black) , Afrikaan (Swart)
- ( ) Coloured, Bruin (Kleurling)
- ( ) White. Wit

Thank you for your time and cooperation to complete the questionnaire, your input is valued and will assist to promote vocational Agricultural Education in South Africa . I you have further comments or want to provide further inputs please feel free to contact me for a discussion my e-mail address is Gerhard.viljoen@UMP.ac.za

Dankie vir u tyd en samewerking om die vraelys te voltooi, u insette word opreg waardeer en sal bydrae tot die bevordering van beroeps georiënteerde Landbou-onderrig in Suid Afrika . Indien u verder inligting benodig of verdere insette wil lever , kontak my gerus , my e-pos is Gerhard.viljoen@ump.ac.za

Annexure 7: Higher Education Questionnaire

1. Competence in vocational orientated Agricultural Qualifications at Higher Education Institutions

Good day

I am Gerhard Viljoen and I am doing research with Prof F Mudau , a professor in the Department of Agriculture, towards a PhD degree at the University of South Africa (Unisa) We are inviting you to participate in a study entitled " *Evaluation of the competence gap between South African vocational orientated Agricultural Education and training (Agricultural Diploma) and the Agricultural industry requirements.* The aim of the study is to determine if there is a gap between Higher Education and the Industry requirements, the extend of the gap and how it can be remedied.

As Manager of an Agricultural Programme and /or an experienced lecturer at diploma level and beyond you are a role player in Agricultural Education and Training and your input will contribute to the accuracy and validity of the study, Please take a few minutes (about 20 minutes) of your valuable time and complete the questionnaire

The focus of this study is to determine how skills or competence are addressed in vocational orientated qualifications at the various Higher Education institution of South Africa that offer a Diploma in Agriculture. This is one part of the triangular study involving Higher Education institutions , the Agricultural Industry and the Agricultural Diploma graduates

Your assistance and information will assist in the completion of the study and the transformation of vocational orientated Agricultural Education. Please complete all the questions and submit on or before 7 February 2020

You are welcome to contact me should you have any concerns or want to provide further inputs

Best regard
Gerhard Viljoen
082 -372-0775
Gerhard.viljoen@ump.ac.za
October 2019

* 1. Deceleration:. Please complete the deceleration before you proceed

- [ ] I understand the nature of the research
- [ ] I participate in this research voluntarily
- [ ] I am aware that I can with draw from the research at any time
- [ ] By proceeding with this questionnaire I except the conditions set out above

2.

* 2. The Higher education Qualifications sub framework state the purpose and characteristic of the Diploma as follows." ***This qualification has a vocational orientation which includes professional , vocational or industry specific knowledge that provides a sound understanding of general theoretical principles as well as a combination of general and specific procedures and their applications*** " (CHE , 2013)
What is you understanding of the following :

vocational orientated qualification

vocational or Industry specific knowledge

How should the application of the general and specific procedures be assessed?

* 3. The same document state that " ***the purpose of the diploma is to develop graduates who can demonstrate focused knowledge and skills in a particular field "***

How are these skills assessed at your institution ?

What competence do you focus on in your study area ?

How do your institution declare a student competent in a particular competence?

4. Please provide a brief overview of how your institution ensure that the Agricultural Students have the necessary competence needed for the Diploma qualification

Does you institution have facilities available where students can obtain the required practical skills ? Please elaborate	
Is the practical facilities in line with the modern technology used in agriculture ? Please motivate	
How much time is available on the time table for practical activities?	
Is the time allocation adequate?	
What is the ration between theory and practice in your programme?	
How do you assess the competence of the learner regarding the skills needed.?	
Is the practical skill/s your institution focus on in line with what the industry require at the current moment? Please motivate your answer	

5. Diploma programmes typically include an appropriate work integrated learning (WIL) component.

Does your diploma programme include a WIL component ?	
What is the duration of the WIL component and when does it take place?	
How is the quality of work integrated learning controlled?	
How is competences assessed in you WIL programme?	
How does the students report back on their activities?	
Is there a feedback system for the onsite mentors in place ? How does it work ?	
What happens with the feedback from the onsite mentors ?	

6. In your professional view is there a difference between a diploma obtained form a) An Agricultural College , b) An University of Technology and c) a Comprehensive university .

Yes or No	
Please motivate your response	

* 7. Please provide your professional view on the following

The creation of a professional body representing the different role players to regulate and quality assure the practical component (skills , competence and capabilities) of the diploma programmes.	
What is your proposal to promote skills and competence training in the Diploma Programme	

8. Does your institution collaborates with other South African Higher Education Institutions ?

Please provide the nature of collaboration

What is the value of such collaboration?

Please provide your view on Public Private partnerships

Competence is defined as a combination of skills , knowledge and attitudes. As an experienced Lecturer, involved in vocational orientated qualifications, you have your view of the competence a diploma graduate should have , to meet the requirements of the Agricultural industry, Please assist by rating the competence mentioned below in terms of its importance and add where you feel important competence were left out.

9. **Planning and management competence**. A diploma graduate should be able to ....

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
plan and directs or oversee farming operations	○	○	○	○	○	○
manage his time optimally	○	○	○	○	○	○
draft and implement project plans	○	○	○	○	○	○
observe time limits and deadlines	○	○	○	○	○	○

Other (please specify)

Vocational competence or production skills . Only complete Question 10 **or** 11 , unless you are involved in or have knowledge about mixed farming then you must please complete both the section on Plant and animal Production.

10. **Crop production vocational or production skills or competence**. A diploma graduate should be able to ...

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
perform production related farming operations	○	○	○	○	○	○
practice different soil cultivation methods to prepare a proper seed bed for planting	○	○	○	○	○	○
correctly plant and cultivate plants	○	○	○	○	○	○
maintain and cares for agricultural crops	○	○	○	○	○	○
plan and construct an orchard or a vineyard	○	○	○	○	○	○
propagates and cultivates trees or plants	○	○	○	○	○	○
apply vegetative reproduction in plants (budding and grafting)	○	○	○	○	○	○
prune trees and scrubs.	○	○	○	○	○	○
scout for pest and diseases	○	○	○	○	○	○
control pest and diseases chemically and biological	○	○	○	○	○	○
Identify , monitor and control weeds chemically and mechanical	○	○	○	○	○	○
handle, mix and store agrochemicals correctly	○	○	○	○	○	○
monitor and control efficiency of production	○	○	○	○	○	○
monitor quality and the conformation to standards	○	○	○	○	○	○

11. **Animal Production Skills or competence.** A diploma graduate should be able to .....

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
perform production related farming operations	○	○	○	○	○	○
train or handle animals	○	○	○	○	○	○
provide health care for animals	○	○	○	○	○	○
operate and clean a milking machine	○	○	○	○	○	○
perform routine production tasks	○	○	○	○	○	○
cleaning and disinfecting production facilities	○	○	○	○	○	○
harvest animal products	○	○	○	○	○	○
classify animal products	○	○	○	○	○	○
perform basic veterinary practices	○	○	○	○	○	○
perform artificial insemination	○	○	○	○	○	○
apply bio-security measures at the production facilities	○	○	○	○	○	○
do selection of animals	○	○	○	○	○	○
be a stock-man	○	○	○	○	○	○

Other (please specify)

12. **Administrative skills.** An agricultural diploma graduate should be able to ....

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very important	N/A
keep accurate production records	○	○	○	○	○	○
operate a computer and software programmes ,should have ICT skills	○	○	○	○	○	○
keep accurate financial records	○	○	○	○	○	○
provide technical support	○	○	○	○	○	○
perform administrative work	○	○	○	○	○	○
do stock control	○	○	○	○	○	○

Other (please specify)

13. **Technical or Mechanical Competence** . An agricultural diploma graduate should be able to .....

	Not Important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
maintain farm implements and infrastructure	○	○	○	○	○	○
set, adjust and operate farm machinery and equipment	○	○	○	○	○	○
calibrate and monitor planters and sprayers	○	○	○	○	○	○
drive and operate mechanical equipment	○	○	○	○	○	○
drive a vehicle with a valid drivers licence (minimum code B or EB)	○	○	○	○	○	○
service mechanical equipment (change oil)	○	○	○	○	○	○
perform minor repair work , replace warn parts and/or re-assembles components	○	○	○	○	○	○
use an apply new technology	○	○	○	○	○	○

Other (please specify)

14. **Irrigation management** . An Agricultural graduate ill be able to ....

	Not important	Might be considered or recommend	Advisable or preferred	Important	Very important	N/A
Install irrigation systems	○	○	○	○	○	○
maintain an irrigation system	○	○	○	○	○	○
operates a manual irrigation system	○	○	○	○	○	○
operate a computerised irrigation system	○	○	○	○	○	○
do irrigation scheduling	○	○	○	○	○	○
do fault finding and problem solving on irrigation systems	○	○	○	○	○	○

Other (please specify)

15. **Processing and value adding skills**. An Agricultural diploma graduate should be able to .....

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
process agricultural products	○	○	○	○	○	○
supervise activities in the processing plant or pack house	○	○	○	○	○	○
handle the marketing of the products produced or processed	○	○	○	○	○	○
maintain hygiene and bio-security standards	○	○	○	○	○	○
clean and disinfect the production facilities	○	○	○	○	○	○

Other (please specify)

16. **Professional, personal and ethical skills (Soft Skills)** . Skills an Agricultural diploma graduate should have .

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Decision making skills	○	○	○	○	○	○
Critical thinking ability	○	○	○	○	○	○
Ability to solve problems	○	○	○	○	○	○
Internal motivation	○	○	○	○	○	○
Work Ethic	○	○	○	○	○	○
Honesty	○	○	○	○	○	○
Responsibility - being able to accept responsibility for his/her own actions	○	○	○	○	○	○
Hard working or diligence	○	○	○	○	○	○
Professional discipline	○	○	○	○	○	○
Trustfulness	○	○	○	○	○	○
Ability to diagnose or identify problems	○	○	○	○	○	○
Ability to see the big picture (Holistic view)	○	○	○	○	○	○
Inductive and/or deductive thinking	○	○	○	○	○	○
Good human relations	○	○	○	○	○	○
Ability to collaborate with other people	○	○	○	○	○	○
Good verbal and written communication	○	○	○	○	○	○
Innovative - ability to create new ideas	○	○	○	○	○	○

Other (please specify)

17. Please **rank** the following in your **order of preference form the 1 , the most important to 10 the least important.** You must rank all of the statements and cannot rank them the same or use the same number . The most important competence an Agricultural Graduate should have is ....

	Most important	2nd most important	3rd most important	4th most important	5th most important	6th	7th	8th	9th	Least imported
professional ethical skills	○	○	○	○	○	○	○	○	○	○
personal ethical skills	○	○	○	○	○	○	○	○	○	○
technical or mechanical skills	○	○	○	○	○	○	○	○	○	○
production skills	○	○	○	○	○	○	○	○	○	○
management skills	○	○	○	○	○	○	○	○	○	○
planning skills	○	○	○	○	○	○	○	○	○	○
administrative skills	○	○	○	○	○	○	○	○	○	○
ICT skills	○	○	○	○	○	○	○	○	○	○
Interpersonal skills	○	○	○	○	○	○	○	○	○	○
Problem solving skills	○	○	○	○	○	○	○	○	○	○

Please provide the following bibliographical information

18. Please indicate your age

0 100

19. Please indicate your gender .

20. Please indicate your years of teaching experience in the Agricultural Diploma

0 40

21. Your position at the Higher Education Institution

- [ ] Lecturer
- [ ] Professor
- [ ] Senior Lecturer
- [ ] Head of school or Division
- [ ] Programme leader
- [ ] Principal or Dean
- [ ] Other (please specify)

22. Please indicate your highest qualification

- [ ] Diploma
- [ ] Masters degree
- [ ] Bachelors degree
- [ ] PhD
- [ ] Honours degree
- [ ] Other (please specify)

23. I employed /was employed at

- ( ) An Agricultural College
- ( ) A University of Technology
- ( ) A Comprehensive University

Thank you for your time and cooperation to complete the questionnaire, your input is valued and will assist to promote vocational Agricultural Education in South Africa . I you have further comments or want to provide further inputs please feel free to contact me for a discussion my e-mail address is Gerhard.viljoen@UMP.ac.za

Annexure 8: Diploma Graduates Questionnaire

Competence needed by Agricultural Diploma Graduates

Good day

I am Gerhard Viljoen,and I am doing research with Prof F Mudau, a Professor in the Department of Agriculture towards a PhD degree at the University of South Africa. We have partial funding from ETDP SETA for this PhD study. We are inviting you to participate in a study entitled;

Evaluation of the competence gap between South African vocational orientated Agricultural education and training (Agricultural Diploma) and Agricultural industry requirements.

The aim of the study is to determine if there is a gap between the competence required by the Agricultural Industry and the vocational oriented Agricultural training provided by the Higher Education institutions of South Africa and how the gap can be bridged, to provide graduates that will meet the Industry requirements.

As an Agricultural Diploma Graduate you are a major role players in the Agricultural industry. The fact that you have completed your Diploma qualification and obtained practical experience in Agriculture is of critical importance to the envisaged study. Your input will contribute to the accuracy and validity of the study. The study will also provide Higher Education Institutions with valuable information that can be used in the provision of education and training in the sector.

This Triangular study will entail collecting data from three sources, the Agricultural Industry, Higher Education Institutions offering a Diploma in Agriculture (Lecturing staff) and the graduates from these Higher education institutions. Through the data collected the competence required by the industry will be determined and measured against what is provided by the Higher Education institutions and the graduates.

The benefits of this study are that gaps can be identified and measures to bridge the gaps will be suggested to bring the different role players together. The study will also give direction to Higher Education institutions and other training providers on what it is the industry require.

Potential risks are low feedback and response for participants in the agricultural industry that can affect the validity and accuracy of the data collected. Therefore the request for your cooperation in the completion of this electronic questionnaire, please pass it on to colleagues and fellow graduates who graduated with an Agricultural Diploma.

The feedback procedure will entail publication of the results of the study in various academic journals and a copy of the thesis will be presented to HEI (on request) for their information.

It will take you about 20 minutes to complete the electronic questionnaire, please take the time and complete it. Your collaboration will assist to get a clear indication of the view of the Diploma Graduates regarding competence needed.

I would appreciate it if you could complete the questionnaire and return it to me. The questionnaire could be accessed through the link on the covering email

Kindly circulate this e-mail to you colleagues and fellow graduates who graduated with an Agricultural Diploma and is working in the Agricultural sector . I will appreciate it if you can complete the questionnaire ASAP before 7 February 2020.

Thanking you in advance,

Yours sincerely

G.P.Viljoen

PhD student Unisa

Cell number: 082-372-0775
E-mail address : Gerhard.viljoen@ump.ac.za

* 1. Deceleration on participation in the research. Please complete the statements below to be able to proceed with the questionnaire

- [ ] I understand what the research is about
- [ ] I voluntarily participate in the research project
- [ ] I am aware that I can withdraw from the research at any time
- [ ] By proceeding with this questionnaire I accept the conditions .

Please continue to answer the rest of the questionnaire

This questionnaire consist of two parts . **Section A** request your biographical information and **Section B** is about the view of Agricultural Diploma graduates about competence needed in the Agricultural Industry . Please answer both sections based upon your own perception

Section A: Biographical Information

2. Did your diploma study prepared you adequately for the competencies required by the Agricultural Industry ? Please motivate your answer.

3. Why did you enrol to study an Agricultural Diploma ?

4. What recommendations can you make to Higher Education institutions (HEI) with regards to the competence required by the Agricultural Industry according to your experience ?

5. Please answer the follwoing questions

When did you complete your Agricultural Diploma ?

Please indicate you age

Please indicate your gender

6. Please indicate the type of Higher Education Institution where you obtained your Diploma

- [ ] Agricultural College or Agricultural Training Institute
- [ ] University of Technology
- [ ] Comprehensive University (A University that offers diploma and degree programmes)
- [ ] Private Higher Education Institution
- [ ] Other (please specify)

7. Where did you grew up ?

- [ ] On a commercial farm
- [ ] Township
- [ ] In a rural farming community (fromer homelands)
- [ ] City
- [ ] Town
- [ ] Other (please specify)

8. Please indicate the Secondary or High school you attended

- [ ] Secondary school without Agricultural Subjects
- [ ] Technical High School
- [ ] Secondary shool that offered Agricultural Science as a subject
- [ ] Private school
- [ ] Agricultural High School
- [ ] Other (please specify)

* 9. Are you currently working in the Agricultural Industry ?

10. If you are employed in the Agricultural industry please indicate the following

Type of business in the Agricultural Industry	
Your current position	
Your years of experience	

Section B : Competence expected from a Agricultural Diploma graduate.

11. **Planning and Management skills** . Please indicate how important you rate the task below , using the given rating scale . Please rate all the questions

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Planning farming operations	○	○	○	○	○	○
Directs and oversee farming operations	○	○	○	○	○	○
Control of farming operations	○	○	○	○	○	○
Ensure compliance with regulations	○	○	○	○	○	○
Time managment	○	○	○	○	○	○
Observation of time limits and deadlines	○	○	○	○	○	○

Other . Please add any skill not included above and rate it for importance

Vocational Knowledge and skills . Please complete question 11 **or** 12 unless you are involved in a mixed farming operation with both Plant and Animal Production , then please complete both questions .

12. Plant production skills

	Not important	Might be considered or Recommended	Advisable or prefered	Important	Very important	N/A
Ability to perform production related farming operations	○	○	○	○	○	○
Assist with the cultivation and land preparation	○	○	○	○	○	○
Ability to monitor and control the efficiency of production	○	○	○	○	○	○
Skills to produce plant or cultivate plants /crops	○	○	○	○	○	○
Maintain and cares for agricultural crops	○	○	○	○	○	○
Plan and construct an orchard or a vinyard	○	○	○	○	○	○
Propograte and cultivate trees	○	○	○	○	○	○

	Not important	Might be considered or Recommended	Advisable or prefered	Important	Very important	N/A
Prune trees or scrubs	○	○	○	○	○	○
Applies pest management/control techniques	○	○	○	○	○	○
Control pest chemically and biologically	○	○	○	○	○	○
Applies weed management/control techniques	○	○	○	○	○	○
Control weeds chemically and mechanically	○	○	○	○	○	○
Correct mixing, handling and storage of agrochemicals	○	○	○	○	○	○
Identify, monitor and repot on weeds	○	○	○	○	○	○
Scouting, identifies and monitors pest and diseases.	○	○	○	○	○	○

Other (please specify)

13. **Animal Husbandry Production Skills**

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very Important	N/A
Perform production related farming operations	○	○	○	○	○	○
Perform routine production tasks (e.g. feeding and handling of cattle)	○	○	○	○	○	○
Cares for animals and perform basic veterinary practices (heath care)	○	○	○	○	○	○
Operates a milking mashine	○	○	○	○	○	○
Perform artificial insemination	○	○	○	○	○	○
Maintain bio-security standards and ensure hygiene of the production facilities	○	○	○	○	○	○
Harvest animal products	○	○	○	○	○	○
Classify animal products such as wool and mohair	○	○	○	○	○	○
Manage natural and cultivated pastures	○	○	○	○	○	○
The ability to select animals acording to set standards	○	○	○	○	○	○
Stockman-ship	○	○	○	○	○	○

Other (please specify)

14. **Administrative skills** (Record keeping and data handling)

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very important	N/A
Provides technical support to promote production	○	○	○	○	○	○
Performs test and trials related to production	○	○	○	○	○	○
Keep accurate records and analyse data	○	○	○	○	○	○
Collecting of technical and production information	○	○	○	○	○	○
Analyse and share technical information	○	○	○	○	○	○
Ability to do office work	○	○	○	○	○	○
Financial record keeping	○	○	○	○	○	○
Stock control	○	○	○	○	○	○
ICT skills	○	○	○	○	○	○

Other (please specify)

15. **Technical and Mechanical Skills**

	Not important	Recomended or might be considered	Advisable or prefered	Important	Very important	N/A
Monitors and control mechanical operations	○	○	○	○	○	○
Perform routine and emergency maintenance of farm implements and infrastructure	○	○	○	○	○	○
Calibrate and monitor farm eqipment before and during usage	○	○	○	○	○	○
Replace and repair worn parts and re-essemble mechanical components	○	○	○	○	○	○
Correctly operate machines and mechanical equipment in agricultural production	○	○	○	○	○	○
Have a valid driver's licence (Minimum Code B or EB)	○	○	○	○	○	○
Knowledge and ability to apply new technology	○	○	○	○	○	○
Ercets and repair fences	○	○	○	○	○	○

Other (please specify)

16. **Irrigation skills**

	Not important	Might be considered or recommended	Advisable or preferred	Important	Very important	N/A
Install an irrigation system	○	○	○	○	○	○
Maintain an irrigation system	○	○	○	○	○	○
Operates a manual irrigation system	○	○	○	○	○	○
Operates a computerised irrigation system	○	○	○	○	○	○
Scheduling of irrigation	○	○	○	○	○	○
Follow standard operating procedures (SOP's) for irrgation	○	○	○	○	○	○

Other (please specify)

17. **Processing and value adding skills**

	Not important	Might be considerd or recomended	Advisable or prefered	Important	Very important	N/A
Knowledge and skills for the processing of agricltural products	○	○	○	○	○	○
Supervise activities at the processing plant or pack house	○	○	○	○	○	○
Cleaning , disinfecting and maintaining of bio-security standards in processing facilities	○	○	○	○	○	○
Marketing of agriculturla products or handling of sales	○	○	○	○	○	○

Other (please specify)

18. **Professional , personal and ethical skills (Soft skills)**

	Not important	Might be considered or recomended	Advisable or prefered	Important	Very Important	N/A
Decision making	○	○	○	○	○	○
Critical thinking ability	○	○	○	○	○	○
Ability to diagnose problems	○	○	○	○	○	○
Problem solving ability	○	○	○	○	○	○
Motivation	○	○	○	○	○	○
Work ethics	○	○	○	○	○	○
Honesty	○	○	○	○	○	○
Responsibility - the ability to accept responsibility for actions or desicions	○	○	○	○	○	○
Hardworking -diligence	○	○	○	○	○	○
Profesional discipline	○	○	○	○	○	○
Trust fulness	○	○	○	○	○	○
Possess a holistic view - ability to see the biger picture	○	○	○	○	○	○
Inductive and deductive thinking	○	○	○	○	○	○
Ability to collaborate with different people	○	○	○	○	○	○
Brainstorming and creation of new ideas - inovative	○	○	○	○	○	○
Verbal communication ability including public speaking	○	○	○	○	○	○
Ability to communicate using other media	○	○	○	○	○	○
Leadership	○	○	○	○	○	○
Team work	○	○	○	○	○	○
Conficence	○	○	○	○	○	○
Inter personal skills	○	○	○	○	○	○
Collaboration or networking and liaison with stakeholders	○	○	○	○	○	○

	Not important	Might be considered or recomended	Advisable or prefered	Important	Very Important	N/A
Human relations	◯	◯	◯	◯	◯	◯
Supervision of older employees	◯	◯	◯	◯	◯	◯

Other (please specify)

19. Please add skills /competence that are not on the list, that you regard as important or very important

20. Please indicate **in order of your preference,** what you regard as the most important skill / competence listed below . You can only allocate a number once. **Please rank the skills /competence from 1 the most important and 10 the least important**

	Most important	2nd most important	3rd most important	4th most important	5th most important	6th most important	7th most important	8th most important	9th most important	Least important (10)
Professional , personal and ethical skills	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Personal ethical skills /competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Processing and value adding skills / competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Irrigation management skills	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Technical and mechanical skills	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Administrative competence (Record keeping and data handling)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Vocational or production competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Management competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Planning Skills or competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Problem solving skills or competence	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Thank you for your contribution. The information provided by you will assist me in my research and will give valuable insight into the practical skills or competence needed in Agricultural Industry. It will assist the HEI by providing insight into what is needed by the Agricultural Industry and a yardstick to evaluate their programmes .

Thank you for your time and cooperation .

Annexure 9: List of agricultural industry respondents

Respondent Number	Age	Gender	Years of experience in Agri-Industry	Highest qualification.						Farming operation
				Grade 12	Diploma	Bachelor's degree,	Honours degree	Master's degree	PhD	
3	23	Male	3			X				Smallholder farmer
4	28	Female	6		X					Large commercial farmer
5	45	Male	15		X					Small commercial farmer
6	69	Male	47	X						
9	26	Male	4			X				Large commercial farmer
10	47	Male	15						X	
13	55	Male	30				X			Large commercial farmer
15	73	Male	50						X	Large commercial farmer
16	53	Male	33				X			Small commercial farmer
17	62	Male	40				X			Large commercial farmer
19	61	Male	37						X	Large commercial farmer
23	47	Male	30					X		Mega farmer
26	31	Female	3				X			Smallholder farmer
27	63	Male	30					X		Small commercial farmer
28	47	Male	30		X					Large commercial farmer
31	56	Male	20			X				
35	62	Male	35					X		Large commercial farmer
37	35	Male	5				X			Mega Farmer
39	28	Male	10	X						Large commercial farmer
41	60	Male	41			X				Large commercial farmer
42	35	Female	9						X	Small commercial farmer
43	63	Male	25				X			Small commercial farmer
44	56	Male	15				X			Large commercial farmer
45	60	Male	38					X		Mega farmer
47	60	Male	40				X			
49	61	Male	40			X				Large commercial farmer
50	32	Male	13		X					Large commercial farmer
52	33	Male	15		X					Small commercial farmer
53	60	Male	4					X		
54	38	Male	18					X		Large commercial farmer
56	70	Male	50						X	Large commercial farmer
57	25	Female	7	X						Small holder farmer
58	30	Male	21			X				Large commercial farmer
59	57		30				X			Large commercial farmer
60	45	Male	36			X				Large commercial farmer

Annexure 10: List of HEI respondents who were interviewed and ıpleted the questionnaire

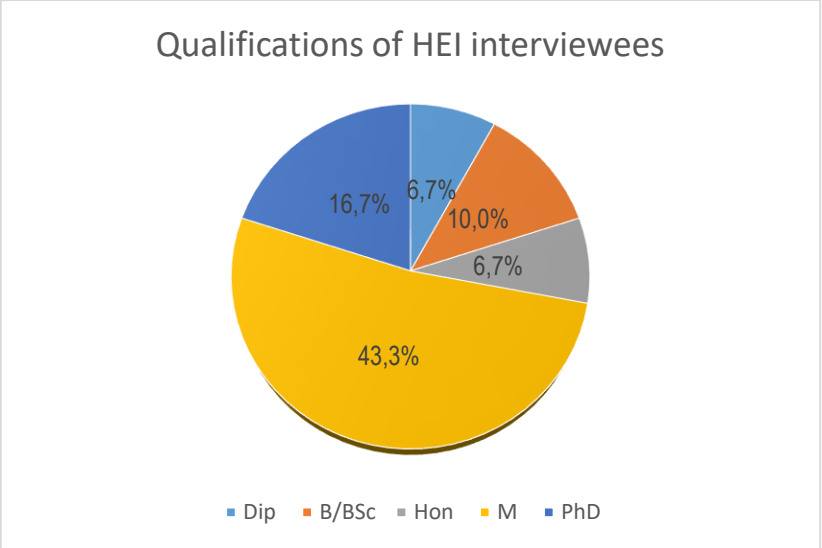
Respondent Number	HEI.	Position at the HEI					Gender		Population group				Age			Years of service	Highest Qualifications						Interview or questionnaire
		Lecturer	Senior lecturer	Programme	HOD or Head of	Other	Male	Female	Asian	Black	Coloured	White	0 - 35	36 - 55	55 +		Diploma	B/BSc	Hon	M	PhD		
2	PAC		1				1					1			1	40		1					Int
3	PAC	1					1					1		1		12		1					Int
4	PAC				1		1			1					1	14			1				Int
5	PAC					1	1					1			1	30			1				Int
6	PAC																						Int
7	UNISA	1						1		1			1			14					1		Int
8	UNISA		1				1					1			1	24				1			Int
9	UNISA		1				1			1				1		20				1			Int
10	UMP		1					1		1				1		5					1		Quest
11	UMP	1					1			1				1		11				1			Quest
22	TSAC					1	1			1					1	32				1			Int

10	FCAC					1				1				1		7				1			Int
11	Tardi		1				1			1					1	25		1				BVsc	Int
12	Tardi	1					1			1			1			5		1	1			BVSc	Int
13	Tardi					1	1			1				1		7				1			Int
14	Tardi				1			1		1				1		1	1						Int
15	FCAC				1		1			1						15				1			Int
16	FCAC				1		1			1				1		9					1		Int
17	FCAC	1					1			1				1		12			1				Int
18	FCAC		1					1		1				1		9				1			Int
19	FCAC				1			1		1				1		1	1						Int
20	TSAC	1						1		1			1			8		1					Int
21	TSAC				1		1			1					1	14				1			Int
23	UMP				1		1			1											1		Int
24	CAC					1	1					1								1			Int

23b				1			1								1	6					1		Quest
28				1				1					1			15				1			Quest
33							1						1			19				1			Quest
37		1						1				1				6				1			Quest
Total		7	5	3	6	4	15	8		18	0	3	3	10	5	361	2	3	2	13	5		
Percentage		23,3%	16,7%	10,0%	20,0%	13,3%	50,0%	26,7%		60,0%	0,0%	10,0%	10,0%	33,3%	16,7%	12,03	6,7%	10,0%	6,7%	43,3%	16,7%	0,0%	

Agric Colleges	
Tompi Seleka	TSAC
Tsolo College of Agriculture	Tardi
Fort Cox College of Agriculture	FCAC
Potchchefstroom College of Agriculture	PAC
Cedara College of Agriculture	CAC
Universities	
Comprehensive universities	
Unisa	Unisa
University of Mpumalanga	UMP

Qualifications of participants				
Dip	**B/BSc**	**Hon**	**M**	**PhD**
6,7	10,0	6,7	43,3	16,7



University of Technology	
Cape Peninsular University of Technology	CPUT

Annexure 11: List of agricultural diploma graduate questionnaire respondents

Respondent number	Diploma Completion date	Age	Gender	Type of HEI where graduated				
				Agricultural College or Agricultural Training Institute	University of Technology	Comprehensive University	Private Higher Education Institution	Other (please specify)
1	2016	29	Female	1				
2	2017	24	Male		2			
5	2018	24	Male		2			
6	2017	24	Female	1				
7	2012	30	Male	1				
8	2018	27	Male			3		
10	2018	33	Male			3		
13	2017	24	Male			3		
14	2014	30	Male			3		
15	1990	22	Male	1				
21	2018	28	Female					
23	2018	23	Female			3		
24	2018	21	Female			3		
26	2018	26	Male			3		
32	2018	25	Female			3		
34	2018	23	Female			3		
36	2018	21	Male			3		
40		24	Female			3		
45	2018	23	Male			3		
48	2018	22	Male			3		
50	2018	25	Female			3		
53	2018	23	FEMALE			3		
54	2018	25	Male			3		
			Total	4	2	16		