

**AN INVESTIGATION INTO THE ADEQUACY OF INFRASTRUCTURE IN ENGINEERING AND RELATED DESIGN (ERD) AT TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET) COLLEGES IN GAUTENG PROVINCE, SOUTH AFRICA**

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**ABSTRACT**

The purpose of this study was to investigate the adequacy of infrastructure in Engineering and Related Design at Technical and Vocational Education and Training (TVET) colleges in Gauteng Province, South Africa. The study was a cross-sectional survey that was conducted on National Certificate level 3 TVET college students that were pursuing their studies in Engineering and Related Design (ERD). The data collection tool was a self-administered, structured questionnaire. The respondents to the questionnaire were conveniently selected. The research findings revealed that in the TVET colleges that were sampled, there was a shortage of the workshop equipment and machines, audio-visual equipment, accommodation and transport. On the other hand, it was discovered that the majority of students were happy with classrooms, furniture, and library facilities. There is a need for the colleges to have adequate infrastructure in order to create a conducive teaching and learning environment.

**KEYWORDS**

TVET colleges, infrastructure, vocational students.

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## **1 INTRODUCTION:**

Technical and Vocational Education and Training (TVET) colleges in South Africa have the mandate to train future electricians, builders, carpenters, machinists, fitters and turners, welders, boiler makers and motor mechanics. The majority of students who are enrolled in vocational programmes are post-grade 9 school leavers. College records reveal that this group comprises students who performed poorly in secondary schools or did not gain entry into the universities. Students with grade 9, 10, or 11 passes qualify to pursue their studies at National Certificate Vocational (NCV) level. Students who enter the TVET colleges after completing grade 12 are allowed entry into the diploma programmes provided they obtained low pass grades at matric level.

The ERD subjects that are taught at TVET colleges expose students to the practical tasks on a day-to-day basis in order to help them learn how to operate the different machines in the workshop. TVET colleges draw upon various methods and techniques in order to make the workshop environment safe and clean.

### **1.1 Problem statement**

The shortage of machinery and the lack of workshop management skills are factors that hinder practical training in most TVET colleges. These factors affect the throughput rate of TVET colleges. Over the years, the Government of South Africa has been funding tuition fees and other college costs to all deserving students, through the National Student Financial Aid Scheme (NSFAS). As government invests significantly in the TVET projects, it should be as concerned as the general South African citizen about the numbers, knowledge depth and skills of TVET college graduands.

There are many factors that affect the teaching and learning at TVET colleges. Some of the factors are the skills and the knowledge depth of the lecturers, governance of the college institutions, provision of practical training by the industry, and infrastructure that supports teaching and learning. Public TVET colleges seem to be struggling to sustain quality education due to inadequate financial support from the central government.

### **1.2 Purpose of study**

The purpose of this study is to investigate the adequacy of infrastructure in the Engineering and Related Design (ERD) division at public Technical and Vocational Education and Training (TVET) Colleges in Gauteng Province, South Africa

## **2 LITERATURE REVIEW**

### **2.1 Infrastructure in TVET Colleges**

This study would like to put forward the conviction that having good infrastructure in an educational institution has a positive impact towards the attainment of quality education, good results and improved pass rates. Some of the important resources include adequate classrooms, furniture, machinery and technology. A learning institution that has a conducive learning environment should; provide comfort to the students, teachers and administrators; have proper lighting, water, electricity and internet services; have a provision for libraries, and laboratories, have facilities for entertainment, cultural activities, and development of talent, and have provision for sanitary services (CAF.com, 2016). Workshops during the Corona Virus pandemic and post corona period should revolutionise and ensure they adhere to all safety regulations meant to protect students and everyone in the workshop. Social distancing should be observed even when operating machinery in workshops. A different outlook of workshops is a reality.

Workshops in TVET colleges provide simulated environments for practical work that the students would do when they are in the workplace. The absence of these workshops in TVET colleges render teaching and learning ineffective (Buthelezi, 2016). Learners come to TVET colleges expecting to do modules that have a bias toward practicals; however, they then find themselves doing more theory than the practicals (Badenhorst & Radile, 2018). The learners apparently get frustrated and disorientated. According to Alexander & Masaobi (2017), the majority of TVET colleges do not have adequate equipment and proper machinery to facilitate successful teaching of engineering programmes. The shortages make it difficult for the TVET colleges to train and educate students who will make meaningful contributions to the industry (Alexander & Masaobi, 2017).

Buthelezi points out that the shortages in TVET colleges were not restricted to workshops only. The TVET colleges are also grappling with shortages of furniture, textbooks, libraries, computers, printers, photocopies and equipment that is necessary for vocational education (Buthelezi, 2018). These shortages were cited as contributing factors to the high failure rate in TVET colleges, (Buthelezi, 2018).

The majority of learners who enrol in TVET colleges are visual and kinaesthetic learners who need to combine viewing and listening in order to comprehend the learning content (Tilestone, 2010). The shortages of machinery and equipment discussed above, therefore creates a learning environment that is difficult to both learners and lecturers (Alexander & Masaobi, 2017). The shortages makes it difficult for the TVET lecturers to impart meaningful knowledge to the engineering students (Alexander & Masaobi, 2017). Another observation is that the infrastructure is getting old and obsolete (Buthelezi, 2018). The prevailing situation is blamed on insufficient budget allocation made to the TVET colleges (Buthelezi, 2018).

Papier (2006) also noticed that besides the shortages of resources in workshops, there are cases where lack of critical management skills in TVET colleges is an obstruction to meaningful and productive teaching and learning.

## **2.2 Impact of infrastructure on teaching and learning**

There is a strong evidence that quality infrastructure improves learners' academic performance and reduces dropout rates (Khakhau, 2019). Well-planned infrastructure, clean, quiet, safe, comfortable and healthy environment are important components of successful teaching and learning (Fisher, 2006). Quality infrastructure has an impact of reducing the student attrition rate in TVET colleges; it also positively influence the attitude, attendance and interest in learning (CAF.com, 2016). It is likely that there will be an improvement of attendance and classroom participation when there is adequate infrastructure in TVET colleges. Moreover, Armsterdam (2010) and Zulu (2020) report that there will be reduced incidences of aggression if there is adequate infrastructure at TVET institutions.

According to Dube & January (2012), lack of access to water and sanitation had the risk of leading to learners developing illnesses and missing school in Zimbabwean rural schools. This risk does not only affect Zimbabwean rural schools, it is a risk that affects schools from all quarters. A response to this challenge requires that there be adequate water and refuse reticulation system. This requirement has become even more critical and a non-negotiable factor in 2020 following the outbreak of the Corona pandemic. Rivera (2016) caps it by saying that it is essential for authorities to observe the significant role of infrastructure interacting with other essential educational inputs, so that comprehensive proposals are undertaken in order to improve the quality of education.

## **3 METHODOLOGY**

The study was a cross-sectional survey that was conducted on National Certificate level 3 TVET college students that were pursuing their studies in vocational subjects in Engineering and

Related Design (ERD). It was conducted in seven public TVET colleges in Gauteng. The colleges had a combined population of 458 students that were at National Certificate Level 3 of their studies. Of the 458 students, only 139 participated in the survey. The participants were conveniently selected in each college. The idea was to use the research findings as a basis for future studies.

The data collection tool was a self-administered. The study was quantitative and it was conducted with the objective of investigating how adequate infrastructure assisted the National Certificate ERD students at public TVET colleges in Gauteng.

The questionnaire was entirely composed of closed-ended questions. The questions were presented logically in order to ease the respondents through the questions. The questions required participants to simply rate the infrastructure in TVET colleges. Questionnaires were personally hand distributed to all the conveniently sampled level 3 ERD students across the seven TVET colleges, on different days.

The descriptive component of the study characterised the TVET colleges' 1) classroom environment, 2) furniture, 3) cleanliness of the learning environment, 4) the equipment and machinery in the workshops, 5) audio visual equipment, 6) lighting, 7) library facilities, 8) student accommodation, and 9) provision of transport.

### **3.1 Ethical considerations**

Prior to conducting the survey, ethical clearance was sought from the University of Johannesburg Faculty of Engineering and the Built Environment ethics committee. Written permission was granted. The researchers also sought permission to conduct the study from eight public TVET colleges within Gauteng province. Seven out of eight public TVET colleges granted permission to conduct the study.

The researchers respected each participant's autonomy. The participants were informed of the purpose and benefits of the research. Confidentiality and informed consent were adhered to. The participants consented to be part of the study only after they had been informed of the purpose of the study. The consent document was included as an attachment to the questionnaire. The participants completed the questionnaire in safe and secure classrooms with no threat or potential harm posed to them. The participants were allowed to withdraw from participating in the study at any stage.

## **4 FINDINGS**

The study revealed that there were a number of factors that negatively affected students in TVET colleges. Findings reveal that there are shortages of; equipment and machinery, library facilities, audio visual equipment, accommodation and transport. Collectively, these shortages resulted in the production of graduates that were poorly trained and therefore, could not compete in their respective industrial sectors.

The results in Table 1 give a summary of the findings on TVET college infrastructure ratings from selected level 3 students within the public TVET colleges in Gauteng.

### **4.1 Classroom**

There were 137 students who responded to the question on classroom space. There were 25 (18.3%) who rated the space provided in vocational classrooms as poor and very poor. The remaining 82.7% rated the space as average, good and excellent. Khakau (2019) argues that quality infrastructure improves a learner's academic performance and reduces dropout rates. In this regard, the TVET colleges seem to create and maintain a conducive learning environment that retains the majority of students.

#### **4.2 Provision of Furniture**

Out of the 137 respondents, 41 (29.9%) students rated the available furniture as poor. The remaining 70.1% rated the furniture as average, good, and excellent. The figure indicates that the colleges are on average doing fairly well on the furniture aspect. Going by Armsterdam's (2010) and Zulu's (2020) sentiments, this is one area where the colleges are working very hard to improve attendance and classroom participation.

#### **4.3 Cleanliness of the classroom environment**

Of the 137 students who responded to the question on the classroom environment 43 (31.4%) rated the colleges as either poor or very poor in terms of cleanliness. The remaining 68.6% rated the colleges as either average, good or excellent in terms of cleanliness. Going by Fisher (2006) findings, colleges are doing fairly well in creating an environment that promotes teaching and learning.

#### **4.4 Adequacy of Equipment and Machinery**

There were 136 students who responded to this question, and 83 (61%) rated the equipment and machinery as poor and very poor. Only 39% rated the machinery as average, good, and excellent. This is a cause for concern. A study that was conducted by Tilestone (2010) reports that the majority of the students who go to TVET colleges were visual and kinaesthetic learners. Hence, the shortage of equipment and machinery in workshops creates a difficult learning environment because visual and kinaesthetic learners grasp what they learn if they see the material and are actively involved in shaping the end product (Tilestone, 2010). These are hands-on calibre of students; theory on its own does not take them anywhere.

#### **4.5 Availability of Visual Equipment in Vocational Classrooms**

The number of students who responded to the question on the availability of visual equipment in vocational classrooms was 136. The number of students who rated the equipment as poor and very poor is 85 (62.5%). This rating is very close to the rating on equipment and machinery which was at 61%. The lack of equipment makes it very difficult for TVET college lecturers to impart knowledge to the ERD students (Alexander & Masoabi, 2017).

#### **4.6 Average Temperature in the Classroom**

Of the 136 students who answered this question, 55 (40.4%) rate the average temperature in the classrooms as poor and very poor. In this case, the majority of 59.6% rated the environment as either average, good or excellent. Considering the fact that there are many conflicting demands on budgetary allocations, the TVET colleges are doing a great job on this aspect. However, Fisher (2006) found out that a comfortable environment is an important components of successful teaching and learning.

#### **4.7 The Quality of Lighting in Classrooms, library and other learning facilities**

On the lighting issue 33 (24.3%) of 136 students rated it as poor and very poor. 75.7% rated the lighting as either average, good or excellent. In as far as this issue is concerned, the TVET colleges are doing a commendable job in providing a conducive environment for learning.

#### **4.8 Provision of Relevant Textbooks**

Out of 133 students who responded, only 45(33.8%) rated the quality of textbooks as either poor or very poor. The majority, 66.2%, were happy. Books are central to learning. Buthelezi (2018) reports that the shortages of textbooks is one factor that is contributing to failure rates in colleges. In this regard, it is important that the TVET colleges pay more attention to the concerns of the students.

#### **4.9 Provision of Accommodation**

On the question related to accommodation offered by the colleges, only 126 students responded. It is assumed the other 13 who did not respond did not stay in college accommodation. Of the 126 who responded, 97 (77%) rated the accommodation provided by the colleges as either poor or very poor. The response presents a poor picture with regards to accommodation. As articulated by Zulu (2020), quality infrastructure has the effect of improving student attitude and interest in learning. This is one area where the TVET colleges need to improve.

**Table 1: Public TVET College Infrastructure Ratings in Gauteng**

		Very Poor	Poor	Average	Good	Excellent	Total
Space provided in vocational classrooms is...	Count	6	19	52	48	12	137
	%	4,4%	13,9%	38,0%	35,0%	8,8%	100,0%
Furniture (chairs and tables) in vocational classrooms is...	Count	13	28	40	47	9	137
	%	9,5%	20,4%	29,2%	34,3%	6,6%	100,0%
Cleanliness of the vocational classrooms is...	Count	14	29	33	42	19	137
	%	10,2%	21,2%	24,1%	30,7%	13,9%	100,0%
Machinery and equipment in vocational workshops is...	Count	50	33	23	22	8	136
	%	36,8%	24,3%	16,9%	16,2%	5,9%	100,0%
The audio visual equipment in vocational classrooms is...	Count	49	36	36	11	4	136
	%	36,0%	26,5%	26,5%	8,1%	2,9%	100,0%
The temperature in vocational classrooms is...	Count	27	28	40	30	11	136
	%	19,9%	20,6%	29,4%	22,1%	8,1%	100,0%
The quality of light in vocational classrooms is...	Count	11	22	37	47	19	136
	%	8,1%	16,2%	27,2%	34,6%	14,0%	100,0%
Vocational textbooks found in the college library are...	Count	26	19	33	33	22	133
	%	19,5%	14,3%	24,8%	24,8%	16,5%	100,0%
Accommodation provided by the college to learners is...	Count	70	27	18	9	2	126
	%	55,6%	21,4%	14,3%	7,1%	1,6%	100,0%
Transport provided by the college to learners is...	Count	89	20	12	3	3	127
	%	70,1%	15,7%	9,4%	2,4%	2,4%	100,0%

#### 4.10 Provision of Transport

The number of students who responded was 127. The 12 who did not respond might not be benefiting from college transport. There were 109 (85.8%) students who rated the transport as either poor or very poor. This is an essential service where the colleges are not doing well. This is one component that Fisher (2006) mentions as an important component of successful teaching and learning. In this regard, it is important that the colleges pay attention to it.

### 5 CONCLUSIONS AND RECOMMENDATIONS

The study found out that there are areas where the TVET college infrastructure is below expectations and others where it is above expectations.

Infrastructure components that the students were not satisfied with are the workshop equipment and machinery, audio visual equipment, accommodation, and transport. The first two components are central to learning. Tilestone (2010) reports that the majority of students who go to TVET colleges are visual and kinaesthetic students who need to combine viewing and listening in order to understand the learning content. In this regard, the TVET colleges need to improve and provide more equipment and machinery in classrooms and workshops. According to Amrsterdam (2010); Zulu (2020), this will improve attitude, interest in learning, class attendance, and classroom participation.

The majority of students were happy with the quality and space in the classrooms, furniture, cleanliness of classrooms, ventilation, lighting, and books. These components provide comfort to students and are important components of successful teaching and learning to take place (Fisher, 2006).

An improvement in these areas has an impact on reducing student attrition and failure rate [CAF.com (2016); Buthelezi (2018)].

In the prevailing environment where there is a shortage of resources, TVET colleges must assume a cautious approach and aim to attain a 50% rating on all the components of the infrastructure. A green sustainable economy may be achieved by positively transforming the TVET college infrastructure and aligning it with the advancing technology. Through continuous improvement initiatives, the TVET colleges can then work their way up and produce graduands that are adequately trained to compete in their respective sectors of the industry.

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