PERCEPTIONS OF ENGINEERING LECTURERS AND GRADUATES ON EMPLOYABILITY SKILLS: A CASE OF A TVET COLLEGE IN KWAZULU-NATAL, SOUTH AFRICA

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─Abstract ─
South Africa needs people with knowledge and expertise to contribute to national economic development. To achieve this milestone, employers have to hire highly skilled graduates who are ready to make an immense contribution to industry. Therefore, adequately trained engineering Technical and Vocational Education and Training engineering graduates are a critical asset for industrial development. However, there seems to be a mismatch between skills acquired by Technical and Vocational Education and Training (TVET) graduates and those required by industry. Addressing this mismatch is crucial as it makes TVET graduates relevant to the industry. The purpose of the study was to explore the employability skills required for sustainable employability of TVET graduates in industry and develop a framework for addressing the mismatch between TVET graduate skills and the industry needs. A qualitative case study approach was adopted. Semi-structured interviews were used to generate data from a sample of fifteen (9 students and 6 lecturers). Both convenience and purposive sampling were used to select research participants. A conceptual framework from Pavlova's three pillars of sustainable development guided the study. Data analysis was conducted through content analysis. The findings revealed that engineering graduates require both technical and soft skills for sustainable

employability. The study recommends that the teaching methodology should put more emphasis on the impartation of technical and soft skills required by industry. Furthermore, the curriculum needs to be revised to reflect the new realities as well as address the industry needs. TVET engineering instructors should be equipped with skills so that they can transfer the industry-relevant skills to graduates. Further research could focus on the perceptions of employers on the skills set required for sustainable employability in industry.

Key Words: Technical and Vocational Education and Training, Employability, Skills, Engineering, Lecturers, Employers, Graduates.

JEL Classification: I19

1. INTRODUCTION

South Africa requires engineering graduates with the relevant industry knowledge and expertise such that they contribute meaningfully to national economic development (Tickly, 2013). In the same vein, employers seek graduates who have the skills set for sustainable employability and ready to enter the workforce. Engineering graduates with both technical and soft skills make an immense contribution to industrial development (UNESCO, 2012). However, technical and soft skills are scarce. Against this background, the South African technical education system should address the skills gap in industry to improve the nation's productivity levels (Frankham, 2017). Education is viewed as a means to meet the socio-economic and development needs of a country (Frost, 2005; McGrath, 2012). Technical and Vocational Education and Training (TVET) colleges, as education institutions, are ideally positioned to respond to the national needs as they contribute to the provision of relevant technical and high-quality education for sustainable development (King, 2011). The World Bank has, historically, associated formal TVET education with the process of industrialisation and economic development (UNESCO, 2012). However, there seems to be a mismatch between the skills acquired by TVET graduates and those required by industry as the TVET college training appears to lack the impartation of technical and soft skills set needed for sustainable employability in industry. Therefore, TVET institutions must develop individuals for employment in industry (Fien, Maclean & Park, 2009; UNESCO, 2012).

TVET colleges in South Africa are regarded as a core component of the National Skills Development Strategy of the Department of Higher Education and Training and mandated to meet the skills needs of industry (Department of Higher

Education and Training, 2013). In order to address the needs of industry, there is a need for TVET colleges to understand the skills set needed by TVET graduates for sustainable employability. This paper seeks to answer the question: 'What skills set are needed by TVET engineering graduates for sustainable employability in the industry?'

Various studies were conducted on TVET employability skills (Powell**,** 2013; Nefdt, 2015; Haruna, Kamin & Buntat, 2019; Olojuolawe & Fadila, 2019). Powell (2013) conducted a study on why students enrol in TVET colleges. According to the results of the study, students enrol in TVET colleges to be equipped with the knowledge and skills required in the world of work as well as to support their families. Ismail and Mohammed (2015) carried out a study on the employability skills in TVET curriculum in Nigeria's Federal Universities of Technology. The study revealed that the curriculum gave more attention to theory-based courses than practice-based courses that provided critical skills for employability. Moreover, no course in the programme curriculum directly taught good attitudes and traits which are needed in jobs. Also, graduates lack employability skills, such as problem-solving and decision making. Nefdt (2015) studied the Life Skills programme in the National Certificate Vocational (NCV) and 'employability'.

The findings of the study were that the NCV Life Skills course was both successful and unsuccessful in enabling participants to develop generic skills which made them 'ready for work'. Similarly, Lolwana (2016) carried out a study on the TVET in Sub-Saharan Africa in which the findings showed that the TVET sector in the majority of the Sub-Saharan countries lack the practical relevance and responsiveness to labour market needs, have insufficient infrastructure and equipment, and have extremely low throughputs. Further to that, a limited number of lecturers combine pedagogical competencies with technical qualifications and industry experience. A study by Haruna *et al*. (2019) on "Understanding Work-Based Learning in TVET in Nigeria", showed that there is a low level of work-based learning awareness in Nigeria, and work-based learning must be adopted to enhance students' acquisition of work-based skills. Nugraha, Kencanasari, Komari, and Kasda (2019) researched on employability skills in TVET. The results illustrated that employability skills needed in industry include social skills, knowledge in the field of Engineering, communication skills, information and technology skills, management skills, creative and innovative skills, problem-solving and critical thinking. A study on the determination of employability skills required by Electrical Technology college students in Nigeria done by Olojuolawe and Fadila (2019) indicated that both hard skills and soft skills are generally needed by Electrical Technology graduates from TVET colleges. Such skills

include technical skills, non-technical skills, motives, self-concept, and lifelong learning. There is a dearth of studies on lecturers and students' perceptions on the employability skills of engineering graduates in the South African TVET colleges. This study seeks to plug that gap by exploring the skills set needed by TVET graduates for sustainable employability in the industry from the perspective of engineering lecturers and students in a TVET college in KwaZulu-Natal, South Africa. This study is vital in that it informs both students and lecturers about the critical skills that TVET engineering graduates need to acquire during training such that they meet industry needs and expectations.

2. LITERATURE REVIEW

2.1 The TVET sector in South Africa

There are two programmes offered concurrently at TVET colleges, namely, the National Certificate (Vocational) (NC(V)) and the National Technical Education Diploma (NATED), which is also known as Report 191 or N-programme. The entry qualification to both programmes is a minimum of Grade 9, but a higher qualification is an added advantage (DHET, 2014). These courses are aimed at equipping students with the required skills set for sustainable employability so that they contribute to personal, community, and national development. The NATED course is offered from levels N1 to N6. Each level is supposedly covered in a single trimester (10 weeks) within which a national examination is written (DHET, 2020). By contrast, the NC(V) qualification is a full-year program at each of the National Qualifications Framework (NQF) levels (2, 3 and 4) of study and a certificate is issued on completion of each level. NC(V) has seven subjects in total, which comprise four vocational subjects and three fundamental subjects (Language, Mathematics and Life Orientation) (DHET, 2014). DHET (2018) stipulates that the ratio of practicals to theory is 60 to 40, respectively. These practicals offer a simulated workplace environment so that students experience work situations while studying.

The TVET sector is viewed as a means of preparing students for the world of work (UNESCO, 2015). As such, it has the transformative capacity that promises its students the right to quick employment (Maclean, 2011). TVET has emerged as one of the most significant human resource development strategies for training and modernising the technical workforce for rapid industrialisation and national development (The African Union, 2007). Against this backdrop, the sector drew attention and gained momentum in the 1960s (The African Economic Outlook,

2015), and many African nations injected funding in the 1980s to formalise the TVET sector (The African Union, 2007). Some countries, like South Africa, Kenya, Tanzania, and Zimbabwe, have established TVET systems that address their economic and human resource development needs.

There has been significant redesigning of education and training landscape in South Africa since 1994 (Mouton, Louw & Strydom, 2012) to meet the national developmental goals, and community and industry needs and expectations (Department of Education, 2008). Enhancing lecturer qualifications, redesigning curriculum so that it could be industry-linked, improving TVET college management systems, and providing funding were some of the notable changes introduced by the South African government in the TVET sector (Field, Musset & Álvarez-Galván, 2014). Among the programmes that were redesigned were the NATED engineering programmes to address the industry needs (Papier, 2017). Such programmes include mechanical engineering (e.g. fitting, diesel and motor trade), civil engineering (carpentry, plumbing and bricklaying), chemical engineering (wastewater treatment, chemical technology) and electrical engineering (heavy and light current, instrumentation and millwright) (DHET, 2010). Though the TVET sector churns out many graduates into the labour market, they fall short of industry needs and expectations in terms of soft and technical skills (Papier, 2017). Therefore, the curriculum and the training methodologies need to be revised to address the skills gap.

TVET engineering graduates are required to have specific employability skills. For example, Mechanical Engineering graduates are expected to have technical skills and generic skills (Nugraha & Komaro, 2018). Technical skills include mechanical engineering drawing, conventional machining, computer numerical control, metal fabrication and welding. Generic skills include social skills, teamwork, communication, critical thinking, computer skills, and self-management. (Nugraha & Komaro, 2018). The industry expects TVET Civil Engineering graduates to have technical knowledge, interpersonal skills, computer skills, and other soft skills (Gerek & Efeoglu, 2015; AlMunifi & Aleryani, 2019). In order to be absorbed by industry, Electrical Engineering graduates need to have a thorough knowledge of Electrical Technology education and be competent in the electrical discipline; knowledge of contemporary issues in electrical engineering; knowledge of Sciences, Technology, Engineering & Mathematics (STEM) (Ismail & Mohammed, 2015; Olojuolawe & Fadila, 2019). Furthermore, they must also have problem-solving and life-long learning skills. Therefore, all

engineering graduates should possess both technical and soft skills that are needed in industry (Nugraha *et al*., 2019; Olojuolawe & Fadila, 2019). However, there is a disjuncture between the world of work and the skills that TVET graduates acquire. The following section presents the disjuncture between the world of work and the graduates' skills.

2.3 The Disjuncture Between the World of Work and Graduates' Skills

The mission of the TVET sector, as stated in South African policy documents (DoE, 1998) is to foster intermediate to high-level skills and to facilitate the transition from school to work. The South African Qualifications Authority (SAQA) (2010) concurs by claiming that the TVET programmes aim to prepare learners for the world of work by providing them with the practical knowledge and skills related to a particular vocational sector. However, Jacobsz (2005) states that TVET institutions are often accused of separating theory from practice, giving rise to irrelevant programmes, and failing to meet the needs of learners and the changing demands of the economy and society. Magnus, Prinsloo, Bird and Singh (2013) agree by noting that the vocationally oriented TVET programmes are not useful, work-focused, or flexible, and are, thus, rejected by employers. Furthermore, the lecturers of these programmes lack relevant occupational qualifications and work experience (Papier, 2017). These deficiencies present severe difficulties for TVET colleges in aligning programmes and students to industry needs. Hence, students fail to acquire the required skills set for sustainable employability. Against this background, the current TVET programmes fail to adequately prepare South African learners for the socio-economic challenges facing them in the 21st Century (Makole, 2010). Papier (2017) cites a lack of practical training that supports theoretical study at the college, resulting in work placements where college students require extensive practical exposure and mentoring.

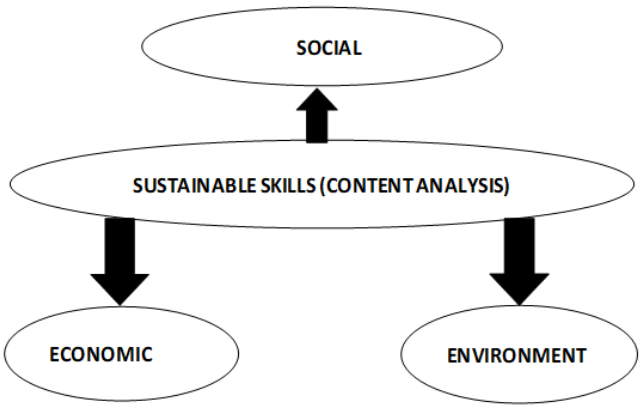
In light of the foregoing, TVET colleges and industry should collaborate in ensuring the graduates acquire the relevant skills. However, the TVET colleges lack the capability and credibility to engage with industry on equal terms. Employers, on the other hand, are reluctant to work with colleges and do not have faith in the college's ability to produce quality graduates (Gewer, 2010). Consequently, employers turn to other sources for skilled staff, including taking Grade 12 school leavers for apprenticeship training (Papier, Needham, Prinsloo, & McBride, 2016). Therefore, if the TVET sector is to be relevant in this Fourth Industrial Revolution era, relevant skill sets have to be imparted to TVET

graduates so that they are absorbed by the industry and be instrumental in economic development.

3. CONCEPTUAL FRAMEWORK

The conceptual framework guiding this study is the sustainable development approach proposed by Pavlova (2007) and Singh-Pillay's (2010) notion of Interface. The sustainable development approach emphasises the purpose of TVET as the provision of skills to support economic, social, and environmental sustainability. Thus, TVET's role is the preparation of learners for sustainable livelihoods (Tickly, 2013). The sustainable development approach has broadened the concept of employability to include lifelong learning; sustainable economies in the context of the information age and the knowledge economy; education for all; and education for human security. According to UNESCO (2012), within a sustainable development approach, TVET assists in addressing challenges, leading to the achievement of socio-economic goals. The indicators of each pillar, as emphasised by UNESCO (2015) and Tickly (2013), were adopted as selective filters to scan the data, TVET graduates and lecturers in order to establish its link to the sustainable employability skills mentioned. They are summarised in Figure 1 below.

Figure 1: Conceptual Framework: Sustainable Development Approach



Source: Adapted from Pavlova (2007).

The economic pillar, in Figure 1, is concerned with economic literacy, sustainable consumption, employment and productivity (Pavlova, 2007). The social pillar

embraces lifelong learning, self-reliance, human security, poverty reduction, social upliftment, while the environmental pillar entails green technologies, minimising waste/pollution and wise use of resources (Pavlova, 2007).

4. RESEARCH DESIGN AND METHODOLOGY

The study draws on a qualitative research approach that is aimed at understanding the skills set required for sustainable employability of TVET graduates from the perspective of lecturers and students. Creswell (2013) posits that researchers using a qualitative approach seek to establish the meaning of a phenomenon from the participants' viewpoint. Both convenience and purposive sampling were adopted in the selection of research participants. Leedy and Ormrod (2005) note that qualitative researchers are non-random in their selection of data sources, as their sampling is purposeful. The convenience sampling method was chosen on the grounds of proximity to the researcher. Therefore, lecturers and graduates who had relevant information and access to the researcher were involved in the study. Empirical evidence was collected through semi-structured interviews from six (6) engineering lecturers and nine (9) engineering graduates of Majuba TVET College in KwaZulu-Natal, South Africa. The six TVET college lecturers taught in the disciplines of mechanical, electrical, and civil engineering. The nine engineering graduates (3 in each field) involved were equally distributed among those who were employed, unemployed, or self-employed. The interviews took approximately 45 minutes. Content analysis was employed in the analysis of data. Lecturers were numbered from 1 to 6, while graduates were numbered from 1 to 9 to protect their identities. Saunders, Kitzinger, and Kitzinger (2015) explain anonymity as making respondents untraceable from the data presented about them.

5. PRESENTATION AND DISCUSSION OF FINDINGS

This section presents and discusses findings on the experiences of lecturers and graduates regarding the skills set for sustainable employability in industry. The findings from the engineering lecturers are presented first, then followed by those from the graduates.

5.1 The analysis of interviews with Lecturers

The results of semi-structured interviews with TVET engineering lecturers are presented regarding the skills sets identified as needed for sustainable employability. The mechanical, civil, and electrical lecturers identified the following skills as critical for sustainable employability:

Mechanical: *Analytical skills, creativity, problem-solving, safety, machine operations, ability to read and draw engineering drawings, use of AutoCAD.*
Civil: *Engineering drawing, design, Mathematics, Troubleshooting, bricklaying, computer skills, plastering, roofing, tiling, and painting, setting out, measuring, bills of quantities.*
Electrical: *General knowledge, basic hand and power tools, electrical symbols, drawing knowledge, House wiring, Automation-installing remote-controlled gates, garage doors.*

All six lecturers emphasised the need for problem-solving, communication skills, analytical, creativity, and computer skills in all engineering fields. Without these skills, it is challenging to succeed as an engineer. In support, Lecturer 1 claimed that:

> *"Analytical skills, creativity, problem-solving skills are important. Problem-solving skills are important because industry solves problems daily".*

Lecturer 4 noted: *"Graduates should have soft skills such as social skills, teamwork, communication, and critical thinking".*

In the same vein, Lecturer 5 said: *"... automation, problem-solving, computer and communication skills are vital".*

Lecturer 6 stressed: *"computer skills and Computer Aided Draughting (CAD) are important".*

The respondents indicate that soft skills are needed for sustainable employability in industry. Literature is replete with evidence that generic or soft skills are critical for an engineering graduate from a TVET college. For example, Nugraha and Komaro (2018) posit that social skills, teamwork, communication, critical thinking, computer skills, and self-management are the generic skills needed by TVET engineering graduates for sustainable employability. Thus, the training programme for TVET engineering students should inculcate soft skills as they are a requirement for employability in industry.

Most of the lecturers noted that a mechanical engineering graduate must have computer skills that are essential for drawing and reading plan. The above is substantiated by Lecturer 3 who stated that:

> *"The mechanical engineering graduates must have computer skills in (AutoCAD/Ally CAD) to help them read and draw plans".*

The participant shows that a mechanical engineering graduate from a TVET college needs to have technical skills. This agrees with extant literature. Nugraha and Komaro (2018) state that technical skills such as mechanical engineering drawing, conventional machining, computer skills, metal fabrication and welding are essential for sustainable employability. Drawing skills are important since they are a way of communicating in the construction industry.

All the civil engineering lecturers stated that a civil engineering graduate must have some technical skills that are specific to this field. In support of this, Lecturer 6 had this to say:

> *"… the ability to draw plans, have computer skills… setting out … measurement".*

The quote illustrates that critical skills in civil engineering include drawing plans, computer skills, setting out, and measurement. In this Fourth Industrial Revolution era, computer skills are essential in any field of engineering. TVET graduates in civil engineering should possess technical skills, interpersonal skills, computer skills, and other soft skills (Legg-Jack, 2014; Gerek & Efeoglu, 2015; AlMunifi & Aleryani, 2019). Therefore, the curriculum and the training methodologies should ensure that civil engineering graduates acquire such skills if they are to be relevant to the South African industry.

Basic hand and power tools, electrical symbols, drawing knowledge, house wiring are some of the critical technical skills that TVET electrical engineering graduates are required to have, as noted by the majority (4 out of 6) of the participants. This is consistent with Lecturer 4's remark that:

> *"…. competency in electrical technology, knowledge of contemporary issues in electrical engineering, knowledge of Sciences, Technology, and Engineering and Mathematics (STEM), drawing knowledge, house wiring…".*

The result indicates the essential technical skills that TVET electrical engineering should possess. This is in tandem with existing literature (Ismail and Mohammed, 2015) that competency in electrical engineering education, knowledge of contemporary issues in electrical engineering, as well as knowledge of STEM is vital for a TVET graduate. Such skills enable TVET graduates to make a meaningful contribution in industry. It is important to note that the value attached to TVET colleges is dependent upon the relevance of TVET graduate skills to industry.

5.2 The analysis of interviews with Engineering Graduates

The study revealed the following skills as required for sustainable employability from the perspective of graduates in the three fields of engineering:

Mechanical: *Safety skills; machine operations, and correct tool handling; engineering drawing; measuring; squaring; safe tools usage; fabrication; welding and joining methods.*
Electrical: *Hand tools skills; install, design, and develop starters and motors from drawings and reading drawings.*
Civil: *Plumbing; building and masonry; supervision of workers; calculations, planning and budgeting; usage of hand tools; handling skills; supervision; ability to calculate, plan and budget.*

The interviews conducted with the graduates support the skills sets listed above. For example, Graduate 1 indicated that:

> *"Machine operations and correct tool handling were learnt, which I did not know before".*

In support, Graduate 2 stated: *"Learnt how to use the tools and machines and apply the safety rules".*

Furthermore, Graduate 3 added: *"Drawing, welding and safety risk are important in order to get employed".*

Also, Graduate 4 echoed that: *"…Hand tools skills are fundamental. It is difficult to work without knowing hand tools".*

Graduate 5 affirmed: *"…Plumbing, building and masonry are important skills that I am currently using now in civil engineering".*

Graduate 8 said:

> *"… I consider work skills such as handling skills, hand tools involved. You need to know the work practically. Workshop exposure in the workshop is more important as there is a big gap between class theory and industry work environment".*

The responses from the excerpts above show that the three fields of engineering have specific essential skills which must be mastered towards an artisan route. However, it has been noted that there are common technical skills which are applicable in all the three fields, such as safety, drawing, and calculations. The results are in line with existing literature. Gerek and Efeoglu (2015), Ismail and Mohammed (2015) and AlMunifi and Aleryani (2019) indicate the critical technical skills required of TVET engineering graduates. It is critical to note that all three fields of engineering require soft skills like communication skills, problem-solving, critical thinking. Such soft skills enable graduates to function successfully as engineers (Ismail & Mohammed, 2015; Lolwana, 2016). The statements from TVET graduates reveal that they mainly acquired technical skills and less of soft skills. Legg-Jack (2014) notes that graduates consider only trade-related skills as critical for employment. Therefore, during training, students need to be made to understand that both soft and technical skills need to be acquired for sustainable employability in industry.

6. SUGGESTED FRAMEWORK FOR ADDRESSING THE MISMATCH BETWEEN TVET GRADUATE SKILLS AND INDUSTRY NEEDS

Based on the results of the study, a framework is suggested for addressing the mismatch between the TVET graduate skills and the skills needs of industry. The curriculum should be revised to address the current industry needs and also reflect the new realities of the Fourth Industrial Revolution. The curriculum revision and the setting of competency standards should be done in consultation with industry and other role players (Mesuwini, 2015). Furthermore, the pedagogical approaches should put more emphasis on the impartation of technical and soft skills required by industry. The inclusion of work-based learning in the training programme also helps to address the skills mismatch as learners will have industry currency. Engineering instructors need to be equipped with the relevant skills so that they transfer current industry skills to graduates. Engineering is a field that is

continuously changing. Therefore, TVET lecturers need to be sent for refresher courses so that they impart up to knowledge and skills to graduates.

7. CONCLUSION

The purpose of this study was to explore the skill set needed by TVET graduates for sustainable employability in industry from the perspective of lecturers and students. The implementation of the framework suggested by the researchers will help address the mismatch between the industry skills needs and the skills acquired by the TVET graduates. The importance of this study lies in the perceptions of the engineering TVET graduates and lecturers regarding the skill sets required for sustainable employability so that appropriate skills will be imparted on TVET engineering students. In this way, the TVET sector will be responsive to the needs of industry. Future research could focus on the perceptions of employers on the skills set required for sustainable employability in industry.

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